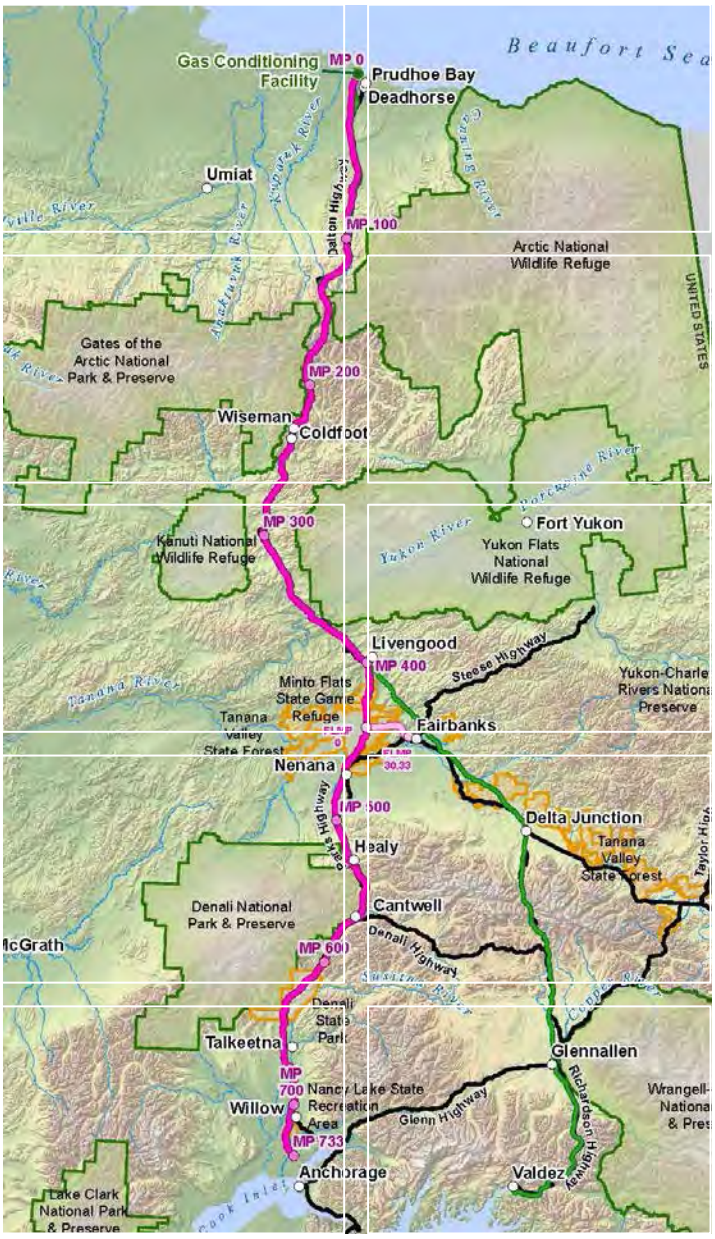




Prepared for:

US Army Corps of Engineers
Alaska District

Alaska Stand Alone Pipeline Project

Final Supplemental Environmental Impact Statement

Chapter 4: Environmental Consequences

June 2018

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Alaska Stand Alone Pipeline Project

Final Supplemental Environmental Impact Statement

Chapter 4: Environmental Consequences

June 2018

United States Army Corps of Engineers, Alaska District

In Cooperation with:

U.S. Bureau of Land Management
U.S. Department of Transportation, Pipeline and Hazardous Materials Safety Administration
U.S. National Park Service
U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service
Alaska Department of Natural Resources, State Pipeline Coordinator's Section

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M: Part I: Applicant Proposed Design Features, Mitigation Measures, and Best Management Practices, Part II: Rationale ASAP Pipeline Route Refinement, and Part III: Regulatory Agency Recommended Mitigation Measures

N: Part I: Corps Letter to NMFS Re-initiating Section 7 Consultation, Part II: ASAP Biological Assessment, and Part III: Biological Opinion

O: Effect of Climate Warming on Expected Long-Term Thaw Depths on the ASAP Right-of-Way, Alaska Stand-Alone Pipeline Project

P: Analysis of Subsistence Impacts

Q: ASAP Comment Analysis Report

R: ANILCA Section 810 Analysis of Subsistence Impacts

S: Fugitive Dust Control Plan

ACRONYMS & ABBREVIATIONS

°C ..... degrees Celsius
°F ..... degrees Fahrenheit
µ..... micron
µPa ..... micropascal
24/7..... 24 hours a day, 7 days a week
AAC..... Alaska Administrative Code
AAAQS ..... Alaska Ambient Air Quality Standards
ABR..... ABR, Inc.
ACEC..... Areas of Critical Environmental Concern
ACIA..... Arctic Climate Impact Assessment
ACP..... Arctic Coastal Plain
ADCCED..... Alaska Department of Commerce, Community, and Economic Development
ADEC ..... Alaska Department of Environmental Conservation
ADF&G ..... Alaska Department of Fish and Game
ADN ..... Alaska Dispatch News
ADNR..... Alaska Department of Natural Resources
ADOLWD ..... Alaska Department of Labor and Workforce Development
ADOT&PF ..... Alaska Department of Transportation and Public Facilities
AEA ..... Alaska Energy Authority
AES ..... ASRC Energy Services Alaska
AFFID..... Alaska Freshwater Fish Inventory Database
AGDC..... Alaska Gasline Development Corporation
AHRS..... Alaska Heritage Resource Survey
AK LNG ..... Alaska LNG Pipeline Project
AKEPIC ..... Alaska Exotic Plant Information Clearinghouse
AKNHP..... Alaska Natural Heritage Program
AMSA..... Arctic Marine Shipping Assessment
ANCSA ..... Alaska Native Claims Settlement Act
ANILCA..... Alaska National Interest Lands Conservation Act
ANIMIDA..... Arctic Nearshore Impact Monitoring in the Development Area
ANSI ..... American National Standards Institute
ANWR..... Arctic National Wildlife Refuge
APDES..... Alaska Pollutant Discharge Elimination System
APE..... Area of Potential Effect
APSC ..... Alyeska Pipeline Services Company
ARRC..... Alaska Railroad Corporation
AS..... Alaska Statute
ASAP ..... Alaska Stand Alone Pipeline
ATV ..... All-terrain vehicle

AWC ..... ADF&G's Catalog of Waters Important for the Spawning, Rearing or Migration of Anadromous Fishes
BACT ..... Best Available Control Technology
BART ..... Best Available Retrofit Technology
BCR ..... Bird Conservation Region
BGEPA ..... Bald and Golden Eagle Protection Act
bgs ..... below ground surface
BIA ..... Bureau of Indian Affairs
BLM ..... Bureau of Land Management
BLMRB ..... Big Lake Maintenance and Response Base
BOEM ..... Bureau of Ocean Energy Management
BPXA ..... BP Exploration (Alaska) Inc.
BMP ..... Best Management Practice
Btu ..... British thermal unit
C ..... carbon
CAA ..... Clean Air Act
CAAA ..... Clean Air Act Amendments
CAM ..... Compliance Assurance Monitoring
CARB ..... California Air Resources Board
CCP ..... Comprehensive Conservation Plan
CDP ..... census-designated place
CEA ..... Chugach Electric Association Inc.
CEQ ..... Council on Environmental Quality
CERCLA ..... Comprehensive Environmental Response, Compensation & Liability Act
CFR ..... Code of Federal Regulations
cfs ..... cubic feet per second
CGF ..... Central Gas Facility
CH_4 ..... methane
CMT ..... Culturally Modified Tree
CNG ..... Compressed Natural Gas
CO ..... carbon monoxide
CO_2 ..... carbon dioxide
CO_2-e ..... carbon dioxide equivalent
CRMP ..... Cultural Resources Management Plan
CSESP ..... Chukchi Sea Environmental Studies Program
CSIS ..... Community Subsistence Information System
CTL ..... Coal to Liquids
CWA ..... Clean Water Act
CWMP ..... Comprehensive Waste Management Plan
CWS ..... community water system
CY ..... cubic yard
DA ..... Department of the Army
dB ..... decibel

DCE..... Design Contingency Earthquake
DEIS..... Draft Environmental Impact Statement
DEW ..... Distant Early Warning
DH..... Dock Head
DH2..... Dock Head 2
DH3..... Dock Head 3
DHRMA..... Dalton Highway Recreation Management Area
DO..... dissolved oxygen
DOA..... Division of Agriculture
DOD..... U.S. Department of Defense
DOE ..... U.S. Department of Energy
DOI ..... U.S. Department of the Interior
DPS ..... Distinct Population Segment
DW..... drinking water
DWPP..... Drinking Water Protection Program
ECDA ..... External Corrosion Direct Assessment
EED..... Environmental Evaluation Document
EFH..... Essential Fish Habitat
EIA..... U.S. Energy Information Administration
EIS..... Environmental Impact Statement
ENP..... Eastern North Pacific
ENSTAR..... ENSTAR Natural Gas Company
E.O. ..... Executive Order
EPA..... U.S. Environmental Protection Agency
ESA ..... Endangered Species Act
ESCP ..... Erosion Sediment Control Plan
ESMU..... Eastside Susitna Management Unit
ETT..... enforcement targeting tool
ExxonMobil ... ExxonMobil Production Company
FAA ..... Federal Aviation Administration
FC..... fecal coliform
FEIS..... Final Environmental Impact Statement
FEMA ..... Federal Emergency Management Agency
FERC..... Federal Energy Regulatory Commission
FIRM..... Flood Insurance Rate Map
FLPMA..... Federal Land Policy and Management Act
FMP..... Fishery Management Plan
FMRB..... Fairbanks Maintenance and Response Base
FNG ..... Fairbanks Natural Gas LLC
FNSB..... Fairbanks North Star Borough
FPPA..... Farmland Protection Policy Act
FR..... Federal Register
FTE..... Full-time Equivalent

gal..... gallon
GCF..... Gas Conditioning Facility
GCFMRB..... GCF Maintenance and Response Base
GHG..... Greenhouse Gas
GIS ..... Geographic Information System
GPS ..... Global Positioning System
G&T ..... generation and transmission
GVEA ..... Golden Valley Electric Association
HABS..... Historic American Building Survey
HAER ..... Historic American Engineering Record
HAP ..... Hazardous Air Pollutant
HC..... Hydrocarbon
HCA..... High Consequence Area
HDD ..... Horizontal Directional Drilling
HEA ..... Homer Electric Association
HEC ..... Health Effects Categories
FF ..... high-frequency
HGM..... Hydrogeomorphic
hp ..... horsepower
HSSE..... health, safety, security, and environmental
HUC..... Hydrologic Unit Code
Hz..... hertz
IBA ..... Important Bird Area
ICDA..... Internal Corrosion Direct Assessment
ID ..... Identification
IGU ..... Interior Gas Utility
IHA ..... Incidental Harassment Authorization
IHLC..... Iñupiat History, Language and Culture Division
ILI..... in-line inspection
INHT ..... Iditarod National Historic Trail
IPaC ..... Information, Planning, and Conservation System
IPCC..... Intergovernmental Panel on Climate Change
ISO ..... International Organization for Standardization
ITR ..... Incidental Take Regulation
IUCN ..... International Union for Conservation of Nature
IWC..... International Whaling Commission
K..... thousand
kHz ..... kilohertz
km ..... kilometer
km/h ..... kilometers per hour
kW..... kilowatt
kWh ..... kilowatt-hour
Lat. ..... Latitude

LDC..... Local Distribution Company
LEDPA ..... Least Environmentally Damaging Practicable Alternative
LF ..... low-frequency
LHV ..... lower heating value
Lmax..... maximum noise levels
LNG..... liquefied natural gas
LOA ..... Letter of Authorization
Long..... Longitude
Lower 48..... Lower Continental 48 United States
LPG..... Liquefied Petroleum Gas
LWCF ..... Land and Water Conservation Fund
m ..... meter
m^3 ..... cubic meters
MAA..... May Adversely Affect
MACT..... Maximum Achievable Control Technology
MAOP..... Maximum Allowable Operating Pressure
Mat-Su..... Matanuska-Susitna
Max..... maximum
MBJ ..... Michael Baker Jr., Inc.
MBTA ..... Migratory Bird Treaty Act
MCF ..... million cubic feet
MCY..... million cubic yards
MEA..... Matanuska Electric Association
MF ..... Mid-frequency
MG/day ..... million gallons per day
mg/L ..... milligrams per liter
mi. ..... mile
min..... minimum
mL..... milliliters
ML&P ..... Municipal Light and Power
MLLW ..... mean lower low water
MLVs ..... mainline valves
MMBtu ..... million British thermal units
MMBtu/hr..... million British thermal units per hour
MMPA..... Marine Mammal Protection Act
MMS ..... Mineral Management Services
MMscfd ..... million standard cubic feet per day (gas distribution)
MOVES..... Motor Vehicle Emission Simulator
MP..... milepost
MS3 ..... Material Site 3
MSFCMA ..... Magnuson-Stevens Fish Conservation and Management Act
MTRS..... Meridian, Township, Range, Section
MW ..... megawatt

N..... Nitrogen
N_2O ..... nitrous oxide
N/A ..... not applicable
NAAQS ..... National Ambient Air Quality Standards
NAM..... No Adverse Modification
NCIMA..... Northern Cook Inlet Management Area
NEPA..... National Environmental Policy Act
NESHAP ..... National Emission Standards for Hazardous Air Pollutants
NGL ..... Natural Gas Liquids
NHD ..... National Hydrography Dataset
NHPA..... National Historic Preservation Act
NIP..... Non-Native Invasive Plant
NLCD ..... National Land Cover Dataset
NLJE ..... Not Likely to Jeopardize Existence
NMFS..... National Marine Fisheries Service
No. ..... Number
NOAA ..... National Oceanic and Atmospheric Administration
NOx ..... Nitrogen Oxides
NPFMC ..... North Pacific Fishery Management Council
NPP..... National Park and Preserve
NPR-A ..... National Petroleum Reserve - Alaska
NPS..... National Park Service
NRC..... National Research Council
NRHP ..... National Register of Historic Places
NSB..... North Slope Borough
NSPS..... New Source Performance Standard
NSR..... New Source Review
NSSI..... North Slope Science Initiative
NTU..... nephelometric turbidity units
NWI..... National Wetlands Inventory
NWR..... National Wildlife Refuge
NWT..... Northwest Territory
OASIS..... OASIS Environmental, Inc.
OC..... open-cut
OCS..... Outer Continental Shelf
O&M..... Operations and Maintenance
Off-ROW..... Off Right-of-Way
OHA ..... Office of History and Archaeology
OHV..... off-highway vehicle
OW..... Otariid pinnipeds
Owl Ridge..... Owl Ridge Natural Resource Consultants, Inc.
P..... Phosphorus
PA ..... Programmatic Agreement

PAC..... potentially affected community
PAH..... poly-cyclic aromatic hydrocarbon
PBU..... Prudhoe Bay Unit
PCB..... polychlorinated biphenyls
PCE..... Power Cost Equalization
Perm..... Permanent
pH..... measure of the acidity or alkalinity of a solution
PHMSA..... Pipeline and Hazardous Materials Safety Administration
pig..... pipeline inspection gage
P.L. ..... Public Law
PLO..... Public Land Order
PM..... Particulate Matter
PM_{10}..... Particulate Matter of 10 µ in diameter or smaller
$PM_{2.5}$..... Particulate Matter of 2.5 µ in diameter or smaller
PMC..... Plant Materials Center
POP..... persistent organic pollutant
ppm..... parts per million
Project..... ASAP Project
PS1 ..... Pump Station 1
PS2 ..... Pump Station 2
PSD ..... Prevention of Significant Deterioration
psig ..... pound per square inch gauge
PSIO..... Petroleum Systems Integrity Office
PSO ..... protected species observer
PSY..... pipe storage yard
Pt. ..... Point
PTE..... potential to emit
PTS..... permanent threshold shift
Pt-Co..... Platinum Cobalt Units
PW..... Phocid pinnipeds
PWS ..... Prince William Sound
QA/QC ..... Quality Assessment/Quality Control
RAC ..... Russian-American Company
RCA ..... Regulatory Commission of Alaska
REAA..... Regional Educational Attendance Area
RFFA..... Reasonably Foreseeable Future Actions
RHA..... Rivers and Harbors Act of 1899
RIRP..... Regional Integrated Resource Plan
RMP..... Resource Management Plan
ROI..... Region of Interest
ROW ..... right-of-way
RS ..... Revised Statute
s/tons ..... short tons

SB ..... Southern Beaufort Sea
SCC ..... stationary construction camp
SCORP..... Statewide Comprehensive Outdoor Recreation Plan
SDH ..... Social Determinants of Health
SDWA..... Safe Drinking Water Act
SEIS..... Supplemental Environmental Impact Statement
SEL..... sound exposure levels
SES ..... Seward Electrical Association
SF..... square foot
SGR ..... State Game Refuge
SHPO..... State Historical Preservation Office
SIP ..... State Implementation Plan
SMAP..... Susitna Matanuska Area Plan
SNC..... Significant Non-Complier
SO_2 ..... Sulfur Dioxide
Southcentral... Southcentral Region
SPCC..... Spill Prevention, Control, and Countermeasure
SPCS ..... State Pipeline Coordinator's Section
SPL..... sound pressure level
SPMT ..... Self-propelled Modular Transporter
spp. ..... several species
SPP ..... suspended particulate phase
SpUD ..... Special Use District
SRA ..... State Recreation Area
SRB&A..... Stephen R. Braund & Associates
SRMA ..... Special Recreation Management Area
ssp. ..... Subspecies
STB..... Surface Transportation Board
STP..... Seawater Treatment Plant
stpy ..... short tons per year
s.u. ..... standard units
SWPPP..... Stormwater Pollution Prevention Plan
TAH..... petroleum hydrocarbon
TAPS..... Trans-Alaska Pipeline System
TBD..... To Be Determined
TCC..... Tanana Chiefs' Conference
TCE ..... Temporary Construction Easement
TDS ..... total dissolved solids
Temp..... Temperature
TEWS..... Temporary Extra Workspace
TLUI..... Traditional Land Use Inventory
TMDL ..... total maximum daily load
TPH..... total petroleum hydrocarbon

TPY ..... tons per year
TS ..... threshold shift
TSS ..... total suspended solids
TTS..... temporary threshold shift
TVSF ..... Tanana Valley State Forest
TW ..... temporary workspace
TWUA ..... Temporary Water Use Authorization
ULSD ..... ultra-low sulfur diesel
UME..... Unusual Mortality Event
UNFCCC..... United Nations Framework Convention on Climate Change
UAA..... University of Alaska, Anchorage
UAF ..... University of Alaska, Fairbanks
U.S..... United States
USACE ..... U.S. Army Corps of Engineers
U.S.C. ..... U.S. Code
USCG..... U.S. Coast Guard
USDA..... U.S. Department of Agriculture
USDOT ..... U.S. Department of Transportation
USFS ..... U.S. Forest Service
USFWS ..... U.S. Fish and Wildlife Service
USGS..... U.S. Geological Survey
UST ..... Underground storage tank
V6 ..... ASAP Pipeline Alignment, Version 6.1
VOC ..... volatile organic compound
Vol..... Volume
VRM..... Visual Resource Management
VSM ..... Vertical Support Members
WELTS..... Well Log Tracking System
WERC ..... Water and Environmental Research Center
WNP ..... Western North Pacific
YKCA ..... Yukon-Koyukuk Census Area
ZRA ..... zone of restricted activity

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4. ENVIRONMENTAL CONSEQUENCES

This chapter describes the predicted consequences, or potential effects, on the physical, biological, and human environment from implementing the alternatives described in Chapter 2. The chapter describes the proposed Project Area and scope of analysis (Section 4.1), defines frequently used terms (Section 4.2), and explains how incomplete or unavailable information is addressed in the analysis (Section 4.3). Section 4.4 describes the steps used for determining the level of impact for elements specific to project alternatives. Resource-specific criteria used in the evaluation of physical, biological, socioeconomic, and cultural resources are described in the introduction to each respective resource section of Chapter 4. Section 4.26 provides the cumulative effects assessment, including an overview of the methods used. The environmental impact assessment presented is based on the following technical reports and updates, as appropriate:

- Alaska Gasline Development Corporation (AGDC). (2014a). *Alaska Stand Alone Pipeline* (ASAP) – *Plan of Development Revision 3*. June.
- AGDC. (2015b). *ASAP Pipeline Stream Crossing Construction Mode Determination Manual*. Document No. 002-C-27-YPW-C-0003. January 12, 2015.
- AGDC. (2015c). *Screening for Port and Dock Site Selection, Dredge Material Disposal and Offload Methodology*. May.
- AGDC. (2015f). *Addendum to the 2014 Alaska Stand Alone Pipeline, Plan of Development*. October.
- AGDC. (2016a). *Alaska Stand Alone Pipeline/ASAP – Joint Application for Permit Revised.* January.
- AGDC. (2016b). *Alaska Stand Alone Pipeline/ASAP Project. Environmental Evaluation Document. 001-C-22-GRD-W-0055.* July 15, 2016.
- AGDC. (2016c). *Addendum #2 to the 2014 Alaska Stand Alone Pipeline Plan of Development*. February. 001-C-22-PLN-WWW-0004. February 3, 2016.
- AGDC. (2016f). *Confidential Report: ASAP Aboveground and Hybrid Project Cost Estimate (RFI #401).* June.
- AGDC. (2016g). *Visual Assessment for Denali Route.* September.
- AGDC. (2016j). *Identification and Evaluation of Time-Dependent Route Geohazards*, Alaska Stand Alone Pipeline. May.
- AGDC. (2016k). *The ASAP Belowground Pipeline Mode: Selection, Construction, Operation, and Maintenance on Alaska's North Slope*. ASAP-22-RTA-DDD-DOC-00066. July 12, 2016.
- AGDC. (2017). *Alaska Stand Alone Pipeline/ASAP – Joint Application for Permit Revised.* June 28, 2017.

- United States (U.S.) Army Corps of Engineers (USACE). (2012a). *Final Environmental Impact Statement* (FEIS). Alaska Stand Alone Pipeline. October.
- USACE. (2014). *Alaska Stand Alone Pipeline Project Supplemental Environmental Impact Statement Public Scoping Report*. November.
- AGDC's responses to USACE's data requests.
- Stakeholder and cooperating agency comments received, as summarized in the November 2014 ASAP Public Scoping Report (USACE, 2014).

4.1. Project Area and Scope for Analysis

The proposed Project components for this Supplemental Environmental Impact Statement (SEIS) includes a natural Gas Conditioning Facility (GCF) capable of producing an annual average 500 million standard cubic feet per day (MMscfd) of natural gas at peak capacity and a 1,480-pound per square inch (psig) natural gas pipeline. The pipeline has two major components: a 733-mile-long, 36-inch-diameter Mainline originating from the GCF near Prudhoe Bay, and extending south to its terminex at the existing ENSTAR Natural Gas Company (ENSTAR) pipeline system in the Matanuska-Susitna (Mat-Su) Borough; and, a 30-mile-long, 12-inch-diameter lateral pipeline terminating in Fairbanks (Figure 2.2-1).

The proposed Project Area includes a 90.6-acre gravel pad containing the proposed GCF and associated workspace, a vertical support member (VSM)-supported 36-inch diameter transmission line connecting the GCF to the Central Gas Facility (CGF) (approximately 4,200 feet in length), a 300-foot wide temporary construction right-of-way (ROW) with a 53-foot wide permanent ROW proposed for the Mainline and Fairbanks Lateral. Additional proposed Project Area includes Dock Head 3 (DH3) at West Dock, currently proposed for dredging and expansion to accommodate offloading of the GCF modules, the nearshore area immediately east of West Dock where dredge material is proposed for disposal and secondary use areas, such as, access roads, TWs, pipe storage yards (PSYs), construction camps, and material borrow sites. Following U.S. Environmental Protection Agency (EPA) Guidance (1999), the spatial scope also takes into consideration the geographic areas that help sustain the resource (*i.e.,* ecoregion, watershed or species range), with an emphasis on where the proposed Project may overlap with those boundaries.

Chapter 2, Table 2.2-7 provides the anticipated schedule of proposed construction activities for Alternative 1 (proposed Action). The proposed construction schedule (referred to as the "Construction Spread Plan") is an important consideration for assessing impacts to resources. The proposed pipeline is expected to begin operating in 2026. While the design life and the amount of gas reserves available on the North Slope may extend beyond 30 years, the timeframe for the SEIS analysis is defined as 2018 through 2038, approximately 10 years into operation of the pipeline. Analysis beyond 2038 is considered speculative given the dynamic nature of the environment. In

addition, future project-related activities, such as permit renewals or decommissioning of the pipeline, would warrant a new evaluation under the National Environmental Policy Act (NEPA), providing an opportunity for agencies and the public to review and evaluate the proposed activities.

4.2. Definition of Terms

The following terms are used throughout the document to discuss potential effects. In this analysis, the terms "effects" and "impacts" are interchangeable.

- Direct Effects – Caused by the action and occurring at the same time and place (40 Code of Federal Regulations [CFR] §1508.8).
- Indirect Effects – "Caused by an action and are later in time or farther removed in distance but are still reasonably foreseeable. Indirect impacts may include growth inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems" (40 CFR 1508.8).
- Cumulative Effects – Additive or interactive effects that would result from the incremental impact of the proposed 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 (40 CFR 1508.7). Direct impacts pertain to the proposed Action and alternatives only, while cumulative impacts pertain to the additive or interactive effects that would result from the incremental impact of the proposed Action and alternatives when added to other past, present, and reasonably foreseeable future actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.
- Reasonably Foreseeable Future Actions (RFFA) – RFFAs are those that are likely to occur and are not purely speculative. Typically, they are based on existing plans, permit applications, or announcements demonstrating active progress on the action. The process for determining what is considered reasonably foreseeable relative to the cumulative impact assessment is further described in Section 4.26, Cumulative Impact Assessment.

4.3. Incomplete and Unavailable Information

The Council on Environmental Quality (CEQ) (40 CFR 1502.22) guidelines require that:

> *When an agency is evaluating reasonably foreseeable significant adverse effects on the human environment in an environmental impact statement and there is incomplete or unavailable information, the agency shall always make clear that such information is lacking.*

In the event that there is relevant information, but "the overall costs of obtaining it are exorbitant or the means to obtain it are not known" (40 CFR 1502.22), the regulations instruct that the following should be included:

- A statement that such information is unavailable;
- A statement of the relevance of such information to evaluate reasonably foreseeable significant adverse impacts;
- A summary of existing information that is relevant to evaluating the adverse impacts; and
- The agency's evaluation of adverse impacts based on generally accepted scientific methods.

In each resource-specific analysis presented in this SEIS (Sections 4.6 through 4.25), authors have identified specific information, literature, or data that are unavailable to support a thorough evaluation of the environmental consequences of the alternatives. The implications of incomplete or unavailable information with regard to analyzing the alternatives is also described.

4.4. Steps for Determining Level of Impact

The CEQ regulations implementing NEPA state that an Environmental Impact Statement (EIS) (or SEIS) should discuss the significance, or level of impact, of the direct, indirect, and cumulative effects of the proposed alternatives (40 CFR 1502.16).

- Significance is determined by considering both the context in which the action would occur and the intensity of the action (40 CFR 1508.27).
- Context can be referred to as the extent of the effect (*e.g.,* geographic extent or extent within a species, ecosystem, or region) and any special conditions, such as endangered species status or other legal status.
- Intensity of an impact is the result of its magnitude and duration.

Actions may have both adverse and beneficial effects on a particular resource. A component of both the context and the intensity of an effect is the likelihood of its occurrence.

Geographic extent of potential impacts may be described using the following terms:

- Species or regional level – Change in species or population throughout its range that would likely affect its long-term survival or change affecting an entire region (*i.e.*, access to energy for multiple communities).
- Subpopulation or local level – Change in a species age-class in a limited area of its range, or change in available jobs in a local community.
- Individual level – Change to a specific animal or small number of animals, or change to a specific home due to land use.

Duration or frequency provides the context of time and may use the following terms:

- Short-term – Temporary effect that lasts from a few minutes to a few days, after which the affected resource reverts to the previous condition.
- Long-term – Effects that may last for years or permanent effects from which the affected resource never reverts to the previous condition.
- Intermittent or infrequent effects – Occur a couple times a year or fewer.
- Frequent – Occur on a regular or repeated basis each year.

The combination of context and intensity is used to determine the level of impact on each type of resource. Analysts utilized the following steps for the analysis:

1. Examine the mechanisms by which the proposed Action could affect the particular resource (*i.e.*, construction activities result in soil disturbance);
2. For each type of effect, establish a set of criteria to distinguish between major, moderate, minor, or negligible impacts; and
3. Based on the impact criteria, rank the expected magnitude, extent, duration, and likelihood of each type of effect under each alternative.

Determining the likelihood of an effect serves to assess whether it is plausible or just speculative. For the purposes of this analysis, analysts have applied the following approach for determining the likelihood of an effect arising from reasonable or demonstrated mechanisms due to the action:

- Most likely effects: greater than 75 percent chance
- Likely effects: between 50 and 75 percent chance
- Somewhat likely: between 10 and 50 percent chance
- Unlikely effects: less than 10 percent chance

This does not imply that the analysts perform a formal probability calculation. Rather, in their professional judgment, the probability of the effect occurring is more likely or less likely using these ranges.

Impact assessment criteria have been developed for physical, biological, and socioeconomic resources, as presented in each resource-specific section (Sections 4.6 through 4.25). The impact criteria tables provide guidelines for the analysts to assess the context of a potential effect and serve as tools for comparing the alternatives based on the conclusions drawn from the analysis. The impact criteria tables use terms and thresholds that are both quantitative and qualitative.

Qualitative thresholds are used where resource-specific baseline data may be lacking or potential effects are difficult to predict quantitatively (*e.g.*, quality of life is difficult to measure in quantitative terms). For a qualitative assessment, analysts must use

professional judgment about where a particular effect falls in the continuum from "negligible" to "major" or whether an effect is unknown.

4.5. Mitigation Measures

By definition, mitigation means to "make less severe or intense; moderate or alleviate." CEQ provided guidance in 1981 stating:

Mitigation measures discussed in an EIS must cover the range of impacts of the proposal. The measures must include such things as design alternatives that would decrease pollution emissions, construction impacts, esthetic intrusion, as well as relocation assistance, possible land use controls, that could be enacted, and other possible efforts. Mitigation measures must be considered even for impacts that by themselves would not be considered "significant." Once the proposal itself is considered as a whole to have significant effects, all of its effects on the environment (whether or not "significant") must be considered, and mitigation measures must be developed where it is feasible to do so (CEQ, 1981).

In January 2011, in accordance with 42 United States Code (U.S.C.) Section 4321 et seq., and CEQ Regulations for Implementing NEPA (40 CFR 1500-1508), CEQ supplemented the original 1981 guidance specifically on the topic of mitigation and monitoring. The 2011 guidance includes procedures for complying with requirements of NEPA and CEQ regulations when conducting mitigation planning and implementation. According to CEQ (2011), mitigation includes:

- Avoiding an impact by not taking a certain action or parts of an action;
- Minimizing an impact by limiting the degree or magnitude of the action and its implementation;
- Rectifying an impact by repairing, rehabilitating, or restoring the affected environment;
- Reducing or eliminating an impact over time, through preservation and maintenance operations during the life of the action; and
- Compensating for an impact by replacing or providing substitute resources or environments.

The following subsections provide: 1) an overview of the Applicant-proposed design features, mitigation measures, and Best Management Practices (BMPs) to further reduce potential effects of the Project; and 2) regulatory Agency-required or recommended measures to consider during the permitting process for the chosen alternative.

4.5.1. Applicant-Proposed Design Features, Mitigation Measures, Best Management Practices, and Project Management Plans

Many agencies and project proponents include mitigation measures as integral components of a proposed project's design. In compliance with CEQ guidance, and as

described in Chapter 2, the route for Alternative 1 (proposed Action) has undergone several revisions since 2012 to refine the alignment and reduce impacts to resources and communities. AGDC has incorporated several design features, mitigation measures, and BMPs that are listed in Appendix M to avoid, minimize, and mitigate impacts of the proposed Project. Appendix M, Part I presents a list of mitigation measures and BMPs proposed by AGDC, while Part II provides route changes (including the specific milepost [MP] location) and the rationale behind AGDC's proposed change for minimizing potential impacts.

The environmental analyses presented in this chapter consider these design features and measures proposed by AGDC under Alternative 1 (proposed Action). The analysis of Alternative 2 (Denali NPP Route Variation) assumes that many of the proposed measures would also apply to large portions of the pipeline, with the exception of those design aspects that are unique under Alternative 2, including the aboveground pipeline mode between MP 0 and MP 62, use of West Dock DH2, Denali National Park and Preserve (NPP) Route Variation, and aerial crossing at the Yukon River. Each resource section in this chapter includes a specific section titled *Applicant-Proposed Design Features, Mitigation Measures, Best Management Practices, and Project Management Plans,* which includes resource-specific measures evaluated in the analysis. Therefore, the conclusions presented in this chapter include consideration of these measures proposed by AGDC. The analysis assumes: 1) AGDC would construct, operate, and maintain the proposed Project as described in Chapter 2 of this SEIS; and, 2) AGDC would implement the measures designed to avoid or reduce impacts described in Appendix M.

Included in Appendix M, Part I are State of Alaska lease stipulations that would apply to all state land within the proposed ROW. According to AGDC, many of the stipulations become the basis of operators' processes and procedures, which would be used line-wide. AGDC is currently working with the U.S. Bureau of Land Management (BLM) to develop stipulations for BLM-managed lands that AGDC would impact. AGDC would also be required to develop lease stipulations with private landowners intersected by the proposed Project. Lease stipulations (*i.e.,* mitigation measures and BMPs) for BLM or private lands along the ROW have not been developed and, therefore, are not known at this time and have not been analyzed in Chapter 4.

4.5.2. Agency-Recommended Mitigation Measures and Best Management Practices

4.5.2.1. Other USACE and ADEC Conditions to be Considered During Permitting

As described in detail in Section 1.9.1, the lead agency, USACE, has the authority to issue or deny permits for placement of dredged or fill material in the waters of the U.S., including wetlands, and to regulate structures or work affecting the course, condition, and/or capacity of navigable waters of the U.S. USACE guidance on mitigation conditions states, "The nature and extent of mitigation conditions are dependent on the

results of the public interest review in 33 CFR 320.4." (33 CFR 320.4(r) and 325.4) To this end, the following conditions described in Table 4.5-1 may be required as part of the controlling agency's authorization at the time of construction. Assuming these agency recommendations would be required and that they would be successfully implemented, additional analysis and conclusions regarding potential impacts are discussed within appropriate resource sections later in this chapter including soils and geology, water, vegetation, and wetlands. The U.S. Army Corps of Engineers (USACE) Section 404 Clean Water Act (CWA 404) permit is not final until Alaska Department of Environmental Conservation (ADEC) issues a Certificate of Reasonable Assurance (401 Certification) that the State's water quality standards have been met.

Table 4.5-1 Recommended Mitigation Measures and Best Practices Under Regulatory Obligations of the Clean Water Act

Recommendations	Legal Jurisdiction	Responsible Agency
No stockpiling of fill materials shall occur in wetlands or other waters of the U.S. that do not have Department of the Army (DA) authorization.	CWA 404	USACE
Trenches may not be constructed or backfilled in such a manner as to drain waters of the U.S. (*e.g.*, backfilling with extensive gravel layers, creating a French drain effect). Ditch plugs or other methods shall be used to prevent this situation.	CWA 404	USACE
Except for material placed as minor trench over fill or surcharge necessary to offset subsidence or compaction, all excess materials shall be removed to a non-wetland location. The backfilled trench shall achieve the pre-construction elevation, within a year of disturbance unless climatic conditions warrant additional time. The additional time must be approved by USACE.	CWA 404	USACE
Excavated material temporarily sidecast into wetlands shall be underlain with geotextile, ice pads, or similar material, to allow for removal of the temporary material to the maximum extent practicable.	CWA 404	USACE
To prevent erosion, disturbed areas shall be stabilized immediately after construction. Revegetation of the site shall begin as soon as site conditions allow and in the same growing season as the disturbance unless climatic conditions warrant additional time. Additional time must be approved by USACE. Native vegetation and topsoils removed for proposed Project construction shall be stockpiled separately and used for site rehabilitation. Except in areas of topsoil excavation, excavated soils shall be sorted into mineral subsoils and topsoil, and stored separately. Topsoil is defined as the upper, outermost layer of soil, usually the top 2 to 8 inches. The depth of topsoil can be measured as the depth from the surface to the first densely packed layer of soil. When backfilling, topsoil shall be placed as the uppermost layer to provide a seed bed for native species. If topsoil and/or organic materials are not available from the proposed Project site for rehabilitation, other locally obtained native materials may be used. Species to be used for seeding and planting shall follow this order of preference: 1) species native to the site; 2) species native to the area; and 3) species native to the state.	CWA 404	USACE

Recommendations	Legal Jurisdiction	Responsible Agency
Prior to commencement of construction activities within waters of the U.S., the limits of the proposed Project disturbance shall be clearly identified at the proposed Project site with highly visible markers (*e.g.*, construction fencing, flagging, silt barriers, etc.) and shall be maintained until construction is complete and the soils have been stabilized.	CWA 404	USACE
Natural drainage patterns shall be maintained using appropriate ditching, culverts, storm drain systems, and other measures to prevent ponding or drying. Excessive ponding and/or dewatering of areas adjacent to fill areas shall indicate non-compliance.	CWA 404	USACE
The Applicant shall ensure that the proposed Project minimizes alterations to water circulation patterns to the extent practicable. If it is determined by USACE that the proposed Project negatively impacts the hydrology within the wetland, the Applicant may be required to take additional measures (*i.e.*, install additional depressed road beds, culvert(s), or a similar water conduit) beneath the road to reestablish the hydrology of the area to that of preconstruction conditions.	CWA 404	USACE
Relocated stream channels shall approximate the length, meander pattern, gradient, channel cross section, substrate, and flow velocity of the original stream channel. Relocated stream channels shall be designed and constructed to avoid excessive loss of flow through the bed or dewatering of the stream channel. The relocation of stream channels shall include establishment of an associated floodplain. The floodplain should be of similar dimension and form as the original.	CWA 404	USACE
As applicable to permit conditions at the time of construction, the permittee must maintain a minimum natural buffer of 25 feet around the edge of any waters of the U.S. and at stream crossings unless the crossing is a necessary and dependent water access construction activity (*e.g.*, open trench pipeline crossing).	CWA 402	ADEC
As applicable to permit conditions at the time of construction, the Stormwater Pollution Prevention Plan (SWPPP) must include a description of temporary and permanent stabilization practices for the site, including a schedule of when the practices would be implemented. The SWPPP must document shutdown and startup activities for projects that are not completed during the winter or summer construction season. The SWPPP must also document (1) the anticipated dates of fall freeze-up and spring thaw, (2) activities leading up to and at fall freeze-up, (3) activities leading up to and at spring thaw, and (4) activities to reestablish control measures prior to and immediately after spring thaw and fall freeze-up.	CWA 402	ADEC
As applicable to permit conditions at the time of construction, stabilization of disturbed areas must be initiated as soon as practicable whenever any clearing, grading, excavating, or other earth disturbing activities have permanently ceased on any portion of the site or temporarily ceased on the site and would not resume for a period exceeding 14 days.	CWA 402	ADEC
As applicable to permit conditions at the time of construction, no later than 14 days after initiating temporary stabilization, the permittee must complete all activities necessary to initially revegetate the area and/or install non-vegetative measures.	CWA 402	ADEC

Recommendations	Legal Jurisdiction	Responsible Agency
As applicable to permit conditions at the time of construction, the permittee must achieve final stabilization for the affected area of coverage. Final Stabilization means that all soil disturbing activities at the site have been completed and either of the two following criteria shall be met: a) a uniform (*e.g.*, evenly distributed, without large bare areas) perennial vegetative cover with a density of 70 percent of the native background vegetative cover for the area has been established on all unpaved areas and areas not covered by permanent structures, or b) equivalent non vegetative permanent stabilization measures have been employed including but not limited to riprap, gabions, porous backfill per Alaska Department of Transportation and Public Facilities (ADOT&PF) Specification 703-2.10, railroad ballast or sub-ballast, ditch lining per ADOT&PF Specification 610-2.01, or geotextiles, or fill material with low erodibility as determined by an engineer familiar with the site and documented in the SWPPP.	CWA 402	ADEC
As applicable to permit conditions at the time of construction, stabilization of disturbed areas must, at a minimum, be initiated immediately whenever any clearing, grading, excavating, or other earth disturbing activities have permanently ceased on any portion of the site or temporarily ceased on any portion of the site and would not resume for a period exceeding: 7 calendar days for those areas of the state with a mean annual precipitation of 40 inches or greater; or, 14 calendar days for those areas of the state with a mean annual precipitation less than 40 inches.	CWA 402	ADEC

4.5.3. Other Agency Recommendations

Following Sections 1502.16(h) and 1505.2(c) of regulations for implementing NEPA, other agencies have recommended modifications to AGDC's proposed mitigation measures or have proposed additional mitigation measures to further reduce potential effects of the proposed Project. Appendix M, Part III provides a comprehensive list of agency recommendations, jurisdiction of the requesting agency, and whether the agency has the authority to require implementation of the recommended measure (40 CFR 1502.16(h) and 1505.2). These other agency recommendations have not been adopted by the Applicant at this time. For this reason, conclusions about potential impacts of the proposed Project on subject resources are based on an analysis of the Applicant's proposed measures and the measures listed in this section and throughout Chapter 4.

4.6. Soils and Geology

4.6.1. Introduction

This section describes the potential direct and indirect effects of the alternatives described in Chapter 2 on soil and geologic resources. A summary of incomplete or unavailable information and a description of how that information has influenced this analysis is provided. This section also describes the methods and impact criteria used for assessing the level of impact to soil and geologic resources. Subsequent subsections evaluate each of the alternatives based on the criteria. For general impact assessment methodology used for all resources, please refer to Sections 4.1 through 4.5.

This section describes some of the mitigation measures that would aid in avoiding or minimizing the potential impacts. Additional information on proposed mitigation and monitoring is provided in Appendix M. The information used in this section builds on the 2012 FEIS (USACE, 2012a) and incorporates new data and information relevant to environmental concerns associated with the alternatives that have become available since the publication of the 2012 FEIS. The proposed changes in route and design described in Alternative 1 are the focus of this assessment. In some instances, information from the 2012 FEIS is replicated with relatively minor changes and updates, while other material is entirely new or substantially altered.

For this SEIS, the following elements have been added or updated since the 2012 FEIS with respect to impacts to soil and geologic resources:

- A new section (Section 4.6.2, Methods) was added to explain the procedures used to evaluate the potential impacts associated with the proposed Project and alternatives;
- Mitigation measures incorporated from the 2012 FEIS have been expanded to include new proposed Project information and recommendations from federal and state agencies (see Section 4.6.3 and Appendix M for detail); and
- Updates have been made to the description of potential environmental consequences based on new alternatives and newly available information.

4.6.1.1. Incomplete or Unavailable Information

In compliance with CEQ guidance (Section 4.3), this section addresses incomplete or unavailable information pertinent to analyzing potential impacts of the alternatives on soil and geologic resources.

Alternative 1 (proposed Action) is a 733-mile-long, 36-inch-diameter low-pressure natural gas pipeline and a 30-mile-long Fairbanks Lateral pipeline. The proposed pipeline would cross areas of continuous, discontinuous, and sporadic permafrost and areas where permafrost is absent. The pipeline would be buried along the entire route, except at elevated bridge crossings, fault crossings, pigging facilities, and valves.

Alternative 2 (Denali NPP Route Variation) would follow a similar route, with the only route difference being the Denali NPP Route Variation. However, under Alternative 2,

the proposed pipeline would be elevated on VSMs for the first 62 miles. To date, most pipelines built in permafrost areas of Alaska have been constructed above ground on VSMs. Compared to a buried pipeline, a pipeline on VSMs has a much smaller area where it interacts with the ground surface. In other jurisdictions, buried pipelines have sunk into thawing permafrost or been heaved to the surface. AGDC is proposing a wide variety of measures to avoid these undesirable outcomes. However, in comparison to pipeline construction on VSMs, there is greater uncertainty with regard to proposed Project outcome for buried pipeline construction in areas of continuous and discontinuous permafrost.

Assessments for this SEIS are made based on the most updated documents available. AGDC has drilled or collected borehole data for more than 10,000 boreholes, most with soil samples and laboratory analysis. This data is maintained in a proprietary geographic information system (GIS) database, which was not accessible to support preparation of this SEIS. Incomplete or unavailable information could create uncertainty regarding potential impacts. Where data are lacking, professional judgment has been applied based on knowledge and experience of the authors, contacted experts, and generally accepted scientific methods. More data is available for the Alternative 1 (proposed Action) than for Alternative 2 (Denali NPP Route Variation). In particular, many of the impacts of Alternative 1 have been quantified, but this information is often unavailable for Alternative 2. For instance, under Alternative 1, an estimated 25 million cubic yards (MCY) of material would be needed from borrow sources. Alternative 2 would require a lower volume, which has not been quantified in the available proposed Project documents. As a result, the assessment of Alternative 2 environmental consequences is often provided relative to Alternative 1.

Overall effects that the interaction of climate changes and the various alternatives would have on soil and geologic resources along the proposed Project corridor are unknown. In addition, effects may differ for different regions of the pipeline. For example, the rate and magnitude of climate change may be different for the Arctic Coastal Plain (ACP) (Beaufort) ecoregion than for the Brooks Foothills or the Brooks Range ecoregions. The proposed Project calls for "a belowground ambient-temperature pipe that would fluctuate seasonally with ground temperature" (AGDC, 2016b) which intends to minimize and mitigate impacts related to permafrost thaw and frost heave. The potential for climate change introduces an additional factor that is difficult to quantify and address and would pose an additional challenge for the proposed Project (or for Alternative 2).

4.6.2. Methods

The potential impacts to soil and geologic resources for the proposed Project presented below are based on the following:

- Evaluation of the resources along the proposed Project corridor;
- Review of available proposed Project descriptions and reports;

- Review of public comments received after the publication of the 2012 FEIS and during the public scoping period for the SEIS held in 2014; and
- Review of public comments received on the Draft SEIS during the July/August 2017 public comment period.

The affected environment includes portions of nine ecoregions ranging from the ACP (Beaufort) to the Cook Inlet Basin. The activities proposed under Alternatives 1 and 2 would impact and be impacted by a variety of geomorphic processes, including:

- Mass wasting;
- Permafrost degradation and aggradation;
- Frost and thaw action;
- Seismic events;
- Glacial processes;
- Fluvial processes; and
- Coastal processes.

4.6.2.1. Description of Effects

Chapter 4 describes potential impacts of the proposed pipeline on resources, in this case, soil and geologic resources. It is acknowledged that the geomorphic processes listed above could also impact the pipeline, but the focus of this section is on impacts that the proposed Project could have on the resource. These impacts may include:

- Alterations to drainage patterns and topography;
- Increased erosion and loss of vegetation;
- Creation of landscape scars, ponding, and siltation;
- Thaw settlement resulting in ground depressions and topographic changes; and
- Development of frost heaves and thaw bulbs.

The proposed Project route would cross a wide range of landscapes, including Arctic tundra, alpine areas, low lands, forests, and wetlands. This includes areas of continuous, discontinuous, and sporadic permafrost, as well as areas where permafrost is absent. Construction of the pipeline, including supporting roads, ice roads, pads, ice pads, material borrow sources, and material disposal areas, would alter drainage patterns and topography. Construction activities would disturb surface soils and the vegetation growing along the ROW. Drainage patterns would be modified to accommodate both temporary and permanent components of the proposed Project. This may result in ponding of water and disposition of silt and other soils in some areas. Other areas may be subjected to increased erosion.

Water flows at the surface and in the subsurface would be modified. The thermal balance of the subsurface would also change. If this results in thaw of frozen, ice-rich soil, it may result in surface depressions and further modification of water flow paths and thermal regime. If these changes result in freezing of unfrozen soils, it may result in frost heaving or changes to groundwater or suprapermafrost groundwater flow paths.

4.6.2.2. Impact Criteria

Table 4.6-1 summarizes the criteria used to determine the level of impact based on the magnitude, extent, duration, and likelihood of occurrence. Where additional resource-specific information may provide further insight into the rationale behind impact criteria, these details are presented following each table.

Table 4.6-1 Impact Criteria for Soil and Geologic Resources

Impact Component	Impact Level			
	Major	**Moderate**	**Minor**	**Negligible**
Magnitude or Intensity	The effect would alter a physical resource in a way that would degrade its value, integrity, or function to the point that it could not be used, or would endanger/ harm biological resources or human health.	The effect would indisputably alter a physical resource, but would allow the resource to be used without endangering human health, biological resources, or the function or integrity of the resource.	The effect would visibly or measurably alter a physical resource without removing its value and without endangering human health, biological resources, or the function or integrity of the resource.	No or minimal effect.
Geographic Extent	The effect would occur on a statewide or regional basis, or throughout the study area.	The effect would occur at an ecoregion level, or on a limited portion of the study area.	The effect would be site-specific or occur within a few isolated locations.	The effect would be limited to a specific, isolated location.
Duration or Frequency	The effect would occur for a duration of greater than 3 years or through the operation and maintenance phase of the proposed Project. Chronic and long-term changes not likely to be reversed over several years or operational life.	The effect would occur intermittently for a duration of 1 to 3 years. Periodic, temporary, or short-term changes could be reversed in 1 year or several seasonal cycles.	The effect would occur intermittently for a duration of less than 1 year. Periodic, temporary, or short-term changes could be reversed over one or two seasons.	The effect would be so intermittent and limited duration that effect dissipates rapidly.
Likelihood	Most likely (Effects are those that have greater than 75 % chance of arising from reasonable or demonstrated mechanisms due to the action)	Likely (Effects are those that have 50% to 75% chance of arising from reasonable or demonstrated mechanisms due to the action)	Somewhat likely (Effects are those that have a 10% to 50% chance of arising from reasonable or demonstrated mechanisms due to the action)	Unlikely (Effects are those that have less than 10% chance of arising from reasonable or demonstrated mechanisms due to the action)

Table 4.6-2 defines the types of effects the proposed Project and activities may have on the soil and geological resources that are assessed in this SEIS.

Table 4.6-2 Types of Effects and Impacts on Soil and Geologic Resources

Type of Effect	Proposed Action Causing Potential Impact	
	Construction	Operations and Maintenance
Effects to local topography, soil, and geology: • Alterations to drainage patterns and topography • Increased erosion and loss of surface vegetation • Creation of landscape scars, ponding, and siltation	Ground disturbance during construction to accommodate road construction, pipeline installation, and equipment staging; fill excavation/removal near the operation material sites	Accessing sections of the pipeline to conduct routine operations and maintenance activities; accessing sections to repair damage associated with changes to the thermal regime
Effects to permafrost and geology: • Thaw settlement resulting in ground depressions and topographic changes • Development of frost heaves and thaw bulbs	Construction of temporary ice roads and pads and permanent gravel roads and pads to stage and transport materials and equipment. Changes to the albedo and vegetation of the ground surface. Pipeline installation.	The presence and temperature of the pipeline and pipeline trench support structures could affect the frozen/thawed nature of the surrounding subsurface

4.6.3. Proposed Design Features, Mitigation Measures, Best Management Practices, and Project Management Plans

4.6.3.1. Applicant-Proposed Design Features, Mitigation Measures, Best Management Practices, and Project Management Plans

This section describes the design features, mitigation measures, BMPs, and Project Management Plans developed to avoid or minimize proposed Project impacts to soil and geologic resources. These measures and plans were taken into consideration when evaluating potential impacts on soil and geologic resources under Alternatives 1 and 2 during the construction and operations phases. Additional USACE conditions for inclusion into the Department of the Army (DA) Permit Authorization are included in Section 4.5.1.

Design features, mitigation measures, and BMPs presented below are proposed by AGDC. A complete list of mitigation measures and BMPs are also provided in Appendix M.

1. Design considerations:
    - Special installation techniques and foundations (*e.g.,* use of additional backfill to account for settling), installation of ditch plugs (*e.g.,* construction measures designed to stop water flow through the trench line), and revegetation.
    - Earthquake mitigation measures and special design considerations at fault crossings (see Table 4.6-4 for details).

- Special design considerations at river crossings (including seven horizontal directional drilling [HDD] crossings, 97 open-cut [OC] crossings for smaller streams, 155 isolated open-cut [IOC] crossings [which may include dams and pumps, diversion, cofferdams, or flumes], and six bridges along the Mainline).
- Erosion control measures.
- Frozen debris: The potential hazard presented to long-term operation of the proposed ASAP Project by the frozen debris lobe near MP 196.1 – the closest to the proposed Project – is being considered as design progresses. Appropriate methods to mitigate the hazard would be defined during detailed engineering. To account for the frozen debris lobe at this point of proposed Project planning, the Mainline alignment has shifted westward, and to the western side of the Dalton Highway, so the ASAP Mainline lies farther from the flow.

2. Operational considerations:
   - Slope stability monitoring
   - Seismic/earthquake monitoring
   - Operations and maintenance Manuals
   - Quality assurance manual
   - Inspection services manual
   - Design basis updates
   - Surveillance manual
   - Environmental management
3. The following mitigation techniques would be used to mitigate impacts as a result of trenching:
   - Special techniques may be used for restoration of the trench for buried pipeline between MP 0 and MP 62 in an effort to prevent alteration of the ice-rich permafrost. These may include using additional backfill to account for excess settling if wet permafrost thaws after pipe installation, installing ditch plugs (blocks of tundra or other native sod, bentonite, or other appropriate material to minimize water flow parallel to the pipeline), or revegetating to aid in achieving thermal stability of the soil in the trench. In drier areas, the trench backfill may remain above the surrounding grade even after settling. In this case, the backfill may be seeded with upland species.
   - Use of ice roads, ice pads, and snow packing on the North Slope;
   - Trench depth for the pipeline to at least 6 feet in permafrost;
   - Keep dormant period to 2 years or less during construction and testing;

- Operate an ambient temperature pipeline, which is below-freezing to protect continuous and discontinuous permafrost between MP 0 and MP 175;
- Conduct maintenance activities in response to any areas where excessive ponded water may occur in or near the filled trench;
- Increase efforts for maintenance during first several years after construction.

4. Plan for handling of surface layer from trench: The proposed Project would entail segregating the surface layer (a thin layer that typically consists of a combination of loose surficial herbaceous material consisting of small shrubs, vegetation, and woody debris, overlaying a thin organics layer and weak, compressible mineral soils)and replacing it as the last layer of backfill in the trench only within designated agricultural lands and in select continuous and discontinuous permafrost areas and permafrost free areas (as discussed in the AGDC planning document, *Segregation of the Surface Layer* [AGDC, 2017g], and in the Revegetation Plan [Appendix E, Part I]). In most locations along the pipeline trench, the surface layer would not be segregated from subsoils and a subsoil-surface layer mixture would be used as general back-fill. The surface layer would be segregated along approximately one quarter of the pipeline length. Construction in wetland areas of Alaska is commonly conducted when the soils are frozen and able to provide support for construction equipment. AGDC considers replacement of the surface layer to be impracticable when construction is done in winter, which would affect wetlands areas.
5. GCF module transport to construction site: Causeway and land roads would be surveyed for damage, erosion, and appropriate width before module movement. Gravel would be used for all maintenance purposes, including widening the roads. GCF road and pad construction (gravel placement) are planned for winter construction. All maintenance would occur after snowmelt is complete.
6. Mitigation for frost heave or thaw settlement depends on identifying portions of the alignment vulnerable to these geohazards, evaluating the depth extent of the hazard, and evaluating the structural and thermal interaction between the proposed pipeline and surrounding soil. Mitigation is indicated if modeling suggests pipeline deflections could exceed allowable values. Frost heave may be mitigated by replacing frost susceptible soil with non-frost susceptible borrow material, by controlling the operational pipe temperature, by applying insulation to control ground freezing, and possibly by providing drainage measures to control moisture migration. Thaw settlement may be mitigated by replacing thaw unstable soils with compact structural fill, by installing thermosyphons or applying insulation to control ground thawing in localized areas, or by controlling the operational pipe temperature. During construction, ice content of soils would be collected at regular intervals to determine a suitable mounding height, as indicated in the Comparative Belowground Designs and Return of Wetlands RFI response (Appendix E, Part IV) in order to determine the appropriate crown height for expected settlement of land over the ditch.

7. Stabilization of soils and the buried pipe: Thaw-stable permafrost soils would be used where possible. Establish a Revegetation Plan (Appendix E, Part I) with Alaska Department of Natural Resources (ADNR) Plant Materials Center; revegetate promptly after construction. Where required, re-grade construction disturbances to a condition that blends with the surrounding terrain and surface drainage patterns. Rely upon wind dispersal of seeds from plant species in the area to naturally recolonize the site. Upon completion of seedbed preparation, construction areas would be left unseeded to allow for natural revegetation/recolonization of the site. For areas that do not meet the revegetation criteria (cover and density standard) within the time standard (usually 3 years), seeds would be planted or some form of adaptive management considered.
8. Use of in-line inspection (ILI) devices (smart pipeline inspection gages [pigs]) to regularly detect longitudinal strain, primarily in continuous and discontinuous permafrost potentially related to slumping or heaving to facilitate prompt maintenance response. Monitoring curvature along the proposed pipeline through ILI surveys would involve the use of a high resolution inertial navigation system based geometry tool. An initial/baseline geometry survey of the proposed pipeline would occur as soon as practicable after construction. Survey-to-survey curvature changes could be used as a basis for estimating the rate of curvature accumulation at any areas of concern.
9. Water management: Implement adequate water management during construction and maintenance phases:
    - Use design and maintenance strategies;
    - Install ditch plugs where appropriate, as determined by environmental engineers;
    - Crown the ditch to allow settlement near to ground level to avoid having the filled trench slump and catch water or avoid runoff erosion;
    - Contour terrain, as needed, to direct water;
    - Maintain natural surface water flow patterns with as little change as possible;
    - Utilize culverts, bridges or other infrastructure as determined by civil engineers; and
    - Implement a maintenance program to manage water flow and ensure prompt maintenance after conditions are reported.
10. Monitoring and maintenance: Conduct monitoring and maintenance surveys by air, ground, and on foot during the dormant period (the time between the completion of construction and the beginning of operations) and operational phase. It is likely that

remote sensing and visual assessment methods would be used. The following describe monitoring and maintenance measures in more detail:

- Implement a programmatic maintenance cycle standard of "Monitor, Detect, Correct" to ensure prompt attention and correction for soil erosion and water management issues identified after construction and during operations.
- Effectively integrate security into SCADA by defining and executing a comprehensive program that addresses all aspects of security, ranging from identifying objectives to day-to-day operation and ongoing auditing for compliance and improvement. Elements of this program are described below:
  - Obtain senior management buy-in;
  - Build and train a cross-functional team;
  - Define charter and scope;
  - Define specific SCADA and control system policies and procedures;
  - Define and inventory SCADA and control system assets;
  - Perform a risk and vulnerability assessment;
  - Define the mitigation controls. The mitigation controls include business continuity planning, disaster recovery planning, configuration management, malicious code detection, intrusion detection system, and change management. These documented controls would be developed during design and integrated into the SCADA and automation systems; and
  - Provide training and raise security awareness for SCADA and control system staff.

Mitigation Measure Nos. 11 through 15 are applicable only to areas where a lease is required from the State Pipeline Coordinator's Section (SPCS) or a federal grant of ROW is required from BLM. AGDC has indicated that these stipulations would be used as the basis for operations processes and procedures that would be used throughout the proposed Project Area.

11. Plans for construction, operation, maintenance, and termination: In areas where a lease is required from the SPCS or where a federal grant of ROW is required from BLM, AGDC would submit to the SPCS/BLM for approval of the following plans, each of which would cover construction, operation, maintenance, and termination activities. These plans have not yet been drafted, and therefore, the specific mitigation measures that would be included in these plans are not considered in this analysis. The mitigation measures would include:
    - Pipeline trench backfill methods.
    - Disposal of trench spoils (a mixture of surface layer and subsoil) and excess and excavated material.

- At the completion of operations, aboveground facilities would be removed and stabilized/revegetated to the satisfaction of the landowner. Buried pipeline would be left in the ground, which would have the least harmful impacts to the land.
- Stipulations of the SPCS ROW lease and BLM federal grant of ROW are referenced throughout this document. The SPCS has entered into agreements with municipalities to apply the SPCS ROW lease stipulations on municipal lands. Many of the stipulations in these documents would become the basis of the operator's processes and procedures, which are used throughout the proposed Project Area. The applicability of the stipulations on private lands would be coordinated with landowners.

12. Surveillance and monitoring: In areas where a lease is required from the SPCS or a federal grant of ROW is required from BLM, a surveillance and monitoring program for the pipeline would be approved by the SPCS/BLM prior to start-up of the pipeline. The program shall be designed, at a minimum, to prevent and mitigate erosion and maintain pipeline integrity and monitor any pipeline movement that may affect integrity.
13. Layout of material sites: In areas where a lease is required from the SPCS or a federal grant of ROW is required from BLM, material site boundaries would be shaped in such a manner as to blend with surrounding natural land patterns. Regardless of the layout of material sites, primary emphasis would be placed on prevention of soil erosion and damage to vegetation.
14. Excavated material: In areas where a lease is required from the SPCS or a federal grant of ROW is required from BLM, excess excavated material would be disposed of in accordance with approved construction plans during construction and as approved by the SPCS/BLM during operation, maintenance, and termination of the pipeline. Excavated materials would not be stockpiled in rivers, streams, active floodplains, or wetlands unless approved by the SPCS/BLM regulatory agencies and designated as an appropriate storage or disposal location by the terms of the lease.
15. Restoration and revegetation: In areas where a lease is required from the SPCS or a federal grant of ROW is required from BLM, revegetation of disturbed areas on state land would be conducted as soon as practicable and, if necessary, would be repeated until revegetation is successful, unless otherwise approved by the SPCS/BLM.
    - Surface materials (*i.e.*, logs, trees, vegetation, boulders, and soils) taken from disturbed areas would be stockpiled and utilized during restoration unless otherwise approved by SPCS/BLM.
    - Stabilization practices, as determined by the needs for specific sites, would include but shall not be limited to the placement of mat binders, soil binders, rock, or gravel blankets or structures.

- All disturbed areas of state/federal land would be left in such stabilized condition that erosion in excess of natural rates would be minimized until the practicable restoration and revegetation of the leasehold could be accomplished in a manner that is reasonably satisfactory to SPCS/BLM.
- Areas on state/federal land disturbed by AGDC would be restored by AGDC to the reasonable satisfaction of SPCS/BLM, as stated in writing.
- Vegetation, trench spoils, and other materials removed during clearing operations would be disposed of by AGDC. Upon completion of the restoration on state/federal land, AGDC would remove all equipment and supplies from the site.
- Installation of the pipeline would occur in winter using proven design measures, installation practices, and equipment common to other arctic pipelines to facilitate safe installation and prompt revegetation, as indicated in the Comparative Belowground Designs and Return of Wetlands RFI response (Appendix E, Part IV).
- Prompt revegetation of wetlands and uplands in arctic and interior Alaska would occur by implementing proven ADNR Plant Materials Center revegetation practices and cover standards that have been successfully implemented for other ground disturbed areas in these regions, as indicated in the Comparative Belowground Designs and Return of Wetlands RFI response (Appendix E, Part IV).

Mitigation Measure Nos. 1 through 15 are referenced numerically in the discussion below.

4.6.3.2. USACE and ADEC Conditions to be Considered During Permitting

A variety of mitigation measures and best practices have been recommended by the cooperating agencies (Appendix M). Many of these recommendations have been incorporated in the proposed Project. Significant differences between the regulatory agency recommendations and the proposed Project are identified below.

USACE has recommended that the backfilled trench achieve the pre-construction elevation within a year of disturbance unless climatic conditions warrant additional time. Ground surface elevation is important because it controls water accumulation and can limit revegetation.

USACE has recommended that, except in areas of topsoil excavation, excavated soils should be sorted into mineral subsoils and topsoil and stored separately. When backfilling, topsoil shall be placed as the uppermost layer to provide a seed bed for native species. Segregation and reuse of the topsoil is intended to speed revegetation. Revegetation in turn helps address any decrease in albedo, minimize the potential for permafrost thaw, and protect the soil resource.

USACE has recommended that final stabilization be attained for the affected area of coverage. Final stabilization means that all soil-disturbing activities at the site have been completed and either of the two following criteria have been met: a) perennial vegetative cover with a density of 70 percent of the native background vegetative cover has been established or b) equivalent non-vegetative permanent stabilization has been constructed.

Section 4.6.8 describes the differences in the anticipated proposed Project impact rankings under the assumption that these recommended measures were implemented. This section is provided as a comparison with the impacts of the currently proposed Project.

4.6.3.3. Agency-Recommended Mitigation Measures

A variety of mitigation measures and best practices have been recommended by the cooperating agencies (Appendix M). Many of these recommendations have been incorporated in the proposed Project and are included in Table 4.6-3 below. The impacts discussed in this chapter are based upon the Applicant-proposed measures. These additional agency recommended measures are not included in the impact analysis.

Table 4.6-3 Soils and Geology Resources Agency-Recommended Mitigation Measures

Additional Measure Consideration	Agency Proposing Mitigation Measure	Agency Jurisdiction	Authority (*i.e.*, CWA, RHA, ESA)	Affected Resources	Comment Code
Stabilization of disturbed areas must be initiated as soon as practicable whenever any clearing, grading, excavating, or other earth disturbing activities have permanently ceased on any portion of the site or temporarily ceased on the site and would not resume for a period exceeding 14 days. Temporary Stabilization: No later than 14 days after initiating temporary stabilization, the permittee must complete all activities necessary to initially revegetate the area and/or install non-vegetative measures.	ADEC	EPA, ADEC	CWA	Waters, Soils and Geology, Vegetation	NA
Final Stabilization and Terminating Construction Stormwater Authorizations: To eliminate a site or terminate authorization for construction stormwater coverage under General Permit AKG320000, the permittee must achieve final stabilization for the affected area of coverage. Final Stabilization includes: a) a uniform (*e.g.*, evenly distributed, without large bare areas) perennial vegetative cover with a density of 70 percent of the native background vegetative cover for the area has been established on all unpaved areas and areas not covered by permanent structures, or b) equivalent non vegetative permanent stabilization measures have been employed including but not limited to riprap, gabions, porous backfill per ADOT&PF Specification 703-2.10, railroad ballast or sub-ballast, ditch lining per ADOT&PF Specification 610-2.01, or geotextiles, or fill material with low erodibility as determined by an engineer familiar with the site and documented in the SWPPP.	ADEC	EPA, ADEC	CWA	Waters, Soils and Geology, Vegetation	NA

Additional Measure Consideration	Agency Proposing Mitigation Measure	Agency Jurisdiction	Authority (*i.e.*, CWA, RHA, ESA)	Affected Resources	Comment Code
Stabilization of disturbed areas must, at a minimum, be initiated immediately whenever any clearing, grading, excavating, or other earth disturbing activities have permanently ceased on any portion of the site or temporarily ceased on any portion of the site and would not resume for a period exceeding: 7 calendar days for those areas of the state with a mean annual precipitation of 40 inches or greater; or 14 calendar days for those areas of the state with a mean annual precipitation less than 40 inches.	ADEC	EPA, ADEC	CWA	Waters, Soils and Geology, Vegetation	NA
Specify the timeframe of restoration	BLM	BLM, ADNR	--	Soils and Geology, Vegetation, Wetlands	MIT_21
Remove and properly store the organic soil layer (*e.g.*, tundra sod blocks and salvaging the organic layer, approximately 15-30 centimeter uppermost layer containing seeds, plant propagules, roots, organic matter, and soil microbes) before trenching to facilitate reestablishing vegetation in a more timely manner.	USFWS	USACE, EPA	--	Soils and Geology, Vegetation, Wetlands	MIT_12
Use a generally accepted timeline of 5 years for achieving 70 percent coverage in the Intermontaine Boreal and Alaska Range Transition Ecoregions.	USFWS	--	--	Soils and Geology, Vegetation, Wetlands	MIT_13
The pipeline shall be elevated on Vertical Support Members (VSMs) from Milepost 0 to at least beyond the area of extensive ice-rich, saturated soils containing a high density of oriented thaw lakes on the Arctic Coastal Plain. The VSMs should also be used to elevate the pipeline in extensive areas of thaw-unstable permafrost and in areas of continuous and discontinuous permafrost where inadvertent	USFWS	USACE	--	Soils and Geology, Vegetation, Wetlands	MIT_15

Additional Measure Consideration	Agency Proposing Mitigation Measure	Agency Jurisdiction	Authority (*i.e.*, CWA, RHA, ESA)	Affected Resources	Comment Code
thermokarst could alter the natural drainage pattern along the pipeline.					
Material sites shall be reclaimed in accordance with a plan approved by the Corps of Engineers in consultation with the USFWS. Reclamation shall be accomplished within 3 years on any portion of the material site that has been inactive (abandoned) for 3 years, or where the material source is no longer practical or economically feasible to extract.	USFWS	USACE	--	Soils and Geology, Vegetation, Wetlands	MIT_15
If open water is created at a material site in the Intermontane Boreal or Alaska Range Transition Ecoregion, then reclamation shall include: 1) constructing a littoral zone at least 20 feet wide (shallow underwater shelf along the bank with slopes averaging less than 10H:1V); 2) constructing an irregular shoreline with bays and spits; and 3) spreading 2 to 4 inches of separately stockpiled organic overburden on the littoral zone and shoreline to enhance revegetation. At least a 25-foot-wide buffer of native vegetation should also be established around the excavation perimeter to help filter sediment and pollutants before they enter the water.	USFWS	BLM	--	Soils and Geology, Vegetation, Wetlands	MIT_15
If open water is created at a material site in the Arctic Tundra Ecoregion, then reclamation shall include: 1) salvaging the active organic topsoil layer (12 to 18 inches) overlaying the footprint of the cell and stockpile on an adjacent ice pad/pad; 2) removing the remaining inorganic/mineral overburden from the cell and stockpile separately from the organic topsoil on an adjacent ice pad/pad; 3) placing a berm of inorganic overburden around the outside edge of the cell as insulation to prevent	USFWS	BLM	--	Soils and Geology, Vegetation, Wetlands	MIT_15

Additional Measure Consideration	Agency Proposing Mitigation Measure	Agency Jurisdiction	Authority (*i.e.*, CWA, RHA, ESA)	Affected Resources	Comment Code
thermokarsting and erosion of the cell sidewalls, and as a safety precaution; 4) instructing side slopes of the cell no steeper than 2H:1V (preferably 3H:1V); 5) placing the inorganic/mineral overburden back into the cell when mining is complete to create 3H:1V side slopes if possible; 6) using the organic topsoil to stabilize the top edges of the side slopes of the mined cell, to reclaim the adjacent tundra disturbed by mining operations, and/or to use in other reclamation sites; and 7) keeping the berm surrounding the pit in place as a safety precaution until the pit has completely filled with water, at which point the berm can be removed (*e.g.*, pushed into the water-filled pit).					
A large number of Applicant-proposed design features, mitigation measures, BMP, and project management plans listed in the Draft SEIS contain the language, "In areas where a lease is required from the State Pipeline Coordinator's Section or a federal grant of ROW is required from BLM ..." These measures generally represent a best management approach that we recommend using to the maximum extent possible along the entire pipeline route, while acknowledging the outstanding need to complete coordination with private landowners.	EPA	--	--	Numerous	MIT_35

AAC = Alaska Administrative Code
ADF&G = Alaska Department of Fish and Game
ADEC = Alaska Department of Environmental Conservation
ADNR = Alaska Department of Natural Resources
AGDC = Alaska Gasline Development Corporation
APDES = Alaska Pollution Discharge Elimination System
BLM = Bureau of Land Management
BMP = Best Management Practice
CAA = Clean Air Act
CWA = Clean Water Act
DHSS = Alaska Department of Health and Social Services
EPA = U.S. Environmental Protection Agency
MBTA = Migratory Bird Treaty Act
NMFS = National Marine Fisheries Service
RHA = Rivers and Harbors Act of 1899
SEIS = Supplemental Environmental Impact Statement
USACE = U.S. Army Corps of Engineers
USFWS = U.S. Fish and Wildlife Service

4.6.4. Alternative 1 – Proposed Action

Chapter 2 provides a detailed description of Alternative 1, the proposed Action (proposed ASAP Project). Anticipated impacts to soil and geology as a result of the proposed Action are related to above and below ground pipeline segments, aboveground facilities, access roads and ice roads, and dredging and disposal of dredged material. Alternative 1 would have a total footprint of approximately 21,493 acres, including 11,788 acres of uplands and 9,705 acres of waters of the U.S., including wetlands.

This section identifies general impacts from construction and operations, and discusses impacts specific to regional geology and topography, permafrost and soil, material resources, and paleontological resources.

4.6.4.1. Construction

The following construction activities may contribute to a significant impact on soil and geological resources:

- Winter dredging of a navigation channel and turn basin at West Dock;
- Nearshore disposal of dredge material on bottom fast sea ice in Prudhoe Bay;
- Excavation of the proposed pipeline route and stripping the surface layer from the pipeline corridor (surface layer to be replaced on agricultural lands, in select continuous and discontinuous permafrost areas, and non-permafrost areas [as discussed in the AGDC planning document, *Segregation of the Surface Layer* [AGDC, 2017g], and in the Revegetation Plan [Appendix E, Part I]);
- Construction of 733 miles of a 36-inch diameter (generally) buried pipe;
- Construction of the 30-mile-long Fairbanks Lateral;
- Development or expansion of 89 material/gravel sites (a total of 5,200 acres of land would be used for material sites);
- Removal of 25 MCY from gravel sources;
- 23 temporary ice roads totaling 22.9 miles;
- Construction of 174.4 miles of new access roads; and
- Disposal of soil removed from the excavation.

4.6.4.1.1. West Dock – Dock Head 3

Under Alternative 1 (proposed Action), the navigational channel near West Dock would need to be to dredged -9 feet below mean lower low water (MLLW) during the winter prior to construction activities. Approximately 250,000 cubic yards (CYs) of bottom material would be removed (AGDC, 2016b). Dredge material would be disposed on bottom fast ice in the nearshore environment in southern Prudhoe Bay. Dredge spoils would be deposited in piles approximately 1 to 2 feet deep over 100 acres. Data

previously collected at the site (see Attachment 4 of the Environmental Evaluation Document [EED]: West Dock Dredge and Disposal Plan [AGDC, 2016o]) suggests that the dredge materials are not contaminated. However, samples were collected at a distance from the proposed dredge site. Chemical analysis of potential dredge sediment would be required under Clean Water Act (CWA) (40 CFR 230.60) prior to dredging and discharging dredge spoils.

Dredging would occur in the winter, when equipment could operate safely on the ice, prior to the sealift (the use of cargo ships for the deployment of assets). Because the sealift would take place in a single construction season, no summer maintenance dredging is expected, but screeding may be done to retain a depth of -9 feet below MLLW. Screeding barges pulling a beam moved by shallow draft assist tugs may be used to level the seafloor, transferring material at high spots to deeper areas.

The effects of dredging and nearshore disposal of dredged materials in support of use of West Dock DH3 are expected to be minor. The geographic extent of the effect would be limited to a specific (but relatively large) area and the effect would only occur once.

4.6.4.1.2. Pipeline Right-of-Way Mainline

On the North Slope, much of pipeline construction is planned to occur in winter utilizing equipment staged on ice pads accessible by ice roads and frost packing to aid in the preservation of wetlands and permafrost. In other areas, construction would take place in summer. A mechanized trenching machine would remove the surface layer and advance the trench, creating a 5-foot wide ditch in which to place thaw-stable padding and the 36-inch diameter pipe (AGDC, 2016e).

Williams (1986) found that although pipeline temperature could play a significant role, a:

> *Larger amount of thawing occurs initially because of the disturbance of the ground surface caused by the laying of the pipe and backfilling. Generally speaking, disturbance of the natural vegetation upsets the exchange of energy at the ground surface in such a way as to raise the temperatures of the ground slightly, and this is very important if the ground is almost at thawing point anyway.*

Following issuance of the 2012 FEIS (USACE, 2012a), the plan for handling the surface layer was modified (Mitigation Measure No. 4, as listed in Section 4.6.3). Initially, where required, vegetation would be removed by clearing or grubbing. The proposed Project would segregate the surface layer and replace it as the last layer of backfill in the trench within designated agricultural lands and in select continuous and discontinuous permafrost areas and non-permafrost areas (as discussed in the AGDC planning document, *Segregation of the Surface Layer* [AGDC, 2017g], and in the Revegetation Plan [Appendix E, Part I]), where AGDC deems the surface layer reuse to be practicable. AGDC considers surface layer reuse impracticable when construction is done in the winter. In most locations along the pipeline trench, the surface layer would not be segregated and would be used as general backfill. Surface layer segregation would be

limited to areas where construction is conducted in the summer and would not be conducted on the North Slope. Failure to salvage the surface layer could result in the loss of nutrients, organic matter, seed bank, and other plant parts that are beneficial to vegetation growth and site restoration.

USACE Regional Condition D states that native vegetation and topsoil removed for proposed Project construction shall be stockpiled separately and used for site rehabilitation. AGDC has indicated that this would not be possible along portions of the ROW where construction takes place during the winter.

Removal of vegetation and the surface layer in a permafrost regime can be problematic. As stated by AGDC in the *Segregation of the Surface Layer* (AGDC, 2017g), "During the construction of the Haul Road to the North Slope (Dalton Highway) in 1974, the crews quickly learned that disturbing the surface layer caused rapid and uncontrolled melting of the underlying permafrost, and the practice was halted immediately." The proposed Project is proposing disturbance of the surface layer and similar issues may result.

During the design phase, AGDC intends to use data on the ice content of soils present beneath each section of pipeline and the modeled temperature of that section of pipeline to estimate the amount of thaw and potential subsidence. This estimate would be used to determine how much material to include in the crown (mound) over the pipeline excavation. The design intent would be to provide for a crown that, following thaw and settling, would leave a very slight mound just above grade. This intent may be difficult to achieve in practice where thaw-susceptible soil is present. Too little crown or more thaw than planned could result in a depression. Experience on similar projects indicates that a depression would fill with water and decrease albedo. If the depression is deep enough, it could prevent revegetation and result in additional thaw.

AGDC expects that, following stabilization, regrowth of vegetation would occur over time. The required timeframe may be very long as most North Slope projects are focused on rehabilitation over time spans of 10 years and more. Many may eventually (over several decades) evolve into restoration projects as plant communities, ground ice conditions, and other site characteristics mature (North Slope Science Initiative [NSSI], 2015). Given removal of the surface layer, which serves to insulate deeper thaw-susceptible soil, preservation of the pre-existing thermal regime would be difficult.

The proposed Project includes three standards that are related to the USACE recommendation that final stabilization attain perennial vegetative cover with a density of 70 percent of the native background vegetative cover:

- As an interim action level criterion, a reclamation standard of at least 30 percent vegetative cover over a 3-year period would be established. Failure to meet this criterion might trigger the need for remedial action, such as seeding, reseeding, application of soil amendments, or incorporation of additional growth media.
- The proposed Project would attempt to attain at least 70 percent canopy (or aerial) cover.

- Species density would be evaluated by comparing the total number of species in the evaluation site to that of the adjacent reference sites.

Final stabilization and revegetation relates directly to the soil resource in that the vegetation and surface layer protect frozen soils from thaw and prevent subsidence. ADGC provides two examples of the proposed Project team's ability to successfully revegetate similar sites, a site in the interior of Alaska and a North Slope site. At the Interior Alaska site, 4 years after fertilizer application and seeding, total plant cover ranged between 52 percent and 59 percent (Nolen, 2008). For the North Slope site, in 2 years following revegetation, ground cover values ranged from less than 5 percent to 90 percent, with an overall cover of approximately 50 percent (Wright, 1995b).

Between MP 0 and MP 62, AGDC may use additional backfill to account for excess settling, and the mounded backfill may be seeded with upland species (Mitigation Measure No. 3). In some areas, the material is expected to contain high and variable concentrations of frozen water. Where frozen backfill is used, determining the correct amount of backfill material, thoroughly mixing the subsoil and material from the surface layer, and uniformly distributing this material may pose construction challenges. Areas mounded above the surrounding ground surface would be easier to revegetate than areas where the surface of the backfill sinks below the ground surface; due to thaw, soils would become saturated and revegetation would be difficult. The potential for introducing non-native species as a result of revegetation is described in Section 4.8, Vegetation.

The vegetative mat, topsoil, and tundra vegetation typical of several locations along the proposed Project route are easily damaged, which could affect the depth of the active layer and thereby, the depth to permafrost and the drainage patterns of the site. In areas where mineral soil is exposed, the active layer is likely to be considerably deeper than in areas with good vegetative cover. Mitigation Measure Nos. 1, 3, 4, 6, 7, and 9, as listed in Section 4.6.3, would be used to help minimize related impacts. As stated in Section 5.1.2.1 of the EED, "Depending on the content of massive ice in the vicinity, some sections of inundated trench may propagate permafrost thaw into the surrounding area, especially where stretches of flooded trench intersect ice wedge troughs." Massive ground ice,[1] up to and greater than 50 percent by volume (Kreig and Reger, 1982), is found along the northern portion of the pipeline route. Propagation of permafrost thaw results in melting of the massive ice. This directly results in a decrease in the volume of the impacted soil and frequently reduces the bearing capacity of the soil to near zero. This could result in a decrease in the elevation of the ground surface. Saturated soil

[1] Massive ice ground can be defined as "a comprehensive term used to describe large masses of ground ice, including ice wedges, pingo ice, buried ice, and large ice lenses" (National Snow and Ice Data Center, 2017a).

tends to be darker than dry soil. Thus, permafrost thaw could result in a decrease in the albedo[2] of the soil causing further propagation of the thaw.

In addition, for the section of the proposed pipeline from MP 0 to MP 62, special techniques may be used for restoration of the trench in an effort to prevent alteration of the ice-rich permafrost. These techniques may include use of additional backfill, installation of ditch plugs, or revegetating (Mitigation Measure No. 3, as listed in Section 4.6.3).

Revegetation is necessary to increase albedo and reestablish the thermal balance of the subsurface. AGDC would rely on the Alaska Plant Materials Center for technical assistance regarding revegetation and site restoration. Review of proposed Project documents published by the Alaska Plant Materials Center indicates that attaining the proposed Project reclamation standard of at least 30 percent vegetative cover over a 3-year period (not including seeding year) could be challenging (Czapla and Wright, 2012; Nolen, 2008; Wright, 1995a, 1995b).

AGDC has proposed methods similar to Project Chariot for revegetation activities on the North Slope. Whereas Project Chariot encountered difficulties using crews on foot to reseed areas of deep mud, ASAP would use fixed wing aircraft to apply fertilizer and broadcast seed. Revegetation for Project Chariot included two areas: an area of mounded soil and a trail (Wright, 1995b). The mounded soil was coarse and well drained and during the second year evaluation was revegetated and described as "performing well" with the reinvasion of other species "continuing at an exceptional rate." "The trail leading to the mound site exhibited areas of excellent growth and areas of very poor growth…The ground cover values for the trail ranged from 90% to less than 5%." Areas of open water and thermal degradation are evident.

AGDC has proposed methods similar to those used at Kanuti Pit for revegetation activities in the interior region of Alaska. Reclamation at Kanuti Pit began in 2002 (Nolen, 2008). The project encountered a number of difficulties: the wrong equipment was used, the field crew lacked trained oversight, there were shortcomings in seed and fertilizer application rates, and parts of the planned area were not treated. By 2006, results ranged from areas of soils with little vegetation to areas where vegetation became well established. Review of revegetation results for Project Chariot and Kanuti Pit indicate that success often varies significantly across even a small site, depending on soil properties and degree of saturation.

As with the surface layer, gravel resources along the pipeline corridor are a limited resource. Gravel is also used for other purposes, such as road and pad construction. Many of the identified material sites are actively used by the Alaska Department of Transportation and Public Facilities (ADOT&PF) (and other organizations). At this stage

[2] Albedo can be defined as "how much sunlight a material reflects back into the atmosphere" (National Snow and Ice Data Center, 2017b).

of proposed Project planning, it is currently unknown whether or not the development of material sites under Alternative 1 would provide an excess of gravel potentially available for other purposes or if it would deplete this resource and hinder future projects. Several of these material sites are key sources of material for the State of Alaska. AGDC and ADOT&PF have agreed to examine the use of each joint material site and develop a Material Site Plan that provides for the needs of both parties. Gravel resources removed from individual material sites would be permanently depleted; therefore, potential effects on the resource would be considered moderate.

Particularly in areas lacking an insulating vegetative mat, repeated frost action could result in cryoturbation[3]. In areas of low centered polygons, the ice wedges between the polygons may extend from a few feet to 20 feet or more in depth. When surface hydrology alters the availability of water for the ice wedges, the result may become high centered polygons with deep fissure between them, which could expose a pipeline. This is also likely to alter vegetative communities towards a dryer regime. In areas with large rocks mixed with finer material, the frost action may create sorted circles, in which the larger stones are forced upwards to the surface and may disrupt buried objects. In areas of very coarse material (*e.g.*, along rivers and deltas), there may be no permafrost and very little vegetation, so disturbance is less likely to have long lasting impacts (Geisler, 2012; Rieger *et al.*, 1979).

A pair of field trials and Material Site 3 (MS3) Trenching Site (North Slope, Alaska) and Washington Creek Trenching Test Site (Interior Alaska) demonstrate challenges associated with constructing buried pipelines in permafrost rich areas. Each of these sites was relatively compact and provided relatively easy access. These trials are discussed in more detail in Appendix E, Part IV *Comparative Belowground Designs and Return of Wetlands*.

Trenching at the MS3 site was conducted in February 2002 to test the effectiveness of trenching equipment and methods that could be used in construction of a below ground gas pipeline in a tundra environment (ABR and BPXA, 2012). A variety of trenching approaches were used to install 13 parallel trenches, with soil segregated by type for some trenches but not for others. The proposed Project would not segregate surface layer material on the North Slope. Each trench was approximately 1,400 feet long. All trenches were backfilled about 1.1 meters (m) above grade to limit the likelihood of thaw subsidence leading to formation of water-filled ditches. By 2003, a pond approximately 160 feet wide by 250 feet long had formed on the south end of the site. Because of permafrost thaw and surface subsidence, supplemental rehabilitation was required in

[3] Cryoturbation can be defined as "(1) (singular) a collective term used to describe all soil movements due to frost action (2) (plural) irregular structures formed in earth materials by deep frost penetration and frost action processes, and characterized by folded, broken and dislocated beds and lenses of unconsolidated deposits, included organic horizons and even bedrock" (National Snow and Data Center, 2017c).

2005. Additional rehabilitation was required in 2007 and 2008, at which point the previously agreed upon rehabilitation standards were made less stringent.

In 2008, an ice road to the site was constructed to allow use of heavier equipment. Ditch plugs were installed at that time and additional backfilling was performed. Despite the 2008 backfill and ditch plug effort, in 2010, some of the trenches were found to still contain flooded segment lengths more than 33 feet long. Water in these segments was deep enough to impede vegetation establishment. Additional rehabilitation was required in 2011 and 2012. Repeated rehabilitation may not be possible along portions of the ROW that can only be accessed by heavy equipment using an ice road. Aerial photographs taken in 2013, 11 years after the trenches were installed, indicate that the outermost trenches remain largely submerged, with the surface water intersecting with flooded ice-wedge polygon troughs (ABR, 2014). A 2016 aerial photograph shows sections of flooded trench and numerous vehicle tracks, apparently caused by restoration efforts. Results from the MS3 pilot study indicate that for areas on the North Slope where initial construction efforts and preliminary thawing result in depressions, revegetation is hindered by the presence of water and additional thaw and subsidence can be expected.

The Washington Creek trenching test site was established to test the effectiveness of various trenching techniques for the installation of pipelines in discontinuous permafrost environments (ABR and BPXA, 2013). The site was cleared by cutting down the open black spruce forest that dominated the area. To prepare the Washington Creek trenching test site for rehabilitation, soil excavated from the trenches was used for backfill. Additional fill (primarily gravel) was hauled to the site and used in some of the trenches, but was top-dressed with on-site material. This approach is similar to the proposed Project. Soil was mounded approximately 1.1 m above the trenches to limit the likelihood of thaw subsidence leading to the formation of ditches. The backfilled trenches were fertilized and seeded to promote rapid establishment of vegetation, which would assist in stabilizing the soil. Despite these efforts, flow followed natural drainages that intersected some of the trenches. At these locations, water flowed along the trenches for some distance; in one case, the flow was subterranean. The topdressing on the trench was partially frozen at the time, and the water flowed through the underlying gravel backfill. The proposed Project would use trench plugs to try to prevent water flow through the trenched area. Eventually, the cap of native soil thawed and collapsed into the trench. No erosion occurred where trenches did not intersect existing natural drainages. Due to the resulting environmental damage, USACE issued a Notice of Noncompliance for the site. Based on observations at the MS3 trenching test site and other rehabilitation sites where the thermal regime has been disrupted, it may take decades before a new thermal equilibrium is reached (ABR and BPXA, 2013). However, in contrast to the MS3 test site on the North Slope, vegetation did recover at the Washington Creek test site, as evidenced by a 2015 aerial photograph that shows no standing water in the trenches.

Buried portions of TAPS also demonstrate challenges associated with constructing buried pipelines in permafrost-rich areas. TAPS used a mix of construction techniques along its length that varied with soil conditions and temperatures. TAPS included 376 miles of conventional belowground pipe and 4 miles of special burial belowground pipe (APSC, 2016). Where either unfrozen or thaw-stable permafrost soils were encountered, the pipeline was buried in the conventional manner with no special provisions for permafrost. Where thaw-sensitive permafrost soils were found, but where the pipeline had to be buried due to a highway or animal crossing or due to risk of rockslides and avalanches, the permafrost was protected from the heat of the pipeline by insulation around the pipeline. Some special burials included ground refrigeration systems along with pipe insulation 3.2 inches thick. In contrast, the proposed Project would be buried for essentially its entire length, but would be transporting relatively cold natural gas and not relatively hot oil. It would not serve as the heat source that TAPS does. Pipe settlement has caused oil leaks along TAPS, such as a 1979 leak that released 4,000 barrels of crude oil. A number of sections of TAPS have also had to be rerouted due to settlement.

Trench excavation would utilize conventional excavation equipment, such as mechanical ditchers, draglines, dredgers, clamshell buckets, or backhoes for most of the length of the proposed Project. Steeper terrain would require a greater amount of either cut or fill during construction than in flatter terrain, and would therefore, have a greater impact on the topography because the excavated slope areas could more easily erode. All other factors being equal, construction in steeper terrain tends to cause greater impacts.

Any action that involves ground disturbance could create a potential for impacts to paleontological resources existing in the proposed Project Area. Pleistocene fossils discovered along the Trans-Alaska Pipeline System (TAPS) ROW necessitated their removal at the time of discovery, and similar discoveries along the proposed Project ROW are reasonably likely. The proposed pipeline corridor crosses the Cantwell Formation, which has been demonstrated to contain dinosaur bones and tracks as well as an intact Cretaceous ecosystem. Given the variability of the scientific importance of these resources, the potential for adverse impacts exists. Mitigation efforts to reduce impacts to these paleontological resources might include changes in proposed Project plans or steps to remove and catalog such fossils.

Temporary localized drainage pattern alterations (*e.g.,* diversions) could occur during construction to accommodate pipeline installation and equipment staging. AGDC proposes to identify measures that would mitigate long-term impacts to local drainage patterns during engineering design (Mitigation Measure Nos. 1, 3, and 11, as listed in Section 4.6.3). Specific measures might include ditch plugs (foam, sandbags, bentonite, or compacted, cohesive soils placed next to the pipeline to prevent water from running parallel to the pipe), crowning soil in a mound over the pipeline trench to account for subsequent settlement, and recontouring to promote runoff and minimize ponding and erosion.

On the North Slope, approximately 22.9 miles of temporary ice roads would be built outside of the pipeline ROW. Ice pads would also be constructed to stage and transport materials and equipment, which would allow the work to be less disruptive to the proposed Project Area. Although thaw settlement could result if the ice road compaction of vegetation appreciably decreases the insulating capacity of the active layer (Felix *et al.*, 1992), investigations addressing ice road impacts show impacts are confined to the vegetative layer, thereby limiting impacts to soil containing permafrost (Walker *et al.*, 1987).

The design of roads in permafrost areas generally follows one of two approaches. Either the road is designed to provide full thermal protection to maintain underlying permafrost condition or the road is designed to allow limited thaw penetration into the underlying subgrade (Crory, 1991). Typically, this is accomplished by placing a sufficient thickness of gravel such that the *in situ* frozen ground in insulated by the gravel. AGDC documents describe the thickness of the gravel ROW access pad as varying from 18 inches to 60 inches depending on underlying soil properties.

Wintertime construction offers the ability to reduce the work pad thickness or to eliminate gravel pads altogether. Mitigation measures would be further defined during detailed engineering. The construction of gravel pads and roads on permafrost requires a thickness of fill equal to or greater than the depth of the summer thaw. The addition of fill effectively increases the insulating capacity of the active layer and prevents destructive thaw settlement (National Research Council [NRC], 2003a; Klinger *et al.*, 1983).

Off-road travel on state land on the North Slope requires a land use permit issued by the ADNR Division of Mining, Land, and Water. The date of tundra opening has ranged from as early as November 4 to as late as January 27 (ADNR, 2015). The permit remains in effect until thawing conditions have resulted in snow that would be too soft or too limited to permit travel without resulting in damage to the tundra. In years of limited snowfall, the tundra may be opened conditionally with specific operating restrictions. Thus, the window for construction would be limited by this permit.

Sands, gravels, rip rap, and other materials would be required at various locations for infrastructure, pad construction, and production and ancillary facilities along the proposed Project ROW. Local impacts due to the removal of geological material would occur. AGDC has estimated that approximately 25 MCY of material from gravel sources may be required for total proposed Project construction. A total of 89 material sites would be required and would impact approximately 5,200 acres of land. This includes the construction of new sites and use of existing commercial sites.

Impacts associated with obtaining material from these resources would include modifications of local topography, loss of surface vegetation, loss of wetlands, creation of landscape scars, and a temporary increase of soil erosion and siltation near the operation of material sites. Prior to Operating Material Sites development, Material Site Mining Plans and Reclamation Plans would be developed to reduce impacts associated

with material extraction. Stripping of the surface layer from the material sites may have major effects that could degrade the value, integrity, and function of soil and geologic resources in areas where permafrost is present. These resources provide an insulating effect that may require decades to re-establish.

In addition to impacts from material sites, disposal of material may also have substantial impacts. The proposed Project proposes to replace some thaw susceptible material from the pipeline excavation with thaw-stable permafrost soils from the material sites. Permafrost excavated in winter would cause severe problems if it is not properly disposed of prior to spring thaw. When thawed, ice-rich permafrost, typically silts with segregated ice or massive ground ice, experiences a substantial reduction in strength owing to the exceedingly high water content and lack of drainage and consolidation during the thawing process (ADOT&PF, 2009). The result could be a soft boggy area that gives way underfoot, in which construction equipment is bogged down or slope failure could result. Serious environmental issues could arise if thawed particulate laden fluids occur. Possible consequences of thermal erosion are as follows (R&M Consultants, Inc., 1973):

- Settlement-induced depressions resulting in water ponding;
- Surficial movement or sliding of thawed materials also involving the interception of drainage structures;
- Re-deposition of slope material that may result in the covering or destruction of previously installed erosion control treatments;
- Headward erosion and severe gully and fissure development, particularly in areas of cross drainage; and
- Stream pollution by excessive sediment transport.

AGDC proposes to design the pipeline to address frost heave potential and other geomorphic processes. The design model being used to address frost heave is also intended to address future possible changes to permafrost and the active layer depth based on climate change. Please see Sections 3.18 and 4.22 for discussion of climate change. Section 3.18 discusses the impacts of greenhouse gases (GHGs) on the global climate; Section 4.22 provides an estimate of the GHGs that would be produced by the proposed Project.

However, thermal erosion specifically due to pipeline construction may have major effects that could degrade the value, integrity, and function of soil and geologic resources in areas where permafrost is present. Specifically, construction of temporary ice roads (on the North Slope) and pads and permanent gravel roads and pads and excavation for the pipeline are expected to result in changes to the thermal balance. Based on the experiences of other similar projects, such changes are not likely to be reversed over a period of decades. Examples of other projects that experienced significant environmental consequences due to thermal degradation of permafrost include (but are not limited to):

- Various Russian pipelines where stresses caused by frost action have broken pipelines and resulted in large scale environmental degradation (Williams, 1986; Gubarkov, 2010; Radio Canada International, 2017);
- IKHIL gasline in Inuvik, Canada where thaw of backfill material and sinking of the pipeline occurred (North of 60 Engineering Ltd., 2004);
- The Norman Wells oil pipeline which experienced several yards of vertical permafrost thaw, complete loss of thin permafrost, ponding, and ground subsidence of more than 6 feet (Williams, 1986, Williams *et al.*, 2013);
- Cameron Hills (Strategic Oil & Gas Ltd., 2017);
- MS3 where permafrost degradation occurred (ABR and BPXA, 2012; ABR, 2014);
- Washington Creek, a discontinuous permafrost site where surface and groundwater flow intercepted the trench, the soil cap and subsurface soil collapsed, and drainage patterns were changed (ABR and BPXA, 2013); and
- The Mackenzie Valley fiber optic project at which ice-rich material thawed, the soils subsided, and melt water flow cut gullies along the trench line (http://www.cbc.ca/news/canada/north/mackenzie-valley-fibre-inspection-1.3428012).

Few examples of similar projects that did not experience significant environmental consequences due to thermal degradation of permafrost were identified:

- Transalaska Pipeline System (TAPS), which used a flexible approach to design and construction (USDOI, 1976; BLM, 2002; APSC, 2013); and
- Nuiqsut Natural Gas Pipeline, which did not allow the thaw bulb generated by the pipe from penetrating into thaw unstable permafrost (NSB, 2014).

Alternative 1 proposes to cross the Yukon River using HDD. This approach is not expected to have significant impacts to soil and geologic resources.

Sections of the proposed pipeline would require a lease from the State of Alaska. Mitigation Measure Nos. 11 through 15, as listed in Section 4.6.3, describe actions that AGDC has proposed for construction, operation, maintenance, and termination of the pipeline; to conduct surveillance and monitoring; and to layout material sites to meet state requirements. Details of these mitigation measures would be presented in plans that have not yet been drafted.

4.6.4.2. Operations and Maintenance

Alternative 1 (proposed Action) may affect adjacent permafrost by heat transfer from the pipeline and due to changes in the surface cover and vegetative cover, which would affect albedo and insulation. AGDC proposes to design the pipeline "to operate as a belowground ambient-temperature pipe that would fluctuate seasonally with ground temperature" (AGDC, 2016b). AGDC used a coupled hydraulics/geothermal model to

predict the thermal conditions of the proposed pipeline (see Appendix D, Identification and Evaluation of Time-Dependent Route Geohazards). AGDC proposes to operate the pipeline at below-freezing temperatures at the point of product entry on the North Slope for predominantly permafrost terrains (to protect the thermal stability of the surrounding soil). Similarly, AGDC proposes to operate the pipeline at above-freezing temperatures in predominantly thawed settings (so as to not create frost-bulbs around the pipe, which could lead to frost-heave displacement or adverse hydraulic impacts on drainages).

Under Alternative 1, the gas would be conditioned to below-freezing temperature at the GCF. After that point, the product would flow through the pipeline without any temperature controls. The temperature of both the pipeline exterior surface and the temperature of the surrounding soil would vary throughout the year. Although the pipeline would be designed to operate as a belowground ambient-temperature, at times the pipeline temperature could be either warmer or colder than the surrounding soil depending on the variability in temperature of the soil. This is demonstrated based on the results of a Canadian project described below. Pipeline temperature variability could result in the significant effects of permafrost thaw or creation of frost bulbs. In particular, impacts may occur in areas where soil temperatures and other characteristics change significantly over short distances (discontinuous permafrost areas). Such impacts may include alterations to drainage patterns and changes to the thermal regime. The impact level may be major resulting from a wide impact area (AGDC defines areas of discontinuous permafrost as MP 168-634) and impacts that could last decades if the thermal regime is disrupted.

In 1985, builders of a 500-mile oil pipeline through discontinuous permafrost, from Norman Wells in the Northwest Territories to the province of Alberta, Canada, planned to flow the crude oil at ambient temperature. However, the ground temperature varied more than planned, depending on the surface and soil. The construction and heat from the oil altered ground temperatures and resulted in tens of kilometers (km) of "artificial, shallow thermokarst" (Williams, 1986). The proposed ASAP pipeline is also planned as an "ambient temperature" pipeline. Differences between the proposed ASAP pipeline and the Norman Wells pipeline include natural gas having a lower heat capacity than crude oil and that the ASAP pipeline would lay dormant for an extended period before the chilled gas would begin to flow. Although these differences could affect the likelihood of altered ground temperatures occurring, the ASAP pipeline could face similar challenges in terms of thaw settlement and frost heave. Mitigation Measure Nos. 2, 6, and 7 through 10, as listed in Section 4.6.3, would be employed to address such challenges. These include operational considerations such as monitoring for vulnerable locations; considering replacement of frost susceptible soil, controlling the operational pipe temperature, applying insulation, or installing thermosyphons at vulnerable locations (south of MP 175); and implementing water management techniques.

During the first 2 years following construction, the proposed pipeline would be dormant. As demonstrated by tests of buried pipelines conducted at Washington Creek

and MS3, potential issues with permafrost degradation and water accumulation (which further propagates permafrost degradation) could occur and would be considered a potential major impact based on the level of degradation involved, the regional area that could be impacted, and the long duration required for impacts to attenuate. Specifically, the proposed construction techniques have many similarities to the Washington Creek and MS3 field trials, which resulted in significant degradation of the soil resource (permafrost thawing), such that the bearing capacity of the soil decreased. In addition, thaw resulted in decreased soil volumes and changes in drainage patterns. These impacts were experienced at the Washington Creek and MS3 sites, even though those sites did not have pipelines installed.

There are a number of measures that AGDC proposes to minimize the negative consequences experienced during the trenching tests at MS3 and Washington Creek. As part of initial construction, AGDC is proposing the use of trench breakers or ditch plugs to restrict water flow parallel to the pipeline. The ice content of the soil would be measured beforehand and used to estimate the potential for subsidence; this data would be used to estimate the backfill crown height to minimize the risk of open water collecting along the length of the trench. AGDC is proposing a more aggressive and diverse seeding program and a more robust revegetation monitoring and maintenance program than were employed for the trenching tests. Fertilizer would be applied at a higher rate, and a more diverse seed mix would be used and applied at a higher rate.

The proposed Project would pose additional technical challenges when compared to the pilot tests. The pilot tests were conducted in isolated areas not far from roads and support infrastructure. The flat and compact pilot test sites contrast with the 733-mile-long Mainline, which would cross various types of terrain and slopes and would be crossed by surface water, groundwater, and suprapermafrost groundwater flow paths. Pipeline temperatures would vary over time. When operational, the first 170 miles of the pipeline are expected to be below the freezing temperature of water in summer. In winter, the entire pipeline is expected to be below the freezing temperature. A freezing front and ice layer would form around the pipeline. The ice can alter the flow of suprapermafrost groundwater and lead to frost heave and additional changes to the thermal balance. The outcomes of the trenching tests at MS3 and Washington Creek indicate that once permafrost thaw has begun, a feedback loop can be created involving decreased albedo, soil subsidence, altered water flow routes, and water accumulation at the ground surface resulting in additional thaw. The proposed Project includes a number of operational mitigative measures that would be employed if excessive pipe displacement occurs. These measures might include insulation, excavation, elevation of the pipeline in an embankment, and use of thermosyphons (Appendix D). The remote nature of many sections of the pipeline would make implementation of these operational mitigative measures challenging. Evidence from the MS3 pilot test indicates that returning to the site to mitigate permafrost damage resulted in additional damage.

AGDC engineers carried out thermal modeling and thaw settlement calculations for the length of the pipeline to support pipeline design, construction planning, and routing

(AGDC, 2016e). The proposed approach includes, careful route selection, and the use of thaw-stable permafrost soils (padding) and ditch plugs to prevent water from travelling parallel to the pipeline. The pipeline would be designed to operate at below freezing temperatures in predominantly permafrost terrains, and above freezing temperatures in predominantly thawed-ground settings. The operating temperature of the buried pipeline could affect the frozen/thawed nature of the surrounding subsurface that, in turn, could affect the pipeline trench support conditions. The operating temperature could also potentially cause surface expression such as local subsidence (due to permafrost thaw) or heave (due to ice accumulation over the course of repeated freeze-thaw cycles). In areas and timeframes where the pipeline has a higher temperature than the surrounding subsurface environment, it could create an area of thawed material along the proposed route. Where the pipeline traverses from unfrozen, stable ground to ice-rich, unstable ground, or visa-versa, thaw settlement could occur (French, 2007).

The *Pipeline & Gas Journal* reported that (White, 2014):

> *If the pipe is exiting a permafrost zone and entering unfrozen soil, it could frost heave in the unfrozen soil while being locked tight into the permafrost. That could put acute strain on the steel at the transition point. A similar strain on the steel could occur when the pipe transitions between unfrozen soil that doesn't tend to frost heave and soil susceptible to heaving.*

Thaw could be caused by a variety of factors:

- Insolation thawing due to a decrease in the albedo of the surface layer material;
- Thawing due to water flow;
- Thawing due to heat from the pipeline (only in the southern portion of the pipeline); and
- Thawing could be intensified by climate change.

AGDC proposes to mitigate frost heave and thaw bulbs to the extent practicable. However, AGDC anticipates that in some sections of the pipeline, permafrost thaw may propagate in areas surrounding the pipeline corridor (Section 5.1.2.1 of the EED).

Conversely, ice accumulation (permafrost aggradation) could occur in areas where the proposed pipeline is operating in below freezing temperatures. This might occur in the discontinuous permafrost zone wherever the pipeline (operated at or below freezing temperatures) crosses unfrozen ground; there would be moisture migration towards the pipeline, potentially resulting in frost heave when the moisture freezes. Even in areas where permafrost is absent, ground ice could grow, producing frost heave in some areas, especially in areas where thawed, fine-grained soil is dominant in the subsurface. A freezing front would form around the pipeline. As water vapor migrates towards the freezing front, it would form an ice layer. This ice layer would decrease the porosity and hydraulic conductivity of the soil and may alter the flow of groundwater above the permafrost.

Fertilization would occur during the operations period if the vegetation reclamation standard of 30 percent cover over a 3-year period is not attained. Such fertilization could require re-accessing remote portions of the pipeline.

If the pipe were buried in a thaw-susceptible area, monitoring for thaw settlement would detect whether (over time) mitigation is needed. Such monitoring would use ILI pigging operations to monitor the vertical position of the pipeline along the alignment, and would be combined with aerial and on the ground monitoring. If the pipe is buried in a thaw-susceptible area, monitoring for thaw settlement would detect whether additional mitigation is necessary to protect the pipeline. As part of the "Identification and Evaluation of Time-Dependent Route Geohazards" (Appendix D), AGDC has proposed a range of potential mitigation measures that might be required:

- Use of thermosiphons to remove heat from the ground;
- Elevate the pipeline above the ground surface;
- Lifting and leveling pipe; and
- Replacing soil with select backfill (AGDC, 2016e).

Depending on the type of maintenance required, access may occur by foot, low ground pressure equipment such as a rolligon, or by helicopter. Winter maintenance access may also include new ice roads. The available data suggests that repeated access may be required to some very remote areas to address potential issues. Although TAPS was a very different engineering challenge, (relatively hot crude oil flowing through a pipeline that is raised off the ground surface by VSMs for most of its northern half) operational challenges may be similar. During TAPS' first 6 years of operations, it was necessary to dig up at least eight buried sections that had buckled or cracked due to thaw settlement or frost heaves (White, 2014). Thus, it is likely that AGDC would need to access remote portions of the proposed pipeline to address significant issues. As acknowledged by AGDC, "Some of these [mitigation measures] are seen to be the same as for design, although the practical ability to employ them during operations may be limited." Re-accessing remote portions of the pipeline to mitigate design or construction issues may not always be practical and could result in long-lasting environmental consequences; however, pipeline integrity is AGDC's primary responsibility.

The proposed Project route would cross two seismic zones and five mapped Holocene-active or potentially active fault traces.[4] Seismic activity could trigger mass wasting processes such as landslides and soil instabilities including liquefaction. Mitigation Measure Nos. 1 and 2, as listed in Section 4.6.3, include actions proposed to address earthquakes/seismic activity.

[4] Fault trace: "The fault trace is the intersection of a fault with the ground surface; also, the line commonly plotted on geologic maps to represent a fault" (USGS, 2017).

For each fault, the design earthquake would be calculated based on a seismic event with a 5 percent chance of exceedance in 50 years, the Design Contingency Earthquake (DCE). The primary parameter used to quantify the seismic energy of an event is the peak ground acceleration. Peak ground acceleration values used by AGDC were based on values developed by the U.S. Geological Survey interactive disaggregation program (2015).

Seismic events could result in a number of geohazards potentially affecting the proposed ASAP Project:

- Surface fault rupture;
- Seismically-induced slope failure;
- Liquefaction-related hazards;
- Ground shaking; and
- Buoyancy (forces that cause the pipeline to rise vertically).

AGDC stated that only the first three of these have the potential to cause failure or rupture of the pipeline; each is discussed below.

Surface fault rupture is differential ground movement along a fault resulting from an earthquake. At each fault location, the design of the pipeline would be based on fault-specific rupture parameters, including the type of fault, the anticipated displacement, the width of the fault crossing, recurrence interval, and the angle of the fault relative to the pipeline. For instance, the Denali Fault (strike-slip) was calculated to have a scarp width of 7 feet, a zone width of 330 to 3,300 feet, a single event displacement of 9 vertical feet and 27 horizontal feet, and a recurrence interval of 300 to 500 years. Each fault crossing would have a mitigation mode assigned to it. For instance, the proposed Project pipeline would cross the Denali Fault on an aboveground beam/slider system, similar to those used on the TAPS. Under Alternative 1, the current route alignment includes small changes to improve pipeline alignment relative to individual fault crossings.

Seismically induced landslides represent a potentially significant geohazard. Slopes would be designed to withstand the dynamic condition of the DCE with a minimum factor of safety of 1.0 or be demonstrated to have less than 5 inches of total slope movement. Areas rated in the high and very high hazard risk categories were most commonly located in the vicinities of the Park Road Fault and Denali Fault. The primary mitigation for seismically induced slope failure would be avoidance, modifying the design route to avoid the hazard. Other options that may be taken during the design phase to mitigate the risk include: slope flattening, subsurface drainage improvements, construction of buttresses near the slope base, removal of material near the top of the slope, alignment of pipeline parallel to slope to take advantage of pipe resiliency to normal vs. sheer forces, and increasing the depth of the pipeline to go below the calculated failure surface.

Liquefaction refers to the loss of shear strength in a saturated soil subject to vibration. Liquefaction generally requires three things: saturated soil, soil of loose to medium density, and a seismic event. Liquefaction analysis would start with screening level analysis using typical soil types correlated to terrain unit mapping, wetlands extent, and qualitative soil density. Assessment conducted to date included evaluation of data from at least 20 boreholes. Liquefaction susceptibility ranged up to very high for some boreholes. Liquefaction is particularly a concern immediately upstream of the entire eastern boundary of Denali NPP, where it poses a very significant geotechnical challenge. The primary technique to be used to mitigate the liquefaction hazard would be route selection to avoid steeper stream banks and to stay out of saturated floodplains, where possible. Other mitigation techniques may include drainage control, dewatering, slope flattening, and compaction of soil prior to pipeline construction. Grouting may be used in localized areas. Other options include increased pipe wall thickness and changes to the pipeline profile (to go deeper or wider to be outside of the area of influence of lateral spreading).

In addition to seismic events and liquefaction, mass wasting is a geomorphic process that would have to be addressed in the design; refer to Section 3.2.4.1 regarding this issue. Mitigation Measure No. 1, as listed in Section 4.6.3, proposes steps to address a frozen debris lobe near MP 196.1 of the proposed ASAP route (approximately MP 219 of the Dalton Highway). The debris lobe is currently approximately 100 feet east of the Dalton Highway (University of Alaska, Fairbanks [UAF], 2016) and 550 feet from the proposed ASAP route. Based on data presented by the University of Alaska, at the current rate of movement (approximately 5.4 m per year), Frozen Debris Lobe A would reach the proposed pipeline route in approximately 30 years (UAF, 2016). The rate of movement may accelerate if the climate warms. Table 4.6-4 provides a summary of mitigation measures proposed for each fault crossing.

Sections of the proposed pipeline would crosses steep slopes and may be subject to landslides or avalanches. Rock, soil, or snow above the pipeline could slide and cause an impact load. Likewise, material on the slope below the pipeline could move and cause unsupported spans. Were the section of ground that includes the pipeline to move, high compressive (or tensile) strains and pipeline buckling could occur.

Table 4.6-4 Fault Zone Crossings

Fault Designation	Fault Type	Holocene Activity	Ground Movement Relative to ASAP	Approximate Fault Zone MP	Fault Crossing Mitigation Mode
Northern Foothills Thrust	Thrust	Possibly Active	Possible vertical shear (longitudinal extension)	Unknown	To be determined
Backthrust faults of the Northern Foothills Thrust	Reverse	Possibly Active	Possible vertical shear (longitudinal extension)	499	TAPS style aboveground beam/sliders
Healy and Healy Creek	Reverse	Possibly Active	Possible warping (longitudinal extension)	Unknown	To be determined
Park Road	Reverse	Active	Horizontal/vertical shear	537	Bridge to TAPS style aboveground beam/sliders
Denali	Strike Slip	Active	Horizontal/vertical shear	559	TAPS style aboveground beam/sliders
Castle Mountain	Reverse	Active	Horizontal/vertical shear; longitudinal extension	723	TAPS style aboveground beam/sliders

Source: Alaska Stand Alone Pipeline/ASAP Project, *Summary of Significant Surface Fault Rupture and Potential Mitigation*, ASAP-27-RTA-GGG-DOC-00052, Deliverable No: 002-14-919-005, February 1, 2016

4.6.4.3. Summary of Potential Direct and Indirect Effects of Alternative 1 on Soil and Geologic Resources

The effects of dredging and nearshore disposal of dredged materials are expected to be minor. The geographic extent of the effect would be limited to a specific (but relatively large) area and the effect would only occur once.

Stripping of the surface layer from the pipeline corridor may have major effects that could degrade the value, integrity, and function of soil and geologic resources in areas where permafrost is present. The vegetative mat and the surface layer moderate the albedo of the surface and provide an insulating effect. Destruction of this material could cause long-term changes not likely to be reversed over a period of decades. As stated in Section 5.1.2.1 of the EED, some sections of inundated trench may propagate permafrost thaw into the surrounding area. Rehabilitation of thawed permafrost generally requires spans of 10 years and longer, and only after several decades do plant communities, ground ice conditions, and other site characteristics return to preexisting conditions (NSSI, 2015). Propagation of thaw may occur directly adjacent to the pipeline or, due to the flow of suprapermafrost groundwater or surface water, at some distance to the pipeline. In areas of massive ground ice, propagation could cause a feedback loop, such that thaw and settling makes adjacent areas more susceptible to additional thaw. AGDC's initial geothermal modeling shows that by revegetating the ROW in discontinuous permafrost terrain, the indirect permafrost thaw affected zone over a 30-year period would be limited to less than 10 m (35 feet) beyond the directly impacted area.

Permafrost thaw, whether caused by the proposed Project or by cumulative/climate change (discussed in Section 4.26), can impact soil and geologic resources. However, the proposed Project also depends on those resources for physical support, both for the pipeline and the gravel access pad. AGDC geothermal modeling predicts no subsidence on the North Slope, but does not account for changes in albedo, surface water flow, or groundwater flow. AGDC geothermal modeling shows a predicted thaw depth of 22 to 28 feet (6.7 to 8.5 m) could occur in discontinuous permafrost areas (Technical Memorandum: Effect of Climate Warming on Expected Long-Term Thaw Depths on the ASAP Right-of-Way, ASAP Project, February 17, 2017). The model is based on the results of soil and rock laboratory testing of samples from over 10,000 discrete boreholes. In some areas, a portion of that discontinuous permafrost material may be ice lenses and wedges and the remainder may be thaw susceptible material. In some soil layers, ice content can be as high as 70 percent to 90 percent. Thawing in areas of massive ice or thaw-susceptible soil would result in subsidence. Subsidence changes water flow for both surface water and suprapermafrost groundwater. The potential for heat to be added to the system through water flow paths is not considered in the model used to provide the predicted thaw depth. Accurate estimation of the thaw depth and the proportion of subsurface ice within thaw susceptible soil that would thaw is required to accurately estimate how much thaw-stable permafrost soils should be placed in the trench. Either too much or two little thaw-stable permafrost soils would result in ground surface elevation changes (the crown being higher or lower than the surrounding ground surface), which can result in the potential for areas of water to collect or channel, resulting in further heat addition and melting.

The maximum expected thaw strain (*i.e.*, thaw settlement per thaw depth) expected by AGDC is 20 percent. For cleared terrain, AGDC calculated the 30-year thaw depth to be 5.5 m. Beneath the gravel pad, the 30-year thaw depth was calculated to be 6.7 m to 7.6 m with and without an organic layer below the gravel pad, respectively 30 years after construction (Appendix D). Up to 1.1 to 1.5 m of thaw settlement could occur based on the modeled thaw depth below the undisturbed active layer in discontinuous permafrost terrain.

Construction of buried pipe in permafrost areas may cause impacts of major intensity. Based on observations at the MS3 trenching test site and Washington Creek test site where the thermal regime was disrupted, it could take decades before a new thermal equilibrium is reached (ABR and BPXA, 2013).

Construction would require approximately 25 MCY of material from gravel sites, impacting approximately 5,200 acres of land. An unspecified volume of thaw-sensitive permafrost soils would be removed from the pipeline trench and roadbeds. Once disposed of, such material is expected to thaw. Handling of this thawed material is expected to result in major impacts that last for more than 3 years where the material is disposed of (ADOT&PF, 2009; R&M Consultants, Inc., 1973).

Operations and maintenance of the proposed pipeline may have major impacts to soil and geologic resources. Installation of thermosiphons, lifting and leveling the pipe, or replacing backfill would require heavy equipment. AGDC has indicated that maintenance may require construction of new ice roads. For less intrusive work, use of low ground pressure equipment or helicopter would be considered. Given that long stretches of pipeline are not located adjacent to existing roads, accessing sections to repair damage associated with changes to the thermal regime or due to other factors could require access for heavy equipment over long distances. Impacts from these maintenance measures could degrade the integrity of the resource, occur over wide areas, and could last more than 3 years.

4.6.5. Alternative 2 – Denali NPP Route Variation

Alternative 2 includes crossing the Yukon River on a suspension bridge, dredging associated with use of DH2, ocean disposal of dredge material, use of VSM from MP 0 to MP 62, and routing a section of the pipeline through Denali NPP. In other aspects, impacts from Alternative 2 would be very similar to Alternative 1, the proposed Action. This section describes the potential impacts of Alternative 2 to soil and geologic resources for those aspects of the proposed Project that are different.

4.6.5.1. Yukon River Crossing

Alternative 2 includes aerial crossing of the pipeline across the Yukon River using a new suspension bridge. This component of Alternative 2 is expected to have negligible impacts on soil and geologic resources.

4.6.5.2. Dock Head 2, Associated Dredging, and Ocean Disposal

Under Alternative 2, the existing channel to access DH2 would need to be widened and deepened to the 9-foot depth contour to accommodate large vessels delivering prefabricated modules. Alternative 2 would require dredging more than 750,000 CYs of disposal material to allow barge access (three times the volume required for Alternative 1). Dredging the navigational channel would occur during the winter before the sealift.

Under this alternative, dredge material would be disposed of in the ocean, approximately 3.5 miles off shore. Depths in this area are approximately 24 feet (at MLLW) (National Oceanic and Atmospheric Administration [NOAA] Office of Coast Survey, 2015). A USACE Ocean Dumping of Dredge Materials Permit under Section 103 of the Marine Protection Research and Sanctuaries Act for the disposal of dredged material would be required and would be subject to EPA concurrence.

Data previously collected at the site (West Dock Dredge and Disposal Plan, AGDC, 2016o) states that the dredge materials are not expected to be contaminated. Similar to Alternative 1, Alternative 2 would include development, approval, and implementation of a sampling and analysis plan and an assessment of compliance with ocean disposal criteria (33 U.S.C. 1413 and 40 CFR 220-229).

The effects of dredging and nearshore disposal of dredged materials are expected to be minor. The geographic extent of the effect would be limited to a specific (but relatively large) area and the effect would only occur once. When compared to Alternative 1, dredge material disposal under Alternative 2 would be in deeper water, further from shore, and would occur over a longer period.

Alternative 2 could require summer maintenance dredging to keep the channel open for the duration of the mobilization effort. Sediments would be disposed at the proposed disposal site during the summer months. In previous maintenance dredge operations at West Dock, dredged sediments have been placed along the causeway. Depositing dredge spoils along the causeway for maintenance would be the most practical option for summer maintenance dredging. However, dredge spoils may consist of fine silty sands rather than a gravelly sand mixture, which is more suitable for beneficial reuse. These finer materials may erode more rapidly than coarser materials.

4.6.5.3. Use of Vertical Support Members (VSM)

Under Alternative 2, the pipeline would be elevated on VSMs through the extent of the ACP (Beaufort) from MP 0 to MP 62. Soil in this area is generally ice-rich and saturated; continuous permafrost is present. However, the use of elevated pipe would not cover the entire area of continuous permafrost, which extends to approximately MP 168. Nor would it cover areas of discontinuous permafrost between MP 168 and 634 (and along the Fairbanks Spur) or areas of sporadic permafrost (the remainder of the pipeline). VSMs would be designed with heat pipes to passively remove heat from the ground and maintain permafrost in a frozen state. The use of VSMs is expected to avoid or minimize impacts for the initial 62 miles of Mainline pipeline (when compared to Alternative 1, proposed Action). Differences include:

- Reduced stripping of surface layer from the pipeline corridor;
- Reduced excavation of the pipeline route;
- Reduction in the acreage of land impacted by material sites;
- Decreased volume of material removed from gravel sources;
- Decreased need for disposal of soil removed from the excavation; and
- Increased acerage of the Prudhoe Bay Pipe Storage Yard and Franklin Bluffs Pipe Storage Yard to handle the increased volume of pipe and material for the VSMs.

The aboveground section of the pipeline would generally follow the belowground route, but would be longer. Due to the need to account for thermal movement, Z bends or pipe loops would be included and add approximately 200 feet of pipe length for every 1500 feet of overall distance. This would result in the need for approximately 8 miles of additional pipe.

The majority of wetlands impacted by the proposed Project would occur within the area of continuous permafrost, which extends to approximately MP 168. By elevating the

pipeline on VSMs for the first 62 miles, impacts to soil and geologic resources are expected to be reduced (when compared to Alternative 1). The reduction of impact in this area includes not only the pipeline corridor, but also material borrow and disposal sites. However, this reduction would only influence the first 62 miles of the proposed Project.

TAPS was constructed with 420 miles of aboveground pipe, 376 miles of conventual belowground pipe, and 4 miles of special burial pipe (required for avalance protection, caribou crossings, the Glenn Highway crossing, and 23 other animal crossings. It should be noted that the TAPS pipeline is buried on the North Slope from TAPS MP 12.6 to MP 52 and elsewhere along its length where either unfrozen or thaw-stable permafrost was encountered. Termed belowground (conventional) pipe, these sections are underlain with a layer of fine bedding material and covered with prepared gravel padding and soil fill material, in a ditch from 8 to 16 feet deep in most locations. In information published by the Alyeska Pipeline Service Company, relatively few issues have been reported along this stretch (APSC, 2013). Review of aerial photographs suggests that surface water features have formed in some areas, suggesting localized permafrost thaw. Much of this section of TAPS is in the Sagavanirktok River floodplain, and soils that have been reworked by fluvial processes are generally more thaw stable because the fines have been washed out and they drain better.

4.6.5.4. Denali NPP Route Variation

The route for Alternative 2 would differ from Alternative 1 between MP 535.8 and MP 543.0. In this area, the Alternative 2 pipeline would travel to the west of the Nenana River, crossing the river twice. Based on review of the data provided in the AGDC Interactive Map Viewer, the Denali NPP Route Variation segment would travel through an area of lower elevation and encounter 86.8 fewer wetland acres than the route around Denali NPP for Alternative 1. The Alternative 1 route would run at an elevation of approximately 600 to 700 m mean sea level; the Denali NPP Route Variation would run adjacent to the Parks Highway at an average elevation of approximately 550 m. Permafrost is present in the area immediately adjacent to the Alternative 2 route based on recent drilling data for a proposed railroad realignment. Based on a visual review of the data presented in the AGDC Interactive Map Viewer, the Denali NPP Route Variation (Alternative 2) is expected to have a reduced level of impact on soil and geologic resources that are comparable to the route proposed for Alternative 1. This reduction is due to a reduced need for access roads and material source areas.

4.6.5.5. Other Construction Impacts

Use of VSMs for the first 62 miles would help reduce impacts due to the removal of geological material. Use of VSMs would also reduce impacts due to disposal of thaw susceptible material removed during construction. This would serve to reduce material disposal impacts, such as settlement-induced depressions resulting in water ponding, surficial movement or sliding of thawed materials also involving the interception of

drainage structures, re-deposition of slope material that may result in the covering or destruction of previously installed erosion control treatments and stream pollution by excessive sediment transport.

4.6.5.6. Summary of Potential Direct and Indirect Effects of Alternative 2 on Soil and Geologic Resources

When compared to Alternative 1, use of VSMs as part of Alternative 2 is expected to reduce stripping of surface layer, reduce the volume of material to be excavated and backfilled, decrease the volume of material requiring disposal, and reduce the land area required for material sites. Thus, the use of VSMs would reduce impacts on soil and geologic resources, but this reduction would be limited to the first 62 miles of the pipeline.

Drainage patterns may be altered. The aerial crossing of the pipeline across the Yukon River using a new suspension bridge is expected to have negligible impacts on soil and geologic resources. Despite the large volume of material to be moved, the effects of dredging and offshore disposal of dredged materials under Alternative 2 are expected to be minor. The geographic extent of the effect would be limited to a specific (but relatively large) area and the effect would occur over a single construction season.

4.6.6. Alternative 3 – No Action

Under Alternative 3 (No Action), the proposed Project would not be constructed and operations and maintenance requirements would not exist. There would be, therefore, no effects to topography, soil, or geology under Alternative 3.

4.6.7. Conclusions and Comparison of Alternatives

Alternative 1 proposes to install and operate a buried pipeline throughout its route. Alternative 2 would place the pipeline on VSMs for the initial 62 miles. The challenges involved in installing a natural gas pipeline in Arctic and sub-Arctic areas are well documented (Williams, 1986).

Construction and operation of a buried pipeline and other facilities in active layer soils above permafrost may result in propagation of permafrost thaw and alternations to drainage patterns. If propagation of permafrost thaw begins, it may be difficult to control. Due to the remote nature of much of the pipeline, mitigation efforts would be difficult and would have environmental consequences. For buried portions of the pipeline proposed under Alternatives 1 and 2, potential impacts are considered major.

Magnitude or intensity: Permafrost thaw and development of frost bulbs could reduce environmental functions. Decreased soil volume (due to thaw of ice-rich soils) could result in reduced support for the proposed buried pipeline. Thaw and development of frost bulbs could alter the thermal regime and change drainage patterns. AGDC documents indicate that propagation of thaw into surrounding soils may occur. Such propagation represents a positive feedback loop where changes in the thermal regime and water flow routes result in additional degradation that could be difficult to mitigate.

If it were necessary to re-access remote areas, environmental impacts would be increased. In contrast, the use of VSMs for the first 62 miles proposed under Alternative 2 would reduce result in only minor impacts to the soil and geologic resource for that portion of the pipeline.

Geographic extent: Areas of continuous, discontinuous, and sporadic permafrost are found over approximately the first 625 miles of the proposed pipeline.

Duration or frequency: Based on experience at other, similar sites, long-term changes may occur that are not likely to be reversed over a period of decades.

Likelihood: Significant impacts have arisen at other sites when the proposed construction methods have been implemented.

There are a number of differences between Alternatives 1 and 2. From the perspective of the soil and geologic resources, the two most important differences are that under Alternative 2, the pipeline would be placed on VSMs for the first 62 miles and the Denali NPP Route Variation would require less access roads and material sites within Denali National Park. The use of VSMs would reduce impacts to soil and geologic resources because a large trench would not be required for that portion of the pipe; this reduces the need for borrow material and the need to disposal of excavated, thaw-susceptible soil. The Denali NPP Route Variation would parallel portions of the Parks Highway and Alaska Railroad line. This would reduce the need for access roads and material sites. However, for the southern 671 miles of Mainline pipeline (excepting Denali NPP), Alternatives 1 and 2 are very similar. Significant impacts to drainage patterns, vegetation, and landscape may occur in areas where the pipeline is buried in sensitive terrain. Thus, both alternatives would have major impacts to soil and geologic resource, but Alternative 2 would have less impact.

Table 4.6-5 compares impacts to soil and geologic resources for Alternatives 1, 2, and 3.

Table 4.6-5 Comparison of Alternatives Summary for Impacts to Soil and Geology (Direct & Indirect)

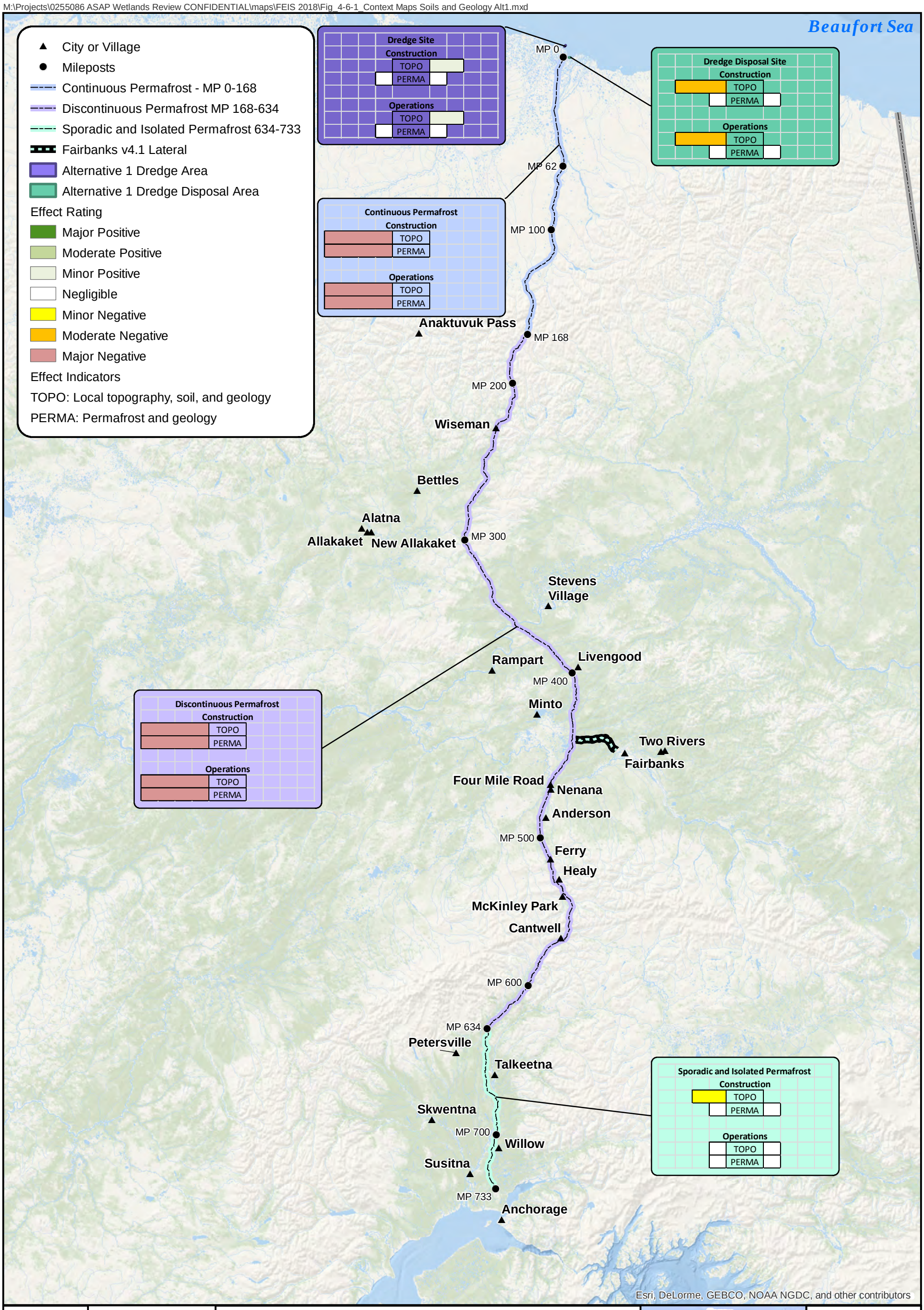
Physical Resource Effect	Alternative 1		Alternative 2		Alternative 3
	Construction	Operations	Construction	Operations	Construction / Operations
	Impact Rating		Impact Rating		Impact Rating
Effects to local topography, soil, and geology	*Major*	*Major*	*Major*	*Major*	*Negligible*
Effects to permafrost and geology	*Major*	*Major*	*Major*	*Major*	*Negligible*

Attaining the regulatory agency recommendations discussed in Section 4.6.4 would restore the backfilled trench to the pre-construction elevation, segregate the surface layer from mineral subsoil, use the surface layer as the uppermost layer of backfill to provide a seed bed for native species, and achieve uniform revegetation with a perennial vegetative cover density of at least 70 percent. These steps would help protect the soil and geologic resource.

Figure 4.6-1 provides a geographic representation of the potential impacts that Alternative 1 would have on soil and geologic resources. The most significant negative impacts would occur in areas of continuous and discontinuous permafrost.

Figure 4.6-2 provides a geographic representation of the potential impacts that Alternative 2 would have on soil and geologic resources. The most significant negative impacts would occur in areas between MP 62 and MP 634, in areas of continuous and discontinuous permafrost.

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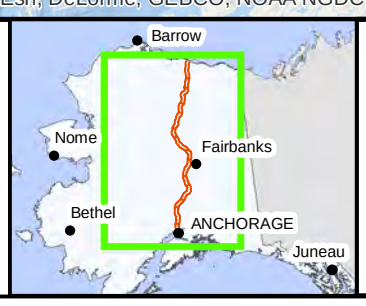
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DATE: MAR 2018
CHKD: K.J.
DRWN: A.V.K.
PROJ. No.: 0416166

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Figure 4.6-1: SOIL AND GEOLOGY IMPACTS CONTEXT MAP, ALTERNATIVE 1
ALASKA STAND ALONE PIPELINE

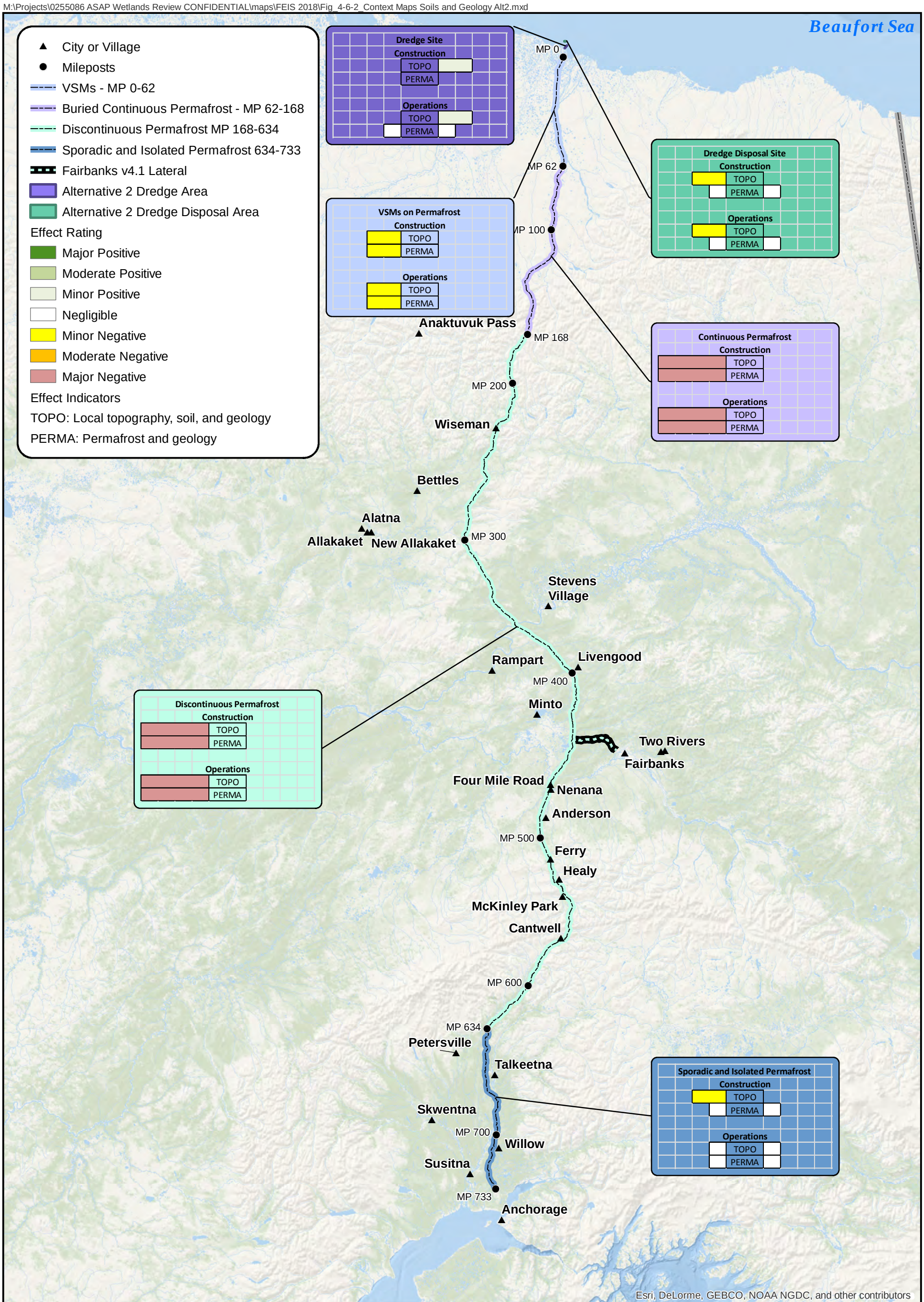
0 25 50 100 150 Miles



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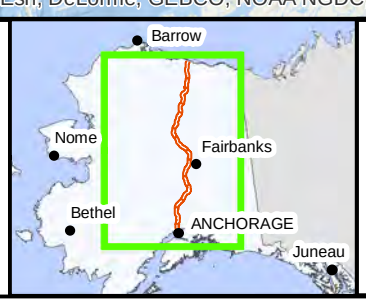
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Figure 4.6-2: SOIL AND GEOLOGY IMPACTS CONTEXT MAP, ALTERNATIVE 2
ALASKA STAND ALONE PIPELINE

0 25 50 100 150 Miles



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4.6.8. Summary of Differences if USACE Conditions are Implemented

Section 4.5.2.1 discusses conditions that would be considered for inclusion into a USACE DA permit. Likely permit conditions would require implementation of Alternative 1 or Alternative 2 in a manner that would reduce impacts to the soil and geology resource. Requirements that would likely be contained within the DA permit that are not included in Alternatives 1 or 2 include:

- Excavated material temporarily sidecast into wetlands would be underlain with geotextile, ice pads, or similar material.
- Excavated soils shall be sorted into mineral subsoils and the surface layer, which would be stored separately.
- When backfilling, the surface layer would be placed as the uppermost layer.

AGDC planning documents indicate that a pile of trench spoil approximately 30 feet wide would be placed parallel to the pipeline trench (Appendix D). A portion of the trench spoils would work their way into the underlying wetlands vegetation and likely remain at the end of construction. This would harm vegetation that insulates underlying permafrost. By placing the excavated materials on a geotextile or ice pad, more of the excavated material could be removed at the end of the construction process. Less damage would be done to vegetation, which would help preserve underlying permafrost.

Sorting excavated materials into subsoils and the surface layer, storing these materials separately, and placing the surface layer as the uppermost layer would provide a number of benefits. In their review of the Kanuti Pit project, Alaska Plant Material's Center recommended that "highly organic topsoil should be placed across the entire project area to help insure uniform establishment of revegetation species and encourage natural reinvasion of native plants" (Nolen, 2008). The surface layer includes organic soil that is beneficial to plant seed germination and plant growth and root mat that binds the material together. The surface layer also includes the soil seed bank. Restoring the surface layer as the uppermost layer would speed revegetation and reduce permafrost thaw.

Inclusion of DA permit conditions would decrease impacts to the soil and geology resource. Implementing likely permit conditions would reduce the magnitude/intensity of impacts to the resource. Under both Alternative 1 and Alternative 2 use of geotextile or ice pad beneath spoils would help protect the wetlands from trench spoil. Under both Alternatives 1 and 2 restoring the surface layer would help minimize impacts along the trenched area. It would also help minimize the risk that permafrost thaw propagates into a larger area.

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4.7. Water

4.7.1. Introduction

This section describes the potential direct and indirect effects of the alternatives described in Chapter 2 on water resources. This section begins by outlining the proposed Project Area and defining frequently used terms. A summary is provided of incomplete or unavailable information and how that lack of information has influenced this analysis. This section also describes the methods for determining the level of impact to water resources and presents the results of the assessment. Additionally, this section describes some of the mitigation measures that would aid in avoiding or minimizing the potential impacts. Additional information on proposed mitigation and monitoring is provided in Appendix M. The information used in this section builds on the 2012 FEIS (USACE, 2012a) and incorporates new data and information relevant to environmental concerns associated with the alternatives that have become available since the 2012 FEIS. Importantly, the proposed changes in route and design described in Alternative 1 are the focus of this assessment. The information provided here often supersedes the information provided in the 2012 FEIS; in some instances, the information is replicated with relatively minor changes and updates, while other material is entirely new or substantially altered.

For this SEIS, the following elements have been added or updated since the 2012 FEIS with respect to impacts to water resources:

- A new section (Section 4.7.2, Methods) was added to explain the procedures used to evaluate the potential impacts associated with the proposed Project and alternatives;
- Several water resource datasets were updated to reflect updates in data availability as well as changes and refinements to the proposed Project;
- The number and type of stream crossings and stream crossing methods have changed due to changes and refinements in the proposed Project route. The total number of stream crossings since the publication of the 2012 FEIS has been reduced to 310 (263 Mainline, 7 Fairbanks Lateral, 40 access roads);
- The definition of a stream has been modified from the 2012 FEIS to include only the waterbodies that meet the USACE's definition of a stream (provided in Chapter 3, Section 3.3.5.1, Types of Surface Waterbodies). This resulted in a total of 181 wetlands or inundated areas to be re-classified as waterbodies that do not meet the USACE's definition of a stream (see Section 3.3.5.1 Types of Surface Waterbodies);
- Mitigation measures were carried over from the 2012 FEIS and expanded on to include recommendations from federal and state agencies and new information provided by AGDC;
- AGDC provided a list of potential water sources for hydrostatic testing or other construction uses along the proposed Project route. Any proposed watersheds with

the potential for withdrawal restrictions and/or conditions that may be present at the time of construction were evaluated;

- Impacts that are a result of modifications to the proposed Project description (including elimination of compressor stations and a straddle and offtake facility) and Alternative 2 have been revised;
- In response to public and agency comments, the text has been revised throughout the section, where necessary; and
- The proposed Project identifies use of eight sets of HDD Entry/Exit Pads.

4.7.1.1. Incomplete or Unavailable Information

In compliance with CEQ guidance (see Section 4.3), this section addresses incomplete or unavailable information pertinent to analyzing impacts of the alternatives on water resources. Assessments for this SEIS are made based on the most updated and accessible documents. When specific information could not be obtained, more generalized information is incorporated and a statement of the relevance of this information, as well as any implications of the data with regard to analyzing the alternative, are described.

While Alaska has an abundance of surface water, according to ADNR, very little data have been collected on this resource on a statewide basis. Water availability data was collected by AGDC for the Arctic Hydrologic Subregion as part of the 2010 Lake Studies Completion Report, Prudhoe Bay to Galbraith Lake. Water availability information is not readily available for the Interior-Yukon Hydrologic Subregion or the Southcentral Hydrologic Subregion. To account for this unknown, the likelihood of impacts to water availability has been rated higher in locations where water availability data is not available when compared to areas where the water availability is known.

4.7.2. Methods

The potential water resource impacts for the proposed Project presented below are based on the evaluation of existing water resources along the proposed Project corridor, review of available proposed Project descriptions and reports, review of public comments received after the publication of the 2012 FEIS and during the public scoping period for the SEIS held in 2014, and review of public comments received on the Draft SEIS during the July/August 2017 public comment period. Information about water use, quality, and availability was obtained from a combination of sources including:

- USACE. 2012a. *Final Environmental Impact Statement, Alaska Stand Alone Pipeline*. October.
- AGDC's USACE Department of the Army Permit Application (DA Application) (Appendix C) and 2010 Lake Studies Completion Report, Prudhoe Bay to Galbraith Lake (AGDC, 2011a).

- U.S. Geological Survey's (USGS) National Hydrography Dataset (USGS, 2011a), Estimated Use of Water in the U.S. (Maupin *et al.*, 2014; Kenny *et al.*, 2009), and National Water Information System (gauging sites) (USGS, 2010e).
- Federal Emergency Management Agency's (FEMA) floodplains data (FEMA, 2011).
- ADNR's Well Log Tracking System (also known as WELTS) (ADNR, 2011a).
- ADEC (Alaska Department of Environmental Conservation). 2013. *Final 2012 Integrated Water Quality Monitoring and Assessment Report*. December 23.
- Various publications on water resources in Alaska are provided in Chapter 7, Literature Cited, of this SEIS.

Potential impacts for this SEIS were analyzed by assessing the magnitude, extent, duration, and likelihood of occurrence as presented in Table 4.7-1, Impact Criteria for Water Resources.

Table 4.7-1 Impact Criteria for Water Resources

Impact Component	Impact Level			
	Major	**Moderate**	**Minor**	**Negligible**
Magnitude or Intensity	The effect would alter a physical resource in a way that would degrade its value, integrity, or function to the point that it could not be used, or would endanger/ harm biological resources or human health.	The effect would indisputably alter a physical resource, but would allow the resource to be used without endangering human health, biological resources; or the function or integrity of the resource.	The effect would visibly or measurably alter a physical resource without removing its value and without endangering human health, biological resources; or the function or integrity of the resource.	No or minimal effect.
Geographic Extent	The effect would occur on a statewide or regional basis, or throughout the study area.	The effect would occur at a borough or community level, or on a limited portion of the study area.	The effect would be site specific or occur within a few isolated locations.	The effect would be limited to a specific, isolated location.
Duration or Frequency	The effect would occur for a duration of greater than 2.5 years or through operations of the proposed Project. Chronic and long-term changes not likely to be reversed over several years or operational life.	The effect would occur intermittently for a duration of 1 to 2.5 years. Periodic, temporary, or short-term changes could be reversed in an annual or several seasonal cycles.	The effect would occur intermittently for a duration of less than 1 year. Periodic, temporary, or short-term changes could be reversed over one or two seasons.	So intermittent and limited duration that effect dissipates rapidly.

Impact Component	Impact Level			
	Major	Moderate	Minor	Negligible
Likelihood	Most likely (Effects are those that have greater than 75% chance of arising from reasonable or demonstrated mechanisms due to the action)	Likely (Effects are those that have 50% to 75% chance of arising from reasonable or demonstrated mechanisms due to the actions)	Somewhat likely (Effects are those that have a 10% to 50% chance of arising from reasonable or demonstrated mechanisms due to the action)	Unlikely (Effects are those that have less than 10% chance of arising from reasonable or demonstrated mechanisms due to the action)

The analysis of environmental consequences on water resources describes in detail the types of effects and impacts presented in Table 4.7-2. Types of effects and impacts include alteration of surface water availability, floodplains, stream bank stability, surface water quality, and groundwater.

Table 4.7-2 Types of Effects and Impacts on Water Resources

Type of Effect	Proposed Action Causing Potential Impact	
	Construction	Operations and Maintenance
Water Availability: • Impacts to current water uses due to proposed Project-related water use • Impacts to biological function of the waterbody (temporary limitations of habitat)	GFC construction, hydrostatic testing, HDD, ice work pads, ice access roads, hydroseeding, dust control, camp use and earth work would require water withdrawal	GCF operation, ice road construction, and dust control
Floodplains: • Changes in thermal regime of stream, bank stability, and floodplain/ flood storage capacity; • Increased surface water runoff • Ice Dams and Aufeis • Reduction in flood storage capacity or flow restrictions causing backwater effects • Increased flooding due to water discharge	• Excavation activities taking place in permafrost • Ice road construction and melting	• Storage of sand and gravel materials located within a floodplain • A cooler or warmer pipe temperature at any location compared to the surrounding ambient ground temperature and placement of aboveground facilities may impact permafrost • Impact of flooding on the pipeline could result in structural damage to the pipeline and VSMs
Stream Bank Stability: • Altered stream profile, changes in channel morphology and stability caused by channel and bank modifications • Altered stream structure (bed and Hyporheic zone) • Modified preferential flow patterns	• Excavation activities and disturbance of ground cover. • Utilization of gravel from streams • Waterbody crossings	• Operation and maintenance of permanent stream crossing locations • A warmer pipe temperature at any location compared to the surrounding ambient ground temperature (permafrost) and placement of aboveground facilities

Type of Effect	Proposed Action Causing Potential Impact	
	Construction	Operations and Maintenance
• Altered surface drainage patterns • Loss of riparian habitat • Changes in thermal regime of permafrost, thermokarst and thaw bulb development		
Surface Water Quality: • Decreased oxygen concentrations, increased organic matter • Increase in suspended solids, turbidity • Sedimentation • Increase/change in contaminant concentrations or distribution • Changes in temperature • Aquatic species and fish mortality	• Discharge of water withdrawn from permitted lakes and reservoirs to support construction activities (*i.e.,* ice roads, ice pads, hydrostatic testing, and earthwork) • Excavation activities, soil stockpiling, and disturbance of ground cover, potential for contaminant redistribution • Potential for spills during HDD • Contamination may occur due to heavy construction equipment leaks or fueling activities • Chemicals used and wastes generated during construction (*i.e.,* wash water) • Dredging and disposal of dredged materials at West Dock • Loss of drill muds, bentonite blowouts	• Regular vehicle use on roads and pads could potentially leak lubricants and toxic substances over the long-term, which could contaminate the surrounding surface waters. • Areas where ground cover is permanently disturbed (*i.e.,* access roads) could contribute to erosion and or sediment transport
Groundwater: • Altered groundwater and stream flows (thawing of the permafrost and warming of the ground may alter groundwater and surface water flow characteristics) • Changes in thermal regime of permafrost • Thermokarst and thaw bulb development	• Contamination could occur due to heavy construction equipment leaks or fueling activities • Pipeline construction in areas of continuous and discontinuous permafrost	Pipeline operation in areas of continuous and discontinuous permafrost

4.7.3. Proposed Design Features, Mitigation Measures, Best Management Practices, and Project Management Plans

4.7.3.1. Applicant-Proposed Design Features, Mitigation Measures, Best Management Practices, and Project Management Plans

The following mitigation measures are proposed by AGDC, and have been taken into consideration when evaluating potential impacts on water resources under Alternatives 1 and 2 during the construction and operations phases. A complete list of mitigation measures and BMPs are also provided in Appendix M.

1. Pipeline Temperature – To maintain the existing thermal regime and protect the stability of water resources, the proposed pipeline would remain at or near the ambient soil temperature and would not be chilled or heated for transport.
2. Stream Flow Regimes & Profiles – Stream characteristics and riparian areas would be restored to preconstruction conditions to the maximum practicable extent. Maintain, to the maximum extent practicable, existing surface water hydrology at waterbody crossings:
    - Prevent discharges that have the potential to adversely affect waterbodies.
    - Stabilize cut slopes immediately when design grade is obtained.
    - Initiate reclamation of disturbed areas as soon as practicable.
    - Comply with federal and state standards and guidelines for water withdrawals
    - Keep construction activities within the pipeline ROW and proposed Project footprint.
    - Perform water crossings in a manner that minimizes effects to water quality, including use of materials that do not introduce sediment or other harmful substances into waters when using IOC methods.
3. For culvert and bridge installation and maintenance in fish bearing streams, AGDC would be required to obtain a Fish Habitat Permit from ADF&G and would refer to ADF&G guidance documents for the design and maintenance of stream crossing structures. The General Pipeline Stream Crossing BMPs described in AGDC's Pipeline Stream Crossing Construction Mode Determination (as provided in Attachment 12 of the 2016 ASAP EED; AGDC, 2016b) include:
    - Locate extra work areas (*e.g.*, fabrication and staging areas) at least 50 feet from water's edge when practical, and no less than 30 feet from the water's edge when approved.
    - Locate fueling and fuel storage at least 100 feet from streams and waterbodies. When conditions require refueling within 100 feet of waterbodies, the Contractor must implement a preapproved spill prevention and cleanup plan. Refueling of

excavation equipment would take place at least 100 feet from any surface waterbody as a mitigation measure.

- Limit extra work area sizes to that needed to construct the stream crossing.
- Implement established erosion and sediment control measures are across the work area.
- Store as much instream spoil on the banks as is practical (additional TW may be required). When placing spoils in the active channel, deposit spoils in long piles oriented parallel to flow to minimize erosion, avoiding areas of highest water velocity.
- Construct berms or other sediment barriers to prevent saturated spoils on banks from flowing back into the waterbody. If working at a dry crossing, berms would not likely be required unless groundwater and saturated spoils are encountered.
- Retain a 30-foot buffer from the stream bank of undisturbed vegetation during initial clearing, except where necessary for equipment crossing. Sediment control measures would be in place prior to construction within the 30-foot vegetation buffer.
- Limit clearing of vegetation between the waterbody edge and extra work areas to the proposed Project ROW.
- Salvage and store vegetation layer to aid in bank reclamation following construction.
- Grading of stream banks for trenching equipment would be limited to the trench line.
- Grading of work areas would be directed away from the waterbody to minimize runoff entering the waterbody.
- Temporary or permanent vehicle crossings may be constructed, as required.
- Maintain natural stream flow rates at all times.
- Retain undisturbed native soils (hard plugs) between the stream and overbank trench. These would remain in place during instream excavation to prevent diversion into the open trench. Trench plugs would be removed immediately prior to pipe placement and backfilled once the pipe is in place.
- Install trench breaker (soft plug) adjacent to waterbody where consolidated soils or organic materials are prone to washing out.
- If necessary, install soft plugs and dewater trench in a manner that does not cause erosion and inhibits silt-laden water from entering the waterbody.
- When performing instream blasting, implement blasting methods that minimize overall shockwave, deploy air bubble curtains to dampen shockwave, limit blasting to times of least environmental/biological impact, displace fish from

blast area using approved methods, use confined explosives, and avoid using ammonium nitrate based explosives.

- Install approved instream sediment controls, such as sediment mats or geotextile blankets, as necessary.
- Complete fabrication (*i.e.*, welding, coating, weighting) and testing of instream pipe string well in advance of completing instream trenching activities.
- Utilize "push-pull" or "float" techniques to place pipe in trench whenever conditions allow.
- Place pipe in trench and backfill immediately. Restore stream channel to approximate preconstruction profile using clean gravel or native materials for the upper 1 foot of backfill.
- Backfilling generally consists of replacing the excavated material; however, clean gravel may be used as backfill when excavated materials increase potential downstream sedimentation, increase scour potential, or do not provide sufficient groundwater flow around the pipe. Where surface layer material has been segregated, in the case of an armor layer overlying fine grain materials, subsurface material would be replaced in the stratified order it was removed.
- Prior to backfilling, the trench would be dewatered as necessary. The pump intake shall be suspended above the trench bottom and water discharged over a well-vegetated upland area with appropriate energy dissipation; splash pup, splash plate, plastic liner, non-woven sediment filter bag, or straw bale dewatering structure. Dewatering activities would be performed such that no silt-laden water is discharged to the stream.
- Backfill from the center of the stream towards the bank to direct silt-laden water toward the plugs where it could be pumped and discharged. Lower bucket into water before releasing backfill.
- No backfill crown would be placed in the waterway. Return the channel profile and gradient to preconstruction conditions.
- Compact backfill on approach slopes and stream banks.
- Stabilize banks and install temporary sediment barriers within 24 hours of completing instream construction. For isolated trenching, restore channel geometry and stabilize banks prior to returning flow to the watercourse. Grade banks back to preconstruction contours when practical, or to an approved stable angle of repose.
- All instream work would comply with construction timing windows and conditions permitted by the appropriate regulatory agencies and applicable permits. Ideally, all instream work would be completed within 24 hours on

minor streams and 48 hours on intermediate and major waterways when conditions allow.

- Vegetative stabilization techniques are preferred where feasible. If soil and/or flow conditions dictate use of riprap or non-native materials (*e.g.*, geogrids) for bank stabilization, their placement must comply with authorizing agencies.
- Install permanent erosion and sedimentation control measures, including revegetation of riparian areas.
- Clean-up water crossing work areas immediately following backfill and erosion control installation. When winter cleanup is impacted by frozen spoils, complete rough cleanup prior to breakup and final cleanup after breakup.

4. Restoring Stream Characteristics and Riparian Area – Following construction, stream characteristics and riparian areas would be restored to preconstruction conditions to the maximum practicable extent as described below by:
   - Salvaging and storing the vegetation layer to aid in bank reclamation following construction.
   - Stabilizing cut slopes immediately when design grade is obtained and installing temporary sediment barriers within 24 hours of completing instream construction.
   - Ensuring backfill is well compacted on approach slopes and stream banks.
   - Using vegetative stabilization technique where feasible unless soil and/or flow conditions dictate use of riprap or non-native materials (*e.g.*, geogrids) for bank stabilization.
   - Immediately restoring stream channel to approximate preconstruction profile using clean gravel or native materials for the upper 1 foot of backfill.
5. Minimize the number of river and stream crossings:
   - Use existing bridges where feasible.
   - Use HDD or other trenchless technology to minimize disturbance to water bodies.
   - Perform water crossings in a manner that minimizes effects on water quality.
   - Use materials for dam construction that do not introduce sediment or other harmful substances into waters when using the open-cut isolation method.
   - Use materials for the flume pipe system that does not introduce sediment or other harmful substances into waters when using the open-cut isolation method.
   - Position flume pipe system discharges to prevent erosion or scouring.
   - Use temporary bridges for transportation as practicable.

- Since the publication of the 2012 FEIS, alignment changes have been made resulting in a reduction in the total number of waterbody crossings from 515 to 430.
- The proposed Project ROW for the Fairbanks Lateral would have seven crossings that are considered streams and rivers. This is a significant reduction from the 2012 FEIS, where 20 stream crossings were previously proposed.

6. Erosion and Sediment Control Measures:
   - At waterbody crossings, AGDC would install sediment control measures prior to and during construction and maintain the exiting surface water hydrology and bank stability to the maximum extent practicable at waterbody crossings.
   - In areas where a lease is required from the SPCS or a federal grant of ROW is required from BLM, erosion control measures would be maintained to limit induced and accelerated erosion, limit sediment production and transport, and lessen the possibility of forming new drainage channels during construction, operation, maintenance, and termination of the pipeline.
7. Chemicals – In areas where a lease is required from the SPCS or where a federal grant of ROW is required form BLM, AGDC would use only non-persistent and immobile types of pesticides, herbicides, preservatives, and other chemicals. Each chemical to be used and its application constraint would be approved by SPCS or the Authorized Officer (BLM) prior to use. The use of pesticides and herbicides are regulated by ADEC's Environmental Health Division through 18 AAC 90 and may require a permit.
8. Disturbance of Natural Waters – In areas where a lease is required from the SPCS or a federal grant of ROW is required from BLM, all proposed Project activities that may create new lakes, drain existing lakes, significantly divert natural drainage and surface runoff, permanently alter stream or groundwater hydrology, or disturb significant areas of streambeds, are prohibited unless such activities and necessary mitigation measures are approved by SPCS/BLM. The temperature of natural surface water or groundwater would not be significantly changed by the Pipeline or by any construction, maintenance, operation, or termination related activities so as to adversely affect the natural surface water or groundwater, unless approved by SPCS/BLM.
9. Pollution Control:
   - In areas where a lease is required from the SPCS or a federal grant of ROW is required from BLM, in the construction, operation, maintenance, and termination of the pipeline, AGDC would perform its activities in accordance with applicable air and water quality standards and related facility siting standards and plans. Mobile ground equipment would not be operated in or on lakes, streams, or rivers on state/federal land unless approved by SPCS/BLM Authorized Officer.

Refueling of excavation equipment would take place at least 100 feet from any surface waterbody as a mitigation measure

- Implement a preapproved Spill Prevention, Control, and Countermeasure (SPCC) Plan, as required by 40 CFR 112 to prevent discharges of oil to waters of the U.S.
- AGDC has committed to avoiding the known contaminated site areas described in Chapter 3 and any newly discovered contamination would be reported to the ADEC in accordance with their reporting requirements and handled in a manner to avoid transport of contaminated materials.

10. Materials Sources – In areas where a lease is required from the SPCS or a federal grant of ROW is required from BLM, gravel and other construction materials would not be taken from streambeds, riverbeds, lakeshores, or outlet of lakes, unless the taking is approved by SPCS Authorized Officer.
11. Additional Monitoring and Maintenance
    - The gas volume, flow, and pipe integrity would be monitored using an ILI program, block valves, and maintenance and response bases.
    - Water quality monitoring would be conducted, as required by the state water quality standards. Water quality and turbidity monitoring would be conducted, as required by the Alaska Pollutant Discharge Elimination System (APDES) permit.
12. AGDC proposes to identify measures that would mitigate long-term impacts to local drainage patterns during engineering design. Specific measures might include ditch plugs (foam, sandbags, bentonite, or compacted, cohesive soils placed next to the pipeline to prevent water from running parallel to the pipe), crowning soil in a mound over the pipeline trench to account for subsequent settlement, and recontouring to promote runoff and minimize ponding and erosion.
13. The minimum required depth of cover at rivers and streams would be the greater of 5 feet or 120 percent of maximum scour.
14. AGDC would avoid construction activities in close proximity to drinking water wells and adjust the location of construction activities within the ROW where necessary and practicable.

In addition to the proposed mitigation measures listed above, in areas where a lease is required from the SPCS, AGDC would be required to submit plans for stream, river, and floodplain crossings and groundwater control to the SPCS for approval. These plans have not been drafted, and therefore, are not considered a mitigation measure in this analysis.

4.7.3.2. Agency-Recommended Mitigation Measures

A variety of mitigation measures and best practices have been recommended by the cooperating agencies (Appendix M). Many of these recommendations have been incorporated in the proposed Project and are included in Table 4.7-3 below. The impacts discussed in this chapter are based upon the Applicant-proposed measures. These additional agency recommended measures are not included in the impact analysis.

Table 4.7-3 Water Resources Agency-Recommended Mitigation Measures

Additional Measure Consideration	Agency Proposing Mitigation Measure	Agency Jurisdiction	Authority (*i.e.*, CWA, RHA, ESA)	Affected Resources	Comment Code
The SWPPP must include a description of temporary and permanent stabilization practices for the site, including a schedule of when the practices would be implemented. The SWPPP must document shutdown and startup activities for projects that are not completed during the winter or summer construction season. The SWPPP must also document (1) the anticipated dates of fall freeze-up and spring thaw, (2) activities leading up to and at fall freeze-up, (3) activities leading up to and at spring thaw, and (4) activities to reestablish control measures prior to and immediately after spring thaw and fall freeze-up.	ADEC	EPA, ADEC	Clean Water Act (CWA)	Waters	NA
Stabilization of disturbed areas must be initiated as soon as practicable whenever any clearing, grading, excavating, or other earth disturbing activities have permanently ceased on any portion of the site or temporarily ceased on the site and would not resume for a period exceeding 14 days. Temporary Stabilization: No later than 14 days after initiating temporary stabilization, the permittee must complete all activities necessary to initially revegetate the area and/or install non-vegetative measures.	ADEC	EPA, ADEC	CWA	Waters, Soils and Geology, Vegetation	NA
Final Stabilization and Terminating Construction Stormwater Authorizations: To eliminate a site or terminate authorization for construction stormwater coverage under General Permit AKG320000, the permittee must achieve final stabilization for the affected area of coverage. Final Stabilization includes: a) a uniform (e.g., evenly distributed, without large bare areas) perennial vegetative cover with a density of 70 percent of the native background vegetative cover for the area has been established on all unpaved areas and areas not covered by permanent structures, or b) equivalent non vegetative permanent stabilization measures have been employed including but not limited to riprap, gabions, porous backfill per ADOT&PF Specification 703-2.10, railroad ballast or	ADEC	EPA, ADEC	CWA	Waters, Soils and Geology, Vegetation	NA

Additional Measure Consideration	Agency Proposing Mitigation Measure	Agency Jurisdiction	Authority (*i.e.*, CWA, RHA, ESA)	Affected Resources	Comment Code
sub-ballast, ditch lining per ADOT&PF Specification 610-2.01, or geotextiles, or fill material with low erodibility as determined by an engineer familiar with the site and documented in the SWPPP.					
Stabilization of disturbed areas must, at a minimum, be initiated immediately whenever any clearing, grading, excavating, or other earth disturbing activities have permanently ceased on any portion of the site or temporarily ceased on any portion of the site and would not resume for a period exceeding: 7 calendar days for those areas of the state with a mean annual precipitation of 40 inches or greater; or 14 calendar days for those areas of the state with a mean annual precipitation less than 40 inches.	ADEC	EPA, ADEC	CWA	Waters, Soils and Geology, Vegetation	NA
Include on-site mitigation to reduce potential impacts to drinking water along the proposed pipeline route. Avoid construction in close proximity to private drinking water wells to the maximum extent practicable by making any available adjustments to trench location within the ROW.	EPA	USACE, EPA	--	Water, Public Health	EFF_26
Include compensation for any unavoidable impacts to quantity or quality of drinking water (*e.g.*, drilling a new drinking water well if needed).	EPA	EPA, ADEC, ADNR	--	Water, Public Health	MIT_33
(1) Waterway crossings should be designed, constructed, and installed according to the Anadromous Salmonid Passage Facility Design (NMFS, 2011), (2) bridges and culverts span waterways to not restrict adequate fish passage and to retain full access to spawning areas where streams are braided, and (3) all crossings should be based on site-specific information, such as anadromy, seasonal instream flows and peak discharge, and flood plain regime (50-year to 100-year flood events).	NMFS	USFWS, ADF&G	Fish and Wildlife Coordination Act, Fish and Wildlife Conservation Act, Anadromous Fish Act	Water, Fish	FISH_4
A large number of Applicant-proposed design features, mitigation measures, BMP, and project management plans listed in the Draft SEIS contain the language, "In areas where a lease is required from the State Pipeline Coordinator's Section" or "a federal grant of ROW is required from BLM ..." These measures generally represent a best management	EPA	--	--	Numerous	MIT_35

Additional Measure Consideration	Agency Proposing Mitigation Measure	Agency Jurisdiction	Authority (*i.e.*, CWA, RHA, ESA)	Affected Resources	Comment Code
approach that we recommend using to the maximum extent possible along the entire pipeline route, while acknowledging the outstanding need to complete coordination with private landowners.					

AAC = Alaska Administrative Code
ADF&G = Alaska Department of Fish and Game
ADEC = Alaska Department of Environmental Conservation
ADNR = Alaska Department of Natural Resources
AGDC = Alaska Gasline Development Corporation
APDES = Alaska Pollution Discharge Elimination System
BLM = Bureau of Land Management
BMP = Best Management Practice
CAA = Clean Air Act
CWA = Clean Water Act
DHSS = Alaska Department of Health and Social Services
EPA = U.S. Environmental Protection Agency
MBTA = Migratory Bird Treaty Act
NMFS = National Marine Fisheries Service
RHA = Rivers and Harbors Act of 1899
SEIS = Supplemental Environmental Impact Statement
USACE = U.S. Army Corps of Engineers
USFWS = U.S. Fish and Wildlife Service

4.7.3.3. Emergency Preparedness and Response

Based on PHMSA national statistics and injuries, the estimated number of significant leaks per year over the 30-year period would be approximately 0.11. This estimate might overstate the potential for leaks because several are related to corrosion (at least in the initial years) or disturbance by digging activities, and these are expected to be less of an issue for a new pipeline located in a remote area. Leak detection remote monitoring would be employed at the GCF complex and the GCF Maintenance and Response Base (GCFMRB).

Appropriate Emergency Preparedness and Response Plans addressing health, safety, security, and environmental (HSSE) risks would be developed, documented, communicated, and maintained for operational locations. The preparedness and response plans include procedures for first aid, firefighting, evacuation of personnel, and communication with emergency services. The plans are periodically reviewed and revised following drills and actual incidents to incorporate lessons learned.

Company personnel are trained in fulfilling their assigned emergency responsibilities including notifications, incident management, emergency operations, hazards identification and mitigation, first aid, and media or public interactions. Response drills are periodically conducted to test the adequacy of emergency plans and resources. Emergency plans and drills include interaction and coordination with external parties that may be involved and impacted during an emergency.

Equipment, facilities, and personnel necessary for emergency response are identified, tested, maintained, and available.

A Spill Prevention and Control Plan (SPCP) must be developed for each storage facility (*e.g.*, tank) with a capacity to store in excess of 1,320 gallons of fuel. This plan would meet the regulations of 40 CFR 112 to develop a SPCC plan. For example, the GCF would include three diesel tanks with a total capacity of 29,940 gallons and one gasoline tank with a capacity of 9,980 gallons. The SPCP would include preventative measures to contain spills and establish countermeasures to prevent petroleum spills from reaching navigable waters. The plan must be maintained on site.

The SPCP would be developed prior to construction where hazardous materials are stored or used, including pesticides, paints, solvents, petroleum products or fertilizers. The SPCP would identify potential spill or source areas such as loading, unloading, storage, and processing areas, and areas designated for waste storage and disposal. The SPCP would identify material handling procedures and storage requirements and outline the actions to reduce spill potential. The construction contractor would be required to have a SPCP approved before beginning construction.

The SPCP would include the following elements:

- Performance of maintenance, including refueling of construction vehicles to prevent spills.

- Storage of fuels and other hazardous materials containment requirements.
- Individuals responsible for implementing the SPCP.
- Measures for storage and disposal of each kind of waste.
- Spill response and cleanup procedures.
- Spill response equipment to be used, including personal protective equipment.
- Reporting requirements.
- Periodic inspection and documentation requirements.
- The SPCP would be developed in accordance with all pertinent regulations and would follow BMPs. It would address specific requirements, such as:
    - The refueling of vehicles would not be performed within 100 feet of a wetland, stream, or other waterbody.
    - Fuel storage areas would be lined and bermed to contain 110 percent of the volume of fuel stored.
    - Vehicle maintenance trucks would contain small spill response kits.
    - Drip trays would be used under vehicles when parked to capture fuel, oil, and grease from vehicle leaks.
- All personnel would be trained in the notification and spill response requirements of the SPCP.
- Personnel would be trained in proper use of freeze depressant during hydrostatic testing.

4.7.4. Alternative 1 – Proposed Action

Alternative 1 is designated the proposed Action (proposed ASAP Project). This alternative is described in detail in Chapter 2. The 733-mile-long, 36-inch diameter Mainline pipeline and a 30-mile-long, 12-inch diameter lateral pipeline, terminating in Fairbanks, would cross various habitats and ecoregions from the North Slope to the existing ENSTAR pipeline system in the Mat-Su Borough.

The proposed ASAP Project, including the Mainline, the Fairbanks Lateral, and off-ROW facilities (*e.g.*, access roads), would cross a total of 310 streams. Of these streams, 263 would be impacted by the Mainline, seven impacted by the Fairbanks Lateral, and 40 impacted by access roads.

The total number of centerline stream crossings in the 2012 FEIS was 515. Since then, changes in pipeline route and the addition of new access roads and other facilities have occurred and better desktop and field data for streams and wetlands have been collected. ASAP engineers and scientists identified 181 additional waterbodies that do not meet the USACE's definition of a stream, provided in Section 3.3.5.1, Types of

Surface Waterbodies, and as such, were re-classified as waterbodies that do not meet the USACE's definition of a stream.

The proposed ASAP Project ROW for the Fairbanks Lateral would have seven crossings that are considered streams and rivers. This is a significant reduction from the 2012 FEIS, where 20 stream crossings were previously proposed (AGDC, 2016b). Access road stream crossings would not change the magnitude or the scope of the potential impact to individual stream crossings presented in the 2012 FEIS (USACE, 2012a). Stream crossing methods have been determined for all crossings based on the Pipeline Stream Crossing Construction Mode Determination developed in 2015 (as provided in Attachment 12 of the 2016 ASAP EED; AGDC, 2016b).

A complete list of stream crossings is provided in Appendix F (Stream Crossings) and stream crossings are summarized in Table 4.7-4.

Table 4.7-4 Project Stream Crossings

Project Component	Total Crossings	Aerial (Bridge) Crossings	OC Crossings	IOC Crossings	HDD Water Crossings[a]	Culvert Crossings
Mainline	263	6	95	155	7	0
Fairbanks Lateral	7	0	3	4	0	0
Access Roads	40	17	0	0	0	23
Total	310	23	98	159	7	23

a An additional HDD would be required to install the pipe through an area of higher elevation rather than at a waterbody crossing. This HDD would require water use from the Nenana River, and as such, is discussed in Section 4.7.4.1.1, Water Availability.

In addition to the stream crossings described above, the following construction, operation and maintenance activities may result in effects to water resources and are discussed in detail in the following sections: water usage for HDD and hydrostatic testing, ice road construction, aboveground and support facilities, heavy equipment usage and refueling, fill placement, material sourcing.

4.7.4.1. Construction

4.7.4.1.1. Water Availability

Water withdrawal would be required for pipeline construction activities, including hydrostatic testing; HDD crossings, ice road, and pad construction; construction of temporary camps; camp use; hydroseeding; and dust control. Water withdrawals would be permitted by ADNR and coordinated with Alaska Department of Fish and Game (ADF&G) for guidance regarding screen requirements for pump inlets, maximum withdrawal rates and volumes. Probable sources for hydrostatic test waters and probable locations and volumes for HDD use are provided in this section, and final water withdrawal locations would be defined prior to construction. A minimum of 975 million gallons of water would be required to support construction activities (USACE, 2012a). Table 4.7-5 presents the ASAP Water Use Requirements by Construction Spread and Section.

Table 4.7-5 ASAP Water Use Requirements by Construction Spread and Section

Spread	Section	Location	Start MP	End MP	Miles	Season	Hydro Test	Workpads	Access Roads	Earthwork	Project Total, Gallons
1	1A	GCF to Pump Station 1 (PS1)	0	6	6	W1	276,000	15,000,000	-	462,200	15,738,200
1	1B-1	PS1 to Happy Valley	6	88	82	W1	4,715,000	168,116,000	1,150,654	538,700	174,520,354
1	1B-2	Happy Valley to Atigun River Valley	88	163	75	W2	8,625,000	74,736,000	1,450,829	951,100	85,762,929
1	1C-1	Atigun River Valley to North Atigun Pass	163	173	10	S1	1,150,000	-	77,343	239,800	1,467,143
1	1C-2	North Atigun Pass to Chandalar Shelf	173	183	10	S2	1,150,000	-	389,310	200,800	1,740,110
2	2A-1	Chandalar Shelf to Coldfoot	183	248	65	W1	7,475,000	42,352,000	469,334	470,200	50,766,534
2	2A-2	Coldfoot to Prospect River	248	286	38	W2	4,370,000	50,288,000	498,635	1,286,200	56,442,835
2	2B	Prospect River to Ray River	286	348	62	S1	7,130,000	93,264,000	5,283,432	2,449,600	108,127,032
2	2C	Ray River to Yukon River	348	360	12	W2	1,380,000	19,200,000	39,636	206,900	20,826,536
3	3A	Yukon River to Livengood	360	405	45	S1	5,175,000	67,984,000	3,375,594	2,038,700	78,573,294
3	3B-1	Livengood to Little Goldstream	405	468	63	W1	7,245,000	86,880,000	36,853,202	30,837,600	161,815,802
3	3B-2	Little Goldstream to Healy	468	529	61	W2	7,015,000	31,008,000	12,812,515	407,400	51,242,915
4	4A-1	Healy to Nenana River	529	535	6	S1	690,000	8,496,000	101,353	2,700	9,290,053
4	4A-2	Nenana River to Lynx Creek	535	541	6	F1/W2	690,000	-	247,521	766,500	1,704,021
4	4B	Lynx Creek to Honolulu Creek	541	602	61	S1	7,015,000	-	2,434,047	994,200	10,443,247
4	4C-1	Honolulu Creek to Susitna River	602	673	71	W1	8,165,000	-	456,119	370,300	8,991,419
4	4C-2	Susitna River to Beluga PL MP 39	673	736.41	63.41	W2	7,291,000	70,250,000	1,111,778	2,539,500	81,192,278
FBKS LAT	FBKS LAT	Mainline (MP 458.75) to Fairbanks	0	34.43	34.43	S2	1,032,900	55,088,000	-	-	56,120,900
						Totals:	**80,589,900**	**782,662,000**	**66,751,302**	**44,762,400**	**974,765,602**

Source: USACE, 2012a
S1 = Summer, season 1
W1 = Winter, season 1
S2 = Summer, season 2
W2 = Winter, season 2

4.7.4.1.1.1. Hydrostatic Testing

The proposed pipeline would be hydrostatically pressure tested in accordance with U.S. Department of Transportation (USDOT) safety standards (49 CFR 192) following installation and backfilling and prior to operation to verify its integrity and to confirm its ability to withstand the maximum allowable operating pressure. Hydrostatic testing consists of installing a hydrostatic test cap and manifold and filling the pipeline with water. Hydrostatic testing is planned to occur in summer and so the use of antifreeze is not anticipated. Water may be pre-heated slightly prior to placing in the pipe, but this would be avoided if possible. The pipeline would be pressurized to exceed its maximum allowable operating pressure (MAOP), and the pipeline would maintain that test pressure for an amount of time in accordance with the USDOT safety standards. Any leaks detected during the test would be repaired, and that segment of pipeline would be re-tested.

Water used for hydrostatic testing would be obtained from designated, permitted, surface water sources listed in Table 4.7-6. Hydrostatic testing would require approximately 197 million gallons of water for the proposed Project. Heated (36 degrees Fahrenheit [°F] to 38°F) and untreated water would be used for hydrostatic testing (AGDC, 2016m). A complete Hydrostatic Test Plan would be developed in conjunction with the selected pipeline contractors and the pipeline operator prior to construction.

Table 4.7-6 Hydrostatic Test Probable Sources of Water Withdrawal

Approximate ASAP V6.1 MP	Potential Water Source[a]	Probable Hydrostatic Test Water Withdrawal[b] (Million Gallons)
20.0	Lake at MP 20	10
56.0	Lake at MP 56	5
80.0	Lake at MP 80	10
94.5	Lake at MP 94.5	5
121.0	Lake at MP 121	4
149.0	Lake at MP 149	9
168.0	Atigun River	3
181.1	Dietrich River	5
208.2	Lake at MP 208.2	11
228.0	Middle Fork Koyukuk River	3
248.7	Middle Fork Koyukuk River	7
281.2	Prospect Creek/Jim River	4
288.2	North Fork Bonanza Creek	2
306.8	Kanuti River	6
340.0	Ray River	8
355.8	Yukon River	3
356.2	Yukon River	4
381.0	Hess Creek	8
401.3	East Fork Tolovana River	1
429.2	Tatalina River	9
453.8	Goldstream Creek	4
472.8	Nenana River	5
494.4	Nenana River	6
511.5	Nenana River	10
535.8	Nenana River	2

Approximate ASAP V6.1 MP	Potential Water Source[a]	Probable Hydrostatic Test Water Withdrawal[b] (Million Gallons)
541.6	Yanert Fork	5
564.6	Jack River	8
596.1	Honolulu Creek	6
610.2	Lake at MP 610.2	4
638.7	Chulitna River	5
639.7	Chulitna River	5
673.4	Susitna River	4
674.4	Susitna River	16

Source: AGDC, 2016m
a *Construction Execution Plan Route Version 6 (v_6)*, ASAP Project, January 2015, as adapted for Route v6.1.
b Withdrawal volume is based on not recycling water from one test segment to another. Water would be withdrawn over a period of several days, depending on pump size.

The water withdrawal rate from the source would be in accordance with a water use permit from ADNR. In general, test segments could range in their length from just over 20 miles to as short as 0.8 mile, in part because of mountainous terrain and the influence of elevation head. The test volume of water associated with a 20 mile-long test segment is approximately 5.3 million gallons. After the test is completed, the test pressure would be released in a controlled fashion to maintain personnel and pipeline safety. Discharged water would be either recycled for use in another hydrostatic test segment of pipeline, or it would be released in accordance with ADEC disposal and discharge permits. Water would be recycled as often as practicable by transferring it into the next adjacent pipeline segment. Hydrostatic test water would be discharged directly to upland areas or would be diverted to a settling basin prior to discharge, as necessary to comply with discharge permit limitations in accordance with applicable regulations.

4.7.4.1.1.2. Horizontal Directional Drilling

The drilling fluid consists of water and other additives, usually clays, such as bentonite. Other low-toxicity additives may be used, if required, to enhance returns. Water would be cleaned and re-used with the addition of fresh make-up water to account for water absorbed by damp solids. The initial mix water and the makeup would be brought to the HDD location via a water truck or pumped directly to the mud tank from a permitted water source. Water would generally be acquired from the waterbody that is crossed, unless the location is not available for water withdrawal, as determined by water use permit and ADF&G guidelines. Table 4.7-7 provides HDD location, length, proposed disposal site location, probable water required, and proposed average daily water consumption. The HDD at the Denali NPP commercial area at the Denali Village area does not cross a waterbody; however, the method was chosen to climb to a higher elevation through the locations steep terrain. HDD is used as the preferred method to install the pipe through an area of higher elevation. The HDD crossing is shown in the table because it would require water use from the Nenana River, but it is not crossing a waterbody.

Table 4.7-7 HDD Locations and Probable Water Requirements

Stream ID	Name of HDD Crossing	Approximate MP for Source[a]	Water Source Name[b]	HDD Length (feet)[c]	Proposed Fluid & Cuttings Disposal Locations[d]	Probable Water Required (Millions of Gallons)[e]	Proposed Average Daily Water Withdrawal (Thousands of Gallons)[f]
ST_356	Yukon River	355.8	Yukon River	3525	MS 3A-F	3.3	36
ST_471.9	Tanana River	494.4	Nenana River	3600	MS 3C-C	3.4	38
N/A	Denali NPP Commercial Area	472.2	Nenana River	4136	MS 3D-H	4.6	27
ST_596.1	Honolulu Creek	596.1	Honolulu Creek	3817	AR-BV-N-599.45	3.6	24
ST_638.4	Troublesome Creek	638.4	Troublesome Creek	1753	MS 4B-G	1.7	23
ST_639.2	Chulitna River	639.7	Chulitna River	4456	MS 4B-G	4.2	34
ST_694.5	Kashwitna River	694.5	Kashwitna River	3068	Third Party Gravel Source Pit	2.9	35
ST_705.5	Willow Creek	705.5	Willow Creek *These waterbodies would be crossed with a single HDD*	4145	Third Party Gravel Source Pit	3.9	51
ST_705.7	Unnamed						
ST_705.8	Unnamed						

Source: AGDC, 2016b

a ASAP Alignment Route v6.1 mileposts.

b The source location is based on proposed Project GIS data.

c Based on proposed Project engineering data.

d Proposed disposal locations for cuttings and drilling fluids are based on closest proposed Project site to the HDD location, final disposal locations would be noted in the ADEC disposal permit. Alphanumeric identifies are identifiable as proposed Project material sites or access roads.

e These volumes are estimated at this time. Final volumes would be included in the water use permit. Probable water volumes were calculated based on formulas and assumptions given in Installation of Pipelines by Horizontal Directional Drilling and Engineering Design Guide, Pipeline Research Council International, Inc., Catalog Number L51730, April 15, 1995. The water sources are either rivers or surface water sources, the Construction Execution Plan does not currently plan to use well water for HDD water sources. The amount of fluids discharged is expected to be dramatically lower than the amount of fluids consumed by the HDD.

f Based on Probable Water Required column divided by the preliminary construction schedule for the duration of the HDD installation. Construction Execution Plan, Route Version (v_6), 1/9/2015, 002-C-24-B-Y-0040, as adapted to Route v6.1.-

A total of approximately 27.6 million gallons of water would be required for HDD activities with proposed daily water withdrawal rates ranging from 23 to 51 thousand gallons per day. This volume is a conservative (larger volume than anticipated) estimate of water needs for HDDs based on the possibility of encountering unpredictable geotechnical conditions.

4.7.4.1.1.3. Ice Roads

Ice roads would be developed over the two winter construction seasons to access waterbodies, and to construct the ROW. Ice road construction on the North Slope would take place during November through April during winter of years 1 and 2, subject to approval from ADNR (AGDC, 2016n). The years in which winter construction of ice roads would occur are consistent with the dates and locations provided in Table 2.2-7 (Alternative 1: ASAP Construction Spread Plan). Ice chips and unfrozen water would be used to build and maintain ice roads throughout the construction season. Impacts are expected to be temporary.

4.7.4.1.1.4. Impact Summary

Water availability could be impacted by changes to hydrology or permafrost resulting from operation of the pipeline, which could affect surface or groundwater resources. Topographic changes caused by gravel placement or thawing permafrost may cause hydrologic changes that result in the creation of new surface water bodies or reduction of existing ones. As described in Section 4.7.3, mitigation measure No. 1 would reduce impacts to permafrost. Measures No. 3, 4, 5, and 8 would mitigate the likelihood and magnitude of impacts to changes in hydrology and impacts to surface water and groundwater resources.

Impacts to drinking water availability could occur as a result, or if water withdrawals took place at a waterbody that is hydrologically connected to a drinking water reservoir. Table 3.3-14 (See Section 3.3.6, Groundwater) provides a list of drinking water wells within 500 feet of the proposed pipeline route. Proposed water withdrawal locations are provided in Tables 4.7-6 and 4.7-7 above. Mitigation Measure No. 8 (Section 4.7.3) would be employed to minimize impacts to water availability. Water withdrawal would be conducted in accordance with permits issued by ADNR, and in coordination with ADF&G and are anticipated to be intermittent and relatively short in duration.

The impacts on water availability as a result of water use for HDD, hydrostatic testing, and ice road development, is expected to be moderate, as provided in Table 4.7-8.

Table 4.7-8 Impacts of the Proposed Project Construction on Water Availability

Impact Component	Impact Level
	Moderate
Magnitude or Intensity	Water use during construction to support hydrostatic testing, HDD, and ice road construction, would alter water availability. Obtaining water from ADNR and ADF&G permitted locations and adhering to Mitigation Measure No. 8 would mitigate effects to human health, biological resources, or the function or integrity of the resource.
Geographic Extent	Effects would occur throughout the study area including the waterbodies shown in Tables 4.7-6 and 4.7-7 above.
Duration or Frequency	The effects would occur intermittently throughout construction, over a period of 2.5 years.
Likelihood	It is most likely that the effects described in this section would occur.

4.7.4.1.2. Floodplains

Affects to floodplains may occur as a result of ice road construction, aboveground and support facility construction, use of heavy construction equipment, and fill placement.

4.7.4.1.2.1. Ice Roads

Ice bridges may form and persist across rivers and streams where ice roads were developed. Ice roads and potential bridges would melt slower than the surrounding ice in the stream; however, standard ice road mitigation includes slotting the ice at stream crossings and outlets before breakup to allow streams to flow as the snow pack melts. The primary impact from ice bridging across streams would include flooding during spring break up resulting in increased sedimentation loads, which is also natural during spring break up from floods. This would be expected to be a temporary and local impact to water resources; however, would also impact fish resources as noted in Section 4.11, Fish.

When developed properly using slotting at stream crossings and outlets to allow water to flow past the ice road, ice road development would not adversely affect surrounding water resources, ice road construction would visibly or measurably alter flooding during spring break up without endangering human health, biological resources; or the function or integrity of the resource. Flooding due to ice roads would be somewhat likely, would be site-specific or occur within a few isolated locations, and would occur intermittently for a duration of 1 to 2.5 years. When constructed properly, the impact of ice roads on floodplains would be minor.

4.7.4.1.2.2. Aboveground and Support Facilities

Proposed Project facilities would be located outside of known floodplains, where practicable. In general, if aboveground facilities were located within a floodplain, the result could reduce flood storage capacity of the flood plain due to the changes in topography, or reduce flow restriction causing increased upstream stages due to backwater effects. Construction of the GCF would not require fill in a FEMA-mapped floodplain. Specific locations of waterbody crossings for the access road development to

the GCF have not been determined. The area is primarily wetland habitat within the ACP and is discussed in detail in Section 4.9, Wetlands. The expected effect of the GCF facility on flood storage capacity would be negligible. Storage of sand and gravel materials could result in a reduction in flood storage capacity, if located within a floodplain. Five material storage sites are proposed within the Sagavanirktok River floodplain. Material would be stockpiled in these locations prior to transport. These affects would be minimal, localized and temporary during the construction phase of the proposed Project.

The effects of aboveground and support facilities, the use of heavy construction equipment, and fill placement during trench installation within a floodplain could would visibly or measurably alter the floodplain capacity, but not to the extent that it would endanger human health, biological resources, or the function or integrity of the floodplain. Construction of a permanent facility within a floodplain would be unlikely, but the effect would occur throughout operations of the proposed Project. Permanent placement of aboveground facilities within a floodplain would most likely result in a moderate affect to floodplain capacity.

4.7.4.1.2.3. Use of Heavy Construction Equipment

Heavy equipment use at pipeline installation locations and staging areas may result in altered surface water flow and availability due to soil compaction. This may also result in increased surface water runoff and the potential for flooding due to reduced soil permeability. Surface water drainage patterns should return to pre-construction conditions, but there is a possibility that soil compaction could permanently alter surface water flow in the footprint of the proposed Project.

There is potential for the effect to occur for a duration greater than 2.5 years or through operations of the proposed Project. The effect would be specific to the proposed Project Area, and is likely to arise. For these reasons, the potential impacts of use of heavy construction equipment on soil compaction and surface water flow would be considered moderate.

4.7.4.1.2.4. Fill Placement

Placement of fill for the pipeline trench installation may result in a reduction in flood storage capacity, if located within a floodplain. Short-term disturbance would be limited to construction impacts and construction of the proposed Project is not expected to cause long-term effects to stream flow, stream profile, or structural components of streams or waterbodies.

The use of temporary fill placement within a floodplain would produce a limited, specific effect to floodplain capacity without altering the integrity of the floodplain. Use of temporary fill placement within a floodplain would produce a minor effect.

4.7.4.1.2.5. Impact Summary

Mitigation Measure No. 8 provided in Section 4.7.3 would be employed to minimize impacts to floodplains. The impacts on floodplains during as a result of ice road development, construction of aboveground and support facilities, use of heavy construction equipment, and fill placement is expected to be moderate, as provided in Table 4.7-9.

Table 4.7-9 Impacts of the Proposed Project Construction on Floodplains

Impact Component	Impact Level
	Moderate
Magnitude or Intensity	When the mitigation measures described in this section are applied, construction would visibly or measurably alter flooding during spring break up without endangering human health, biological resources; or the function or integrity of the resource.
Geographic Extent	The construction activities described in this section would occur throughout the proposed Project Area; however, potential impacts to floodplains would be site-specific, or within a few isolated locations.
Duration or Frequency	Construction would take place over a period of 2.5 years; however, impacts to floodplains as a result of these activities would occur intermittently for a duration of less than 1 year. Although unlikely, floodplain impacts as a result of a permanent facility would occur for a period of greater than 10 years.
Likelihood	It is only somewhat likely that impacts to floodplains would occur as a result of construction if the mitigation measures described in this section were employed. Construction of a permanent facility within a floodplain would be unlikely.

4.7.4.1.3. Stream Bank Stability and Geomorphology

The proposed pipeline would be buried with a minimum cover of 30 inches and a bottom-of-ditch depth of 6 to 8 feet throughout the entire length of the ROW, except for elevated pipeline bridge crossings, possible fault crossings, pigging facilities, and off-take valve locations. Stream crossing methods have been determined for all crossings based on the Pipeline Stream Crossing Construction Mode Determination developed in 2015 (as provided in Attachment 12 of the 2016 ASAP EED; AGDC, 2016b).

The primary construction impacts to surface waters would be from excavation in waterbodies at stream crossings. The proposed pipeline route and access roads would cross a total of 310 streams by one of five methods (as presented in Table 4.7-2): 1) aerial (bridge) crossings, 2) OC, 3) IOC, 4) HDD, or 5) culvert crossings. Disturbance to ground cover in relation to streams would occur within the 120-foot construction ROW. Appendix F (Stream Crossings) provides a complete list of waterbody crossings for the Mainline, Fairbanks Lateral and access roads, along with the waterbody type and crossing mode. Wetland impacts are described in Section 4.9. A total of 57 anadromous waterbodies would be crossed.

The number of waterbody impact locations for each type of stream crossing technology is summarized, below:

- A total of 310 stream crossing impact locations:
  - 263 Mainline (7 HDD, 95 OC, 155 IOC, 6 aerial spans)
  - 7 Fairbanks Lateral: (3 OC and 4 IOC)
  - 40 access roads (culverts and bridges)
- An additional 181 waterbody crossings that do not meet the USACE definition of a stream

Mitigation Measure Nos. 2 through 6 and 8 (Section 4.7.3) would be employed to minimize impacts to stream bank stability as a result of stream crossings.

4.7.4.1.3.1. Open-Cut and Isolated Open-Cut

The OC method involves excavating through a stream, placing the pipe in the trench and then backfilling. The OC method would be used at smaller streams and could be completed in winter or summer. The IOC method isolates the open trench from the flowing water of the stream prior to and during the installation. IOC techniques include dam and pump, diversion, cofferdams, and flumes. The IOC crossings could be completed in winter or summer and applied at crossings with higher flow volume than streams, where the OC would be employed.

Permanent impacts could include changes to the stream profile and structure (bed and hyporheic zone) at crossing locations. The substrate could be altered in composition and quality for spawning fish. In areas of the ROW where the proposed Project is associated with existing utility corridors and ROWs, drainage structures already in place would be utilized. Changes to the hyporheic zone (*i.e.*, the zone where stream surface water and groundwater mix) and substrate composition and quality could occur from installation of the pipeline. Impacts also include the loss of riparian habitat at stream crossings, which could temporarily affect erosion. AGDC proposes to initiate reclamation of disturbed areas as soon as is practicable. Cut slopes would be stabilized immediately after the design grade is obtained. Increased occurrences of sedimentation and erosion could occur prior to revegetation and stabilization activities, especially during the construction process before design grade is obtained. Mitigation measures identified to minimize impacts to stream flow regimes and profile are described in Section 4.7.3, Applicant-Proposed Mitigation Measures, Best Management Practices, and Project Management Plans.

The construction duration across a waterbody (stream) would occur over 1 to 3 days. The potential for stream bank erosion as a result of vegetation removal could occur for a period of time after construction activities or spring break up if constructed during winter. Construction during the winter when the ground is frozen would have substantially fewer impacts on water resources versus during the summer construction

season. Potential alteration of a stream could negatively impact biological resources such as fish. The short-term (1 to 3 days) affects and somewhat likely occurrence indicate that OC and IOC crossings, which account for the majority of stream crossings throughout the study area, would have a moderate impact on stream bank stability.

4.7.4.1.3.2. Trenchless Drilling

The trenchless drilling (TD) method consists of the pipe installation below the thalweg (*i.e.,* the line connecting the lowest points of successive cross-sections along the course of a stream). There are many types of trenchless techniques, including HDD, horizontal directional boring, direct pipe jacking, micro-tunneling, and others. Trenchless drilling activities are expected to have a negligible impact stream banks or beds.

4.7.4.1.3.3. Aerial Span

The aerial span method utilizes a support structure, such as a new or existing bridge, to keep the pipe above the water. The aerial span method would be used at six locations where existing infrastructure could be easily retrofit to carry the pipeline: aerial span crossings are planned at the Putuligayuk River, the Nenana River (two crossings), Lynx Creek, the Susitna River, and Montana Creek. Bank stabilization and restoration measures described above would be utilized, where applicable to minimize the impacts of sedimentation on water quality and riparian habitat along the riverbanks. This would result in negligible impacts to stream bank stability and geomorphology.

4.7.4.1.3.4. Access Roads

A total of 61 access roads would require a waterbody crossing, including 13 anadromous waterbodies and 40 streams. Access road stream crossings would consist of 17 bridges and 23 culverts.

Permanent impacts could include changes to the stream profile and structure (bed and hyporheic zone) at crossing locations. Access road stream crossings would result in both permanent and temporary impacts to stream crossings, are likely to cause changes to the stream profile, and would be limited to 40 discrete locations throughout the proposed Project Area, which results in a moderate impact to waterbodies overall.

4.7.4.1.3.5. Material Sources

In-river material extraction would temporarily impact stream banks at five locations within one waterbody, the Sagavanirktok River. Mitigation measures to avoid fish habitat and minimize impacts to water quality and aquatic species would be coordinated with ADF&G. Areas above ordinary high water mark would be utilized where possible. Any gravel removal would have temporary and localized effects in the immediate vicinity of the removal site; impacts to surface water hydrology and stream bank stability are expected to be minimal.

4.7.4.1.3.6. Impact Summary

Mitigation Measure Nos. 2 through 6 and 8 (Section 4.7.3) would be employed to minimize impacts to stream bank stability. The impacts on stream bank stability during as a result of the stream crossing and gravel material extraction describer in this section are considered moderate, as provided in Table 4.7-10.

Table 4.7-10 Impacts of the Proposed Project Construction on Stream Bank Stability

Impact Component	Impact Level
	Moderate
Magnitude or Intensity	Stream alteration as a result of OC or IOC methods would alter the stream profile during the crossing, but is unlikely to endanger any biological resources. TD and aerial span crossings are not expected to impact stream bank stability.
Geographic Extent	Stream crossings would be limited to discrete locations throughout the proposed Project Area. The impacts of gravel removal would be localized in the immediate vicinity of the removal site at the Sagavanirktok River.
Duration or Frequency	The duration of impacts to stream bank stability during an OC or IOC crossing would occur for a period of 1 to 3 days. Potential exists for permanent impacts to the stream profile and structure OC and IOC crossing locations. The potential for stream bank erosion as a result of vegetation removal could occur for a period of time after construction activities or spring break up if constructed during winter. Access road stream crossings would result in both permanent and temporary impacts to stream crossings.
Likelihood	The occurrence of long-term stream bed alteration following construction us somewhat likely after stabilization measures have been employed, however access road stream crossings are likely to cause changes to the stream profile.

4.7.4.1.4. Surface Water Quality

Impacts to surface water quality could occur as a result of refueling and use of hazardous materials, stream crossings, construction of aboveground facilities and access roads, construction near impaired waters, discharge and disposal, and dredging and disposal of dredged materials.

4.7.4.1.4.1. Refueling and Use of Hazardous Materials

Releases during refueling activities or use of hazardous materials near surface waterbodies could result in detrimental impacts to surface water quality and potentially groundwater quality. Depending on the magnitude of the release and the substance, impacts could range from minimal to major and could affect human populations, wildlife, vegetation, and many additional resources. The duration and extent of impact would also depend on the quantity and substance released.

Surface water contamination related to equipment leaks or fueling activities would be minimized by conducting all refueling of excavation equipment at least 100 feet from any surface waterbody as a mitigation measure. Should conditions require refueling within 100 feet of waterbodies, the contractor would implement a preapproved SPCC Plan required by 40 CFR 112. Aboveground facilities may store hazardous substances that could contaminate surface water or groundwater from a spill. A SPCC Plan would

be developed and implemented to manage handling and disposal of hazardous waste generated by ASAP construction activities and to minimize the potential for a spill. Refueling of excavation equipment would take place at least 100 feet from any surface waterbody as a mitigation measure (Mitigation Measure No. 4).

Mitigation Measure Nos. 7, 9, and 11 would be employed to minimize impacts to surface water quality as a result of the use of hazardous materials.

4.7.4.1.4.2. Stream Crossings

Stream crossing methods are described in detail in Section 4.7.1.1.3, Stream Bank Stability and Geomorphology. The OC and IOC methods would impact surface water quality downstream temporarily through trench excavation within streambeds and banks. Disturbance to ground cover may result in increased sediment loading in surface water due to erosion during runoff events; or from soil exposure from wind processes. AGDC would use erosion control procedures described in Mitigation Measure Nos. 2 through 4 and 6, and a Stormwater Pollution Prevention Plan (SWPPP) would be developed, as required by 18 Alaska Administrative Code (AAC) 83.

4.7.4.1.4.3. Stream Crossings – Horizontal Directional Drilling Method

Temporary workspaces (TWs) associated with the HDD crossings of the rivers would likely require a total land use of 239 acres. HDDs would be scheduled to occur during both winter and summer construction seasons with construction-related activities occurring around the HDD site for 24 hours per day, until pipe placement is complete. In winter, glycol or other antifreeze additives would not be required because of ongoing circulation of fluids in the bellhole resulting from the on-going drilling activity. The HDD crossings, coatings, pressure testing, and isolation valves would be installed in accordance with 49 CFR 192.

HDD activities could impact water resources from a potential spill of drilling mud, which could result in increased sediment in surface waterways, or contamination of ground or surface water. The drilling mud would be composed primarily of bentonite clay, inert solids, and water and no synthetic or highly toxic (Type C) drilling fluid additives would be used for the proposed Project. Proper drilling procedures would contain the mud and prevent releases into surface waters.

ADEC categorizes drilling fluids by increasing order of additive toxicity, resulting in Type A, B, and C drilling fluids. ASAP intends to use Type A and B drilling fluids, but not Type C fluids, which typically include barite and/or potentially highly toxic additives (AGDC, 2016m). Type A drilling fluids are typically base fluids with known toxicities that are categorically prohibited from containing chemical additives that would necessitate a Drilling Fluids Plan. They are usually water-based fluids that increase viscosity to enhance borehole sweep of the cuttings, or cooled brines to maintain *in situ* permafrost conditions (*e.g.*, shallow geotechnical drilling) and typically have no additional chemical additives. ADEC generally allows Type A fluids to be used

in Alaska drilling projects. Type B fluids are generally clay-based fluids consisting mostly of water, bentonite or other clay, and slightly toxic additives if the complexity of the subsurface geology dictates modified fluid properties. Typical additives include natural and modified polymers such as starches, cellulose, xanthium, fluids to modify viscosity, and soda ash or other chemicals to adjust pH (*i.e.*, measure of the acidity or alkalinity of a solution). Because Type B fluids could include slightly toxic additives, disclosure of the chemicals that could be used and an estimate of worst-case toxicity is required to be submitted to ADEC in a Drilling Fluids Plan. Type B drilling characteristically demonstrates a moderate Suspended Particulate Phase (SPP) Toxicity (*e.g.*, SPP LC50 over a 96-hour period of greater than 500,000 parts per million [ppm] [50 percent concentration], but less than 750,000 ppm [75 percent concentration]). ADEC generally allows Type B fluids to be used in accordance with an approved Drilling Fluids Plan in Alaska drilling projects.

ASAP plans to dispose of excess drilling fluids and cuttings in upland areas. Specifically, this would occur at the nearest material source, access road, or other upland area as authorized in the ADEC permit. In the event of inadvertent discharge of drilling fluids and drill cuttings into a stream (*e.g.,* due to failure of an HDD boring) the fluid would be cleaned up in accordance with the ADEC permits. Typically, a 500-foot mixing zone for turbidity is required by ADEC.

Impacts are expected to be temporary during the short (3-day maximum in-stream) construction process per crossing. The potential for stream bank erosion could still occur for a period of time after construction activities or spring break up if constructed during winter. The impacts to surface water due to any of the stream crossing techniques would occur intermittently for duration of less than 1 year and are considered minor. Construction taking place during the winter when the ground is frozen would have fewer impacts on water resources than summer construction. Suspended solids may increase temporarily during construction, resulting in a moderate affect to water quality, but the use of erosion control techniques would mitigate potential impacts to the function or integrity of the stream. Because stream crossings would impact localized areas of each stream, and any effects to water quality would be site specific, the geographic extent of the impact is minor. Because of the number of OC stream crossings, potential impacts are considerable but temporary. Potential surface water contamination due to use of hazardous drilling fluids would be mitigated through the use of an approved ADEC permit as well as minimizing the use of highly toxic types of drilling fluids so affects to surface waters are expected to be negligible. For the remaining types of stream crossings, erosion and sedimentation are likely to impact biological resources such as fish temporarily and in isolated locations, producing an overall moderate impact.

4.7.4.1.4.4. Aboveground Facilities and Access Roads

Aboveground support facilities include:

- GCF pad and workspace (90.6 acres);
- GCF camp (20.2 acres);
- 89 total material sites required; approximately 25 million cubic yards (MCYs) of material needed from gravel sources, Project-wide;
- 26 PSY locations;
- 298 new access roads totaling 174.4 miles, and 23 temporary ice access roads totaling 22.9 miles; and
- 13 camp locations.

Access road waterbody crossings are described in Section 4.7.4.1.3.4. Excavation of borrow material as described in Section 4.7.4.1.3 could result in increased sediment loading of surface water due to erosion during runoff events if the borrow pit was near the waterbody. Storage of sand and gravel materials could result in increased sedimentation of surface water. Existing disturbed sites would be utilized wherever possible. Approximately 546 disturbed sites have been identified along the route, mostly as a result of the TAPS development (AGDC, 2011a). Measures would be taken to mitigate impacts to surface waters such as permanent and temporary disturbance to ground cover, and erosion and compaction of soils reducing permeability and increasing sediment loading on nearby surface waters. These measures would be outlined in the proposed Project's SWPPP, as well as in Appendix M.

Based on the mitigation measure provided in Section 4.7.3, the impacts due to increased sediment loading would be would be minimal. Aboveground facilities would result in permanent impacts to ground cover potentially affecting stormwater infiltration at permanent facilities and access roads. This would result in permanent impacts to surface water flow at several locations throughout the study area, hence impacts are considered moderate.

4.7.4.1.4.5. Construction near Impaired Waters

The Fairbanks Lateral would extend east from the Mainline pipeline through the Yukon-Koyukuk Census Area (YKCA) and the Fairbanks North Star Borough (FNSB). It would cross Goldstream Creek, in the Tolovana River Watershed, which is listed as impaired (Category 5) by ADEC, as described below. Large volumes of fine sediment have been deposited in Goldstream Creek over time since the 1900s due to hydraulic stripping and dredging from placer gold mining in the Goldstream Valley (ADF&G, 1987). As a result, Goldstream Creek has a constant elevated level of turbidity and total suspended solids (TSS). Mitigation measures would be developed to minimize adverse effects to these impaired waters in accordance with ADEC's SWPPP requirements, including the requirements of the Goldstream Creek total maximum daily load (TMDL) for turbidity.

Mitigation measures would be comprised of the erosion control and bank stabilization measures described in Section 4.7.3 and Appendix M. With the implementation of the stringent TMDL requirements in combination with appropriate mitigation measures, the impacts on Goldstream creek due to sediment loading are expected to be localized, and temporary, producing an overall minor impact on the resource. Pipeline construction is not expected to impact the fecal coliform content of Cottonwood Creek (near Wasilla), which is listed as an impaired waterbody for fecal coliform.

4.7.4.1.4.6. Water Discharge and Disposal

Impacts to water resources associated with the final discharge of water withdrawals could include altered water quality of the discharge waterbody including decreased oxygen concentrations, increased organic matter, turbidity, temperature, and changes to pH (AGDC, 2011b). The use of additives (*e.g.*, flocculants, solids, settling agents) is not planned. Hydrostatic testing is planned to occur in summer so the use of antifreeze is not anticipated. Water may be pre-heated slightly prior to placing in the pipe, but this would be avoided if possible. Impacts due to discharge and disposal of hydrostatic test water would not affect the receiving waterbodies in a manner that would endanger the integrity of the resource, and effects would occur temporarily, and in isolated locations resulting in minor impacts to surface waters.

4.7.4.1.4.7. Dredging and Disposal at West Dock

The winter dredging period would occur when equipment could safely operate on the ice. Winter dredging would occur in stages but it is likely the majority of dredging would occur in mid-winter. Dredging may not be complete until late winter before ice out. The sediment depth would be monitored regularly, and some summer screeding would be likely to maintain the 10-foot channel depth during the ice-free season through the end of the sealift to promote safe delivery of the modules. After the sealift, AGDC would allow the channel to infill as there would be no need for the proposed Project to maintain it.

Upgrades to dock and causeway infrastructure would be required and would primarily occur during winter. One of the existing dock ramps would be raised to 25 feet to accommodate a taller barge sideshell height, while the other two would remain at a height of 20 feet. Portions of the causeway road would be widened to 60 feet to accommodate module transport. Sheet piling and gravel would be used to develop abutments that would connect the temporary bridge to each side of the causeway breach. The piling and infrastructure forming the offshoot and ramp to the temporary barge bridge would be left in place rather than pulling it out as this could result in erosion or weakening of the existing causeway. Impacts due to dredging and disposal would be moderate, as they would indisputably alter a physical resource. The effect would be localized, occur for a period of less than 2.5 years, and affects to water quality due to sedimentation would be temporary.

4.7.4.1.4.8. Trench Excavation

Temporary localized drainage pattern alterations (*e.g.*, diversions) could occur during construction to accommodate pipeline installation and equipment staging. AGDC proposes to identify measures that would mitigate long-term impacts to local drainage patterns during engineering design. Specific measures might include ditch plugs (foam, sandbags, bentonite, or compacted, cohesive soils placed next to the pipeline to prevent water from running parallel to the pipe), crowning soil in a mound over the pipeline trench to account for subsequent settlement, and recontouring to promote runoff and minimize ponding and erosion (Mitigation Measure No. 12).

Based on observations at the MS3 trenching test site (Section 4.6, Soils and Geology) at locations where natural drainages that intersect the trench, water could be expected to flow along the trench above or below the ground surface. Altered water flow paths could contribute to further soil erosion and subsequently, further altered surface water flow.

4.7.4.1.4.9. Impact Summary

Mitigation Measure Nos. 1 through 11 (Section 4.7.3) would be employed to minimize impacts to surface water quality. As a result, the impacts on surface water quality as a result of pipeline construction described in this section are considered moderate, as provided in Table 4.7-11.

Table 4.7-11 Impacts of the Proposed Project Construction on Surface Water Quality

Impact Component	Impact Level
	Moderate
Magnitude or Intensity	• Stream crossing: Suspended solids may increase temporarily during construction, resulting in a moderate affect to water quality, but the use of erosion control techniques would mitigate potential impacts to the function or integrity of the stream. • Aboveground facilities and access roads: Based on the mitigation measure provided above, the impacts due to increased sediment loading would be would be minimal. • Construction near impaired waters: With the implementation of the stringent TMDL requirements in combination with appropriate mitigation measures, the impacts on Goldstream creek due to sediment loading are expected to be minor. Pipeline construction is not expected to impact the fecal coliform content of Cottonwood Creek (near Wasilla), which is listed as an impaired waterbody for fecal coliform. • Water discharge and disposal: Water discharge and disposal would take place in accordance with all permits and is not expected to affect the receiving waterbodies in a manner that would endanger the integrity of the resource, and effects would occur temporarily, and in isolated locations resulting in minor impacts to surface waters.
Geographic Extent	Although effects would occur throughout the proposed Project Area, they would be limited to only a few discrete areas at any one time.

Impact Component	Impact Level
	Moderate
Duration or Frequency	• Stream crossing: Impacts are expected to be temporary during the short (3-day maximum in-stream) construction process per crossing. The potential for stream bank erosion could still occur for a period of time after construction activities or spring break up if constructed during winter. The impacts to surface water due to any of the stream crossing techniques would occur intermittently for duration of less than 1 year and are considered minor. • Aboveground facilities: Aboveground facilities would result in permanent impacts to ground cover potentially affecting stormwater infiltration and runoff at permanent facilities and access roads.
Likelihood	When proper mitigation measures are employed, the likelihood of a potential discharge of hazardous chemicals to surface water is unlikely. Mitigation measures include spill prevention and control as well as sediment and erosion control and permitting.

4.7.4.1.5. Groundwater

4.7.4.1.5.1. Hazardous Materials

Contamination to groundwater could occur due to equipment leaks or fueling activities. Releases significant enough to reach groundwater could also affect drinking water sources for nearby communities. Should contaminated groundwater daylight as surface water, wildlife, vegetation, and other resources could also be impacted by hazardous releases. Similar to surface water impacts (Section 4.7.4.1.4), the magnitude, and extent of impact would depend on the quantity and substance released. The duration of impact as well would depend on these two factors. Mitigation Measure Nos. 7 and 9 would be employed to prevent hazardous materials from reaching the groundwater. Incorporation of spill prevention measures that are a requirement of 40 CFR 112, such as secondary containment for fuel storage, fuel transfer procedures that minimize the potential for a discharge to waters of the U.S., would limit the likelihood of a discharge to groundwater.

Construction of the pipeline or associated facilities could cause disturbance of contaminated sites, which could result in additional groundwater and soil contamination. As described in Mitigation Measure No. 9, AGDC has committed to avoiding the known contaminated site areas described in Chapter 3 and any newly discovered contamination would be reported to the ADEC in accordance with their reporting requirements and handled in a manner to avoid transport of contaminated materials. As a result of these measures, effects to groundwater due to disturbance of existing contaminated sites are expected to be negligible.

4.7.4.1.5.2. Trench Excavation

Disturbance of the active layer (which serves as a layer of insulation from above freezing atmospheric temperatures) during construction could result in permafrost thaw. Permafrost thaw could result in thermokarst, soil subsidence, and altered surface and groundwater drainage patterns, ultimately leading to additional erosion. Based on

observations at the MS3 trenching test site (Section 4.6, Soils and Geology) at locations where natural drainages that intersect the trench, water could be expected to flow along the trench above or below the ground surface. Altered water flow paths could contribute to further soil erosion and subsequently, altered groundwater flow. To prevent intersecting natural flow patterns, pipe on the North Slope would be, in general, installed parallel to sheet water flow, following the north-to-south gravitational gradient from the Brooks Range to the Beaufort Sea and would assist in mitigation of some impacts to surface and subsurface waters.

Removal of the vegetative mat and the surface layer, which serve to insulate deeper thaw-susceptible soils, would affect the pre-existing thermal regime. The proposed Project would entail segregating the surface layer and replacing it as the last layer of backfill in the trench within designated agricultural lands and in select continuous and discontinuous permafrost areas and non-permafrost areas (as discussed in the AGDC planning document, *Segregation of the Surface Layer* [AGDC, 2017g], and in the Revegetation Plan [Appendix E, Part I]). In areas where the surface layer would not be segregated, the time required for revegetation to take place would be significantly greater. Impacts to soils and geology are described in detail in Section 4.6, Soils and Geology. Mitigation Measure Nos. 2 and 4 would be used at stream crossings to encourage revegetation and minimize permafrost thaw.

4.7.4.1.5.3. Impact Summary

Mitigation Measure Nos. 1 and 6 through 9 would be employed to minimize impacts to groundwater during construction. The impacts on groundwater during as a result of trench excavation, use of hazardous materials, and stream crossings is expected to be major, as provided in Table 4.7-12.

Table 4.7-12 Impacts of the Proposed Project Construction on Groundwater

Impact Component	Impact Level
	Major
Magnitude or Intensity	The effect of thawing of permafrost would significantly alter the groundwater flow characteristics in addition to contributing to soil subsidence, erosion, and impacts to surface water.
Geographic Extent	The effect would take place in areas of continuous or discontinuous permafrost and in areas where hazardous materials are used throughout the proposed Project Area.
Duration or Frequency	Impacts to permafrost could permanently and irreversibly alter the permafrost and groundwater flow.
Likelihood	The likelihood of discharges of hazardous materials and disturbance of hazardous materials would be limited by the mitigation measures described in Section 4.7.3. Impacts to permafrost are likely to occur in areas of continuous and discontinuous permafrost.

4.7.4.2. Operations and Maintenance

4.7.4.2.1. Water Availability

Water requirements for the GCF operations may include potable water, mud plants, road dewatering, and general facility operations. Ice road construction may be necessary for scheduled winter maintenance during ASAP operations (AGDC, 2016n) and water would be used for dust control on gravel surfaces. Extensive use of local water bodies could stress the resource and limit its availability to local communities, wildlife, and vegetation. Overuse of water supplies could also impact ecosystems, and continuous overuse may result in localized changes to ecosystems, plant communities, and wildlife composition. AGDC would acquire permits for water withdrawal from lakes and streams and coordinate with ADF&G and ADNR on water withdrawal methods (screen requirements for pump inlets, maximum withdrawal rates and volumes, etc.). Permitted water withdrawal through ADNR and ADF&G would mitigate impacts from overuse and to other resources dependent on water availability. For these reasons, the impacts of GCF operations on water availability are considered moderate.

Mitigation Measure No. 8 would be employed to minimize impacts to water availability. The impacts on water availability as a result of GCF operation and ice road development is expected to be moderate, as provided in Table 4.7-13.

Table 4.7-13 Impacts of the Proposed Project Operations on Water Availability

Impact Component	Impact Level
	Moderate
Magnitude or Intensity	Coordination with ADF&G and ADNR would regulate affects that could endanger the function or integrity of the resource.
Geographic Extent	The effects would be limited to mostly water resources in the area of the GCF.
Duration or Frequency	Impacts on water availability as a result of GCF operations would occur throughout the lifetime of the proposed Project.
Likelihood	It is most likely that the effects described in this section would occur.

4.7.4.2.2. Floodplains

To maintain the existing thermal regime and protect the stability of water resources, the ASAP pipeline would remain at or near the ambient soil temperature and would not be chilled or heated for transport. Although the pipeline would be at ambient temperature, the potential exists for the thermal regime of streams to become altered in locations where the pipeline temperature is acclimating to the surrounding environment. Pipeline temperatures below freezing could result in creating ice dams and aufeis where the ground (stream bottom) over the buried pipe is cooler than the surrounding stream flow. While the use of an ambient temperature pipeline greatly reduces this risk, the potential for ice bridges and damming exists. Permanent facilities would be sited such that they do not cause flooding of existing water resources.

Mitigation Measure No. 8 would be employed to minimize impacts to floodplains. The impacts on floodplains during as a result of pipeline temperature are considered moderate, as provided in Table 4.7-14.

Table 4.7-14 Impacts of the Proposed Project Operations on Floodplains

Impact Component	Impact Level
	Moderate
Magnitude or Intensity	If flooding were to occur, water quality and fish habitat would be affected.
Geographic Extent	The geographic extent of the flooding would be limited to a specific area.
Duration or Frequency	The flood duration would be expected to last less than one season.
Likelihood	Flooding is unlikely considering the pipeline design to remain at or near ambient soil temperatures.

4.7.4.2.3. Stream Bank Stability and Geomorphology

The stream bank at crossing locations would be susceptible to erosion from wind, rain, runoff, and high water events for several years. Streambanks would be re-contoured to preconstruction conditions and revegetated; however, it would take time for the natural vegetation to reestablish. Forested riparian vegetation would be lost permanently; however, the area would be maintained to a non-forested vegetation state. Monitoring would be conducted to evaluate soil stability, vegetative cover and/or density, presence of invasive species, and damage as a result of human or animal use in the ROW.

Earthwork and spoil application would be assessed for excess erosion periodically and immediately following major rainstorms and after spring breakup. Remedial action to correct instability would be taken as soon as feasible following detection of substantial erosion or loss of spoils material. Planned revegetation activities are described in detail in ASAP's Revegetation Plan (Appendix E, Part I; AGDC, 2016b).

Mitigation Measure Nos. 1 through 6, 8, and 10 would be employed to minimize impacts to stream bank stability during operations. The impacts on floodplains during as a result of the stream crossing described in this section are considered minor, as provided in Table 4.7-15.

Table 4.7-15 Impacts of the Proposed Project Operations on Stream Bank and Bed Stability

Impact Component	Impact Level
	Minor
Magnitude or Intensity	Stream alteration as a result of OC or IOC methods would be restored following construction, so the magnitude of the impact is expected to be moderate as it could alter a physical resource until full restoration has taken place.
Geographic Extent	Stream crossings would be limited to a few isolated locations.

Impact Component	Impact Level
	Minor
Duration or Frequency	The duration of significant impacts to stream bank stability during following construction would be most likely to occur intermittently for a duration of less than 1 year; however, some impacts such as removal of natural vegetation and increased susceptibility to erosion could last several years or more.
Likelihood	The occurrence of long term stream bed alteration following construction is unlikely after stabilization measures have been employed

4.7.4.2.4. Surface Water Quality

The short-term impacts to water quality during the operation and maintenance of the proposed Project for the Mainline ROW could include increased sedimentation and turbidity reducing water quality at locations adjacent to waterbodies. These impacts would occur immediately after construction activities and would be expected to improve over time as conditions from stream disturbance subside disturbed ground is revegetated. The impacts would be similar to those discussed in Section 4.7.4.1.4, Surface Water Quality; however, significantly less extensive and significant continued disturbance would not take place, and vegetation would begin to re-establish. The impacts are considered minor.

If a leak occurred in the pipeline segment at a waterbody crossing, natural gas would be released in gaseous phase resulting in potential negative aquatic impacts (depending on volume, discharge location, and timing) including changes to dissolved oxygen, total dissolved gases, and the structure and/or function of biologic communities. The proposed pipeline is designed to operate at ambient temperature, so major changes in temperature between the pipeline and adjacent waterbodies are not expected to occur. A leak could result in a slightly reduced water temperature in the immediate vicinity of the leak. The pipeline would be carefully monitored, as described in Mitigation Measure No. 11, to determine the existence and location of leaks. Leaks would be repaired as soon as practicable. Impacts from a leak occurring along a waterbody crossing are considered minor as the likelihood of a release would be low and the geographic extent of impact would be localized.

Permanent facilities would have onsite hazardous substances such as lubricants, cleaners, and fuels. Regular vehicle use on roads and pads as well as fueling activities could result in a release of toxic substances over the long-term, which could contaminate the surrounding surface waters. Facility workers would be trained in spill reporting and if a release occurs, or is observed, it would be reported immediately to the proper facility representative.

Clearing of the permanent ROW may allow public access via ATVs to waterbody and wetland areas that were previously inaccessible, potentially impacting stream bank stability and in turn, reducing surface water quality. Because the proposed Project ROW generally follows existing or officially designated transportation and utility corridors including the Dalton Highway/TAPS corridor and Parks Highway, an increase in user access would not be expected in these areas. However, increased access in areas that do

not follow existing transportation or utility corridors, particularly between the TAPS corridor and Parks Highway in the Minto Flats vicinity, could experience increased use.

Mitigation Measure Nos. 2 through 11 would be employed to minimize impacts to surface water quality (See Section 4.7.3.1). As a result, the impacts on surface water quality as a result of pipeline operations described in this section are considered moderate, as provided in Table 4.7-16.

Table 4.7-16 Impacts of the Proposed Project Operations on Surface Water Quality

Impact Component	Impact Level
	Moderate
Magnitude or Intensity	Increased sedimentation and the impacts of hazardous substances on surface waterbodies could potentially alter a physical resource in a way that would degrade its value, integrity, or function to the point that it could not be used, or would endanger/harm biological resources or human health.
Geographic Extent	The effects would be limited to an isolated specific location at any one time.
Duration or Frequency	The results would occur from less than 1 year to throughout the duration of the proposed Project.
Likelihood	When the mitigation measures described in this section are employed, the likelihood of a potential discharge of hazardous chemicals to surface water is unlikely.

4.7.4.2.5. Groundwater

The GCF could contribute to thawing of the permafrost over time, as it would be located in the continuous permafrost of the ACP. Warming of the ground and thawing of the permafrost could alter groundwater and surface water flow characteristics (Intergovernmental Panel on Climate Change [IPCC], 1997). The GCF would be built on a gravel pad to insulate the permafrost and minimize thawing.

In areas such as the ACP, stripping of vegetation could contribute to permafrost thaw. AGDC plans to operate the pipeline at a temperature that would match the surrounding ground, maintaining the thermal regime. The gas would be conditioned to below-freezing temperature at the GCF and would be compatible with ground temperatures expected in the northern segment. The proposed pipeline would operate at below-freezing temperatures in predominantly permafrost terrains to protect the thermal stability of the surrounding soil. Similarly, the pipeline would operate at above freezing temperatures in predominantly thawed settings to avoid creation of frost-bulbs around the pipe that could lead to frost-heave displacement or adverse hydraulic impacts on drainages.

Altered groundwater thaw could be caused by a variety of factors, including insolation thawing due to a decrease in the albedo of the surface layer material, thawing due to water flow, and thawing due to heat from the pipeline (only in the southern portion of the pipeline). These factors could be exasperated due to climate change.

Where the proposed pipeline traverses from unfrozen, stable ground to ice-rich, unstable ground, or visa-versa, thaw settlement could occur (French, 2007). This impact

would occur most significantly in areas of discontinuous permafrost during the summer months when non-permafrost areas thaw naturally, which contributes to fluctuations in pipeline temperature. This impact would be limited to areas where thawed unstable soil exists. During the first 2 years following construction, the pipeline would be dormant. During this time, permafrost degradation and water accumulation (which further propagates permafrost degradation) could occur and would be considered a potential major impact based on the level of degradation involved, the regional area that could be impacted, and the long duration required for impacts to attenuate. The proposed construction techniques have many similarities to the Washington Creek Trenching Test Site and MS3 field trials, which resulted in permafrost thaw and changes in drainage patterns (ABR and BPXA, 2013).

Conversely, ice accumulation (permafrost aggradation) could occur in areas where the pipeline is operated at below freezing temperatures. This might occur in the discontinuous permafrost zone wherever the pipeline (operated at or below freezing temperatures) crosses unfrozen ground; there would be moisture migration towards the pipeline, potentially resulting in frost heave when the moisture freezes. Even in areas where permafrost is absent, ground ice could grow, producing frost heave in some areas, especially in areas where thawed, fine-grained soil is dominant in the subsurface. A freezing front would form around the pipeline. As water vapor migrates towards the freezing front, it would desublimate / deposit forming an ice layer. This ice layer would decrease the porosity and hydraulic conductivity of the soil and may alter the flow of suprapermafrost groundwater.

AGDC proposes to mitigate frost heave and thaw bulbs to the extent practicable. However, AGDC anticipates that in some sections of the pipeline, permafrost thaw may propagate in areas surrounding the pipeline corridor (Section 5.1.2.1 of the EED). If the pipe were buried in a thaw-susceptible area, monitoring for thaw settlement would detect whether (over time) mitigation were necessary. Such monitoring would use ILI pigging operations to monitor the vertical position of the pipeline along the alignment, and would be combined with aerial and on the ground monitoring. If the pipe is buried in a thaw-susceptible area, monitoring for thaw settlement would detect whether additional mitigation is necessary to protect the pipeline. As part of "Identification and Evaluation of Time-Dependent Route Geohazards" (included as Appendix D of this document), AGDC has proposed a range of potential mitigation measures that might be required:

- Removing heat from the ground through the use of thermosiphons;
- Elevating the pipeline above the ground surface;
- Lifting and leveling pipe; and
- Replacing soil with select backfill (AGDC, 2016e).

The impacts on groundwater during as a result of trench excavation, use of hazardous materials, and stream crossings is expected to be moderate overall, as provided in Table 4.7-17.

Table 4.7-17 Impacts of the Proposed Project Operations on Groundwater

Impact Component	Impact Level
	Moderate
Magnitude or Intensity	The effect of thawing of permafrost would significantly alter the groundwater flow characteristics in addition to contributing to soil subsidence, erosion, and impacts to surface water results in a major magnitude and intensity impact criteria rating.
Geographic Extent	The effect would generally take place in areas of continuous or discontinuous permafrost where the pipeline temperature is acclimating to the surrounding environments.
Duration or Frequency	The effect would be irreversible and would occur throughout operations of the pipeline, resulting in a duration rating of major.
Likelihood	Impacts to permafrost are somewhat likely to occur in the areas of continuous and discontinuous permafrost described above.

4.7.5. Alternative 2 – Denali NPP Route Variation

Alternative 2 includes an alternate route that extends through Denali NPP, aboveground construction of the pipeline from MP 0 to MP 62, use of DH2 at West Dock, ocean disposal of dredge material, and an aerial crossing at the Yukon River.

4.7.5.1. Denali NPP Route Variation

The Denali NPP Route Variation would begin at MP 535.8 and enters the Denali NPP boundary approximately 0.2 miles after crossing the Nenana River on the pedestrian bridge to the west of the Parks Highway (also contained within Denali NPP) and would rejoin the proposed route at MP 543 after crossing the Nenana River downstream (east) of McKinley Village. The Denali NPP Route Variation is shown with the water resources for the proposed Project Area on Figure 2.4-1. There are two major river crossings proposed for the Denali NPP Route Variation: 1) an existing pedestrian/bike bridge to the west of the Parks Highway, and 2) an OC crossing of the Nenana River east of the McKinley Village.

4.7.5.1.1. Construction

The Denali NPP Route Variation construction impacts would include two crossings of the Nenana River: an OC crossing of the Nenana River south east of the McKinley Village and an aboveground crossing using an existing pedestrian/bike bridge to the west of the Parks Highway. Anticipated impacts associated these additional river crossings are described below.

- Negligible affects to water availability are expected to be associated with the OC and aerial span crossings as described in Section 4.7.4.1.1, Water Availability.

- Minor affects to stream bank stability are expected to be associated with the OC crossing, as described in Section 4.7.4.1.3, Stream Bank Stability and Geomorphology.
- Removal of vegetation along steep slopes for ROW construction could have the potential to increase sedimentation into waterways from erosion. Moderate affects to surface water quality are expected as a result of sedimentation associated with the OC crossing described in Section 4.7.4.1.4, Surface Water Quality, and mounting the pipeline aerially across the Nenana River at the second crossing would not be expected to cause additional impacts to water resources because of the use of the existing pedestrian bridge.

The route would avoid a crossing of Lynx Creek Canyon (a pipeline suspension bridge at MP 336.7), Montana Creek (IOC at MP 537.4), and Yanert Fork (IOC at MP 541.6). Overall, the avoidance of one waterbody crossing under this alternative is not expected to significantly alter the proposed Project impacts from Alternative 1.

4.7.5.1.2. Operations and Maintenance

Operations and maintenance affects are expected to be consistent with the affects described for Alternative 1.

4.7.5.2. Partially Elevated Pipeline

Alternative 2 proposes to elevate the pipeline on VSMs through the extent of the ACP (Beaufort) from MP 0 to approximately MP 62, as shown on Figure 2.4-2.

Under Alternative 2, water needs for constructing the ice pads associated with the aboveground portion of the route are approximately 10 percent greater than for the proposed belowground pipe installation. This would result in approximately 10 percent greater water useage.

Aboveground construction of the pipeline from MP 0 to MP 62 would eliminate 10 OC waterbody crossings including two stream crossings, which reduces the total number of waterbody crossings by 2 percent. Although this reduction in OC crossings would reduce the potential for sediment loading and erosion, the change would not significantly affect the overall moderate impact ratings of stream crossings on water quality and stream bank stability during construction or operations.

As described in groundwater Sections 4.7.4.1.5 and 4.7.4.2.5 for Alternatives 1 and 2, respectively, the effect of thawing of permafrost would significantly alter the groundwater flow characteristics in addition to contributing to soil subsidence, erosion, and impacts to surface water. This would permanently and irreversibly alter the permafrost and groundwater flow and is likely to occur in areas of continuous and discontinuous permafrost. By elevating the portion of the pipeline route that would traverse the area of continuous permafrost, the impact to permafrost in these areas would be reduced to areas where the pipeline would be buried. The geographic extent of the impact to continuous permafrost is reduced by approximately 62 miles,

approximately 10 percent. While this alternative reduces the potential impacts to groundwater flow due to permafrost thaw and soil subsidence, the impacts remain major, overall for construction and moderate overall for operations.

4.7.5.3. Yukon River Crossing

Alternative 2 includes aerial crossing of the pipeline at the Yukon River using a new suspension bridge. This option was analyzed in detail in the 2012 FEIS and is carried forward as part of Alternative 2 in the SEIS. No permanent structures, such as footings, would be installed within the Yukon River under this alternative. Figure 2.4-3 depicts the conceptual Yukon River suspension bridge crossing details, while Figure 2.4-4 provides a graphic depiction of the footprint for the aerial crossing.

The aerial span method involves suspending the pipeline aboveground over the waterway. An aerial span could include one of the following approaches: suspension from an existing structure, single-span bridge with no instream supports, and multi-span bridge with at least one support in the waterway. The aerial span method would be used for the most difficult crossing conditions, or where existing infrastructure could be easily retrofit to carry the pipeline.

4.7.5.3.1. Construction

Construction of a suspension bridge (at the Yukon River) would not place any structure below the ordinary high water mark; therefore, anticipated impacts to water resources would be expected to be negligible. However, riparian habitat would be impacted, see Section 5.3, Terrestrial Vegetation, along the riverbanks, which play an important role in erosion control, and therefore, sedimentation resulting in minor affects to water quality.

4.7.5.3.2. Operations and Maintenance

The impacts to water resources from operations and maintenance of an existing bridge would be similar to those of a new bridge and would be negligible.

4.7.5.4. Dock Head 2

DH2 is located in shallower waters and could require retrofitting, including the addition of a third berth, to accommodate the weight and offloading of the modules. Under Alternative 2, the existing channel from DH2 would need to be widened and deepened to the 10-foot depth contour to accommodate large vessels delivering the modules. Bathymetric data suggest the depth at DH2 could require dredging more than 750,000 CYs to allow for the barges. To stabilize DH2, new sheet piling would be installed prior to beginning any dredge work. As under Alternative 1, dredging of the navigational channel would occur during the winter prior to construction; although, the rate of infill at DH2 is greater than at DH3 due to its location, introducing the likelihood of summer maintenance dredging to keep the channel open for the duration of the mobilization effort. Disposal of dredge material during summer would also introduce sediments into the water column, at least temporarily. This short-term change due to

increased turbidity would not likely cause long-term changes to physical or biological resources (including marine mammals), and as such would not affect the overall impact ranking for surface water quality during Project construction.

Alternative 1 proposes removing approximately 250,000 CYs of dredged material. As the volume of dredged material required at DH2 is three times the volume required for Alternative 1, the impacts to water quality due to sedimentation would be expected to be significantly greater using DH2. However, it would not change the resulting impact rating of moderate for dredging, as long as sediment loading would not endanger the function or integrity of the water resource. Dredging at DH2 would not affect the impact rating for impacts to water quality during operations.

4.7.5.5. Ocean Disposal

Under Alternative 2, dredge material would be disposed of in the ocean at the location depicted on Figure 2.2-4. Currently, no offshore disposal sites have been designated by EPA near the proposed Project Area. The closest disposal site is offshore Nome, nearly 800 miles away. In coordination with EPA, a disposal site would be identified and designated as specified in the conditions under Section 103 of an individual Marine Protection, Research and Sanctuaries Act permit. A USACE Dredge Materials Permit for the disposal of dredged material would be required for any EPA-designated ocean disposal site and would be subject to EPA concurrence. The USACE CWA 404 is not final until ADEC issues a 401 Certification that the State's water quality standards have been met.

The process for obtaining an ocean disposal permit for dredged material typically lasts between 6 to 18 months after application. Similar to Alternative 1, Alternative 2 would include development, approval, and implementation of a Sampling and Analysis Plan and an assessment of compliance with the ocean disposal criteria (40 CFR 220-229).

During construction, impacts to water quality due to disposal of the dredged material would include significantly increased sediment loading and an increase geographic area of impacts. The affect is likely to temporarily alter water quality for less than 1 year at an isolated location, and would not be likely to endanger biological resources, as the process would be coordinated with EPA. Based on these findings, impacts to water quality would be considered moderate. Impacts are not expected to extend past the construction phase, into operations.

4.7.6. Alternative 3 – No Action

Under Alternative 3 (No Action), the proposed Project would not be constructed, and there would be no surface water, groundwater, or floodplain impacts.

4.7.7. Conclusions and Comparison of Alternatives

A comparison of the alternatives discussed above is provided below, in Table 4.7-18. Based on the results described above, the aboveground pipeline alternative (Alternative

2) would slightly reduce impacts to surface water quality and would the extent of potential permafrost thaw leading to reduced alterations of groundwater flow. Neither Alternative 1 nor 2 would significantly change the overall impact of the proposed Project on the water resources described in this SEIS.

Figure 4.7-1 illustrates some of the key findings from the impact analysis. The figure provides geographic context for the description of potential impacts of both Alternatives 1 and 2, as described in detail in this section, (Section 4.7). The figure uses a consistent color scheme with the impact summary table (Table 4.7-18) for ease of comparison. The most notable conclusions illustrated by this figure are summarized below:

- The effect of thawing of permafrost could significantly alter the groundwater flow characteristics in addition to contributing to soil subsidence, erosion, and impacts to surface water, especially in areas of discontinuous permafrost (MP 168 – MP 634). Impacts to permafrost could permanently and irreversibly alter the permafrost and groundwater flow.
- Impacts to surface water and stream bank stability are expected to occur somewhat equally throughout the proposed Project Area at OC and IOC stream and waterbody crossings as well as sediment loading from aboveground facilities and access roads, as described in Sections 4.7.4 and 4.7.5.
- Localized impacts to water availability where water would be withdrawn for HDD and hydrostatic tests would occur throughout the proposed Project Area from MP 20 to MP 705.5, as described in Tables 4.7-6 and 4.7-7.
- Minor and temporary flooding could occur in a few isolated locations such as at some ice road waterbody crossings. Flood impacts may be greater within existing floodplains (several areas south of MP 650), which are identified on Figure 3.3-8; however, a significant portion of the proposed Project Area is not mapped by FEMA and these areas are designated as having possible but undetermined flood hazard risks.

Table 4.7-18 Comparison of Alternatives Summary for Impacts to Water (Direct & Indirect)

Type of Effect	Alternative 1		Alternative 2		Alternative 3	
	Construction	Operations	Construction	Operations	Construction/Operations	
	Impact Rating		Impact Rating		Impact Rating	
Altered Surface Water Quality	*Moderate*	*Minor*	*Moderate*	*Minor*	*Negligible*	*Negligible*
Altered Groundwater	*Major*	*Moderate*	*Major*	*Moderate*	*Negligible*	*Negligible*
Stream Bank Stabilization & Geomorphology	*Moderate*	*Minor*	*Moderate*	*Minor*	*Negligible*	*Negligible*
Flooding	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*Negligible*	*Negligible*
Altered Water Availability	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*Negligible*	*Negligible*

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City or Village
Mileposts
Areas of Continuous, Sporadic, or No Permafrost Within the Project Area
Areas of Discontinuous Permafrost Within the Project Area

Effect Rating
Major Positive
Moderate Positive
Minor Positive
Negligible
Minor Negative
Moderate Negative
Major Negative

Effect Indicators
SW: Altered surface water quality
GW: Altered groundwater
SBS: Stream bank stability
FL: Flooding
AV: Altered water availability

Beaufort Sea

MP 0
MP 62
MP 100
Anaktuvuk Pass
MP 200
Wiseman
Bettles
Alatna
Allakaket
New Allakaket
MP 300
Stevens Village
Rampart
Livengood
MP 400
Minto
Two Rivers
Pleasant Valley
Fairbanks
Four Mile Road
Nenana
Anderson
MP 500
Ferry
Healy
McKinley Park
Cantwell
MP 600
Petersville
Talkeetna
Skwentna
MP 700
Willow
Susitna
MP 733
Anchorage

Continuous, Sporadic or No Permafrost

Construction	
	SW
	GW
	SBS
	FL
	AV

Operations	
	SW
	GW
	SBS
	FL
	AV

Discontinuous Permafrost

Construction	
	SW
	GW
	SBS
	FL
	AV

Operations	
	SW
	GW
	SBS
	FL
	AV

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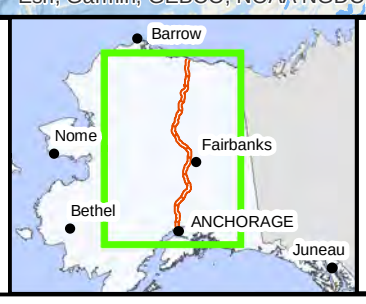
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DATE: MAR 2018
CHKD: K.J.
DRWN: A.V.K.
PROJ. No.: 0416166

825 W. 8th Ave., Anchorage, AK 99501, (907) 258-4880

Figure 4.7-1: WATER IMPACTS CONTEXT MAP
ALASKA STAND ALONE PIPELINE

0 25 50 100 150 Miles



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4.8. Vegetation

4.8.1. Introduction

This section describes potential impacts to vegetation resources associated with the construction and operation of the proposed Project and connected actions. The information, data, methods, and/or analyses used in this discussion are based on information provided in the 2012 FEIS (USACE, 2012a), as well as new circumstances or information relevant to environmental concerns that have become available since the publication of the 2012 FEIS, including the new proposed route, Revision 6.1. Specifically, the following items have been substantially updated from the 2012 FEIS document related to impacts to vegetation resources:

- The section has been reorganized into three alternatives, each with a construction and operations sub-section;
- A new section (Section 4.8.2, Methods) was added to explain the methodology used to evaluate potential vegetation impacts associated with the proposed Project. This section describes how the assessment methodology used for the SEIS evaluation differs in some respects from the methodology used for the 2012 FEIS evaluation;
- Vegetation acreage impacts differ from those presented in the 2012 FEIS due to route alterations and modified vegetation evaluation methods; and
- Information describing reduction of impacts to vegetation resources, mitigation and monitoring, is discussed in Section 4.8.3, Applicant-Proposed Design Features, Mitigation Measures, Best Management Practices, and Project Management Plans.

4.8.2. Methods

The potential vegetation impacts for the proposed Project presented below are based on the evaluation of the vegetation resources along the proposed Project corridor, review of available proposed Project descriptions and reports, public comments received after the publication of the 2012 FEIS and during the public scoping period for the SEIS held in 2014, and review of public comments received on the Draft SEIS during the July/August 2017 public comment period. Vegetation data and descriptions were obtained from a combination of sources, including the

- USACE. 2012a. *Final Environmental Impact Statement, Alaska Stand Alone Pipeline*. October.
- Alaska Exotic Plant Information Clearinghouse (AKEPIC) (ACCS, 2015);
- Alaska Natural Heritage Program (AKNHP) (2015);
- Hultén (1986);
- National Land Cover Database (NLCD) (MRLC Consortium, 2016);

- University of Alaska Museum of the North Herbarium Database (UA Museum of the North, 2016);
- Viereck *et al.* (1986); and
- Several other publications specific to Alaskan vegetation, all of which are included in Chapter 7, Literature Cited, of this SEIS.

Acreage calculations in this section were developed using NLCD (MRLC Consortium, 2016) data and AGDC's proposed Project footprint GIS data.

Potential impacts for this SEIS were analyzed by assessing the magnitude, extent, duration and likelihood of occurrence as presented in Table 4.8-1, Impact Criteria for Biological Resources.

Effects that were assessed include:

- Vegetation loss or disturbance;
- Non-native, invasive, and noxious plants introduction and/or propagation; and
- Habitat fragmentation; and
- Soil compaction and erosion.

4.8.2.1. Description of Effects

4.8.2.1.1. Vegetation Loss or Disturbance

Vegetation loss or disturbance may include:

- The direct loss due to placement of gravel;
- Damage to the rootstock from clearing, grubbing, grading, or mowing;
- Removal or disturbance to sensitive plant species;
- Removal or disturbance of forest vegetation;
- Reduction of plant species diversity;
- Disturbance or damage from dust deposition;
- Crushing, covering, or compaction of vegetation; and
- Increased human access to potentially sensitive areas.

Rare and sensitive plant individuals and populations may be more significantly impacted by loss or disturbance than other vegetation species.

4.8.2.1.2. Non-Native, Invasive, and Noxious Plants

Introduction and propagation of non-native, invasive, and noxious plants may result in competition and/or displacement of native plants, reducing biological diversity and altering community composition.

4.8.2.1.3. Habitat Fragmentation

Fragmentation of habitat could cause invasive plant establishment, alteration of soil temperature and sunlight availability, a long recovery time for vegetation communities, and impacts to other resources (*e.g.*, wildlife, threatened and endangered species, wetlands, land use, visual resources).

4.8.2.1.4. Soil Compaction and Erosion

Soil compaction and erosion could result in the inhibition of native seed germination, hinder root establishment, reduce water infiltration, and cause soil instability.

4.8.2.2. Impact Criteria

Table 4.8-1, Impact Criteria for Biological Resources, summarizes the criteria used to determine the level of impact based on the magnitude, extent, duration and likelihood of occurrence. Table 4.8-2 defines the types of effects the proposed Project and activities may have on the vegetation resources that are assessed in this SEIS. Applicant-proposed design features, mitigation measures and BMPs that may reduce impact to vegetation resources are listed in Section 4.8.3. These design elements and mitigation measures to reduce impacts, such as the implementation of the Revegetation Plan, SPCP, SWPPP, and Fugitive Dust Control Plan, have been taken into account to determine a final integrated impact result of negligible, minor, moderate, or major.

Table 4.8-1 Impact Criteria for Biological Resources

Impact Component	Impact Level			
	Major	Moderate	Minor	Negligible
Magnitude or Intensity	The impact is sufficient to cause population level or entire community level changes to productivity, growth rate, survival rate, and range.	The impact is sufficient to cause sub-population level changes to productivity, growth rate, survival rate, and range.	The action would impact a few individuals in a population but not affect population productivity, growth rate, survival rate, and range.	There are no perceivable impacts or the mechanism for effects on population status (*i.e.*, productivity, growth rate, survival rate and range) are indistinguishable from baseline.
Geographic Extent	Impacts are statewide, or over the entire range of the species or identified community.	Impacts are at a regional or community level, on a limited portion of the study area.	Impacts are site specific or occur within a few isolated locations.	No measurable effects.
Duration or Frequency	The effect would cause chronic and long-term changes that are likely to be permanent.	The effect would cause periodic, temporary, or short-term changes that are reversed after a 1-3 reproductive seasons (3 years).	The effect would cause periodic, temporary, or short-term changes that are reversed over one reproductive season (1 year).	No measurable effects.

Impact Component	Impact Level			
	Major	Moderate	Minor	Negligible
Likelihood	Most likely (Impacts that have greater than 75% chance of arising from the action)	Likely (Impacts that have a 50% to 75% chance of arising from the action)	Somewhat likely (Impacts that have a 10% to 50% chance of arising from the action)	Unlikely (Impacts that have less than 10% chance of arising from the action)

Table 4.8-2 Types of Effects and Impacts on Vegetation Resources

Type of Effect	Proposed Action Causing Potential Impact	
	Construction	Operations and Maintenance
• Vegetation Loss/Disturbance • Of rootstocks (clearing, grubbing, grading) • Of sensitive plants or species • Of forest vegetation • Of plant/species diversity • Through dust deposition • Through compaction/covering /crushing	• Clearing, grubbing, grading, blasting and trenching in the ROW • Use of TWs • Construction of access roads • Dust deposition onto vegetation from vehicles using existing and new access roads during construction • Facility development during construction	• Dust deposition onto vegetation from vehicles using existing and new access roads during operations • Aboveground facilities development
Introduction and propagation of non-native, invasive, and noxious plants could outcompete and displace native plants reducing biological diversity and community composition.	• Vehicle and equipment use in ROW during construction • Construction of access roads • Disturbance to vegetation from TWs	Vehicle and equipment use in ROW during operations
• Habitat Fragmentation (causing): o Non-native, invasive, and noxious plants establishment. o Alteration of soil temperature and sunlight availability. o Long recovery time for vegetation communities. o Impacts to other resources (*e.g.,* wildlife, threatened and endangered species, wetlands, land use, visual resources).	• Clearing, grubbing, grading, and blasting in the ROW • Trenching and backfilling trenches in the ROW • Access road development • Disturbance to vegetation from temporary extra workspace construction and use	Roads without proper drainage (culverts) or without proper maintenance of culverts would alter the hydrology and could conceivably result in habitat fragmentation.
• Soil Compaction and erosion causing inhibition of: o Native seed germination o Root establishment o Water infiltration o Soil instability	• Backfilling of trenches in the ROW • Access road development • Vehicle and equipment use in ROW during construction	Vehicle and equipment use in ROW during operations

4.8.3. Proposed Design Features, Mitigation Measures, Best Management Practices, and Project Management Plans

4.8.3.1. Applicant-Proposed Design Features, Mitigation Measures, Best Management Practices, and Project Management Plans

The following design features, mitigation measures and BMPs are proposed by AGDC, and have been taken into consideration when evaluating potential impacts on vegetation resources under Alternatives 1 and 2 during the construction and operations phases. A complete list of mitigation measures and BMPs are also provided in Appendix M. Additional USACE conditions for inclusion into the DA Permit Authorization are included in Section 4.5.1.

Proposed measures would include:

1. Various compressor stations, the Straddle and Offtake Facility, and the natural gas liquid extraction plant were removed from the proposed Project as described in the 2012 FEIS, eliminating vegetation and wildlife impacts from those proposed Project elements.
2. Ditch excavation: Construction scheduling is the most appropriate way of limiting thaw of open-ditch segments. To the extent possible, thaw-unstable soils would be excavated during winter seasons. In all cases, durations of open-ditch construction activities would be minimized. After trenching, pipe lowering in, and backfilling any compacted areas would be tracked to mitigate the compaction effects of the excavator and associated traffic, graded to facilitate drainage, covered with any available growth media (surface layer materials), and scarified to allow natural revegetation by native plants. Fertilization and/or seeding would occur in sensitive and erosive areas immediately, other areas would be allowed to revegetate naturally. If the reclamation standard of 30 percent cover over a 3-year period does not occur, then additional revegetation efforts would commence, per the Revegetation Plan (Appendix E, Part I).
3. Crowning: The slope over the crown is critical to stabilizing soils and directing ponding, thereby mitigating some erosion and drainage impacts. The remaining spoil material not used for backfilling and crowning would be feathered and blended across the construction corridor, creating a roughened surface to capture precipitation, decrease erosion, and provide safe sites for plant establishment.
4. Earthwork/Recontouring: Recontouring would be done in a way to emphasize the use of existing drainage patterns and landform types to blend with and be compatible with the surrounding landscape to the extent practicable (*e.g.*, where vertical cuts or other features cannot be physically recontoured to the original contours due to factors such as blasting or the natural angle of repose of the native fill material after it has been excavated). Recontouring disturbed areas would be done with site complexity in mind. Generally, revegetation of disturbed areas is planned for long-term stabilization.

5. Dust suppression: The proposed Project would perform dust suppression using water, if necessary. The proposed Project Area would be monitored for fugitive dust generation during construction. Abatement of fugitive dust would be required on the construction areas associated with the GCF and the pipeline ROW or on access roads when a visible plume of dust with an estimated opacity exceeding 20 percent (objects partially obscured) extends more than 300 feet from the source. Proposed Project contractors would be responsible for controlling dust using measures such as applying dust suppressants (*e.g.*, water), and in some cases, reducing vehicle speeds.
    - Use only proposed Project approved roads for access. Paved access roads would be kept free of mud and soil that may track onto the road surface from the construction ROW through the use of gravel access pads and/or equivalent. If soil is transported onto a public road surface or other paved area, including parking lots, by construction equipment and vehicles, it would be removed as soon as practical from the road by shoveling or sweeping and would be transported back to a designated sediment control disposal area within the construction ROW. Road washing, if necessary, would only be allowed after the soil has been scraped from the paved road surface.
    - Reduce vehicle speeds, where needed, on unpaved roads; speed limits may be set on unpaved roads.
    - Clean up track-out and/or carry-out areas at paved road access points.
    - Ensure that all haul truck cargo compartments are maintained so as to minimize spills and loss of materials. Cover haul loads of open body trucks where applicable.
    - Apply water to affected unpaved roads, unpaved haul/access roads, and staging areas when in use and when appropriate. Water for fugitive dust control purposes would be obtained as necessary through permits or purchase contracts with owners of valid existing water rights. These approvals would be acquired prior to construction.
    - Apply approved dust suppressant, such as a water/magnesium chloride mixture or calcium chloride, when appropriate and as needed. The use of magnesium chloride would be restricted in sensitive vegetative areas, where only water or alternative dust suppressants would be considered.
    - Apply water to active construction areas as needed. Areas should be pre-watered and soils maintained in a stabilized condition where support equipment and vehicles would operate. Water-disturbed soils would form a crust, reducing the potential for dust creation.
    - Control water spray so that over-spraying and pooling would be avoided to the extent possible.
    - Where roads are paved, no dust mitigation may be necessary.

6. Site de-compaction: In areas that have been compacted as a result of summer construction activities and require de-compaction to facilitate revegetation, the areas would be ripped to mitigate the compaction effects of the traffic, equipment use, storage, or from other construction-related activities and other use. Site de-compaction is not intended for use in areas that would be constructed during the winter (*i.e.*, on the ACP). Identified areas would be ripped to a minimum depth of 8 to 20 inches (20 to 50 centimeters) prior to surface soil replacement. The equipment used to rip the soil should be operated along the contours to minimize soil erosion and facilitate soil-water retention to aid revegetation. For sloped sites, ripping along the contour would intercept runoff as it flows downslope. Revegetation actions would be performed as soon as practicable after site compaction has been alleviated. Fertilization and/or seeding would occur in sensitive and erosive areas immediately, other areas would be allowed to revegetate naturally. If the reclamation standard of 30 percent cover over a 3-year period does not occur, then additional revegetation efforts would commence, per the Revegetation Plan (Appendix E, Part I).
7. Implementation of the Revegetation Plan (Appendix E, Part I), which was developed by ADNR's Plant Materials Center using the following resources:
    - *The Alaska Coastal Revegetation and Erosion Control Guide* (Wright and Czapla, 2010);
    - *Interior Alaska Revegetation & Erosion Control Guide* (Czapla and Wright, 2012);
    - *Strategic Plan for Invasive Weed and Agricultural Pest Management and Prevention* (ADNR, 2011c);
    - *Native Plant Revegetation Manual for Denali National Park and Preserve* (Densmore *et al.*, 2000); and
    - NPS Invasive Plant Management Plan.
8. Site-specific rehabilitation and revegetation measures determined in the plan:
    - Soil de-compaction methods;
    - Erosion control and slope stabilization methods;
    - Seed species composition and application rates;
    - Seed application methods (hydroseeding, aerial distribution, or hand methods)
    - Fertilizer and/or mulch requirements, composition, and application rates;
    - Long-term vegetation maintenance and monitoring requirements; and
    - Identification of additional site treatment options if initial revegetation efforts are unsuccessful.
9. Revegetation Management - AGDC would consult with BLM and follow ADNR's PMC Revegetation Manual for Alaska. The proposed Project's Revegetation Plan

stipulates seed mixes for different geographic areas, seed application methods, and application rates (if any) for fertilizers.

10. AGDC would develop a framework for preventing spatial dispersal of invasive terrestrial and aquatic plants, which could result from transporting invasives through access road construction and use, or bringing gear from a contaminated waterbody to another. Considerations would include seed sources, preventative measures, and monitoring and eradication procedures. Before any construction activities, any equipment brought in from outside of Alaska would be thoroughly decontaminated upon entering Alaska; any equipment stored in Alaska would be likewise decontaminated before any construction activities. Aquatic invasives would be controlled by decontaminating all equipment and gear used by personnel (including boots, waders, etc.) between watersheds to ensure invasive species are not inadvertently spread between work sites along the proposed Project route. Contractors would be responsible for decontaminating their own equipment.
11. Granular Workpad Areas: Granular workpads would be utilized for areas scheduled for summer construction. In wetlands overlying thaw-unstable permafrost, the surface layer under the workpad would not be removed, in order to maintain the thermal stability of the underlying permafrost. The workpad would be left in place after construction, leaving the surface layer intact beneath the gravel pad, which is important to slow thermal degradation of the permafrost. For workpads not required for operations and maintenance, any compacted areas of the workpad would be ripped to mitigate the compaction effects of traffic, graded to facilitate drainage, covered with any available growth media (surface layer materials), and scarified to allow natural revegetation by native plants. Fertilization and/or seeding would occur in sensitive and erosive areas immediately, other areas would be allowed to revegetate naturally. If the reclamation standard of 30 percent cover over a 3-year period does not occur, then additional revegetation efforts would commence, per the Revegetation Plan.
12. Timber Clearing, Salvage, and Utilization: In areas where a lease is required from the SPCS or a federal grant of ROW is required from BLM, prior to initiation of clearing operations on state/federal land, AGDC would provide SPCS/BLM with an estimate of the amount of merchantable timber, if any, which would be cut, re-mobilized, or destroyed in the construction and maintenance of the proposed pipeline, and would pay in advance of construction or maintenance activity, and would pay in advance the sum of money SPCS/BLM determines to be the full stumpage value of the timber to be cut, removed, or destroyed. AGDC would provide an opportunity for residents and local communities to utilize the salvaged timber. All debris resulting from clearing operations and construction that may block stream flow, delay fish passage, contribute to flood damage, or result in a streambed scour or erosion would be removed. Logs would not be skidded or yarded across any watercourse without approval. No log storage would be located

within 300 feet of any watercourse on state or federal land, except with approval from SPCS/BLM.

13. For riparian vegetation clearing, vegetation would be cut off at ground level to leave the existing root systems in place to provide streambank stability. In riparian areas, the pulling of tree stumps and rooting for grading activities would be limited to the area directly over the trench line. Where conditions allow, riparian vegetation would be restored with native plant species (*e.g.*, riparian species planting is only successful where enough water is present).

4.8.3.2. USACE and ADEC Conditions to be Considered During Permitting

A variety of mitigation measures and best practices have been recommended by the cooperating agencies (Appendix M). Many of these recommendations have been incorporated in the proposed Project. Significant differences between the regulatory agency recommendations and the proposed Project are identified below.

- To prevent erosion, disturbed areas shall be stabilized immediately after construction. Revegetation of the site shall begin as soon as site conditions allow and in the same growing season as the disturbance unless climatic conditions warrant additional time. Additional time must be approved by USACE. Native vegetation and topsoils removed for proposed Project construction shall be stockpiled separately and used for site rehabilitation. Except in areas of topsoil excavation, excavated soils shall be sorted into mineral subsoils and topsoil and stored separately. Topsoil is defined as the upper, outermost layer of soil, usually the top 2 to 8 inches. The depth of topsoil can be measured as the depth from the surface to the first densely packed layer of soil. When backfilling, topsoil shall be placed as the uppermost layer to provide a seed bed for native species. If topsoil and/or organic materials are not available from the proposed Project site for rehabilitation, other locally obtained native materials may be used. Species to be used for seeding and planting shall follow this order of preference: 1) species native to the site; 2) species native to the area; and 3) species native to the state.
- As applicable to permit conditions at the time of construction, stabilization of disturbed areas must be initiated as soon as practicable whenever any clearing, grading, excavating, or other earth disturbing activities have permanently ceased on any portion of the site or temporarily ceased on the site and would not resume for a period exceeding 14 days.
- As applicable to permit conditions at the time of construction, no later than 14 days after initiating temporary stabilization, the permittee must complete all activities necessary to initially revegetate the area and/or install non-vegetative measures.
- As applicable to permit conditions at the time of construction, the permittee must achieve final stabilization for the affected area of coverage. Final stabilization means that all soil disturbing activities at the site have been completed and either of the two following criteria shall be met: a) a uniform (*e.g.*, evenly distributed, without large

bare areas) perennial vegetative cover with a density of 70 percent of the native background vegetative cover for the area has been established on all unpaved areas and areas not covered by permanent structures, or b) equivalent non-vegetative permanent stabilization measures have been employed including but not limited to riprap, gabions, porous backfill per ADOT&PF Specification 703-2.10, railroad ballast or sub-ballast, ditch lining per ADOT&PF Specification 610-2.01, or geotextiles, or fill material with low erodibility as determined by an engineer familiar with the site and documented in the SWPPP.

- As applicable to permit conditions at the time of construction, stabilization of disturbed areas must, at a minimum, be initiated immediately whenever any clearing, grading, excavating, or other earth disturbing activities have permanently ceased on any portion of the site or temporarily ceased on any portion of the site and would not resume for a period exceeding: 7 calendar days for those areas of the state with a mean annual precipitation of 40 inches or greater; or, 14 calendar days for those areas of the state with a mean annual precipitation less than 40 inches.

Section 4.8.8 describes the differences in the anticipated proposed Project impact rankings under the assumption that these recommended measures were implemented. This section is provided as a comparison with the impacts of the currently proposed Project.

4.8.3.3. Agency-Recommended Mitigation Measures

A variety of mitigation measures and best practices have been recommended by the cooperating agencies (Appendix M). Many of these recommendations have been incorporated in the proposed Project and are included in Table 4.8-3 below. The impacts discussed in this chapter are based upon the Applicant-proposed measures. These additional agency recommended measures are not included in the impact analysis.

Table 4.8-3 Vegetation Resources Agency-Recommended Mitigation Measures

Additional Measure Consideration	Agency Proposing Mitigation Measure	Agency Jurisdiction	Authority (*i.e.*, CWA, RHA, ESA)	Affected Resources	Comment Code
Stabilization of disturbed areas must be initiated as soon as practicable whenever any clearing, grading, excavating, or other earth disturbing activities have permanently ceased on any portion of the site or temporarily ceased on the site and would not resume for a period exceeding 14 days. Temporary Stabilization: No later than 14 days after initiating temporary stabilization, the permittee must complete all activities necessary to initially revegetate the area and/or install non-vegetative measures.	ADEC	EPA, ADEC	CWA	Waters, Soils and Geology, Vegetation	NA
Final Stabilization and Terminating Construction Stormwater Authorizations: To eliminate a site or terminate authorization for construction stormwater coverage under General Permit AKG320000, the permittee must achieve final stabilization for the affected area of coverage. Final Stabilization includes: a) a uniform (*e.g.*, evenly distributed, without large bare areas) perennial vegetative cover with a density of 70 percent of the native background vegetative cover for the area has been established on all unpaved areas and areas not covered by permanent structures, or b) equivalent non-vegetative permanent stabilization measures have been employed including but not limited to riprap, gabions, porous backfill per ADOT&PF Specification 703-2.10, railroad ballast or sub-ballast, ditch lining per ADOT&PF Specification 610-2.01, or geotextiles, or fill material with low erodibility as determined by an engineer familiar with the site and documented in the SWPPP.	ADEC	EPA, ADEC	CWA	Waters, Soils and Geology, Vegetation	NA

Additional Measure Consideration	Agency Proposing Mitigation Measure	Agency Jurisdiction	Authority (*i.e.*, CWA, RHA, ESA)	Affected Resources	Comment Code
Stabilization of disturbed areas must, at a minimum, be initiated immediately whenever any clearing, grading, excavating, or other earth disturbing activities have permanently ceased on any portion of the site or temporarily ceased on any portion of the site and would not resume for a period exceeding: 7 calendar days for those areas of the state with a mean annual precipitation of 40 inches or greater; or 14 calendar days for those areas of the state with a mean annual precipitation less than 40 inches.	ADEC	EPA, ADEC	CWA	Waters, Soils and Geology, Vegetation	NA
Specify the timeframe of restoration	BLM	BLM, ADNR	--	Soils and Geology, Vegetation, Wetlands	MIT_21
Include specific fugitive dust control measures, such as speed limits and frequency of watering during non-winter months, that would be implemented to achieve control limits.	EPA	EPA, ADEC	--	Vegetation, Wetlands, Fish, Public Health, Air Quality	MIT_34
We recommend that the Final SEIS list specific fugitive dust control measures, such as speed limits and frequency of watering during non-winter months, that would be used to achieve this level of control.	EPA	EPA, ADEC	CAA	Air, Wetlands, Vegetation, Human Health, Recreation	AIR_22
Remove and properly store the organic soil layer (*e.g.*, tundra sod blocks and salvaging the organic layer, approximately 15-30 centimeter uppermost layer containing seeds, plant propagules, roots, organic matter, and soil microbes) before trenching to facilitate reestablishing vegetation in a more timely manner.	USFWS	USACE, EPA	--	Soils and Geology, Vegetation, Wetlands	MIT_12
Use a generally accepted timeline of 5 years for achieving 70% coverage in the Intermontaine Boreal and Alaska Range Transition Ecoregions.	USFWS	--	--	Soils and Geology, Vegetation, Wetlands	MIT_13

Additional Measure Consideration	Agency Proposing Mitigation Measure	Agency Jurisdiction	Authority (*i.e.*, CWA, RHA, ESA)	Affected Resources	Comment Code
The pipeline shall be elevated on Vertical Support Members (VSMs) from MP 0 to at least beyond the area of extensive ice-rich, saturated soils containing a high density of oriented thaw lakes on the Arctic Coastal Plain. The VSMs should also be used to elevate the pipeline in extensive areas of thaw-unstable permafrost and in areas of continuous and discontinuous permafrost where inadvertent thermokarst could alter the natural drainage pattern along the pipeline.	USFWS	USACE	--	Soils and Geology, Vegetation, Wetlands	MIT_15
Material sites shall be reclaimed in accordance with a plan approved by the Corps of Engineers in consultation with the Service. Reclamation shall be accomplished within 3 years on any portion of the material site that has been inactive (abandoned) for 3 years, or where the material source is no longer practical or economically feasible to extract.	USFWS	USACE	--	Soils and Geology, Vegetation, Wetlands	MIT_15
If open water is created at a material site in the Intermontane Boreal or Alaska Range Transition Ecoregion, then reclamation shall include: 1) constructing a littoral zone at least 20 feet wide (shallow underwater shelf along the bank with slopes averaging less than 10H:1V); 2) constructing an irregular shoreline with bays and spits; and 3) spreading 2 to 4 inches of separately stockpiled organic overburden on the littoral zone and shoreline to enhance revegetation. At least a 25-foot-wide buffer of native vegetation should also be established around the excavation perimeter to help filter sediment and pollutants before they enter the water.	USFWS	BLM	--	Soils and Geology, Vegetation, Wetlands	MIT_15
If open water is created at a material site in the Arctic Tundra Ecoregion, then reclamation shall include: 1) salvaging the active organic topsoil	USFWS	BLM	--	Soils and Geology, Vegetation, Wetlands	MIT_15

Additional Measure Consideration	Agency Proposing Mitigation Measure	Agency Jurisdiction	Authority (*i.e.*, CWA, RHA, ESA)	Affected Resources	Comment Code
layer (12 to 18 inches) overlaying the footprint of the cell and stockpile on an adjacent ice pad/pad; 2) removing the remaining inorganic/mineral overburden from the cell and stockpile separately from the organic topsoil on an adjacent ice pad/pad; 3) placing a berm of inorganic overburden around the outside edge of the cell as insulation to prevent thermokarsting and erosion of the cell sidewalls, and as a safety precaution; 4) instructing side slopes of the cell no steeper than 2H:1V (preferably 3H:1V); 5) placing the inorganic/mineral overburden back into the cell when mining is complete to create 3H:1V side slopes if possible; 6) using the organic topsoil to stabilize the top edges of the side slopes of the mined cell, to reclaim the adjacent tundra disturbed by mining operations, and/or to use in other reclamation sites; 7) keeping the berm surrounding the pit in place as a safety precaution until the pit has completely filled with water, at which point the berm can be removed (*e.g.*, pushed into the water-filled pit).					
All disturbed, stockpile, and fill areas shall be stabilized to prevent erosion. Increased water turbidity and accumulation of sediment in drainages, sloughs, and other wetlands shall be evidence of insufficient stabilization.	USFWS	EPA, ADEC	--	Soils and Geology, Vegetation, Wetlands	MIT_15
A large number of Applicant-proposed design features, mitigation measures, BMPs, and project management plans listed in the Draft SEIS contain the language, "In areas where a lease is required from the State Pipeline Coordinator's Section" or "a federal grant of ROW is required from BLM ..." These measures generally represent a best management approach that we recommend using	EPA	--	--	Numerous	MIT_35

Additional Measure Consideration	Agency Proposing Mitigation Measure	Agency Jurisdiction	Authority (*i.e.*, CWA, RHA, ESA)	Affected Resources	Comment Code
to the maximum extent possible along the entire pipeline route, while acknowledging the outstanding need to complete coordination with private landowners.					

AAC = Alaska Administrative Code
ADF&G = Alaska Department of Fish and Game
ADEC = Alaska Department of Environmental Conservation
ADNR = Alaska Department of Natural Resources
AGDC = Alaska Gasline Development Corporation
APDES = Alaska Pollution Discharge Elimination System
BLM = Bureau of Land Management
BMP = Best Management Practice
CAA = Clean Air Act
CWA = Clean Water Act
DHSS = Alaska Department of Health and Social Services
EPA = U.S. Environmental Protection Agency
MBTA = Migratory Bird Treaty Act
NMFS = National Marine Fisheries Service
RHA = Rivers and Harbors Act of 1899
SEIS = Supplemental Environmental Impact Statement
USACE = U.S. Army Corps of Engineers
USFWS = U.S. Fish and Wildlife Service

4.8.4. Alternative 1 – Proposed Action

Alternative 1 is designated the proposed Action (proposed ASAP Project). This alternative is described in Chapter 2 in detail. The 36-inch, 733-mile-long pipeline and the 12-inch, 30-mile lateral pipeline to Fairbanks would cross various habitats and ecoregions from the North Slope to the existing ENSTAR pipeline system in the Mat-Su Borough. This section discusses the analysis of impacts to vegetation along the route.

The proposed Project would intersect vegetation communities and land cover types in a wide variety of ecoregions in Alaska, described in Chapter 3. The following sections discuss activities that are proposed to occur during the construction, operations, and maintenance phases of the proposed Project with associated potential impacts. The proposed construction spread (*i.e.*, schedule) for the pipeline is presented in Chapter 2, Table 2.2-7 (Alternative 1: ASAP Construction Spread Plan).

In areas where a lease is required from the SPCS, AGDC would submit to the state for approval the following plans, each of which would cover construction, operation, maintenance, and termination activities: erosion and sedimentation control; restoration and revegetation of disturbed areas; and timber clearing, salvage and utilization.

4.8.4.1. Construction

The construction ROW and associated proposed Project features in Alternative 1 (proposed Action) would permanently and temporarily impact vegetation acreage, after proposed design features, mitigation measures, BMPs, and Project management plans are instated. Proposed Project features that would have permanent impacts due to gravel fill, gravel removal, trenching, or VSM footprints include access roads, camps, facility pads, construction impacts (the trench line and ROW), material sources, PSYs, railroad siding, and VSMs. Proposed Project features that would have temporary impacts include bridges, pipeline stream crossings, ice roads, temporary construction impacts, HDD crossings, HDD entry pads, HDD exit pads, HDD false ROWs, and TWs. The temporary work areas would be located adjacent to the permanent impacts area and could be used for such things as spoil storage, staging, equipment movement, material stockpiles, and pull string assembly associated with HDD installation. Stream crossings and the associated suspension bridges are considered temporary impacts because there would be no permanent placement of fill or proposed Project features in the streams. Roads that crossed streams would have culverts or suspension bridges removed as part of the abandonment process. Abandoned workpads outside of the permanent ROW would be ripped to mitigate compaction, scarified to allow natural revegetation, and may be seeded or fertilized to facilitate revegetation (Mitigation Measure No. 11).

A total of 17,187.62 acres of vegetated land would be permanently impacted in Alternative 1 with construction of the ROW and proposed Project features. Alternative 2 would permanently impact slightly less vegetated land: 17,137.12 acres. Table 4.8-4 shows acres of vegetation per ecoregion that would be permanently or temporarily impacted by Alternative 1. In Alternative 1, approximately 25.3 percent of the vegetation

that would be permanently impacted is shrub/scrub, 24.2 percent is evergreen forest, 11.9 percent is dwarf shrub, 10.7 percent is sedge/herbaceous, 11.2 percent is deciduous forest, 11 percent is mixed forest, 2.7 percent is woody wetland, 1.7 percent is grassland/herbaceous, 1.2 percent is emergent herbaceous wetlands, and cultivated crops and pasture/hay are each less than 0.1 percent.

Table 4.8-4 Vegetation Types (Acres) by Ecoregion in the Permanent Impacts Area and Temporary Impacts Areas

Ecoregion	Vegetation / Land Cover Type (MRLC Consortium, 2016)	Alternative 1		Alternative 2	
		Vegetation Acres within Permanent Impacts Area[a]	Vegetation Acres within Temporary Impacts Areas[b]	Vegetation Acres within Permanent Impacts Area[a]	Vegetation Acres within Temporary Impacts Areas[b]
Beaufort Coastal Plain	Emergent Herbaceous Wetlands	91.20	13.44	93.07	1.11
	Sedge/Herbaceous	1,103.01	210.75	1,154.48	43.59
	Shrub/Scrub	13.38	0	13.39	0
	Woody Wetlands	1.15	0	1.16	0
	Total Vegetated	*1,208.73*	*224.19*	*1,262.09*	*44.70*
	Barren Land	195.61	0.54	196.42	0
	Developed	176.79	4.86	169.05	1.50
	Open Water	294.77	4.31	125.70	0
	Total Land Cover	*1,875.91*	*233.90*	*1,753.27*	*46.21*
Brooks Foothills	Dwarf Shrub	1,428.41	1.05	1,427.75	1.06
	Emergent Herbaceous Wetlands	6.73	0.01	6.67	0.01
	Sedge/Herbaceous	624.79	3.01	625.25	1.44
	Shrub/Scrub	125.78	0.03	125.42	0.03
	Total Vegetated	*2,185.70*	*4.09*	*2,185.09*	*2.53*
	Barren Land	145.60	0	145.60	0
	Developed	21.07	0.16	21.88	0.16
	Open Water	21.77	0	21.84	0
	Total Land Cover	*2,374.14*	*4.25*	*2,374.41*	*2.70*
Brooks Range	Deciduous Forest	5.69	0	5.60	0
	Dwarf Shrub	551.75	0.45	552.27	0.45
	Emergent Herbaceous Wetlands	2.53	0.02	2.49	0.02
	Evergreen Forest	599.31	0.91	599.67	0.91
	Grassland/Herbaceous	2.22	0	2.22	0
	Mixed Forest	27.76	0.01	27.79	0.01
	Sedge/Herbaceous	34.55	0.55	34.29	0.55
	Shrub/Scrub	1,049.07	1.71	1,055.86	1.71
	Woody Wetlands	0.93	0	0.92	0

Ecoregion	Vegetation / Land Cover Type (MRLC Consortium, 2016)	Alternative 1		Alternative 2	
		Vegetation Acres within Permanent Impacts Area[a]	Vegetation Acres within Temporary Impacts Areas[b]	Vegetation Acres within Permanent Impacts Area[a]	Vegetation Acres within Temporary Impacts Areas[b]
	Total Vegetated	*2,273.81*	*3.64*	*2,281.10*	*3.65*
	Barren Land	334.38	1.82	332.51	1.82
	Developed	196.46	0.50	191.12	0.50
	Open Water	1.69	0.03	1.57	0.03
	Total Land Cover	*2,806.35*	*5.99*	*2,806.31*	*5.99*
Kobuk Ridges and Valleys	Deciduous Forest	1.11	0	1.11	0
	Dwarf Shrub	6.45	0	6.45	0
	Evergreen Forest	57.06	0.23	56.45	0.23
	Mixed Forest	1.78	0	1.78	0
	Sedge/Herbaceous	22.06	0	22.37	0
	Shrub/Scrub	137.29	0	137.33	0
	Woody Wetlands	1.58	0	1.62	0
	Total Vegetated	*227.32*	*0.23*	*227.11*	*0.23*
	Developed	16.22	0	16.43	0
	Total Land Cover	*243.55*	*0.23*	*243.55*	*0.23*
Ray Mountains	Deciduous Forest	406.39	9.68	406.64	5.56
	Dwarf Shrub	38.39	0	38.35	0
	Emergent Herbaceous Wetlands	2.48	0	2.50	0
	Evergreen Forest	1,623.10	40.18	1,629.57	7.24
	Grassland/Herbaceous	245.24	0.51	245.51	0.36
	Mixed Forest	350.79	2.19	353.47	1.64
	Sedge/Herbaceous	55.82	0	55.71	0
	Shrub/Scrub	1,554.41	0.06	1,557.41	0.06
	Woody Wetlands	100.86	2.41	101.86	0.05
	Total Vegetated	*4,377.48*	*55.02*	*4,391.01*	*14.91*
	Barren Land	6.58	0.02	6.61	0.02
	Developed	383.47	0	485.82	0
	Open Water	2.52	5.98	2.57	5.98
	Total Land Cover	*4,770.06*	*61.02*	*4,886.02*	*20.90*

Ecoregion	Vegetation / Land Cover Type (MRLC Consortium, 2016)	Alternative 1		Alternative 2	
		Vegetation Acres within Permanent Impacts Area[a]	Vegetation Acres within Temporary Impacts Areas[b]	Vegetation Acres within Permanent Impacts Area[a]	Vegetation Acres within Temporary Impacts Areas[b]
Tanana-Kuskokwim Lowlands	Deciduous Forest	177.51	96.59	177.81	97.08
	Dwarf Shrub	1.62	0	1.61	0
	Emergent Herbaceous Wetlands	4.58	3.77	4.57	3.73
	Evergreen Forest	466.80	289.69	467.16	289.41
	Grassland/Herbaceous	10.13	3.77	10.10	3.79
	Mixed Forest	56.06	39.58	55.89	39.35
	Pasture/Hay	0.89	0	0.88	0
	Sedge/Herbaceous	0	0.36	0	0.36
	Shrub/Scrub	225.45	58.70	224.87	58.67
	Woody Wetlands	84.63	115.69	84.49	116.09
	Total Vegetated	*1,027.66*	*608.15*	*1,027.37*	*608.47*
	Barren Land	5.11	2.83	5.16	2.82
	Developed	41.50	9.16	40.94	9.62
	Open Water	1.85	9.64	1.83	9.63
	Total Land Cover	*1,076.12*	*629.77*	*1,076.09*	*629.75*
Yukon-Tanana Uplands	Cultivated Crops	2.37	0	2.38	0
	Deciduous Forest	199.57	67.19	199.43	67.15
	Dwarf Shrub	4.09	0	4.10	0
	Emergent Herbaceous Wetlands	0.80	0	0.77	0
	Evergreen Forest	355.54	61.22	355.49	60.96
	Grassland/Herbaceous	27.84	0	27.81	0
	Mixed Forest	101.69	27.08	101.79	27.35
	Sedge/Herbaceous	0.27	0	0.27	0
	Shrub/Scrub	192.29	0	192.33	0
	Woody Wetlands	20.74	2.56	20.69	2.58
	Total Vegetated	*905.19*	*158.05*	*905.07*	*158.04*
	Barren Land	0.13	0	0.13	0
	Developed	23.54	0	223.57	0
	Open Water	0.30	0	0.29	0
	Total Land Cover	*929.16*	*158.05*	*1,129.05*	*158.04*

Ecoregion	Vegetation / Land Cover Type (MRLC Consortium, 2016)	Alternative 1		Alternative 2	
		Vegetation Acres within Permanent Impacts Area[a]	Vegetation Acres within Temporary Impacts Areas[b]	Vegetation Acres within Permanent Impacts Area[a]	Vegetation Acres within Temporary Impacts Areas[b]
Alaska Range	Deciduous Forest	57.26	9.42	53.87	3.42
	Dwarf Shrub	17.92	0.72	17.91	0.73
	Emergent Herbaceous Wetlands	14.96	0	14.86	0
	Evergreen Forest	876.86	45.09	808.56	16.98
	Grassland/Herbaceous	1.73	0	1.73	0
	Mixed Forest	361.60	51.79	356.13	45.42
	Sedge/Herbaceous	5.37	0	5.35	0
	Shrub/Scrub	1,011.04	39.47	963.15	18.36
	Woody Wetlands	126.39	1.66	124.00	1.14
	Total Vegetated	*2,473.13*	*148.15*	*2,345.57*	*86.05*
	Barren Land	39.22	1.36	40.30	1.16
	Developed	71.08	1.11	75.71	1.13
	Open Water	2.75	0.17	1.76	0.44
	Total Land Cover	*2,586.19*	*150.79*	*2,463.35*	*88.79*
Cook Inlet Basin	Cultivated Crops	10.84	0	11.02	0
	Deciduous Forest	1,079.66	80.66	1,079.96	80.26
	Emergent Herbaceous Wetlands	80.66	19.84	80.50	19.84
	Evergreen Forest	185.63	27.55	185.95	27.57
	Mixed Forest	1,004.61	62.32	1,004.60	62.38
	Pasture/Hay	1.19	0.09	1.15	0.09
	Shrub/Scrub	38.61	1.60	38.59	1.68
	Woody Wetlands	125.97	48.50	125.51	48.47
	Total Vegetated	*2,527.16*	*240.57*	*2,527.27*	*240.29*
	Barren Land	0.14	2.30	0.14	2.30
	Developed	117.30	4.59	162.26	4.85
	Open Water	0.71	5.51	0.71	5.53
	Total Land Cover	*2,645.32*	*252.98*	*2,690.38*	*252.97*
Total Vegetated Acres		*17,206.20*	*1,442.09*	*17,151.70*	*1,158.88*

Ecoregion	Vegetation / Land Cover Type (MRLC Consortium, 2016)	Alternative 1		Alternative 2	
		Vegetation Acres within Permanent Impacts Area[a]	Vegetation Acres within Temporary Impacts Areas[b]	Vegetation Acres within Permanent Impacts Area[a]	Vegetation Acres within Temporary Impacts Areas[b]
	Total Land Cover Acres	*19,306.79*	*1,496.98*	*19,422.43*	*1,205.57*

[a] Proposed Project features considered permanent impacts in this table include: Access roads, camps, construction impacts - permanent, dredge disposal area, facility pads, HDD entry pads, HDD exit pads, material sources, PSYs, railroad siding, VSMs, West Dock dredge area, West Dock mooring dolphins, and West Dock new fill.

[b] Proposed Project features considered temporary impacts in this table include: Pipeline stream crossings, construction impacts - temporary, HDD false ROWs, TWs, and West Dock temporary barge bridge.

Sources: Alaska Ecoregions (Nowacki *et al*., 2001) was modified to include infrastructure in Prudhoe Bay, AGDC GIS wetlands data provided 12-14-2017 and modified by USACE 3-23-2018, AGDC GIS Project infrastructure data provided 7-13-2016, and the NLCD 2011 dataset (MRLC Consortium, 2016), which was clipped to a 5-mile buffer around the pipeline centerline. Approximately 370 acres of additional proposed Project impacts occur outside of the 5-mile buffer portions of several including access roads and the Seward Marshalling Yard.

Note that the primary dataset used for this analysis, the NLCD (MRLC Consortium, 2016), is very coarse in comparison to the AGDC project mapping data. NCLD data is presented in 30-m pixels, based on LANDSAT-8 data.

4.8.4.1.1. Pipeline ROW – Mainline and Fairbanks Lateral

4.8.4.1.1.1. Gravel Fill

Gravel fill placed during construction of the proposed Project to build access roads, camps, PSYs, marshalling yards, facility pads, and HDD entry and exit pads would remain in place during the operations phase of the proposed Project, and would likely remain after proposed Project completion. The placement of gravel fill on vegetation would result in a direct and permanent loss of the vegetation. Approximately 2,682 acres of vegetation would receive gravel fill during the construction phase of the proposed Project, and the vast majority of these areas would remain filled in the operations phase; this total includes access roads, camps, facility pads, HDD pads, PSYs, and railroad sidings, and it omits non-vegetated land. Several proposed Project facilities were eliminated from plans that would have impacted vegetation communities, such as compressor stations, the Straddle and Offtake Facility, and the natural gas liquid extraction plant (Mitigation Measure No. 1).

Placement of gravel fill would have similar impacts to all ecoregions crossed by the pipeline ROWs.

The impacts to vegetation due to placement of gravel fill during the construction phase would be moderate, as it would result in the direct and permanent loss of the vegetation. Impacts resulting from placing gravel fill on vegetation would be widespread throughout the ROW.

4.8.4.1.1.2. Clearing, Grubbing, and Grading

Clearing, grubbing, and grading of vegetation in the proposed ROW would occur during pre-construction activities, outside of migratory bird nesting periods. Grading would not include separating the surface layer (including the vegetative layer and roots) from the subsoil mineral layer to create a flat working surface for construction, as was originally proposed in the 2012 FEIS (USACE, 2012a). The surface layer would be segregated and stored for rehabilitation use in agricultural areas and in select continuous and discontinuous permafrost areas and non-permafrost areas (as discussed in the AGDC planning document, *Segregation of the Surface Layer* [AGDC, 2017g], and in the Revegetation Plan [Appendix E, Part I]). The surface layer would be salvaged for at least 186 miles of the 733-mile pipeline. Pre-construction activities would begin in the summer prior to the first season of pipeline construction. Subsoil exposed to the physical environment before construction could cause erosion, and sedimentation impacts and the extent of impacts would depend on the length of time the soil is exposed.

In areas where a lease is required from the SPCS or a federal grant of ROW is required from BLM, prior to initiation of clearing operations, AGDC would provide SPCS/BLM with an estimate of the amount of merchantable timber, if any, which would be cut, removed, or destroyed in the construction and maintenance of the pipeline, and would pay the state in advance of construction or maintenance activity, the sum of money

ADNR/BLM determines to be the full stumpage value of the timber to be cut, removed, or destroyed (Mitigation Measure No. 12). AGDC would provide an opportunity for residents and local communities to utilize the salvaged timber. All debris resulting from clearing operations and construction that may block stream flow, delay fish passage, contribute to flood damage, or result in a streambed scour or erosion would be removed. Logs would not be skidded or yarded across any watercourse without approval. No log storage would be located within 300 feet of any watercourse on state land except with approval from SPCS/BLM. Grading and surface layer stripping has the potential to destroy the plant rootstock, which would delay vegetation recovery substantially. Areas that are constructed in the winter on ice pads would have considerably less impact as grading would only occur over the centerline. Natural establishment of native vegetation should occur over time from slow encroachment and seed dispersal of surrounding vegetation, with the exception of the Beaufort Coastal Plain tundra, which may never fully recover. Sensitive plants or species that are intolerant to this type of disturbance may not fully recover.

Approximately 9,560.5 acres of vegetated land would be cleared for the operations/permanent ROW, and an additional 834.3 acres of vegetated land would be cleared for the construction/temporary ROW for the Mainline and Fairbanks Lateral; these totals only consider the ROW impacts (*i.e.*, categories Construction Impact – Avoidance, Temporary, and Permanent), vegetated areas, and omit the Beaufort Coastal Plain Ecoregion. Of these acres, 5,394.3 acres (52 percent) are forested, 4,421.9 acres (43 percent) are scrub/shrub, dwarf shrub, or woody wetlands, 567.6 acres (5 percent) are herbaceous vegetation, and the remaining 11 acres are crops and pasture/hay. Most herbaceous and scrub-shrub vegetative communities would be expected to recover within 5 to 20 years (ADF&G, 2001). Vegetation communities in the southern latitudes of the proposed Project, such as the Cook Inlet Basin and Alaska Range ecoregions, would recover faster than the more northern ecoregions such as the Beaufort Coastal Plain and the Brooks Foothills because of differences in daylight, temperature, and the length of the growing season. Minimal or no clearing would be done in Beaufort Coastal Plain tundra, as these areas would be constructed during the winter and the vegetation is already very short in height. Forested vegetation would take much longer to recover due to the length of time it takes for trees to reach maturity. Forest vegetation would not be allowed to completely grow back in the permanent ROW; it would be mowed and cleared periodically to allow access for the ROW. In areas outside of the permanent ROW, where forest vegetation is cleared, it would take several decades to several hundred years to reach pre-disturbance conditions (ADF&G, 2001). The potential for disturbance to forested vegetation types could be reduced by associating the proposed Project alongside existing infrastructure where the amount of forested vegetation is generally less; however, the current pipeline alignment is located primarily outside of existing ROWs, co-location is minimal.

For riparian vegetation clearing, vegetation would be cut off at ground level to leave the existing root systems in place to provide streambank stability. In riparian areas, the

pulling of tree stumps and rooting for grading activities would be limited to the area directly over the trench line. Where conditions allow, riparian vegetation would be restored with native plant species (Mitigation Measure No. 13).

Clearing, grubbing, and grading would have greater impacts to ecoregions with scrub/shrub and forested vegetation and those that have more topography. The Nearshore Beaufort Sea and the Beaufort Coastal Plain ecoregions would receive the fewest impacts from clearing, grubbing, and grading because the Nearshore Beaufort Sea is marine and has no vegetation and although the vegetation species are slow growing coupled with a short growing season, the Beaufort Coastal Plain's vegetation is already short and the landscape is flat so little to no clearing, grubbing, or grading would be necessary. However, vegetation removal above permafrost soils, especially areas with discontinuous permafrost (*e.g.*, MP 168 - 634), can exacerbate permafrost thaw, as it would alter the isolative properties of the soil.

The impacts to vegetation due to clearing, grubbing, and grading during construction of the pipeline ROW is considered moderate as it would result in direct loss and disturbance to the community structure of forested and scrub/shrub areas throughout the entire corridor, which cannot be reversed in one growing season. This would result in a long-term conversion of forested land. Herbaceous communities would not experience as great of an impact as forested and scrub/shrub communities because herbaceous species generally have faster growth rates than shrubs and tree species. In addition to direct vegetation loss and disturbance, habitat fragmentation, non-native, invasive, and noxious species introduction, soil compaction, and erosion are also possible outcomes from clearing, grubbing, and grading. Clearing, grubbing, and grading could also increase the public's accessibility to potentially sensitive areas, such as wetlands and anadromous streams, which prior to clearing would have been more difficult to access. As stated previously, cleared areas outside of the permanent ROW would be allowed to revegetate and again restrict some access. Mitigation measures proposed by the Applicant to restrict public access to the proposed pipeline and facilities would also limit the public's access to these sensitive areas.

There are no proposed measures to mitigate the impacts to forested communities cleared and mowed in the permanent ROW. Construction plans of the Mainline would be coordinated with both state and federal agencies to minimize disturbance.

4.8.4.1.1.3. Open-Cut Trenching and Backfilling

OC trenching involves creating a narrow ditch to place the pipeline after the area has been graded and stripped of the surface layer. Trenching would include excavating subsoil and placing it on the non-working side of the trench. The surface layer would be segregated and stored for rehabilitation use in agricultural areas and in select continuous and discontinuous permafrost areas and non-permafrost areas, but not in all land cover types (as discussed in the AGDC planning document, *Segregation of the Surface Layer* [AGDC, 2017g], and in the Revegetation Plan, Appendix E, Part I). The

replacement of the surface layer would greatly improve the likelihood of rehabilitation success. Vegetation would reestablish on a replaced surface layer faster than in clays or gravels that may be found deeper in the ground. Table 1 in *Segregation of the Surface Layer* (AGDC, 2017g) shows the minimum MPs where AGDC would conduct surface layer segregation and replacement on the trench. The surface layer would be salvaged in at least 186 miles of the 733-mile pipeline (approximately 25 percent). Trenching has the potential to destroy the plant rootstock, which would delay vegetation recovery substantially. Trenching in continuous and discontinuous permafrost areas (*i.e.*, MPs 0 - 634) would result in permafrost damage and altered hydrology. In more northern areas such as the Beaufort Coastal Plain, Brooks Foothills, and Brooks Range, recovery of vegetation would be expected to be slower than in other areas (*e.g.*, greater than 20 years), due to the extremely short growing season; additionally, the vegetation communities that recover would likely result in different vegetation regime than was originally disturbed.

During trenching, the soil and vegetation would be damaged, which could affect the depth of the active layer and thereby, the depth to permafrost and the drainage patterns of the site. In areas where mineral soil is exposed, the active layer is likely to be considerably deeper than in areas with good vegetative cover. Mitigation measures for soils and geology are discussed in Section 4.6.3. As stated in Section 5.1.2.1 of the 2016 ASAP EED, "Depending on the content of massive ice in the vicinity, some sections of inundated trench may propagate permafrost thaw into the surrounding area, especially where stretches of flooded trench intersect ice wedge troughs" (AGDC, 2016b). Massive ground ice, up to and greater than 50 percent by volume (Kreig and Reger, 1982), is found along the northern portion of the pipeline route. Propagation of permafrost thaw results in melting of the massive ice. This directly results in a decrease in the volume of the impacted soil and frequently reduces the bearing capacity of the soil to near zero. This could result in a decrease in the elevation of the ground surface. Saturated soil tends to be darker than dry soil. Thus, permafrost thaw could result in a decrease in the albedo of the soil causing further propagation of the thaw. Areas with discontinuous permafrost (MP 168 - 634) are expected to have more significant negative impacts due to trenching via permafrost thaw and altered hydrology than areas with continuous permafrost, which is more stable (MP 0 - 168).

Particularly in areas lacking an insulating mat of vegetation, such as the proposed Project's trench line, repeated frost action could result in cryoturbation. In areas of low centered polygons, the ice wedges between the polygons may extend from a few feet to 20 feet or more in depth. When surface hydrology alters the availability of water for the ice wedges, the result may become high centered polygons with deep fissure between them, which could expose a pipeline. This is likely to alter vegetative communities towards a dryer regime. In areas with large rocks mixed with finer material, the frost action may create sorted circles, in which the larger stones are forced upwards to the surface and may disrupt buried objects. In areas of very coarse material (*e.g.*, along

rivers and deltas), there may be no permafrost and very little vegetation, so disturbance is less likely to have long lasting impacts (Geisler, 2012; Rieger *et al.,* 1979).

Backfilling includes cleaning the trench of debris before pipeline placement, and then adding fill with excavated material after pipeline installation. Fine-grained material may be used as fill to surround the pipe. The placement of original excavated material near the surface would be beneficial for vegetation establishment. After trenching, pipe lowering in, and backfilling any compacted areas would be tracked to mitigate the compaction effects of the excavator and associated traffic, graded to facilitate drainage, covered with any available growth media (surface layer material), and scarified to allow natural revegetation by native plants (Mitigation Measure No. 2). Additionally, disturbed soils, such as soils and gravels backfilled above trenches, are particularly vulnerable to establishment of non-native, invasive, and noxious plant species.

The slope over the crown above the trench and backfilled area is critical to stabilizing soils and directing ponding, thereby mitigating some erosion and drainage impacts (Mitigation Measure No. 3). The remaining spoil material not used for backfilling and crowning would be feathered and blended across the construction corridor, creating a roughened surface to capture precipitation, decrease erosion, and provide safe sites for plant establishment.

Re-contouring the trenched and backfilled area would be done in a way to emphasize the use of existing drainage patterns and landform types to blend with and be compatible with the surrounding landscape to the extent practicable (Mitigation Measure No. 4).

OC trenching and backfilling would have the greatest impacts to areas with discontinuous permafrost (MPs 168 - 634) because of the potential for permafrost thaw and altered hydrology; these ecoregions include the Brooks Range, Kobuk Ridges and Valleys, Ray Mountains, Tanana-Kuskokwim Lowlands, and Yukon-Tanana Uplands. The Beaufort Coastal Plain ecoregion would also be greatly impacted because of the short growing season and time it would take for the tundra vegetation to recover.

Impacts to vegetation due to OC trenching during construction of the pipeline ROW is considered major throughout the entire Project, as it would result in direct loss and disturbance to the vegetation communities through crushing, covering, compaction, and/or altered hydrology along the pipeline route. This would result in habitat loss in areas where the trench line does not revert to its original vegetation regime. Disturbance to the rootstock in trenched areas would not recover in one growing season; herbaceous and scrub/shrub communities may recover in 5 to 20 years (ADF&G, 2001), but forested communities would not be allowed to recover in the permanent operations ROW. Vegetation communities in the southern latitudes of the proposed Project, such as the Cook Inlet Basin and Alaska Range ecoregions, would recover faster than the more northern ecoregions such as the Beaufort Coastal Plain and the Brooks Foothills because of differences in daylight, temperature, and the length of the growing season.

4.8.4.1.1.4. Habitat Fragmentation

Fragmentation is the disruption of continuity (Lord and Norton, 1990), and habitat fragmentation is the splitting of larger habitat blocks into smaller, less continuous habitat, primarily by human disturbances, such as land clearing and conversion of one vegetation type to another (Franklin *et al*., 2002). Linear construction projects, such as the proposed Project, could divide continuous vegetation communities and increase edge habitat (Watson, 2005). Increases in edge habitat could facilitate invasive plant establishment and proliferation, which could substantially alter environmental conditions such as soil temperature and light availability (*e.g.,* Brothers and Spingarn, 1992). Habitat fragmentation and its impacts to wildlife are discussed in detail in Section 4.10, Wildlife.

The current pipeline alignment would be primarily located outside of existing ROWs, with co-location being minimal.The pipeline would be buried (except at fault zones, elevated bridge stream crossings, pigging facilities, and block valve locations) at the appropriate depth for USDOT standards for the majority of its length, and the landscape would be contoured to a pre-construction form. Effects from fragmentation could take decades to recover. Impacts would be dependent on the ability and length of time for preexisting vegetation to reestablish. Fragmentation effects would be most likely to occur and would be more significant in forested and shrubland areas, because the ROW would be maintained (*i.e.,* regularly mowed/cleared) to a non-forested state. Clearing the ROW for construction through forested areas would reduce the habitat structure to herbaceous cover. If non-native, invasive, and/or noxious plants species establish in the ROW, fragmentation may be permanent; however, mitigation measures would be put into place to minimize the introduction and spread of non-native and invasive species (Mitigation Measure No. 10). Rehabilitation of forested vegetation in the construction ROW and TWs outside of the permanent ROW would be very slow (*i.e.,* hundreds of years) to recover to reach a mature forested state. Forest vegetation loss may be permanent, or the species composition may change. The proposed Project would result in less fragmentation of habitat if it was co-located with existing ROWs (*e.g.,* TAPS).

Construction of 298 new gravel access roads (174.4 miles in total) would create permanent fragmentation impacts to forested vegetation and the wildlife that depends on it. Habitat fragmentation would impact sensitive species or species less tolerant to habitat discontinuity, especially in forested areas of the proposed Project. In areas where a lease is required from the SPCS, where the leased area crosses roads, a screen of native vegetation would be established over the disturbed areas unless otherwise approved by the SPCS. The proposed pipeline would be located so as to provide a buffer of undisturbed land at least 500 feet wide between the pipeline and the streams, unless otherwise approved. Undisturbed vegetative screens at least 500 feet wide would be maintained between material sites and highways unless otherwise approved.

Impacts due to OC trenching are discussed above in Section 4.8.4.1.1.3. Trenching could result in habitat fragmentation throughout the Project.

The impacts to vegetation due to OC trenching and the resulting habitat fragmentation during construction of the pipeline ROW is considered major throughout the entire Project. It would result in direct disturbance to the hydrology of the trench and surrounding area, especially in discontinuous permafrost areas, and the community structures of forested and scrub/shrub areas throughout the corridor, which could not be reversed in one growing season. Trenching in the permafrost regions would result in permafrost damage and altered hydrology. Disturbance to the rootstock in trenched areas would not recover in one growing season; herbaceous and scrub/shrub communities may recover in 5 to 20 years (ADF&G, 2001), but forested communities would not be allowed to recover in the permanent operations ROW. Vegetation communities in the southern latitudes of the proposed Project, such as the Cook Inlet Basin and Alaska Range ecoregions, would recover faster than the more northern ecoregions such as the Beaufort Coastal Plain and the Brooks Foothills due to the difference in daylight, temperature, and the length of the growing season. Construction of the proposed Project would result in a long-term conversion of forested land. Herbaceous communities would not experience as great of an impact as forested and scrub/shrub communities as herbaceous species generally have faster growth rates than shrubs and tree species. In addition to habitat fragmentation, non-native, invasive, and noxious species introduction is also a possible outcome of habitat fragmentation. If non-native, invasive, or noxious species are allowed to establish in the ROW, habitat fragmentation may be permanent.

4.8.4.1.1.5. Dust Deposition

Dust deposition could impact vegetation adjacent to the construction ROW, primarily from hauling backfill and lining material to the construction areas, and from crew vehicles accessing the construction sites daily. Dust would be generated from development of new gravel access roads and the use of existing gravel roads. Mitigation measures (Mitigation Measure No. 5), BMPs, and the Project's Fugitive Dust Control Plan (Appendix S) would be implemented to reduce dust impacts to vegetation and other resources. Gravel would be placed as fill to construct access roads, and the transportation of gravel with heavy trucks from material sites to road construction areas would create dust deposition onto the surrounding area. Heavy vehicle use on existing gravel roads, including dump trucks, would introduce more dust into the air than regular passenger vehicles. Additionally, numerous trips would be made between the material sites and the construction areas. Dust deposition would be greater during the summer months due to the dryer conditions and exposure of gravel on the road versus snow and ice. Dust would be produced at material sites from the mining of gravel and sand, which would potentially land on surrounding vegetation. However, these impacts would be localized and temporary in most instances, because of the construction sequence of the proposed Project. The ROW would be constructed and rehabilitated in sequence along the pipeline in segments. Impacts from the construction of the ROW would be expected to be temporary and localized to the construction activity for that segment of the proposed Project.

Long-term dust deposition could potentially cause thermokarst effects in permafrost areas along access roads. Melting snow along roadsides is accelerated as dust is deposited over time. Thermokarst areas cause a depression in the ground from thawing permafrost, which could alter vegetation growth and species composition. Impacts would occur by pipeline segment and season, as the proposed Project is constructed. Impacts would depend on dust particle size, wind processes, wetting of the ground, duration and frequency of traffic, and speed of travel. Dust deposition could extend beyond the construction ROW and could interfere with plant photosynthesis and respiration (Farmer, 1993; Prajapati, 2012). USFWS notes that on the Beaufort Coastal Plain, impacts from dust can extend to distances of 100 to 300 feet, depending on road direction and prevailing winds (USFWS, 2017b). The magnitude and duration of dust deposition dictates the intensity of potential impacts (Auerbach *et al.*, 1997), and in extreme cases, leads to the loss of more sensitive species, altering the composition of the plant community.

Dust deposition in the construction ROW would result in temporary, local impacts to vegetation communities. AGDC conducted a fugitive dust impacts analysis to calculate an acreage estimate for vegetation. The analysis conservatively assumes that dust can travel up to 50 feet from gravel roads and up to 350 feet from material sites depending on the prevailing wind direction (Auerbach *et al.*, 1997; Walker *et al.*, 1980; Western Regional Climate Center, 2002; Alaska Energy Authority [AEA], 2014). AGDC estimates that 7,629 acres of vegetation would be impacted by dust from proposed Project features. AGDC would implement BMPs during construction to reduce the impacts of fugitive dust (Section 4.22, Air Quality, Climate Change, and Greenhouse Gas Emissions).

Because dust deposition is a particular concern in permafrost areas, dust deposition would have greater impacts to ecoregions with continuous or discontinuous permafrost. Ecoregions with continuous or discontinuous permafrost from north to south include the Beaufort Coastal Plain, Brooks Foothills, Brooks Range, Kobuk Ridges and Valleys, Ray Mountains, Tanana-Kuskokwim Lowlands, and Yukon-Tanana Uplands.

The impacts to vegetation due to dust deposition during construction of the pipeline ROW is considered moderate in ecoregions with permafrost and minor in ecoregions without permafrost as it could result in direct loss and disturbance to vegetation, but only in localized areas of construction work (*i.e.,* access roads, material sites, and existing gravel roads). Dust deposition resulting from gravel transport in uncovered trucks could contribute to long-term dust deposition, which could in turn result in permafrost thermokarsting or the loss of sensitive species. These impacts could not be reversed in one growing season and may continue for the life of the proposed Project.

4.8.4.1.1.6. Soil Compaction and Erosion

Construction of the ROW may compact soils along the construction area from heavy equipment use, which could inhibit seed germination, reduce water infiltration, inhibit

root establishment, and result in bare soil exposure. Construction activities during the rainy periods could cause rutting where water would pool and delay seed germination and growth. Rehabilitation of the area during post construction would contour the ROW to pre-construction contours for optimal vegetation establishment and seed germination.

Installation of erosion control barriers and timber mats would be required when vehicles are accessing the ROW to mitigate such impacts. Maintaining the natural soil strata would be an important aspect when backfilling the trench. In agricultural areas and in select continuous and discontinuous permafrost areas and non-permafrost areas (as discussed in the AGDC planning document, *Segregation of the Surface Layer* [AGDC, 2017g], and in the Revegetation Plan, Appendix E, Part I), subsoil would be placed in the trench first and covered with the surface layer to maintain the natural strata and improve rehabilitation success of the vegetation community. Effects and mitigation for soil damage and erosion is further discussed in Section 4.6, Soils and Geology.

Erosion issues could be substantially greater in areas with continuous or discontinuous permafrost soils, such as MPs 0 - 634; trenching the pipeline here could cause major impacts to the soils and geology of the region, as discussed in Section 4.6, Soils and Geology. Ecoregions with continuous or discontinuous permafrost could have major impacts to vegetation because of the potential impacts to soils, geology, and altered hydrology (see Section 4.6, Soils and Geology). Impacts to vegetation due to soil compaction and erosion during construction of the pipeline ROW is considered moderate in areas with discontinuous or lacking permafrost, as it would result in direct disturbance to vegetation potentially in widespread areas, and would likely not be reversed within the same construction season through rehabilitation measures. If soils were unstable or were not de-compacted prior to revegetation efforts, native seeds would struggle to germinate, root establishment would be hindered, and water infiltration of the soil would be reduced.

Prior to revegetation, soils would be de-compacted to allow easier penetration of water and roots (Mitigation Measure No. 6). Construction plans of the Mainline would be coordinated with both state and federal agencies to minimize disturbance.

4.8.4.1.1.7. Non-Native, Invasive, and Noxious Plants

Non-native plants found in Alaska are primarily correlated with anthropogenically disturbed areas (*e.g.*, roads, trails, recreation sites, and gravel pits). AKNHP (2011b) documented that 70 percent of recorded infestations of non-native plants were due to fill importation projects, 2.4 percent and 1.7 percent for mowing and material extraction, respectively. Most infestations found in Alaska are relatively small (<0.01 acres) because they are associated with anthropogenic activities, which could be eradicated (AKNHP, 2011b). Proposed Project construction could propagate non-native, invasive, and/or noxious plants through several pathways. However, propagation would likely be limited to the area of disturbance, which would be rehabilitated. The Project would utilize mitigation measures to minimize the introduction and spread of non-native and

invasive species (Mitigation Measure No. 10). These potential propogation pathways include:

- Spread of non-native, invasive, and noxious plants already associated with existing ROWs (*i.e.,* Alaska Railroad Corporation [ARRC], TAPS, and highways) by construction equipment, personnel, and waterways;
- Transport of non-native, invasive, and noxious plant material from other areas within the state or outside of Alaska via machinery, footwear and clothing, hand tools, vehicle tires, and waterways;
- Pollinators such as bees and birds; and
- Seed mixtures used to revegetate exposed soils could contain non-native, invasive, and noxious plants seeds. However, mixtures have a maximum allowable weed seed limit.

Non-native, invasive, and noxious plants are documented along much of the Dalton Highway and the George Parks Highway (AKNHP, 2011c). In areas along the proposed ROW that are associated with existing ROWs (*i.e.,* ARRC, TAPS, and highways), this could create further invasion of these plants. The majority of the proposed Project would be near (but not within) these transportation corridors, and the spread of invasive plants could occur throughout the proposed Project's construction workspace. According to AKEPIC data, there have been significantly more non-native plants documented along the Dalton Highway between the northern foothills of the Brooks Range and Livengood (Figure 3.4-1 in Section 3.4, Vegetation). Fewer non-native plants have been noted along the Parks Highway between Fairbanks and Willow.

The prohibited noxious weed species known to occur within the 10-mile wide corridor include quackgrass (*Elymus repens*), orange hawkweed (*Hieracium aurantiacum*), and field sowthistle (*Sonchus arvensis*); the restricted noxious weed species include butter and eggs (*Linaria vulgaris*), common plantain (*Plantago major*), annual bluegrass (*Poa annua*), and bird vetch (*Vicia cracca* spp. *cracca*).

Invasive plants are aggressive in growth and reproduction, are generalists, and are tolerant to many environmental conditions. Thus, they outcompete and displace native plants once exposure allows establishment. This causes a reduction in biological diversity and community composition. Changes in the composition of vegetation could in turn affect wildlife that inhabits these areas (Section 4.10, Wildlife).

The introduction of non-native, invasive, or noxious plant species would have similar impacts to all ecoregions crossed with the pipeline ROWs.

The impacts to vegetation due to the introduction or propagation of non-native, invasive, or noxious plant species during construction of the pipeline ROW is considered moderate as it would result in direct disturbance to the vegetation communities in the localized areas of introduction or propagation along the proposed Project Area. It is unlikely that an infestation could be reversed in one growing season. If

these species were allowed to invade the proposed Project Area, additional effects could occur, including direct loss of native vegetation and habitat fragmentation.

Construction plans of the Mainline would be coordinated with both state and federal agencies to minimize disturbance. AGDC would develop a framework for preventing spatial dispersal of invasive plants, which could result from access road construction and use. Considerations would include seed sources, preventative measures, and monitoring and eradication procedures. Before any construction activities, any equipment brought in from outside of Alaska would be thoroughly decontaminated upon entering Alaska; any equipment stored in Alaska would be likewise decontaminated before any construction activities (Mitigation Measure No. 10).

4.8.4.1.1.8. Rehabilitation and Revegetation

A SWPPP would be developed in coordination with applicable federal and state agencies (*e.g.,* ADNR Plant Materials Center [PMC], BLM, Division of Agriculture [DOA]) and would be approved prior to proposed Project construction begins. A Revegetation Plan has been developed by AGDC and is included as Appendix E, Part I. These plans would identify appropriate rehabilitation and revegetation measures.

Section 2.1.3 of the Revegetation Plan (Appendix E, Part I) describes which areas and when these areas would receive rehabilitation and revegetation treatments. The temporary/construction ROW is anticipated to be revegetated in its entirety. The permanent/operations ROW would not be revegetated until the proposed Project is dismantled and removed. Initial rehabilitation includes cleanup of remnant debris and finish grading to pre-construction contours as much as possible, after construction is complete. After construction is complete, soil compaction and erosion control would be maintained by the use of low-ground pressure vehicles, and permanent erosion control measures would be installed as required. Rehabilitation work would occur during a rain-free period to prevent rutting from vehicles, since rutting would cause pooling of water, prevention of seed germination, and later, additional erosion.

Revegetation measures, as described in the Revegetation Plan (Appendix E, Part I), would be implemented to promote the establishment of vegetation within the proposed Project Area throughout the life of the proposed Project. The methods used to revegetate the ROW would be determined by site-specific conditions; not all revegetation or rehabilitation techniques would be successful for all vegetation communities and ecoregions. Site-specific rehabilitation and revegetation measures discussed in the Revegetation Plan include:

- Soil de-compaction methods;
- Erosion control and slope stabilization methods;
- Seedbed preparation;
- Seed species composition and application rates;

- Seed application methods (hydroseeding, aerial distribution, or hand methods);
- Wild seed collection if commercial sources are unavailable;
- Mulch requirements, composition, and application rates;
- Fertilizer application if 30 percent vegetative cover over a 3-year period does not occur;
- Long-term vegetation maintenance and monitoring requirements; and
- Identification of additional site treatment options if initial revegetation efforts are unsuccessful.

Specific documents that may be used to supplement the Revegetation Plan include:

- The Alaska Coastal Revegetation and Erosion Control Guide (Wright and Czapla, 2010);
- Assessment of Erosion and Plant Cover on the TAPS Right-of-Way and Evaluation of Gasline and Pump Stations (ADNR, 2013b);
- Interior Alaska Revegetation & Erosion Control Guide (Czapla and Wright, 2012);
- Strategic Plan for Invasive Weed and Agricultural Pest Management and Prevention (ADNR, 2011c);
- Native Plant Revegetation Manual for Denali National Park and Preserve (Densmore *et al.*, 2000); and
- NPS Invasive Plant Management Plan (NPS, 2009a).

The speed of vegetation recovery during post-rehabilitation would be influenced primarily by the ecoregion, if the underlying soils have permafrost, surrounding vegetation community, construction season, and the efficacy of restoration efforts.

Several public and agency comments on the 2012 FEIS expressed concern regarding seed species that would be used in revegetation efforts. Seed mixtures approved by DOA, ADNR PMC, and other applicable agencies would be used for reestablishment of the vegetation growth in disturbed areas. This could include the use of annual ryegrass or another non-native species that may be required for temporary slope stabilization, erosion control, or as a cover crop. However, native seed species would be used as much as possible and practicable in accordance with the primary mission of the PMC. The seed mixtures would be chosen from those which have been tested and for which the species are appropriate for the revegetation efforts and are adapted for success in Alaska. Additionally, seed mixtures would be certified (in accordance with the Federal Seed Act of 1939 [7 CFR 201]) to minimize the use of invasive or noxious weed species. The Federal Seed Act and associated certification standards were established to maintain seed cultivar integrity and places maximum limits on allowable weed seeds, weed plant parts, and foreign material in a unit of seed. The standards establish how "clean seed" is

defined. Commercially sold seed in the U.S. is labeled with test results for germination and purity information, including the percentage of weeds and contaminants.

Mitigation measures associated with the rehabilitation and revegetation work discussed in the Revegetation Plan (Appendix E, Part I) include Mitigation Measure Nos. 7 through 9, as listed in Section 4.8.3.

Rehabilitation and revegetation activities would have similar impacts to all ecoregions crossed with the pipeline ROWs.

If the surface layer were segregated and replaced as the topmost layer, revegetation may require less effort. The geographic extent of revegetation may be reduced because some areas may not need any additional revegetation treatments if the surface layer is replaced. The magnitude/intensity and duration would be reduced because less seed, fertilizer, time, and effort would be needed for revegetating the majority of the trench line. Native, site-specific species would likely return to the trench faster if the site-specific surface layer was replaced. It is reasonable to assume that less revegetation work would also likely mean there would be less traffic along the pipeline and less potential for the introduction of invasive and non-native vegetation species.

The impacts to vegetation due to rehabilitation and revegetation activities during the post-construction period in the pipeline ROW is considered minor, as it would only result in loss and disturbance to vegetation or introduction of non-native, invasive, or noxious species if improper techniques or seed mixes were used during rehabilitation or revegetation efforts. Impacts would be localized to those areas of the ROW where improper techniques or seed mixes were used. It is unlikely that an infestation of non-native, invasive, or noxious plants could be reversed in one growing season.

Methods for rehabilitation and revegetation efforts are included in more detail in the Revegetation Plan (Appendix E, Part I). Construction plans of the Mainline would be coordinated with both state and federal agencies to minimize disturbance.

4.8.4.1.1.9. Spills and Contaminants

The proposed Project has potential to release spills of contaminants into the environment during construction. If spills occur on vegetation, the vegetation is expected to die. Potential spills on terrestrial vegetation would be localized, but their magnitude and intensity would depend on their size; the larger the spill the greater the impact to vegetation and ecosystem. More information regarding potential releases of contaminants is included in Section 4.25, Reliability and Safety.

4.8.4.1.2. Gas Conditioning Facility

4.8.4.1.2.1. Gravel Fill

Gravel fill would be placed on tundra vegetation to construct the GCF. The placement of gravel fill on vegetation would result in a direct and permanent loss of the vegetation. The GCF pad would directly impact approximately 90.6 acres of wetland tundra

vegetation with its gravel fill. The GCF's access road and GCF camp would impact an additional 77.3 acres of wetland tundra vegetation with its gravel fill. No upland tundra vegetation exists within the proposed footprint of the GCF, its camps, or its access roads. Gravel fill for other proposed Project components are discussed in Section 4.8.4.1.1.1, Gravel Fill.

The impacts to vegetation due to placement of gravel fill during the construction phase would be moderate, as it would result in the direct and permanent loss of the vegetation. Impacts would be localized to the site of the GCF, where fill is placed in on vegetation.

4.8.4.1.2.2. Dust Deposition

Dust deposition could impact vegetation adjacent to the GCF, primarily from hauling gravel to the pad and access road construction areas, and from crew vehicles accessing the construction sites daily. Dust would be generated from development of the gravel pad for the GCF. Numerous trips would be made between the material sites and the construction areas. Dust deposition would be greater during the summer months due to the dryer conditions and exposure of gravel on the road versus snow and ice. Dust would be produced at material sites from the mining of gravel and sand, which would potentially land on surrounding vegetation. However, these impacts would be localized and temporary because of the construction sequence of the proposed Project. Impacts would depend on dust particle size, wind processes, wetting of the ground, duration and frequency of traffic, and speed of travel. Dust deposition could extend beyond the GCF and could interfere with plant photosynthesis and respiration. USFWS notes that on the Beaufort Coastal Plain, impacts from dust can extend to distances of 100 to 300 feet, depending on road direction and prevailing winds (USFWS, 2017b). The magnitude and duration of dust deposition dictates the intensity of potential impacts (Auerbach *et al.,* 1997), and in extreme cases, leads to the loss of more sensitive species, altering the composition of the plant community.

Dust deposition around the GCF would result in temporary, local impacts to vegetation communities. AGDC would implement BMPs during construction to reduce fugitive dust (Section 4.22, Air Quality, Climate Change, and Greenhouse Gas Emissions).

The impacts to vegetation due to dust deposition during construction of the GCF is considered moderate as it could result in direct loss and disturbance to vegetation, but would be localized to areas of construction work (*i.e.,* access road, material site, and existing gravel roads). If not properly controlled with mitigation measures (*e.g.,* road watering and covering gravel loads in trucks), long-term dust deposition could result in thermokarsting of permafrost or the loss of sensitive species, which could not be reversed in one growing season and may continue for the life of the proposed Project.

Construction plans of the GCF would be coordinated with both state and federal agencies to minimize disturbance.

4.8.4.1.2.3. Non-Native, Invasive, and Noxious Plants

Non-native, invasive, or noxious plants could be introduced to the GCF area during construction phases of the proposed Project by several potential pathways:

- Spread of non-native, invasive, and noxious plants already associated with existing ROWs (*i.e.,* ARRC, TAPS, and highways) by construction equipment, personnel, and waterways;
- Transport of non-native, invasive, and noxious plant material from other areas within the state or outside of Alaska via machinery, footwear and clothing, hand tools, vehicle tires, and waterways;
- Pollinators such as bees and birds; and
- Seed mixtures used to revegetate exposed soils could contain non-native, invasive, and noxious plant seeds. However, mixtures have a maximum allowable weed seed limit.

Currently, there are no documented non-native plants in the Prudhoe Bay and Deadhorse area (ACCS, 2016).

The impacts to vegetation due to the introduction or propagation of non-native, invasive, or noxious plant species during construction of the GCF is considered moderate as it would result in direct disturbance to the vegetation communities in the localized areas of introduction or propagation at the GCF. It is unlikely that an infestation could be reversed in one growing season. If these species are allowed to invade the proposed Project Area, additional effects could occur including direct loss of native vegetation and habitat fragmentation.

4.8.4.1.3. Yukon River Crossing (HDD)

In the proposed Action (Alternative 1), HDD methods would be utilized to cross the Yukon River. An entry and exit pad for HDD equipment would be constructed for temporary use on either side of the river, which is included in the temporary construction ROW footprint discussed above in Section 4.8.4.1.1, Pipeline ROW – Mainline and Fairbanks Lateral. All activities with impacts to vegetation at the HDD Yukon River Crossing are discussed previously.

4.8.4.1.4. West Dock (Dock Head 3) and Causeway Upgrades

Gravel fill placement, dredging and screeding activities proposed at DH3 of West Dock would impact 159.3 acres of sea floor in Prudhoe Bay (59.3 acres of dredged area and 100 acres at the dredge placement area). The benthic community, including possible kelp vegetation, would be lost during the proposed Project work. However, the extent of vegetation around West Dock is likely minimal because of frequent ice scouring action and continual movement of fine sediments, which hinders growth of marine vegetation in this area. Additionally, dredging would occur during the winter, when kelp is least photosynthetically active. For this reason, impacts to vegetation in this area would be

negligible. The proposed Project work is located away from the boulder patch in Prudhoe Bay, so no impacts to the boulder patch are anticipated. Impacts to the benthic community are discussed in Section 4.13, Benthic.

4.8.4.2. Operations and Maintenance

4.8.4.2.1. Pipeline ROW – Mainline and Fairbanks Lateral

4.8.4.2.1.1. Mowing

Mowing the vegetation overstory of the operations ROW would occur, as needed, on a regular basis to allow for visual inspections of the pipeline from aerial patrols. Impacts from mowing herbaceous vegetation would not constitute a substantial additional negative impact to that vegetation type, since vegetation would potentially grow denser as it is trimmed to maintain a low ground cover. Maintenance of the ROW would occur during dryer months when rutting and erosion from equipment would be less likely to occur. Mowing in the pre-nesting or post-nesting season would prevent additional impacts to wildlife such as nesting migratory birds (Section 4.10, Wildlife). The spread of invasive plant species could occur from transporting and traversing mowing equipment from one location to another along the ROW.

4.8.4.2.1.2. Habitat Fragmentation

Operations and maintenance also may cause habitat fragmentation. If roads were constructed without proper drainage (culverts) or without proper maintenance of culverts, the hydrology would be altered and could conceivably result in habitat fragmentation. BMPs for culvert placement are discussed in Sections 4.7.3 and 4.11.3, respectively. This impact may occur slowly over several years.

The impacts to vegetation due to habitat fragmentation during operations activities of the pipeline ROW is considered minor as it could result in direct loss and disturbance to vegetation, but only in localized areas of operations work (*i.e.,* access roads and existing gravel roads). If not properly controlled with mitigation measures (*e.g.,* culvert and road maintenance), long-term neglect could result in the loss of sensitive species, which cannot be reversed in one growing season and may continue for the life of the proposed Project.

4.8.4.2.1.3. Dust Deposition

Regular vehicle use during operations of the proposed Project would also create dust along roadsides and facilities. However, dust generation during operations would be significantly less than how much would be created during construction activities, because there would be less vehicle traffic during operations. An enforceable road maintenance plan and on-site driving rules would aid in reducing dust deposition surrounding roads and facilities. During operations, long-term dust deposition could potentially cause thermokarst effects in permafrost areas along access roads. Melting snow along roadsides is accelerated as dust is deposited over time. Thermokarst areas

cause a depression in the ground from thawing permafrost, which could alter vegetation growth and species composition. Accelerated snowmelt along roadsides exposes vegetation earlier than surrounding non-dusted vegetation, which could attract wildlife near the road, potentially causing increased mortality from vehicle collisions (Section 4.10, Wildlife). Additional information regarding dust generation and applicable minimization measures are discussed further in Section 4.22, Air Quality, Climate Change, and Greenhouse Gas Emissions.

Because dust deposition is a particular concern in permafrost areas, dust deposition would have greater impacts to ecoregions with continuous or discontinuous permafrost. Ecoregions with continuous or discontinuous permafrost from north to south include the Beaufort Coastal Plain, Brooks Foothills, Brooks Range, Kobuk Ridges and Valleys, Ray Mountains, Tanana-Kuskokwim Lowlands, and Yukon-Tanana Uplands.

The impacts to vegetation due to dust deposition during operations activities of the pipeline ROW is considered moderate in ecoregions with permafrost and minor in ecoregions without permafrost as it could result in direct loss and disturbance to vegetation, but only in localized areas of operations work (*i.e.,* access roads and existing gravel roads). If not properly controlled with mitigation measures (*e.g.,* road watering and covering gravel loads in trucks [Mitigation Measure No. 5]), long-term dust deposition could result in thermokarsting of permafrost or the loss of sensitive species, which cannot be reversed in one growing season and may continue for the life of the proposed Project.

Operations activity plans of the Mainline would be coordinated with both state and federal agencies to minimize disturbance.

4.8.4.2.1.4. Soil Compaction and Erosion

Operations activities in the ROW may compact soils from heavy equipment use, which could inhibit seed germination, reduce water infiltration, inhibit root establishment, and result in bare soil exposure (Czapla and Wright, 2012). Operations and maintenance activities during the rainy periods could cause rutting where water would pool and delay seed germination and growth. Maintenance activities such as mowing should occur during dry periods to limit rutting. If an area requires extensive heavy equipment use for maintenance activities, rig mats or other ground protecting methods should be considered. Effects and mitigation for soil damage and erosion is further discussed in Section 4.6, Soils and Geology.

Soil compaction and erosion would have similar impacts to all ecoregions crossed with the pipeline ROWs.

The impacts to vegetation due to soil compaction and erosion during operations of the pipeline ROW is considered minor as the initial soil disturbance impacts would have already been accounted for during construction. Construction soil disturbance activities would result in direct disturbance to vegetation in widespread areas, and would not be reversed within the same season.

Prior to revegetation, soils would be de-compacted to allow easier penetration of water and roots (Mitigation Measure No. 6).

4.8.4.2.1.5. Non-Native, Invasive, and Noxious Plants

Non-native, invasive, or noxious plants could be introduced to the ROW area during operation and maintenance of the proposed Project by several potential pathways:

- Spread of non-native, invasive, and noxious plants already associated with existing ROWs (*i.e.,* ARRC, TAPS, and highways) by construction equipment, personnel, and waterways;
- Transport of non-native, invasive, and noxious plant material from other areas within the state or outside of Alaska via machinery, footwear and clothing, hand tools, vehicle tires, and waterways;
- Pollinators such as bees and birds; and
- Seed mixtures used to revegetate exposed soils could contain non-native, invasive, and noxious plant seeds. However, mixtures have a maximum allowable weed seed limit.

The introduction of non-native, invasive, or noxious plant species would have similar impacts to all ecoregions crossed with the pipeline ROWs.

The impacts to vegetation due to the introduction or propagation of non-native, invasive, or noxious plant species during operations of the pipeline ROW is considered moderate as it would result in direct disturbance to the vegetation communities in the localized areas of introduction or propagation along the proposed Project Area. It is unlikely that an infestation could be reversed in one growing season. If these species are allowed to invade the proposed Project Area, additional effects could occur, including direct loss of native vegetation and habitat fragmentation.

4.8.4.2.1.6. Spills and Contaminants

The proposed Project has potential to release spills of contaminants into the environment during operations and maintenance. If spills occur on vegetation, the vegetation is expected to die. Potential spills on terrestrial vegetation would be localized, but their magnitude and intensity would depend on their size; the larger the spill the greater the impact to vegetation and ecosystem. More information regarding potential releases of contaminants is included in Section 4.25, Reliability and Safety.

4.8.4.2.2. Gas Conditioning Facility

4.8.4.2.2.1. Dust Deposition

Regular vehicle use during operations of the proposed Project would also create dust at the GCF. However, dust generation during operations would be significantly less than how much would be created during construction activities, because there would be less

vehicle traffic during operations. On-site driving rules would aid in reducing dust deposition surrounding roads and facilities. During operations, long-term dust deposition could potentially cause thermokarst effects in permafrost areas along access roads. Melting snow along roadsides is accelerated as dust is deposited over time. Thermokarst areas cause a depression in the ground from thawing permafrost, which could alter vegetation growth and species composition. Accelerated snowmelt along roadsides exposes vegetation earlier than surrounding non-dusted vegetation, which could attract wildlife near the road, potentially causing increased mortality from vehicle collisions (Section 4.10, Wildlife). Additional information regarding dust generation and applicable minimization measures are discussed further in Section 4.22, Air Quality, Climate Change, and Greenhouse Gas Emissions.

The impacts to vegetation due to dust deposition during operations of the GCF is considered moderate as it could result in direct loss and disturbance to vegetation, in localized areas of operations work (*i.e.,* access road and existing gravel roads). If not properly controlled with mitigation measures (*e.g.,* road watering and covering gravel loads in trucks [Mitigation Measure No. 5]), long-term dust deposition could result in thermokarsting of permafrost or the loss of sensitive species, which could not be reversed in one growing season and may continue for the life of the proposed Project.

4.8.4.2.2.2. Non-Native, Invasive, and Noxious Plants

Non-native, invasive, or noxious plants could be introduced to the GCF area during operation and maintenance of the proposed Project by several potential pathways:

- Spread of non-native, invasive, and noxious plants already associated with existing ROWs (*i.e.,* ARRC, TAPS, and highways) by construction equipment, personnel, and waterways;
- Transport of non-native, invasive, and noxious plant material from other areas within the state or outside of Alaska via machinery, footwear and clothing, hand tools, vehicle tires, and waterways;
- Pollinators such as bees and birds; and
- Seed mixtures used to revegetate exposed soils could contain non-native, invasive, and noxious plant seeds. However, mixtures have a maximum allowable weed seed limit.

The impacts to vegetation due to the introduction or propagation of non-native, invasive, or noxious plant species during operations of the GCF is considered moderate as it would result in direct disturbance to the vegetation communities in the localized areas of introduction or propagation at the GCF. It is unlikely that an infestation could be reversed in one growing season. If these species are allowed to invade the proposed Project Area, additional effects could occur including direct loss of native vegetation and habitat fragmentation.

Operations activity plans of the GCF would be coordinated with both state and federal agencies to minimize disturbance.

4.8.4.2.3. Yukon River Crossing (HDD)

The HDD crossing at the Yukon River is within the permanent operations ROW, so there would be no additional impacts to vegetation at this location besides those listed above for the pipeline ROW during the operations and maintenance phase of the proposed Project. The HDD entry and exit pads would be constructed using gravel fill; the ROW at the HDD entry and exit points would be cleared, grubbed, and graded; dust may be deposited; there may be soil compaction and erosion; and non-native and invasive species may be introduced.

4.8.4.2.4. West Dock (Dock Head 3) and Causeway Upgrades

West Dock would only be used for the proposed Project during construction phases; therefore, no operational phase impacts would occur.

4.8.5. Alternative 2 – Denali NPP Route Variation

Alternative 2 of the proposed Project is described in Chapter 2 in detail. The 36-inch, 733-mile-long pipeline and 12-inch, 30-mile lateral pipeline to Fairbanks would cross various habitats and ecoregions from the North Slope to the existing ENSTAR pipeline system in the Mat-Su Borough. This section discusses the analysis of impacts to vegetation along the route.

Alternative 2 would intersect vegetation communities and land cover types in a wide variety of ecoregions in Alaska, described in Chapter 3.

The following sections discuss activities that are proposed to occur during the construction, operations, and maintenance phases of the proposed Project with associated potential impacts.

4.8.5.1. Construction

A total of 17,137.12 acres of vegetated land would be permanently impacted in Alternative 2 with construction of the ROW and proposed Project features. Alternative 1 would permanently impact slightly more vegetated land, 17,187.62 acres. Table 4.8-4 shows acres of vegetation per ecoregion that would be permanently or temporarily impacted by Alternative 2. In Alternative 2, approximately 25.1 percent of the vegetation that would be permanently impacted is shrub/scrub, 23.9 percent is evergreen forest, 11.9 percent is dwarf shrub, 11.1 percent is sedge/herbaceous, 11.2 percent is deciduous forest, 11.1 percent is mixed forest, 2.7 percent is woody wetland, 1.7 percent is grassland/herbaceous, 1.2 percent is emergent herbaceous wetlands, and cultivated crops and pasture/hay are each less than 0.1 percent.

4.8.5.1.1. Pipeline ROW – Mainline and Fairbanks Lateral

Impacts to vegetation along the Fairbanks pipeline ROW during construction are the same as those discussed above in Alternative 1, except where the Alternative 2 differs from the Alternative 1: the Denali NPP Route Variation, using DH2 instead of DH3, the aerial Yukon River Crossing, and the first 62 miles where the pipeline would be suspended on VSMs rather than buried. These differences are discussed in detail in the following sections.

4.8.5.1.1.1. Gravel Fill and VSMs

Impacts to vegetation due to the placement of gravel fill during construction of the proposed Project for access roads, camps, PSYs, facility pads, and HDD entry and exit pads are the same as those discussed above in Alternative 1 for the pipeline route except for the first 62 miles where the pipeline would be suspended on VSMs. In Alternative 2, 7 miles of the pipeline ROW is located within Denali NPP, instead of to the east of the park, as proposed in Alternative 1. The placement of gravel fill on vegetation would result in a direct and permanent loss of the vegetation.

The VSMs for the first 62 miles of the route would be constructed within the operations ROW. These VSMs would be a permanent physical feature on the tundra; however, the impacts of their very small footprints (0.49 acres total) would be substantially less than the potential issues involved with trenching and backfilling in permafrost soils. The impact associated with each VSM anchor is based on 24-inch diameter VSMs, and each VSM glide/slide support is based on 12-inch diameter supports (3.14 and 0.79 square feet each, respectively). This would result in a very small permanent footprint even when approximately 6,400 VSMs would be installed. VSM usage would replace OC trenching for these 62 miles. The impact to vegetation would be small, but permanent, as the VSMs would be permanent structures displacing vegetation. Gravel fill usage for the first 62 miles would be the same as in Alternative 1, for components such as access roads, camps, PSYs, marshalling yards, and facility pads, except for the Prudhoe Bay and Franklin Bluffs PSYs, which would be larger in Alternative 2. The additional permanent impacts to vegetation due to VSM installation with Alternative 2 would be entirely within the Beaufort Coastal Plain ecoregion.

Fewer acres of vegetation would be filled if the 7-mile segment of the pipeline in Denali NPP was utilized, because at this time, there are no access roads, material sites, or other extra proposed Project features, proposed along this segment.

The impacts to vegetation due to placement of gravel fill during the construction phase would be moderate, as it would result in the direct and permanent loss of the vegetation. Impacts would be widespread throughout the entire ROW, where fill is placed on vegetation.

4.8.5.1.1.2. Clearing, Grubbing, and Grading

Impacts to vegetation due to clearing, grubbing and grading along the pipeline ROW Mainline and Fairbanks Lateral during construction are the same as those discussed above in Alternative 1 for the entire pipeline route, even though the pipeline would be suspended on VSMs for the first 62 miles in this alternative. However, in Alternative 2, 7 miles of the pipeline ROW is located within Denali NPP, instead of to the east of the park, as proposed in Alternative 1. Forest and scrub/shrub vegetation would be cleared out and kept short within the permanent operations ROW, but would be allowed to grow back in the temporary construction ROW, the same as Alternative 1. Clearing, grubbing, and grading would have no impacts on the Nearshore Beaufort Sea ecoregion and minimal to no impact on the Beaufort Coastal Plain ecoregion, as discussed for Alternative 1.

4.8.5.1.1.3. Open-Cut Trenching and Backfilling

Alternative 2 would result in less OC trenching and backfilling during construction than Alternative 1, because the first 62 miles of the Mainline would be aboveground on VSMs and therefore would result in significantly fewer impacts to vegetation and hydrology on the Beaufort Coastal Plain. OC trenching and backfilling would be implemented for the remaining 671 miles of the proposed Project. Potential impacts to vegetation remain the same as in Alternative 1 for these 671 miles of pipeline ROW. The use of VSMs for the first 62 miles of the pipeline would reduce potential impacts to permafrost in the Beaufort Coastal Plain ecoregion. Trenching would be avoided along this stretch and the only permanent impact to the wetlands would be the small VSM footprints.

4.8.5.1.1.4. Habitat Fragmentation

Impacts to vegetation due to habitat fragmentation along the pipeline ROW Mainline and Fairbanks Lateral during construction are the same as those discussed above in Alternative 1 for the pipeline route, except for the first 62 miles where the pipeline would be suspended on VSMs in this alternative. There would be substantially fewer impacts to wetland habitats, vegetation, and hydrology especially during breakup over these first 62 miles (Beaufort Coastal Plain ecoregion). In Alternative 2, 7 miles of the pipeline ROW is located within Denali NPP, instead of to the east of the park, as proposed in Alternative 1. The negative impact of habitat fragmentation would be greatest in areas with discontinuous permafrost (*i.e.*, MPs 168 - 634), but still major in all ecoregions crossed by the pipeline ROWs.

4.8.5.1.1.5. Dust Deposition

Impacts to vegetation due to dust deposition along the pipeline ROW Mainline and Fairbanks Lateral during construction are the same as those discussed above in Alternative 1 for the entire pipeline route, even though the pipeline would be suspended on VSMs for the first 62 miles in this alternative. However, in Alternative 2, 7 miles of the pipeline ROW is located within Denali NPP, instead of to the east of the park, as

proposed in Alternative 1. Dust deposition would have greater impacts to ecoregions with continuous or discontinuous permafrost, as discussed for Alternative 1.

4.8.5.1.1.6. Soil Compaction and Erosion

Impacts to vegetation due to soil compaction and erosion along the pipeline ROW Mainline and Fairbanks Lateral during construction would be similar as those discussed above in Alternative 1 for the majority of the pipeline route, except for the first 62 miles in this alternative, which would be suspended on VSMs. Because these first 62 miles would not be trenched, the likelihood of issues arising due to erosion and thawing permafrost are greatly reduced. In Alternative 2, a total of 7 miles of the pipeline ROW is located within Denali NPP, instead of to the east of the park, as proposed in Alternative 1. Soil compaction would have similar impacts to all ecoregions crossed with the pipeline ROWs.

4.8.5.1.1.7. Non-Native, Invasive, and Noxious Plants

Impacts to vegetation due to the introduction of non-native, invasive, and noxious plants along the pipeline ROW Mainline and Fairbanks Lateral during construction are the same as those discussed above in Alternative 1 for the entire pipeline route, even though the pipeline would be suspended on VSMs for the first 62 miles in this alternative. In Alternative 2, however, 7 miles of the pipeline ROW is located within Denali NPP, instead of to the east of the park, as proposed in Alternative 1. The introduction of non-native, invasive, or noxious plant species would have similar impacts to all ecoregions crossed with the pipeline ROWs. Introduction of non-native, invasive, and noxious plants to Denali NPP would increase the financial impact on park operations to monitor and control these species.

4.8.5.1.1.8. Rehabilitation and Revegetation

Impacts to vegetation due to rehabilitation and revegetation activities along the pipeline ROW Mainline and Fairbanks Lateral during construction are the same as those discussed above in Alternative 1 for the entire pipeline route, even though the pipeline would be suspended on VSMs for the first 62 miles in this alternative. In Alternative 2, however, 7 miles of the pipeline ROW is located within Denali NPP, instead of to the east of the park, as proposed in Alternative 1.

Mitigation measures associated with the rehabilitation and revegetation work discussed in the Revegetation Plan (Appendix E, Part I) include Mitigation Measure Nos. 7 through 9, as listed in Section 4.8.3.

The *Native Plant Revegetation Manual for Denali National Park and Preserve* (Densmore *et al.*, 2000) and other Alaska revegetation manuals listed in Section 4.8.4.1.1.8, Rehabilitation and Revegetation, would be utilized to supplement the Revegetation Plan (Appendix E, Part I). Rehabilitation and revegetation activities would have similar impacts to all ecoregions crossed with the pipeline ROWs.

4.8.5.1.1.9. Spills and Contaminants

Impacts to vegetation due to the release of contaminants along the pipeline ROW Mainline and Fairbanks Lateral during construction are the same as those discussed above in Alternative 1 for the entire pipeline route, even though the pipeline would be suspended on VSMs for the first 62 miles in this alternative. In Alternative 2, however, 7 miles of the pipeline ROW is located within Denali NPP, instead of to the east of the park, as proposed in Alternative 1. The potential release of contaminants would have similar impacts to all ecoregions crossed with the pipeline ROWs.

4.8.5.1.2. Gas Conditioning Facility

Impacts to vegetation at the GCF are the same as those discussed above in Alternative 1. Direct loss of vegetation due to gravel fill placement, dust deposition, and the potential to introduce non-native and invasive species are the main impacts that the proposed Project could induce at the GCF.

4.8.5.1.3. Denali NPP Route Variation

The Denali NPP Route Variation would traverse 7 miles of Denali NPP lands, of which the majority is located adjacent to the Parks Highway ROW. Approximately 8.2 percent of this route is currently developed land. Detailed maps for the Denali NPP Route Variation are provided in Chapter 2 (Figure 2.4-1).

This Denali NPP Route Variation is composed of approximately 83.3 percent forest, 5.7 percent scrub/shrub vegetation, and 35.8 percent herbaceous vegetation, throughout both the construction and permanent ROWs. In comparison with the Mainline route segment, which would be avoided if Alternative 2 was selected, the Denali NPP Route Variation would result in fewer impacts to vegetation resources, primarily by development of approximately 117 fewer acres of forested vegetation and 71.3 fewer acres of scrub/shrub and woody wetlands vegetation in the proposed Project ROW. However, at this time, there are no access roads, material sites, or other additional proposed Project features proposed along the Denali NPP Route Variation.

4.8.5.1.4. Yukon River Crossing (Aerial)

In Alternative 2, a new construction of an aerial suspension bridge would be used to cross the Yukon River (Figure 2.4-3). A small access road on the north side of the river, cable anchors on both sides of the river, and a construction material storage area on the south side of the river would be needed for this alternative. All of these development features would be included within the permanent operations ROW footprint. All activities with impacts to vegetation at the aerial Yukon River Crossing are discussed previously in Section 4.8.4.1.1, Pipeline ROW – Mainline and Fairbanks Lateral. The access road and pads for anchors would be constructed using gravel fill; the ROW would be cleared, grubbed, and graded; dust may be deposited; there may be soil compaction and erosion; and non-native and invasive species may be introduced.

4.8.5.1.5. West Dock (Dock Head 2) and Causeway Upgrades

Gravel fill placement, dredging and screeding activities proposed at DH2 of West Dock would impact 316.2 acres of sea floor in Prudhoe Bay (116.2 acres of dredged area and 200 acres at the dredge placement area). The benthic community, including possible kelp vegetation, would be lost during the proposed Project work. However, the extent of vegetation around West Dock is likely minimal because of frequent ice scouring action and continual movement of fine sediments, which hinders growth of marine vegetation in this area. Impacts to the benthic community are discussed in Section 4.13, Benthic.

A figure showing the difference in the Alternative 1 and Alternative 2 dredge disposal impact footprints is included in Chapter 2, Figure 2.2-5.

4.8.5.2. Operations and Maintenance

4.8.5.2.1. Pipeline ROW – Mainline and Fairbanks Lateral

4.8.5.2.1.1. Mowing

Impacts to vegetation due to mowing along the pipeline ROW Mainline and Fairbanks Lateral during operations are the same as those discussed above in Alternative 1 for the entire pipeline route, except the first 62 miles would be suspended on VSMs, as no mowing would be required in the Beaufort Coastal Plain. However, in Alternative 2, 7 miles of the pipeline ROW is located within Denali NPP, instead of to the east of the park, as proposed in Alternative 1. Forest and scrub/shrub vegetation would be kept short within the permanent operations ROW, but would be allowed to grow back in the temporary construction ROW, the same as Alternative 1.

4.8.5.2.1.2. Habitat Fragmentation

Impacts to vegetation due to habitat fragmentation along the pipeline ROW Mainline and Fairbanks Lateral during operations are the same as those discussed above in Alternative 1 for the majority of the pipeline route, except where the pipeline would be suspended on VSMs for the first 62 miles in this alternative. In the first 62 miles of the Project in Alternative 2 (on the Beaufort Coastal Plain), habitat fragmentation would be negligible during operations because the pipeline would be suspended on VSMs. Additinally, 7 miles of the pipeline ROW in Alternative 2 is located within Denali NPP, instead of to the east of the park, as proposed in Alternative 1. The impact of habitat fragmentation would be similar in all ecoregions crossed by the pipeline ROWs.

4.8.5.2.1.3. Dust Deposition

Impacts to vegetation due to dust deposition along the pipeline ROW Mainline and Fairbanks Lateral during operations are the same as those discussed above in Alternative 1 for the entire pipeline route, even though the pipeline would be suspended on VSMs for the first 62 miles in this alternative. However, in Alternative 2, 7 miles of the pipeline ROW is located within Denali NPP, instead of to the east of the park, as

proposed in Alternative 1. Dust deposition would have greater impacts to ecoregions with continuous or discontinuous permafrost, as discussed for Alternative 1.

4.8.5.2.1.4. Soil Compaction and Erosion

Impacts to vegetation due to soil compaction and erosion along the proposed pipeline ROW Mainline and Fairbanks Lateral during operations would be similar as those discussed above in Alternative 1 for the majority of the pipeline route, except for the first 62 miles in this alternative, which would be suspended on VSMs. Because these first 62 miles would not be trenched, the likelihood of issues arising due to erosion and thawing permafrost are greatly reduced. In Alternative 2, however, 7 miles of the pipeline ROW is located within Denali NPP, instead of to the east of the park, as proposed in Alternative 1. Soil compaction would have similar impacts to all ecoregions crossed with the pipeline ROWs.

4.8.5.2.1.5. Non-Native, Invasive, and Noxious Plants

Impacts to vegetation due to the introduction of non-native, invasive, and noxious plants along the pipeline ROW Mainline and Fairbanks Lateral during operations are the same as those discussed above in Alternative 1 for the entire pipeline route, even though the pipeline would be suspended on VSMs for the first 62 miles in this alternative. In Alternative 2, however, 7 miles of the pipeline ROW is located within Denali NPP, instead of to the east of the park, as proposed in Alternative 1. The introduction of non-native, invasive, or noxious plant species would have similar impacts to all ecoregions crossed with the pipeline ROWs.

4.8.5.2.1.6. Spills and Contaminants

Impacts to vegetation due to the release of contaminants along the pipeline ROW Mainline and Fairbanks Lateral during operations are the same as those discussed above in Alternative 1 for the entire pipeline route, even though the pipeline would be suspended on VSMs for the first 62 miles in this alternative. In Alternative 2, however, 7 miles of the pipeline ROW is located within Denali NPP, instead of to the east of the park, as proposed in Alternative 1. The potential release of contaminants would have similar impacts to all ecoregions crossed with the pipeline ROWs.

4.8.5.2.2. Gas Conditioning Facility

Impacts to vegetation at the GCF are the same as those discussed above in Alternative 1. Direct loss of vegetation due to placement of gravel fill, dust deposition, and the potential to introduce non-native and invasive species are the main impacts that the proposed Project could induce at the GCF.

4.8.5.2.3. Denali NPP Route Variation

Impacts to vegetation along the Denali NPP Route Variation are the same as those discussed above for the pipeline ROW; however, these 7 miles of pipeline impacts occur within the Denali NPP.

4.8.5.2.4. Yukon River Crossing (Aerial)

The suspension bridge over the Yukon River would not create additional impacts to vegetation during the operations phase of the proposed Project. Any mowing, dust deposition, soil compaction, erosion, or non-native plant introductions are discussed above for operations of the pipeline ROW and are included within the permanent operations ROW footprint.

4.8.5.2.5. West Dock (Dock Head 2) and Causeway Upgrades

West Dock would only be used for the proposed Project during construction phases; therefore, no operational phase impacts would occur.

4.8.6. Alternative 3 – No Action

Under Alternative 3 (No Action), the proposed Project would not be developed and there would, therefore, be no impacts to vegetation communities for construction or operational phases.

4.8.7. Conclusions and Comparison of Alternatives

Alternatives 1 and 2 would result in similar impacts to vegetation resources during both construction and operations phases of the proposed Project, with differences discussed below. Construction and operations activities would be the same for both Alternatives 1 and 2 (*e.g.,* vegetation clearing, trenching causing altered hydrology, dust deposition, soil compaction, erosion, potential noxious plant species introduction, etc.). A summary of the primary differences Alternative 1 and 2 effects on vegetation is as follows:

- More impacts to the seafloor in Prudhoe Bay would result with Alternative 2 because a larger area would require dredging, which could affect kelp beds or other aquatic vegetation if present.
- The aerial suspension of the Yukon River crossing in Alternative 2 would not have significantly more or less impacts to vegetation than Alternative 1, because all the proposed Project work would be contained within the same ROW in either option.
- Alternative 2 would also result in impacts within Denali NPP, whereas Alternative 1 avoids the park entirely by going to the east. However, a reduction of 188.3 acres of vegetation impacts would result from Alternative 2 within Denali NPP. The Denali NPP Route Variation in Alternative 2 is currently proposed without access roads, material sites, or other extra proposed Project features cited within the existing Parks Highway ROW.

- Less OC trenching would occur with Alternative 2 because the first 62 miles of the Mainline would be supported on VSMs. In turn, this would result in a reduction of risk of soil erosion and impacts to vegetation for these first 62 miles.
- The VSMs for the first 62 miles of the proposed Mainline in Alternative 2 would be constructed within the operations ROW. These VSMs would be a permanent physical feature on the tundra; however, the impacts of their very small footprints (0.49 acres total) would be substantially less than the potential issues involved with trenching and backfilling in permafrost soils.

In Alternative 3, the proposed Project would not be developed and there would be no impacts to vegetation communities for construction or operational phases.

Table 4.8-5 shows the rankings of impacts that the proposed Project activities would have on the vegetation resources.

Vegetation loss and/or disturbance is ranked as a moderate and direct impact to vegetation resources during construction of both the Alternatives 1 and 2. Vegetation loss and/or disturbance would be widespread throughout the entire pipeline ROW, impacts would be long-term, and forested communities would be converted to scrub/shrub or another community type. During operations, it was ranked as minor and direct because impacts would be much less than during the construction phase. Vegetation would be maintained throughout the pipeline ROW for the duration of the proposed Project, but the initial impacts due to construction activities would have already occurred.

There is potential for non-native, invasive, and noxious plant introduction in both Alternative 1 (proposed Action) and Alternative 2 (Denali NPP Route Variation). This was ranked as moderate and direct for both alternatives in both the construction and operations phases because the proposed Project could result in permanent impacts to the vegetation communities if non-native, invasive, or noxious plants were introduced.

Habitat fragmentation would occur similarly with both the Alternatives 1 and 2 during construction phases. It was given a ranking of major and direct for the construction phase for the entire Project route, but is minor or negligible in the operations phase, as very little new fragmentation would occur during operations of either alternative. For operations, Alternative 1 is ranked as minor for the entire Project route; Alternative 2 is ranked as negligible for the Beaufort Coastal Plain and minor for the remaining Project route. Initial fragmentation during Project construction could be widespread throughout the pipeline ROW, would be long-term, and would likely be irreversible.

There is potential for soil compaction and erosion in both Alternatives 1 and 2. This was ranked as moderate and direct for both alternatives in the construction phase, but minor in the operations phases. Soil compaction could be widespread throughout the pipeline ROW. Erosion and soil instability as a result of trenching in permafrost soils poses a greater risk to vegetation and other resources. Construction and operation of a pipeline and other facilities in active layer soils above permafrost may result in propagation of

permafrost thaw and alternations to drainage patterns. If propagation of permafrost thaw begins, it may be difficult to control. Thaw and development of frost bulbs could alter the thermal regime and change drainage patterns. AGDC documents indicate that propagation of thaw into surrounding soils may occur.

Figures 4.8-1 and 4.8-2 illustrate some of the key findings from the impact analysis. The figures intend to provide context for the description of potential impacts of alternatives as described in detail in this section. By illustrating the potential impacts on the proposed Project map using a consistent color scheme consistent with Table 4.8-5, Comparison of Alternatives Summary for Impacts to Vegetation, we can begin to draw a few conclusions. Examples are provided below:

- The results indicate the above listed impacts are more strongly perceived in the Beaufort Coastal Plain ecoregion and other ecoregions that have permafrost soils.
- The most significant impacts to vegetation would be those associated with trenching, habitat fragmentation, and soil compaction and erosion.

4.8.8. Summary of Differences if USACE Conditions are Implemented

In the potential scenario where AGDC follows the request from USACE to fulfill mitigation measures and BMPs under regulatory obligations of the CWA (as discussed in Section 4.5.2.1), overall impacts to vegetation could be different. Some differences between impacts include:

- Revegetation time would likely be shorter when placing the native, site-specific surface layer back onto the top of the trench;
- Less fertilizer and seed needed for revegetation (possibly none in some areas);
- Higher likelihood of native, site-specific species returning to the trench faster;
- Less work required for revegetation (possibly none in some areas), also likely reducing truck traffic and reducing potential for introducing invasive and non-native species; and
- Impacts to vegetation would be lessened overall via the USACE condition where revegetation would occur earlier to prevent erosion.

Inclusion of the USACE DA permit conditions, including the segregation of the surface layer, could decrease impacts to vegetation resources though the magnitude/intensity of the reduction in impacts to vegetation cannot be determined based on existing information available. The segregation and replacement of the surface layer as the topmost layer on the trench would reduce the overall revegetation duration and effort and reduce impacts to vegetation. The geographic extent of the impacts to vegetation may be reduced by some of the conditions involving revegetation.

Table 4.8-5 Comparison of Alternatives Summary for Impacts to Vegetation (Direct & Indirect)

Biological Resource Effect	Potential Impact Description	Alternative 1		Alternative 2		Alternative 3
		Construction	Operations	Construction	Operations	Construction/Operations
		Impact Rating		Impact Rating		Impact Rating
Vegetation Loss/ Disturbance	• Rootstocks (clearing, grubbing, grading) • Sensitive plants or species • Forest vegetation • Plant/species diversity • Dust deposition • Compaction /covering /crushing	*Moderate*	*Minor*	*Moderate*	*Minor*	*Negligible*
Non-native, Invasive, and Noxious Plants	Introduction and propagation of non-native, invasive, and noxious plants would outcompete and displace native plants, reducing biological diversity and community composition	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*Negligible*
Habitat Fragmentation	• Invasive plant establishment • Alteration of soil temperature and sunlight availability • Long recovery time for vegetation communities • Impacts to other resources (*e.g.*, wildlife, threatened and endangered species, wetlands, land use, visual resources)	*Major*	*Minor*	*Major*	*Minor, Negligible on the Beaufort Coastal Plain*	*Negligible*
Soil Compaction and Erosion	• Inhibition of native seed germination • Hindrance of root establishment • Reduction of water infiltration	*Moderate*	*Minor*	*Moderate*	*Minor*	*Negligible*

Attaining the USACE conditions discussed in Section 4.8.3.2 would segregate the surface layer from mineral subsoil, use the surface layer as the uppermost layer of backfill to provide a seed bed for native species, and revegetation would occur earlier to prevent erosion. These steps would help protect the vegetation resource.

M:\Projects\0255086 ASAP Wetlands Review CONFIDENTIAL\maps\FEIS 2018\Fig_4-8-1_Context Maps Vegetation Alt 1.mxd

- City or Village
- Mileposts
- Beaufort Coastal Plain Ecoregion
- Other Ecoregions with Permafrost: Brooks Foothills, Brooks Range, Kobuk Ridges and Valleys, Ray Mountains, Tanana-Kuskokwim Lowlands, and Yukon-Tanana Uplands
- Ecoregions lacking Permafrost: Alaska Range and Cook Inlet Basin
- Fairbanks v4.1 Lateral

Effect Rating

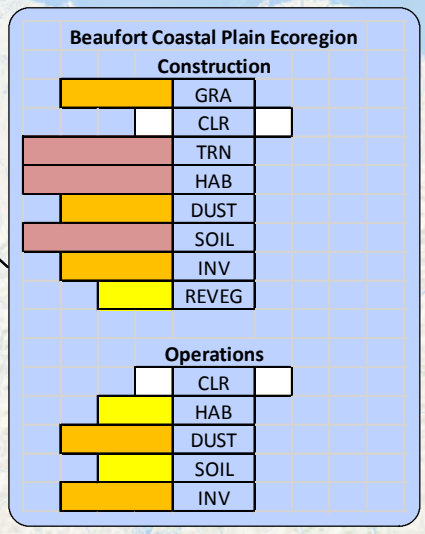
- Major Positive
- Moderate Positive
- Minor Positive
- Negligible
- Minor Negative
- Moderate Negative
- Major Negative

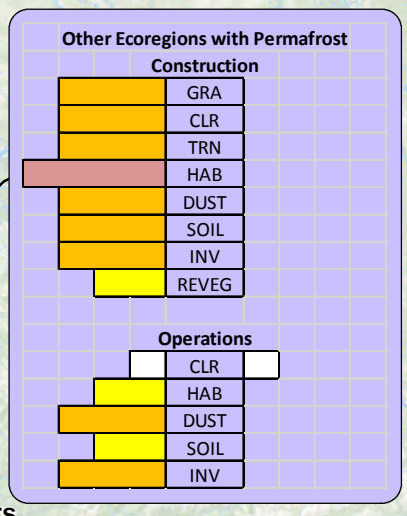
Effect Indicators

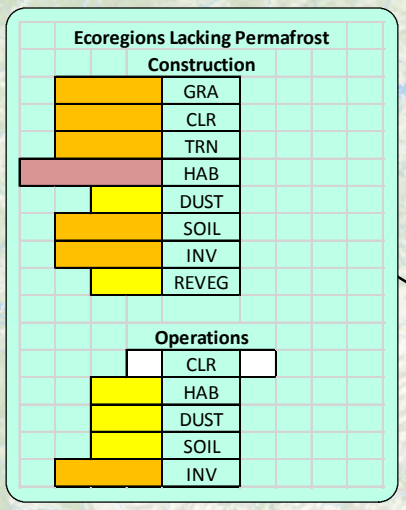
GRA: Placement of gravel fill
CLR: Clearing, grubbing, and grading
TRN: Open-cut trenching and backfilling
HAB: Habitat fragmentation
DUST: Dust deposition
SOIL: Soil compaction and erosion
INV: Introduction of non-native, invasive, or noxious plants
REVEG: Rehabilitation and revegetation activities

Beaufort Sea

MP 0
MP 62
MP 100
Anaktuvuk Pass
MP 200
Wiseman
Bettles
MP 300
Stevens Village
Rampart
Livengood
MP 400
Minto
Two Rivers
Pleasant Valley
Fairbanks
Four Mile Road
Nenana
Anderson
MP 500
Ferry
Healy
McKinley Park
Cantwell
MP 600
Petersville
Talkeetna
Skwentna
MP 700
Willow
Susitna
MP 733
Anchorage







Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

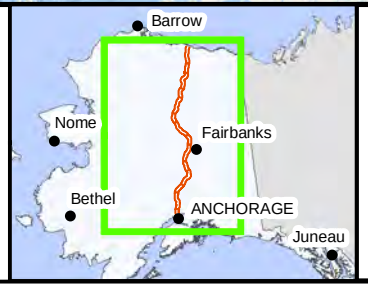
ERM

DATE: MAR 2018
CHKD: K.J.
DRWN: A.V.K.
PROJ. No.: 0416166

825 W. 8th Ave., Anchorage, AK 99501, (907) 258-4880

Figure 4.8-1: VEGETATION IMPACTS CONTEXT MAP, ALTERNATIVE 1
ALASKA STAND ALONE PIPELINE

0 25 50 100 150 Miles



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- City or Village
- Mileposts
- Beaufort Coastal Plain Ecoregion
- Other Ecoregions with Permafrost: Brooks Foothills, Brooks Range, Kobuk Ridges and Valleys, Ray Mountains, Tanana-Kuskokwim Lowlands, and Yukon-Tanana Uplands
- Ecoregions lacking Permafrost: Alaska Range and Cook Inlet Basin
- Fairbanks v4.1 Lateral

Effect Rating

- Major Positive
- Moderate Positive
- Minor Positive
- Negligible
- Minor Negative
- Moderate Negative
- Major Negative

Effect Indicators

GRA: Placement of gravel fill
CLR: Clearing, grubbing, and grading
TRN: Open-cut trenching and backfilling
HAB: Habitat fragmentation
DUST: Dust deposition
SOIL: Soil compaction and erosion
INV: Introduction of non-native, invasive, or noxious plants
REVEG: Rehabilitation and revegetation activities

Beaufort Sea

MP 0
MP 62
MP 100
MP 200
MP 300
MP 400
MP 500
MP 600
MP 700
MP 733

Anaktuvuk Pass
Wiseman
Bettles
Stevens Village
Rampart
Livengood
Minto
Two Rivers
Pleasant Valley
Fairbanks
Four Mile Road
Nenana
Anderson
Ferry
Healy
McKinley Park
Cantwell
Petersville
Talkeetna
Skwentna
Willow
Susitna
Anchorage

Beaufort Coastal Plain Ecoregion
Construction: GRA, CLR, TRN, HAB, DUST, SOIL, INV, REVEG
Operations: CLR, HAB, DUST, SOIL, INV

Other Ecoregions with Permafrost
Construction: GRA, CLR, TRN, HAB, DUST, SOIL, INV, REVEG
Operations: CLR, HAB, DUST, SOIL, INV

Ecoregions Lacking Permafrost
Construction: GRA, CLR, TRN, HAB, DUST, SOIL, INV, REVEG
Operations: CLR, HAB, DUST, SOIL, INV

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DRWN: A.V.K.
PROJ. No.: 0416166

Figure 4.8-2: VEGETATION IMPACTS CONTEXT MAP, ALTERNATIVE 2 ALASKA STAND ALONE PIPELINE

0 25 50 100 150 Miles



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4.9. Wetlands

4.9.1. Introduction

This section describes the potential direct and indirect effects of the alternatives on wetlands, as described in Chapter 2. This section begins by describing the methods used to conduct the impact analysis specific to wetland resources. For general impact assessment methodology used for all resources, please refer to Sections 4.1 through 4.5. The section then describes what information was incomplete or unavailable and how that has influenced this analysis, describes the methods for determining the level of impact to wetlands, and presents the results of the assessment. This section describes some of the mitigation measures that would aid in avoiding or minimizing the potential impacts. The information used in this section builds on the 2012 FEIS (USACE, 2012a) and incorporates new data and information relevant to environmental concerns associated with the alternatives that have become available since the original 2012 FEIS. While this assessment tiers from the 2012 FEIS, the proposed changes in route and design described for Alternative 1 are emphasized. In some instances, information from the 2012 FEIS is replicated with relatively minor changes and updates, while other material is entirely new or substantially altered. For this SEIS, the following elements have been added to the assessment of impacts to wetlands:

- A new section (Section 4.9.2, Methods) was added to explain the procedures used to evaluate the potential impacts associated with the proposed Project and alternatives;
- Wetland acreage impacts differ from those presented in the 2012 FEIS due to route alterations and modified wetland evaluation methods;
- Route refinements have been made to further reduce impacts to wetlands, as shown in Table 4.9-1; and
- Updates to impacts based on new alternatives and a summary of those results.

Since the DSEIS, USACE completed an extensive quality assurance/control review of the Applicant's wetland mapping data. In USACE's review, they identified approximately 797.91 additional acres of wetland within the Project footprint that had not previously been accounted for (8,906.92 acres in DSEIS and 9,704.83 acres in the PFEIS). The additional acreage results in a 8.2 percent increase in wetland impacts.

Table 4.9-1 Version 6.1 Route Refinement

Name	MP	Reason	Description
Rustic Wilderness	~MP 700.5	Change in location of the Rustic Wilderness Camp based on landowner input and public comment.	The location for the Rustic Wilderness Camp has been moved from a private parcel at approximately MP 80.5 of the George Parks Highway, south, to a state-owned parcel at approximately MP 77.5 of the George Parks Highway. The new camp location is adjacent to the Mainline ROW instead of the original location, which was off of the Mainline ROW. The new camp location would also eliminate the need for access road AR-CAMP-E-697.31 (this particular access road is an existing road). This is a change only in the proposed Project footprint. The alignment for the pipeline has not been impacted by this change.
Trapper Creek	MP 645.80 to 655.08	Reroute to avoid larger number of trails on west side of Parks Highway in response to public comments. This alignment is identical to the one finalized for use on AK LNG.	The AK LNG footprint was utilized for the reroute of ASAP. It was assumed that the original engineering for AK LNG was sound and required no additional work. Where ASAP wetlands data were unavailable, AK LNG wetlands data was used. At MP 645.80, the alignment would veer east and cross the George Parks Highway. After crossing the highway, the alignment would parallel the highway on the east side and generally head south until MP 655.08, then cross back to the west side of the George Parks Highway and rejoin the alignment. The new alignment would cross the same streams as the original alignment, but at a location further downstream. The two northern most stream crossings are more incised on the new alignment than the original. The new alignment would add five access road segments and delete two access road segments.
Willow Pipe Storage Yard	~MP 707	Change in location of the Willow PSY based on public comment.	The location for the existing Willow PSY is directly adjacent to a feeder for the Lucky Shot Trail. While the current location does not intersect the trail, it is directly adjacent to the trail. The new location for the Willow PSY would utilize the same parcel, but would move the PSY approximately 150 feet to the west, leaving a 150 foot vegetative buffer between the end of the PSY and the feeder trail. The access road as it currently shows in the footprint would not have to be changed with this proposed location change of the PSY. The new location meets the intent of the public comment, which was to not block the feeder trail access to the Lucky Shot Trail. This is a change only in the proposed Project footprint. The alignment for the pipeline has not been impacted by this change.
Prospect Camp and Pipe Storage Yard	~MP 278	Change in location of the Prospect Camp and PSY to reduce environmental impacts.	The current location for the Prospect Creek Camp and PSY was inadvertently placed onto a riverine wetland feature. The new location proposed for the Prospect Creek Camp and PSY is southwest of the current location by approximately 2,000 feet. The small segment of access road AR-CAMP-YD-N-277.83 has been eliminated and an additional, longer segment has been added to access road AR-CAMP-YD-N-277.82 for Camp and PSY access. This is a change only in the proposed Project footprint. The alignment for the pipeline has not been impacted by this change.
Nenana Native Allotments	~MP 471	An HDD False Right of Way encroaches on two abutting Native Allotments.	Currently, the HDD False Right of Way for the Nenana River HDD overlaps two native allotments that abut each other. The proposed change would trim the edge of the HDD False Right of Way to not encroach on the Native Allotment Parcels. This is

Name	MP	Reason	Description
			a change only in the proposed Project footprint. The alignment for the pipeline has not been impacted by this change.
Reroute near MP 684.5	MP 684.19 to 684.62	Reroute to avoid larger cut/fill at corner of parcel.	The parcel owner requested that the pipeline not cross the parcel at the north west corner of the parcel. The owner also stated that the pipeline could cross the parcel further south on the parcel. The pipeline was rerouted south to the maximum extent while still allowing sufficient room from construction. The reroute also allowed a much less oblique approach to the bluff at the north end of the route revision. This reroute does not affect any new landowners.
Kashwitna HDD	~MP 694	An HDD False Right of Way encroaches private parcel.	Currently, the HDD False ROW for the Kashwitna River covers a home on a private parcel. This parcel has a bluff on the south side, and the low area at the bottom of the bluff would be used for the HDD False ROW. The HDD False ROW for the Kashwitna River HDD has been trimmed to be coincident with the bottom of the bluff. This is a change only in the proposed Project footprint. The alignment for the pipeline has not been impacted by this change.
Titan Parcel	MP 732.51 to 732.99	Reroute to avoid larger cut/fill at corner of parcel.	The parcel owner requested that the pipeline not cross the parcel due to planned expansion of the Titan plant. The proposed reroute turns east earlier and avoids the private parcel in question. This reroute does not affect any new landowners.
ADOT/PF Parks Hwy Above Grade Rail Crossing	~MP 581	Alaska Department of Transportation and Public Facilities – George Parks Highway Above-Grade Rail Crossing highway alignment change.	Because of the George Parks Highway reroute at approximately MP 194, the access road AR-RS-N-580.86 is no longer required because it does not connect to the highway. The solution was to delete the access road AR-RS-N-580.86. This is a change only in the proposed Project footprint. The alignment for the pipeline has not been impacted by this change.
Fairbanks Operations and Maintenance Base	Near intersection of Parks Highway and Geist Road in Fairbanks	Comments received by AGDC have requested AGDC find a new location for the Fairbanks Operations and Maintenance Base.	The Fairbanks Operations and Maintenance Base was originally proposed to be located on University of Alaska Fairbanks property at the corner of Yankovich Road and Miller Hill Road. The new proposed location is a University of Alaska property, which is available for development at the corner of Geist Road and the George Parks Highway. This is a change only in the proposed Project footprint. The alignment for the pipeline has not been impacted by this change.
Sea Ice Access Road	West Dock	NMFS requested AGDC include the sea ice access road and areas vehicles would drive (*i.e.*, additional sea ice work pad) adjacent to the dredge and disposal sites for the West Dock work.	Additional workspace and a connecting road are required between the dredge site at West Dock and the dredge disposal site. A sea ice road was placed between the west dock dredging site sea ice pad and the disposal site sea ice pad. This access road was added, and an existing access road was utilized for proposed Project travel to allow access to the disposal site without requiring driving to West Dock, then driving down the sea ice road to the disposal site. The intent of the sea ice road was to keep this access road on grounded sea ice as much as is practicable. This is a change only in the proposed Project footprint. The alignment for the pipeline has not been impacted by this change.
MP 57-62 ROW Construction Mode	~MP 57 to 62	Right of Way construction mode was changed from MP 57 to MP 62 to reduce Environmental	The Tundra Ice Workpad Typical Right of Way construction mode has been extended from MP 57 to MP 62. An additional 5 miles of ice workpad would replace Gravel Pad Typical Right of Way mode. The intent of this change is to reduce the permanent

Name	MP	Reason	Description
		Impacts. The updated GIS data shows reduced permanent wetlands impact from 32 feet wide to 9 feet wide from MP 0 to MP 57 (and now to MP 62), in accordance with expected impacts.	wetland impact of the pipeline in the Arctic Coastal Plain. In accordance with these changes, gravel access road AR-N-57.06 changes to ice road and gravel access road AR-BV-N-60.06. In addition, the updated GIS data shows the 32 foot permanent impact has been reduced to a 9 foot wide permanent impact to wetlands from MP 0 to MP 57 (and now to MP 62), in accordance with expected impacts. This is a change only in the proposed Project footprint. The alignment for the pipeline has not been impacted by this change.

4.9.1.1. Incomplete or Unavailable Information

In compliance with CEQ guidance (see Section 4.3), this section addresses incomplete or unavailable information pertinent to analyzing impacts of the alternatives on wetlands. Various information sources have been used to assess impacts to wetlands potentially affected by the proposed Project. Generally, where data are lacking, professional judgment has been applied based on knowledge and experience of the authors, contacted experts, and generally accepted scientific methods.

AGDC is developing a Compensatory Mitigation Plan with USACE and other cooperating agencies to ensure that the Project results in no net loss of wetland acreage and function (33 CFR Parts 325 and 322; 40 CFR part 230).

4.9.2. Methods

The potential wetlands impacts for the proposed Project and alternatives presented below are based on the following:

- Evaluation of the wetlands resources along the proposed Project corridor;
- Review of available proposed Project descriptions and reports;
- Public comments received after the publication of the 2012 FEIS and during the public scoping period for the SEIS held in 2014; and
- Review of public comments received on the Draft SEIS during the July/August 2017 public comment period.

Wetland data and descriptions were obtained from a combination of sources including the 2012 FEIS, the USFWS National Wetlands Inventory (NWI) dataset, the 2015 Wetland Delineation Report, and additional data collected by AGDC in 2015 for the Revision 6.1 alignment, all of which are included in Chapter 7, Literature Cited, of SEIS.

Potential impacts for this SEIS were analyzed by assessing the magnitude, extent, duration and likelihood of occurrence as presented in Table 4.9-2, Impact Criteria for Wetlands.

4.9.2.1. Description of Effects

This section addresses the following wetland impacts:

- Permanent loss of wetlands (*e.g.*, gravel fill for access roads, camps, pipe storage yards, material sites, railroad siding, and facility pads);
- Temporary loss of wetlands (*e.g.*, temporary work areas, HDD crossings, pipeline stream crossings, ice roads and pads, and bridges);
- Wetland fragmentation; and
- Changed function, value, or water type code.

The three types of effects to wetlands resources that were assessed for the proposed Project are described below.

4.9.2.1.1. Loss of Wetlands (Permanent and Temporary)

The loss of wetland resources is described in two categories for analysis purposes: permanent and temporary. Permanent impacts are those that would eliminate part or all of a wetland permanently, for example, by adding gravel fill to construct a road or gravel pad. The permanent impacts area is located in the variable-width permanent/operations ROW. Temporary impacts are those that would disturb a wetland temporarily For example, during construction, equipment may need to travel through a wetland or be staged in a wetland. The temporary impacts areas are located adjacent to permanent impacts areas or uplands/avoidance areas, and are located in areas that reduce impacts to wetlands to the extent practicable. A third category, uplands/avoidance, was used in the mapping process to categorize areas of construction or operational impact that are not in wetlands, but also fall within the 2,000-foot wetland mapping corridor. AGDC has indicated that the proposed Project footprint avoids high value wetlands located within this mapping corridor, where practicable.

Wetland functions may be lost or disturbed by other proposed Project-related activities other than direct filling of wetlands. These activities include clearing/mowing of vegetation; grading, trenching, blasting, and backfilling for the ROW; dust deposition; soil compaction and erosion; alteration of physical and chemical processes; the introduction of non-native and invasive plants; and rehabilitation efforts. These activities and impacts are discussed further under each proposed Project component.

4.9.2.1.2. Wetland Fragmentation

Wetland fragmentation could occur when development intersects an existing wetland, separating a part of the habitat or dividing the wetland into smaller sections. Indirect effects that could occur when a wetland is fragmented include potential invasive plant introduction and establishment, alteration of soil temperature and sunlight availability, a long recovery time for vegetation communities and soil horizons, and impacts to other resources (*e.g.,* wildlife, threatened and endangered species, land use, visual resources). The construction of the pipeline ROW, access roads, and other proposed Project features such as trenching for the buried pipe may cause wetland fragmentation.

4.9.2.1.3. Changed Function, Value, or Water Type Code

The functions and values that wetlands provide to the ecosystem could be altered or reduced. Adding gravel fill to a wetland, fragmenting a wetland, introducing invasive species, or altering the wetland's vegetation, soil, or hydrology are examples of how a wetland's function or value could be altered through development. If changes occur in a wetland, the wetland would need time to recover to function at its original capacity. Other natural resources, such as wildlife, threatened and endangered species, fish, water

resources, soils and geology, and visual resources could be impacted as a result of changes in wetland function.

Some examples of potential Project-related changes to a wetland's water type code include pond drainage resulting in a scrub/shrub wetland after several years, or access road construction next to a stream resulting in pond or impoundment formation. In these instances, these wetland's water types would change because of the proposed Project's influence and they would function differently and have different values to the ecosystem.

4.9.2.2. Impact Criteria

Table 4.9-2, summarizes the criteria used to determine the level of impact based on the magnitude, extent, duration, and likelihood of occurrence. Table 4.9-3 defines the types of affects the proposed Project and alternatives may have on the wetland resources. Potential impacts that remain after mitigation measures have been implemented are described for each alternative.

Table 4.9-2 Impact Criteria for Wetlands

Impact Component	Impact Level			
	Major	**Moderate**	**Minor**	**Negligible**
Magnitude or Intensity	The impact is sufficient to cause ecoregion-wide changes to wetland productivity and functionality.	The impact is sufficient to cause community-wide changes to wetland productivity and functionality.	The action would impact one or a few wetlands in a community but not affect ecoregion or community-wide wetland productivity or functionality.	There are no perceivable impacts or the mechanism for effects on wetland productivity or functionality. Effects are indistinguishable from baseline.
Geographic Extent	Impacts are statewide, or ecoregion-wide.	Impacts are at a regional or community level, on a limited portion of the study area.	Impacts are site specific or occur within a few isolated locations.	No measurable effects.
Duration or Frequency	The effect would cause chronic and long-term changes that are likely to be permanent.	The effect would cause periodic, temporary, or short-term changes that are reversed after a 1-3 vegetative growth seasons (3 years).	The effect would cause periodic, temporary, or short-term changes that are reversed over one vegetative growth season (1 year).	No measurable effects.
Likelihood	Most likely (Impacts that have greater than 75% chance of arising from the action)	Likely (Impacts that have a 50% to 75% chance of arising from the action)	Somewhat likely (Impacts that have a 10% to 50% chance of arising from the action)	Unlikely (Impacts that have less than 10% chance of arising from the action)

Table 4.9-3 Types of Effects and Impacts on Wetlands Resources

Type of Effect	Proposed Action Causing Potential Impact	
	Construction	**Operations & Maintenance**
Loss of wetlands • # of acres (temporary loss) • # of acres (permanent loss)	• Access road, gravel pad, or aboveground facility construction. • Grading and trenching over the centerline primarily in frozen soils. • Construction of ice pads and roads; • Equipment use. • Backfilling of trenches in ROW.	• Road and facility operation. • Maintenance work requiring new access roads or other wetland-damaging equipment.
Wetland fragmentation (fill dividing a wetland into segments)	• Access road, gravel pad, or aboveground facility construction. • Backfilling trenches (altering hydrology).	Maintenance work requiring new access roads or other wetland-damaging equipment.

Type of Effect	Proposed Action Causing Potential Impact	
	Construction	Operations & Maintenance
• Changed function, value (geomorphic or hydrologic), or Water Type Code (from the January 2015 AGDC Approved Jurisdictional Determination Report). • Impacts to other resources (*e.g.*, wildlife, threatened and endangered species, fish, water resources, soils and geology, visual resources)	• Vehicular road use during construction of facilities and construction of access roads. • Grading and trenching. • Access road, gravel pad, or aboveground facility construction. • Backfilling trenches (altering hydrology).	• Road and facility operation. • Maintenance work requiring new access roads or other wetland-damaging equipment.

4.9.3. Proposed Design Features, Mitigation Measures, Best Management Practices, and Project Management Plans

4.9.3.1. Applicant-Proposed Design Features, Mitigation Measures, Best Management Practices, and Project Management Plans

The following design features and mitigation measures (including BMPs) are proposed by AGDC. They have been taken into consideration when evaluating potential impacts on wetlands resources under Alternatives 1 and 2 during the construction and operations phases. A complete list of mitigation measures are also provided in Appendix M. Additional USACE conditions for inclusion into the DA Permit Authorization are included in Section 4.5.2.1.

Proposed mitigation measures include:

1. During routing delineated wetlands data, aerial signatures, and LIDAR data were used to avoid and minimize impacts to wetlands wherever practicable.
2. Under the current alignment, several aboveground facilities have been removed from plans: compressor stations (at various MPs), a straddle and offtake facility, and a natural gas liquid extraction plant facility, eliminating wetlands impacts from those facilities.
3. There are several changes to the alignment that reduce the impact to wetlands, including the following:
    - AGDC reviewed the entire alignment and made site-specific changes to avoid and minimize impacts to wetlands, including stream crossings. The changes are reflected in alignment version 6.1.
    - The alignment along the Susitna River has shifted to the west and is now closer to the floodplain than the disturbed transportation corridor. This change was made to avoid encroaching on a steep bluff and results in a slight increase in wetland impacts.

- South of the Tanana River, the alignment has moved to the west of the Nenana River into undeveloped forest and away from the disturbed transportation corridor. This change was made to straighten the alignment and move onto drier terrain. The route moved onto steeper slopes but improves the crossings of streams and reduces bog crossings.
- A portion of the alignment was moved from Minto Flats to the upland Summer Ridge area to avoid and minimize impacts to wetlands and reduce impacts to a state game refuge.
- The Fairbanks Lateral segment has shifted into rural forested ridges, away from the railroad corridor, private property, military property, and several wetlands.
- In the Northern Ecoregion, the alignment has moved west, away from the Sagavanirktok River and the Dalton Highway transportation corridor. This change avoids several lakes, avoids higher value wetlands, and improves stream crossings.

4. Pipeline construction across wetlands would be scheduled during the winter to the maximum extent practicable and existing bridges or HDD/other trenchless technology, as appropriate.
5. Avoid and minimize ground-disturbing activity in wetlands by:
   - Limit grading wetlands to the maximum extent practicable;
   - Locate permanent facilities outside of wetlands, when possible;
   - Maintain existing hydrologic systems;
   - Reseed and revegetate sensitive and erosive areas immediately (*e.g.*, some wetlands) upon completion of construction activities.
   - Use existing bridges or HDD/other trenchless technology where practicable;
   - Designate areas within the proposed Project footprint that would require the use of mats, these would be identified as matted regions; and
   - Use mats or other types of mitigation during non-winter construction to prevent rutting. Rubber mats are planned for areas in which wetlands are short distances across, non-permafrost, and flat; inundated palustrine wetlands are the likely areas where mats would be used. Mats help distribute loads across a wide surface and reduce compaction of the underlying vegetation and soils. This helps to preserve non-permafrost wetlands by limiting long-term damage. Mats are helpful in preserving stream bank vegetation at some erosion-prone areas in permafrost regions.
6. Regulations regarding dredging and deposition of fill material would be followed; 40 CFR 230 Section 404(b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material. The Section 404 of the CWA establishes protocols and policy for the discharge of fill into aquatic resources. Except as provided under

Section 404(b)(2), no discharge of dredged or fill material shall be permitted if there is a practicable alternative to the proposed discharge which would have less adverse impact on the aquatic ecosystem, so long as the alternative does not have other significant adverse environmental consequences of negative impacts on the nation's water resources. Pursuant to these requirements, the district engineer would issue an individual Section 404 permit only upon a determination that the proposed discharge complies with applicable provisions of 40 CFR 230. This includes those provisions that require the permit Applicant to take all appropriate and practicable steps to avoid and minimize adverse impacts to waters of the U.S. Practicable means available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall proposed Project purposes. Compensatory mitigation for unavoidable impacts may be required to comply with the Section 404(b)(1) Guidelines. In accordance with 33 CFR 332 Compensatory Mitigation for Losses of Aquatic Resources, compensatory mitigation must be commensurate with the amount and type of impact that is associated with a particular Department of the Army permit.

7. To avoid a "French-drain effect" in wetlands trenched for the pipeline, trench breakers would be installed in the trench to stop water from flowing along the trench. In areas of discontinuous permafrost, trench breakers would be installed just outside the wetland area to keep water from moving outside of the wetland. In continuous permafrost areas, the trench breakers would stay in place because the bottom of the trench stays frozen, as noted in AGDC's geothermal modeling reports. Trench breakers would be water resistant and stabilized with material designed to resist water movement (*e.g.*, sand bags, bentonite, non-toxic spray foam, etc.) so they would not be penetrated by water, eroded, or moved. AGDC's thermal modeling also shows that areas near the bottom of the trench would be frozen year-round, providing additional stability.
8. For other areas south of MP 175, the subsurface water flow would be mitigated with the use of ditch plugs made from blocks of native sod, bentonite, or other appropriate material during construction.
9. AGDC intends to institute a comprehensive monitoring program and would employ several mitigative measures to offset and minimize indirect impacts to wetlands, including a revegetation program that allows for the recolonization of the ROW by native species in non-sensitive areas and the immediate revegetation of the ROW through re-seeding in sensitive areas (AGDC, 2016e). The program would employ continual detection and field maintenance activities (AGDC, 2016b,e) and the use of thermosyphons or additional ditch plugs (described in the 2016 ASAP EED; AGDC, 2016b) in select areas (AGDC, 2016c). Thermosyphons would be used in select areas of discontinuous permafrost (south of MP 175) where greater permafrost stability near the surface is required; field monitoring crews observing issues such as slumping or reports of suspected thaw by in-line inspection may lead to thermosyphon placement. Thermosyphons have been used historically for areas

along the TAPS ROW and for other projects, such as the Alpine HDD crossing of the Colville River. Additional ditch plugs could be used where newly identified water management efforts are required. In rare instances, where thaw or slumping are identified around permanent facilities that cannot be moved (*e.g.*, block valves) and where a power supply is available, a stationary active refrigeration unit may be employed.

10. For construction, the alignment is already well established, so rerouting outside of the detailed final alignment is not a viable option. The mitigative options are then limited to those physical measures that could be adopted during the construction phase including:
    - Re-routing within the ROW – in some cases, the field conditions encountered might be very site specific and limited. In this case, potential reroute of the ROW pad within the lateral limits of the construction ROW, could limit expected disturbance.
    - Over-excavate and replace thaw unstable material – this technique may be a viable method in some locations; the material would be excavated and removed, and foreign material imported, requiring the mining and importation of additional select fill material to backfill the removed material. This technique could be employed in areas where very high displacement strains in near surface soils are evident, such as massive ice in a near surface strata, but below the active layer.
11. The following options would be considered in extraordinary and specific conditions since they would certainly require new materials, increased field scrutiny, and additional construction delay. Nevertheless, they are included here for completeness:
    - Install localized thermosyphons, which are passive heat pipes designed for installation in select locations along the edge of the ROW to provide a thermal curtain and limit impact. Their use is discussed and depicted in AGDC, 2016b,c.
    - Localized active refrigeration and insulation would be considered in extraordinary and specific conditions. This may be mechanically driven equipment that would refrigerate sections of the ground around permanent facilities where a power supply is available (*e.g.*, use of a design similar to the TAPS PS1 brine system).
    - Workpad insulation.
12. Surface leveling is one possible form of intervention/mitigation that can be employed should the ROW need to be elevated from a settlement condition during operations. New backfill material is placed in the area to be re-leveled. Additional revegetation measures would occur on the newly disturbed areas.

4.9.3.2. USACE and ADEC Conditions to be Considered During Permitting

A variety of mitigation measures and best practices have been recommended by the cooperating agencies (Appendix M). Many of these recommendations have been incorporated in the proposed Project. Significant differences between the regulatory agency recommendations and the proposed Project are identified below.

- No stockpiling of fill materials shall occur in wetlands or other waters of the U.S. that do not have DA authorization.
- Trenches may not be constructed or backfilled in such a manner as to drain waters of the U.S. (*e.g.*, backfilling with extensive gravel layers, creating a French drain effect). Ditch plugs or other methods shall be used to prevent this situation.
- Except for material placed as minor trench over fill or surcharge necessary to offset subsidence or compaction, all excess materials shall be removed to a non-wetland location. The backfilled trench shall achieve the pre-construction elevation, within a year of disturbance unless climatic conditions warrant additional time. The additional time must be approved by USACE.
- Excavated material temporarily sidecast into wetlands shall be underlain with geotextile, ice pads, or similar material to allow for removal of the temporary material to the maximum extent practicable.
- To prevent erosion, disturbed areas shall be stabilized immediately after construction. Revegetation of the site shall begin as soon as site conditions allow and in the same growing season as the disturbance unless climatic conditions warrant additional time. Additional time must be approved by USACE. Native vegetation and topsoils removed for proposed Project construction shall be stockpiled separately and used for site rehabilitation. Except in areas of topsoil excavation, excavated soils shall be sorted into mineral subsoils and topsoil and stored separately. Topsoil is defined as the upper, outermost layer of soil, usually the top 2 to 8 inches. The depth of topsoil can be measured as the depth from the surface to the first densely packed layer of soil. When backfilling, topsoil shall be placed as the uppermost layer to provide a seed bed for native species. If topsoil and/or organic materials are not available from the proposed Project site for rehabilitation, other locally obtained native materials may be used. Species to be used for seeding and planting shall follow this order of preference: 1) species native to the site; 2) species native to the area; and 3) species native to the state.
- Prior to commencement of construction activities within waters of the U.S., the limits of the proposed Project disturbance shall be clearly identified at the proposed Project site with highly visible markers (*e.g.*, construction fencing, flagging, silt barriers, etc.) and shall be maintained until construction is complete and the soils have been stabilized.
- Natural drainage patterns shall be maintained using appropriate ditching, culverts, storm drain systems and other measures to prevent ponding or drying. Excessive

ponding and/or dewatering of areas adjacent to fill areas shall indicate non-compliance.

- The Applicant shall ensure that the proposed Project minimizes alterations to water circulation patterns to the extent practicable. If it is determined by USACE that the proposed Project negatively impacts the hydrology within the wetland, the Applicant may be required to take additional measures (*i.e.*, install additional depressed road beds, culvert[s], or a similar water conduit) beneath the road to reestablish the hydrology of the area to that of preconstruction conditions.
- Relocated stream channels shall approximate the length, meander pattern, gradient, channel cross section, substrate and flow velocity of the original stream channel. Relocated stream channels shall be designed and constructed to avoid excessive loss of flow through the bed or dewatering of the stream channel. The relocation of stream channels shall include establishment of an associated floodplain. The floodplain should be of similar dimension and form as the original.
- As applicable to permit conditions at the time of construction, the permittee must maintain a minimum natural buffer of 25 feet around the edge of any waters of the U.S. and at stream crossings unless the crossing is a necessary and dependent water access construction activity (*e.g.*, open trench pipeline crossing).
- As applicable to permit conditions at the time of construction, stabilization of disturbed areas must be initiated as soon as practicable whenever any clearing, grading, excavating, or other earth disturbing activities have permanently ceased on any portion of the site or temporarily ceased on the site and would not resume for a period exceeding 14 days.
- As applicable to permit conditions at the time of construction, no later than 14 days after initiating temporary stabilization, the permittee must complete all activities necessary to initially revegetate the area and/or install non-vegetative measures.
- As applicable to permit conditions at the time of construction, the permittee must achieve final stabilization for the affected area of coverage. Final stabilization means that all soil disturbing activities at the site have been completed and either of the two following criteria shall be met: a) a uniform (*e.g.*, evenly distributed, without large bare areas) perennial vegetative cover with a density of 70 percent of the native background vegetative cover for the area has been established on all unpaved areas and areas not covered by permanent structures, or b) equivalent non-vegetative permanent stabilization measures have been employed including but not limited to riprap, gabions, porous backfill per ADOT&PF Specification 703-2.10, railroad ballast or sub-ballast, ditch lining per ADOT&PF Specification 610-2.01, or geotextiles, or fill material with low erodibility as determined by an engineer familiar with the site and documented in the SWPPP.
- As applicable to permit conditions at the time of construction, stabilization of disturbed areas must, at a minimum, be initiated immediately whenever any

clearing, grading, excavating, or other earth disturbing activities have permanently ceased on any portion of the site or temporarily ceased on any portion of the site and would not resume for a period exceeding: 7 calendar days for those areas of the state with a mean annual precipitation of 40 inches or greater; or, 14 calendar days for those areas of the state with a mean annual precipitation less than 40 inches.

Section 4.9.8 describes the differences in the anticipated proposed Project impact rankings under the assumption that these recommended measures were implemented. This section is provided as a comparison with the impacts of the currently proposed Project.

4.9.3.3. Agency-Recommended Mitigation Measures

A variety of mitigation measures and best practices have been recommended by the cooperating agencies (Appendix M). Many of these recommendations have been incorporated in the proposed Project and are included in Table 4.9-4 below. The impacts discussed in this chapter are based upon the Applicant-proposed measures. These additional agency recommended measures are not included in the impact analysis.

Table 4.9-4 Wetland Resources Agency-Recommended Mitigation Measures

Additional Measure Consideration	Agency Proposing Mitigation Measure	Agency Jurisdiction	Authority (*i.e.*, CWA, RHA, ESA)	Affected Resources	Comment Code
Specify the timeframe of restoration	BLM	BLM, ADNR	--	Soils and Geology, Vegetation, Wetlands	MIT_21
Include in the wetland mitigation package a monitoring and an adaptive management plan that contains corrective actions should mitigation efforts not meet success criteria.	EPA	EPA, USACE	--	Wetlands	MIT_32
Include specific fugitive dust control measures, such as speed limits and frequency of watering during non-winter months, that would be implemented to achieve control limits.	EPA	EPA, ADEC	--	Vegetation, Wetlands, Fish, Public Health, Air Quality	MIT_34
We recommend that the Final SEIS list specific fugitive dust control measures, such as speed limits and frequency of watering during non-winter months, that would be used to achieve this level of control.	EPA	EPA, ADEC	CAA	Air, Wetlands, Vegetation, Human Health, Recreation	AIR_22
Remove and properly store the organic soil layer (*e.g.*, tundra sod blocks and salvaging the organic layer, approximately 15-30 centimeter uppermost layer containing seeds, plant propagules, roots, organic matter, and soil microbes) before trenching to facilitate reestablishing vegetation in a more timely manner.	USFWS	USACE, EPA	--	Soils and Geology, Vegetation, Wetlands	MIT_12
Use a generally accepted timeline of 5 years for achieving 70% coverage in the Intermontaine Boreal and Alaska Range Transition Ecoregions.	USFWS	--	--	Soils and Geology, Vegetation, Wetlands	MIT_13
To avoid and minimize impacts to wetlands to the extent practicable, the pipeline should be elevated on vertical support members in the Arctic Tundra ecoregion, and other areas where thaw-unstable permafrost exists.	USFWS	USACE, EPA	--	Wetlands	ALT_35

Additional Measure Consideration	Agency Proposing Mitigation Measure	Agency Jurisdiction	Authority (*i.e.*, CWA, RHA, ESA)	Affected Resources	Comment Code
Natural drainage patterns shall be maintained to the extent practicable by the installation of culverts or bridges in sufficient number and size under access roads and trails to prevent ponding, diversion, or concentrated runoff that would result in adverse impacts to adjacent wetlands and other fish and wildlife habitats.	USFWS	USACE, ADF&G ADEC	CWA, RHA	Water, Wetlands, Fish	MIT 15
The boundaries of all construction areas shall be staked or flagged prior to construction to prevent inadvertent encroachment outside the permitted construction area. No fill, equipment, or construction materials shall be stockpiled or stored on wetlands that do not have authorization from the Department of the Army for those activities.	USFWS	USACE, ADEC	CWA, RHA	Wetlands	MIT 15
The pipeline shall be elevated on Vertical Support Members (VSMs) from MP 0 to at least beyond the area of extensive ice-rich, saturated soils containing a high density of oriented thaw lakes on the Arctic Coastal Plain. The VSMs should also be used to elevate the pipeline in extensive areas of thaw-unstable permafrost and in areas of continuous and discontinuous permafrost where inadvertent thermokarst could alter the natural drainage pattern along the pipeline.	USFWS	USACE	--	Soils and Geology, Vegetation, Wetlands	MIT_15
Material sites shall be reclaimed in accordance with a plan approved by the Corps of Engineers in consultation with the Service. Reclamation shall be accomplished within 3 years on any portion of the material site that has been inactive (abandoned) for 3 years, or where the material source is no longer practical or economically feasible to extract.	USFWS	USACE	--	Soils and Geology, Vegetation, Wetlands	MIT_15

Additional Measure Consideration	Agency Proposing Mitigation Measure	Agency Jurisdiction	Authority (*i.e.*, CWA, RHA, ESA)	Affected Resources	Comment Code
If open water is created at a material site in the Intermontane Boreal or Alaska Range Transition Ecoregion, then reclamation shall include: 1) constructing a littoral zone at least 20 feet wide (shallow underwater shelf along the bank with slopes averaging less than 10H:1V); 2) constructing an irregular shoreline with bays and spits; and 3) spreading 2 to 4 inches of separately stockpiled organic overburden on the littoral zone and shoreline to enhance revegetation. At least a 25-foot-wide buffer of native vegetation should also be established around the excavation perimeter to help filter sediment and pollutants before they enter the water.	USFWS	BLM	--	Soils and Geology, Vegetation, Wetlands	MIT_15
If open water is created at a material site in the Arctic Tundra Ecoregion, then reclamation shall include: 1) salvaging the active organic topsoil layer (12 to 18 inches) overlaying the footprint of the cell and stockpile on an adjacent ice pad/pad; 2) removing the remaining inorganic/mineral overburden from the cell and stockpile separately from the organic topsoil on an adjacent ice pad/pad; 3) placing a berm of inorganic overburden around the outside edge of the cell as insulation to prevent thermokarsting and erosion of the cell sidewalls, and as a safety precaution; 4) instructing side slopes of the cell no steeper than 2H:1V (preferably 3H:1V); 5) placing the inorganic/mineral overburden back into the cell when mining is complete to create 3H:1V side slopes if possible; 6) using the organic topsoil to stabilize the top edges of the side slopes of the mined cell, to reclaim the adjacent tundra disturbed by mining operations, and/or to use	USFWS	BLM	--	Soils and Geology, Vegetation, Wetlands	MIT_15

Additional Measure Consideration	Agency Proposing Mitigation Measure	Agency Jurisdiction	Authority (*i.e.*, CWA, RHA, ESA)	Affected Resources	Comment Code
in other reclamation sites; 7) keeping the berm surrounding the pit in place as a safety precaution until the pit has completely filled with water, at which point the berm can be removed (*e.g.*, pushed into the water-filled pit).					
All disturbed, stockpile, and fill areas shall be stabilized to prevent erosion. Increased water turbidity and accumulation of sediment in drainages, sloughs, and other wetlands shall be evidence of insufficient stabilization.	USFWS	EPA, ADEC	--	Soils and Geology, Vegetation, Wetlands	MIT_15
A final mitigation plan shall be approved by the Corps of Engineers in consultation with the Service before work commences in waters of the U.S., including wetlands. Unavoidable direct, indirect, and temporal (>3 years) proposed Project impacts to wetlands shall be compensated with at least equal-functioning wetlands.	USFWS	USACE, EPA	--	Water, Wetlands	MIT_15
At least a 25-foot-wide buffer of native vegetation should also be established around the excavation perimeter to help filter sediment and pollutants before they enter the water.	USFWS/ADEC	EPA, ADEC	CWA	Water, Wetlands	MIT 15
A large number of Applicant-proposed design features, mitigation measures, BMPs, and project management plans listed in the Draft SEIS contain the language, "In areas where a lease is required from the State Pipeline Coordinator's Section" or "a federal grant of ROW is required from BLM ..." These measures generally represent a best management approach that we recommend using to the maximum extent possible along the entire pipeline route, while acknowledging the outstanding need to complete coordination with private landowners.	EPA	--	--	Numerous	MIT_35

AAC = Alaska Administrative Code
ADF&G = Alaska Department of Fish and Game
ADEC = Alaska Department of Environmental Conservation
ADNR = Alaska Department of Natural Resources
AGDC = Alaska Gasline Development Corporation
APDES = Alaska Pollution Discharge Elimination System
BLM = Bureau of Land Management
BMP = Best Management Practice
CAA = Clean Air Act
CWA = Clean Water Act
DHSS = Alaska Department of Health and Social Services
EPA = U.S. Environmental Protection Agency
MBTA = Migratory Bird Treaty Act
NMFS = National Marine Fisheries Service
RHA = Rivers and Harbors Act of 1899
SEIS = Supplemental Environmental Impact Statement
USACE = U.S. Army Corps of Engineers
USFWS = U.S. Fish and Wildlife Service

4.9.4. Alternative 1 – Proposed Action

Alternative 1 is designated the proposed Action (proposed ASAP Project). This alternative is described in Chapter 2 in detail. The 36-inch, 733-mile-long pipeline and 12-inch, 30-mile lateral pipeline to Fairbanks would cross various habitats and ecoregions from the North Slope to the existing ENSTAR pipeline system in the Mat-Su Borough. This section discusses the analysis of impacts to wetlands along the route. The proposed Project would intersect wetland communities of various types in a wide variety of ecoregions in Alaska, described in Chapter 3.

The following sections discuss activities that are proposed to occur during the construction and operations phases of the proposed Project with associated potential impacts.

Mitigation Measure Nos. 1 through 7 and 9 through 12 apply to the entire proposed Project route.

4.9.4.1. Construction

The construction ROW in Alternative 1 (proposed Action) would temporarily impact wetland acreage, except for the placement of gravel fill, which is a permanent impact. Beyond those lands within the operations (permanent impacts) corridor, additional construction areas, such as temporary work areas, HDD crossings, pipeline stream crossings, ice roads and pads, and bridges would be developed. Temporary work areas would be required for construction at road crossings, railroad crossings, crossings of existing pipelines and utilities, pipe stringing truck turnaround areas, wetland crossings, points of inflection, and waterbody crossings. These temporary work areas would be located adjacent to the permanent impacts area and could be used for such things as spoil storage, staging, equipment movement, material stockpiles, and pull string assembly associated with HDD installation. Temporary work areas would be located in areas that reduce impacts to wetlands to the greatest extent practicable. Stream crossings and the associated suspension bridges are considered temporary impacts because there would be no permanent placement of fill or proposed Project features in the streams. Roads that cross streams would have culverts or suspension bridges removed as part of the abandonment process. All bridge crossing portions of access roads, regardless of whether or not they are removed, are not considered a permanent impact to riverine wetlands. There is no impact to these streams because of the use of the suspension bridge. In contrast, all culverts, regardless of whether or not they are removed, are considered to result in a permanent impact to riverine wetlands.

Approximately 51.8 percent of the wetlands in the temporary impacts area are palustrine emergent; 18.6 percent are scrub/shrub; 11.5 percent are forested; 2.3 percent are riverine; and 15.8 percent are estuarine, marine, lacustrine, or other palustrine (Figure 4.9-1). Mapped wetland acres in the temporary impacts area and their NWI classifications are presented in Table 4.9-5. Approximately 68.5 percent of the wetlands in the temporary impacts area have a hydrogeomorphic (HGM) class of organic soil

flats, 14.8 percent are marine, 7.6 percent are depressional, 5.4 percent are riverine, 3.6 percent are slope, 0.01 percent are mineral soil flats, and 0.08 percent are lacustrine or estuarine fringe (Figure 4.9-2). The percentages of slope, lacustrine fringe, and marine are less than 1 percent. Mapped wetland acres in the temporary impacts area and their HGM functional classification are presented in Table 4.9-6.

Tables 4.9-7 and 4.9-8 show acres of wetlands, by types, and by HGM classes respectively, which would be impacted by the proposed Project. For both alternatives, the permanent impacts to wetlands would be primarily to the palustrine scrub/shrub wetlands type (58.9 percent for Alternative 1); palustrine emergent wetlands would receive the second most acres of impact (24.9 percent for Alternative 1). The permanent impacts to wetlands would primarily be to the flat HGM classification (68.2 percent for Alternative 1); the slope HGM class would receive the second most acres of impact (14.0 percent for Alternative 1). Table 4.9-9 shows acres of wetlands impacted by ecoregion found in each Project component, as well as the total acreage within permanent and temporary impacts areas of the proposed Project.

Figure 4.9-1 NWI Classes of Wetlands and Waters within the Temporary Impacts Areas

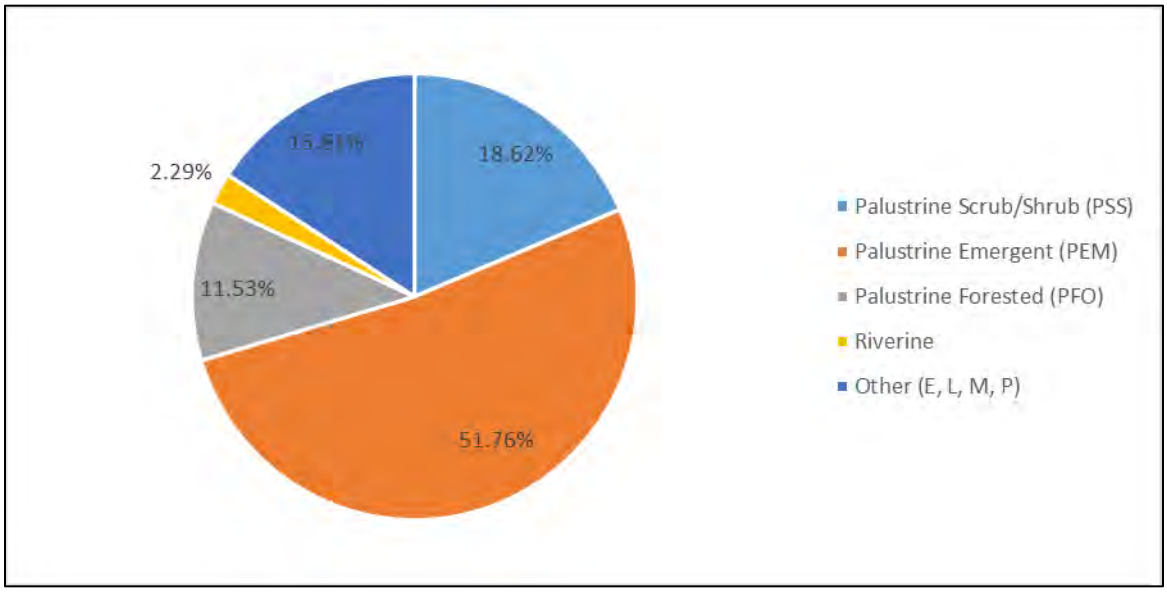


Figure 4.9-2 HGM Functional Classes of Wetlands and Waters within the Temporary Impacts Areas

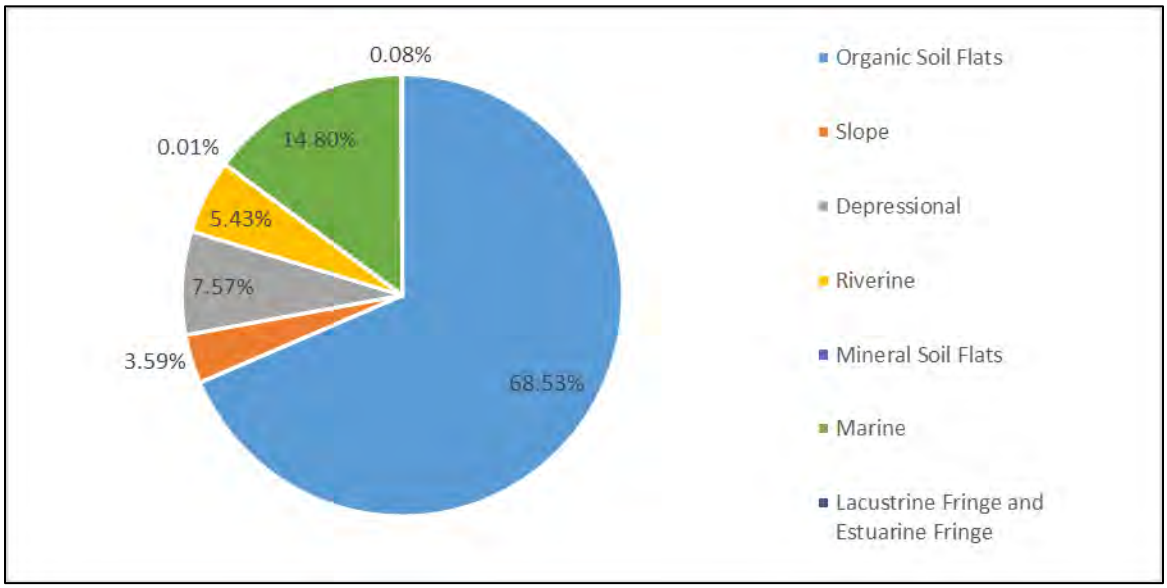


Table 4.9-5 Wetland Type (Acres) Mapped in the Wetland Mapping Corridor, Alternative 1 Permanent Impacts Area, and Alternative 1 Temporary Impacts Areas

Wetland Type	Acres within Wetland Mapping Corridor	Wetland Acres within Permanent Impacts Area	Wetland Acres within Temporary Impacts Areas	Acres within Impacts Areas
Palustrine Forested (PFO)	8,844.93	711.40	194.83	906.23
Palustrine Scrub/Shrub (PSS)	55,836.72	4,719.48	314.67	5,034.14
Palustrine Emergent (PEM)	34,116.92	1,998.83	874.74	2,873.58
Other Palustrine Waters (PAB and PUB)	1,430.64	43.36	16.92	60.28
Riverine Waters (R)	4,083.96	371.04	38.66	409.70
Lacustrine Waters (L)	419.33	0.02	0.00	0.02
Estuarine Waters (E)	173.58	110.83	0.12	110.94
Marine (M)	326.89	59.83	250.10	309.94
Total Wetland Acres	**105,232.96**	**8,014.78**	**1,690.05**	**9,704.83**
Upland	*98,817.25*	--	--	*11,788.20*
Total Acres	*204,050.22*	--	--	*21,493.03*

Note that the totals differ slightly due to rounding of individual values.

Table 4.9-6 HGM Functional Class (Acres) Mapped in the Wetland Mapping Corridor, Alternative 1 Permanent Impacts Area, and Alternative 1 Temporary Impacts Areas

HGM Functional Class	Acres within Wetland Mapping Corridor	Wetland Acres within Permanent Impacts Area	Wetland Acres within Temporary Impacts Areas
Organic Soil Flats	72,509.54	5,467.97	1158.23
Slope	14,583.88	1,118.18	60.63
Depressional	7,951.89	315.45	127.87
Riverine	7,589.59	540.14	91.77
Mineral Soil Flats	1,731.97	402.35	0.10
Marine	326.89	59.83	250.10
Estuarine Fringe	173.58	110.83	0.12
Lacustrine Fringe	365.61	0.02	1.23
Total Wetland Acres	**105,232.96**	**8,014.78**	**1,690.05**
Upland	*98,817.25*	--	--
Total Acres	*204,050.22*	--	--

Note that the totals differ slightly due to rounding of individual values.

Table 4.9-7 NWI Wetland Type (Acres) by Project Component in the Permanent Impacts Area and Temporary Impacts Areas

Project Component	NWI Wetland Type	Alternative 1		Alternative 2	
		Wetland Acres within Permanent Impacts Area	Wetland Acres within Temporary Impacts Areas	Wetland Acres within Permanent Impacts Area	Wetland Acres within Temporary Impacts Areas
Access Road	Palustrine Scrub/Shrub (PSS)	496.26	0.04	465.58	0.04
	Palustrine Emergent (PEM)	235.07	0.01	233.99	0.01
	Palustrine Forested (PFO)	117.64	0	114.25	0
	Other Palustrine Waters (PAB and PUB)	6.56	0	6.55	0
	Riverine Waters (R)	3.67	4.34	3.44	3.64
	Lacustrine Waters (L)	0.02	0	0.02	0
	Estuarine Waters (E)	0.06	0	0.06	0
	Total Wetland Acres	*859.29*	*4.39*	*823.90*	*3.69*
Bridge	Palustrine Emergent (PEM)	0	0	0	0
	Riverine Waters (R)	0	4.57	0	4.76
	Total Wetland Acres	*0*	*4.57*	*0*	*4.76*
Camp	Palustrine Scrub/Shrub (PSS)	76.84	0	76.84	0
	Palustrine Emergent (PEM)	23.79	0	23.79	0
	Palustrine Forested (PFO)	19.87	0	19.86	0
	Other Palustrine Waters (PAB and PUB)	2.31	0	2.31	0
	Total Wetland Acres	*122.82*	*0*	*122.81*	*0*
Construction Impact - Avoidance	Palustrine Scrub/Shrub (PSS)	0	19.89	0	23.05
	Palustrine Emergent (PEM)	0	614.26	0	713.77
	Other Palustrine Waters (PAB and PUB)	0	11.47	0	13.56
	Riverine Waters (R)	0	0.34	0	0.34
	Total Wetland Acres	*0*	*645.95*	*0*	*750.72*

Project Component	NWI Wetland Type	Alternative 1		Alternative 2	
		Wetland Acres within Permanent Impacts Area	Wetland Acres within Temporary Impacts Areas	Wetland Acres within Permanent Impacts Area	Wetland Acres within Temporary Impacts Areas
Construction Impact - Permanent	Palustrine Scrub/Shrub (PSS)	3,204.23	0	3,163.11	0
	Palustrine Emergent (PEM)	1,144.89	0	1,080.32	0
	Palustrine Forested (PFO)	361.45	0	362.65	0
	Other Palustrine Waters (PAB and PUB)	5.83	0	4.54	0
	Riverine Waters (R)	15.31	0	15.36	0
	Total Wetland Acres	*4,731.71*	*0*	*4,625.99*	*0*
Construction Impact - Temporary	Palustrine Scrub/Shrub (PSS)	0	234.67	0	226.98
	Palustrine Emergent (PEM)	0	198.50	0	20.69
	Palustrine Forested (PFO)	0	158.02	0	157.89
	Other Palustrine Waters (PAB and PUB)	0	4.03	0	0.33
	Riverine Waters (R)	0	0.45	0	0.44
	Total Wetland Acres	*0*	*595.67*	*0*	*406.34*
Dredge Disposal	Estuarine Waters (E)	100.00	0	0	0
	Marine Waters (M)	0	0	200.00	0
	Total Wetland Acres	*100.00*	*0*	*200.00*	*0*
Facility Pad	Palustrine Scrub/Shrub (PSS)	7.58	0	7.58	0
	Palustrine Emergent (PEM)	82.33	0	82.33	0
	Palustrine Forested (PFO)	0.77	0	0.77	0
	Other Palustrine Waters (PAB and PUB)	8.28	0	8.28	0
	Riverine Waters (R)	0.01	0	0.01	0
	Total Wetland Acres	*98.97*	*0*	*98.97*	*0*
HDD Crossing	Palustrine Scrub/Shrub (PSS)	0	0.96	0	0.73

Project Component	NWI Wetland Type	Alternative 1		Alternative 2	
		Wetland Acres within Permanent Impacts Area	Wetland Acres within Temporary Impacts Areas	Wetland Acres within Permanent Impacts Area	Wetland Acres within Temporary Impacts Areas
	Palustrine Emergent (PEM)	0	1.49	0	1.49
	Palustrine Forested (PFO)	0	5.82	0	5.82
	Riverine Waters (R)	0	18.61	0	12.73
	Total Wetland Acres	*0*	*26.89*	*0*	*20.77*
HDD Entry Pad	Palustrine Scrub/Shrub (PSS)	1.32	0	0.06	0
	Palustrine Emergent (PEM)	0.11	0	0	0
	Total Wetland Acres	*1.43*	*0*	*0.06*	*0*
HDD Exit Pad	Palustrine Scrub/Shrub (PSS)	1.37	0	0	0
	Palustrine Emergent (PEM)	0.20	0	0.20	0
	Palustrine Forested (PFO)	1.17	0	1.17	0
	Total Wetland Acres	*2.75*	*0*	*1.38*	*0*
HDD False ROW	Palustrine Scrub/Shrub (PSS)	0	35.83	0	25.60
	Palustrine Emergent (PEM)	0	5.31	0	5.31
	Palustrine Forested (PFO)	0	28.96	0	27.13
	Other Palustrine Waters (PAB and PUB)	0	0.08	0	0.08
	Riverine Waters (R)	0	0.14	0	0.14
	Total Wetland Acres	*0*	*70.32*	*0*	*58.25*
Ice Access Road	Palustrine Scrub/Shrub (PSS)	0	19.18	0	19.18
	Palustrine Emergent (PEM)	0	52.64	0	52.90
	Palustrine Forested (PFO)	0	1.83	0	1.83
	Other Palustrine Waters (PAB and PUB)	0	1.32	0	1.32
	Riverine Waters (R)	0	7.84	0	7.84
	Total Wetland Acres	*0*	*82.82*	*0*	*83.08*

Project Component	NWI Wetland Type	Alternative 1		Alternative 2	
		Wetland Acres within Permanent Impacts Area	Wetland Acres within Temporary Impacts Areas	Wetland Acres within Permanent Impacts Area	Wetland Acres within Temporary Impacts Areas
Material Source	Palustrine Scrub/Shrub (PSS)	883.97	0	882.76	0
	Palustrine Emergent (PEM)	480.93	0	480.93	0
	Palustrine Forested (PFO)	203.00	0	203.00	0
	Other Palustrine Waters (PAB and PUB)	20.16	0	20.16	0
	Riverine Waters (R)	352.00	0	352.00	0
	Total Wetland Acres	*1,940.07*	*0*	*1,938.85*	*0*
Pipe Storage Yard	Palustrine Scrub/Shrub (PSS)	45.32	0	45.32	0
	Palustrine Emergent (PEM)	29.90	0	50.56	0
	Palustrine Forested (PFO)	6.47	0	6.47	0
	Total Wetland Acres	*81.69*	*0*	*102.36*	*0*
Pipeline Stream Crossing	Palustrine Scrub/Shrub (PSS)	0	0.23	0	0.23
	Palustrine Emergent (PEM)	0	0.03	0	0.02
	Palustrine Forested (PFO)	0	0	0	0
	Other Palustrine Waters (PAB and PUB)	0	0.02	0	0.02
	Riverine Waters (R)	0	2.03	0	2.05
	Total Wetland Acres	*0*	*2.32*	*0*	*2.34*
Railroad Siding	Palustrine Scrub/Shrub (PSS)	2.40	0	2.40	0
	Palustrine Emergent (PEM)	1.59	0	1.59	0
	Palustrine Forested (PFO)	1.02	0	1.02	0
	Other Palustrine Waters (PAB and PUB)	0.21	0	0.21	0
	Total Wetland Acres	*5.22*	*0*	*5.22*	*0*
Sea Ice Pad	Estuarine Waters (E)	0	0	0	1.81

Project Component	NWI Wetland Type	Alternative 1		Alternative 2	
		Wetland Acres within Permanent Impacts Area	Wetland Acres within Temporary Impacts Areas	Wetland Acres within Permanent Impacts Area	Wetland Acres within Temporary Impacts Areas
	Marine Waters (M)	0	145.93	0	243.37
	Total Wetland Acres	*0*	*145.93*	*0*	245.18
Sea Ice Road	Marine Waters (M)	0	104.18	0	70.74
	Total Wetland Acres	*0*	*104.18*	*0*	*70.74*
TAPS ROW	Riverine Waters (R)	0.05	0	0.05	0
	Total Wetland Acres	*0.05*	*0*	*0.05*	*0*
Temporary Workspace	Palustrine Scrub/Shrub (PSS)	0	3.85	0	3.85
	Palustrine Emergent (PEM)	0	2.50	0	2.50
	Palustrine Forested (PFO)	0	0.19	0	0.19
	Riverine Waters (R)	0	0.34	0	0.34
	Total Wetland Acres	*0*	*6.88*	*0*	*6.88*
GCF Vertical Support Members	Palustrine Emergent (PEM)	0.01	0	0.01	0
	Other Palustrine Waters (PAB and PUB)	0	0	0	0
	Total Wetland Acres	*0.02*	*0*	*0.01*	*0*
West Dock Barge Bridge and Base	Estuarine Waters (E)	1.39	0	0	0
	Total Wetland Acres	*1.39*	*0*	*0*	*0*
West Dock Dredge Area	Estuarine Waters (E)	0	0	0.36	0
	Marine Waters (M)	59.29	0	115.86	0
	Total Wetland Acres	*59.29*	*0*	*116.21*	*0*
West Dock Mooring Dolphin	Estuarine Waters (E)	0.04	0	0	0
	Total Wetland Acres	*0.04*	*0*	*0*	*0*
West Dock New Fill	Estuarine Waters (E)	9.33	0	5.83	0
	Marine Waters (M)	0.55	0	0	0

Project Component	NWI Wetland Type	Alternative 1		Alternative 2	
		Wetland Acres within Permanent Impacts Area	Wetland Acres within Temporary Impacts Areas	Wetland Acres within Permanent Impacts Area	Wetland Acres within Temporary Impacts Areas
	Total Wetland Acres	*9.88*	*0*	*5.83*	*0*
West Dock Temporary Barge Bridge Rake	Estuarine Waters (E)	0	0.12	0	0
	Total Wetland Acres	*0*	*0.12*	*0*	*0*
Yukon River Suspension Bridge Access Road and Anchor	Palustrine Scrub/Shrub (PSS)	0	0	3.59	0.02
	Palustrine Emergent (PEM)	0	0	1.37	0
	Riverine Waters (R)	0	0	0	5.88
	Total Wetland Acres	*0*	*0*	*4.96*	*5.90*
	Total Wetland Acres	*8,014.78*	*1,690.05*	*8,046.60*	*1,658.66*

Sources: AGDC GIS wetlands data provided 12-14-2017 and modified by USACE 3-23-2018, AGDC GIS Project infrastructure data provided 10-31-2017
Note that the totals differ slightly compared to other tables in this section due to rounding of individual values.

Table 4.9-8 HGM Functional Class (Acres) by Project Component in the Permanent Impacts Area and Temporary Impacts Areas

Project Component	HGM Functional Class	Alternative 1		Alternative 2	
		Wetland Acres within Permanent Impacts Area	Wetland Acres within Temporary Impacts Areas	Wetland Acres within Permanent Impacts Area	Wetland Acres within Temporary Impacts Areas
Access Road	Depressional	74.34	0	73.70	0
	Estuarine Fringe	0.06	0	0.06	0
	Lacustrine Fringe	0.02	0	0.02	0
	Mineral Soil Flats	18.96	0	18.96	0
	Organic Soil Flats	622.01	0	604.32	0
	Riverine	23.26	4.39	22.36	3.69
	Slope	120.64	0.01	104.47	0.01
	Total Wetland Acres	*859.29*	*4.39*	*823.90*	*3.69*
Bridge	Organic Soil Flats	0	0	0	0
	Riverine	0	4.57	0	4.76
	Total Wetland Acres	*0*	*4.57*	*0*	*4.77*
Camp	Depressional	3.80	0	3.80	0
	Mineral Soil Flats	10.21	0	10.21	0
	Organic Soil Flats	105.15	0	105.15	0
	Riverine	0.60	0	0.60	0
	Slope	3.07	0	3.07	0
	Total Wetland Acres	*122.82*	*0*	*122.81*	*0*
Construction Impact - Avoidance	Depressional	0	37.32	0	43.44
	Organic Soil Flats	0	603.61	0	701.43
	Riverine	0	4.83	0	5.66
	Slope	0	0.19	0	0.19
	Total Wetland Acres	*0*	*645.95*	*0*	*750.72*
Construction Impact - Permanent	Depressional	162.24	0	158.14	0
	Mineral Soil Flats	101.45	0	101.45	0
	Organic Soil Flats	3,529.63	0	3,442.09	0
	Riverine	116.80	0	116.16	0

Project Component	HGM Functional Class	Alternative 1		Alternative 2	
		Wetland Acres within Permanent Impacts Area	Wetland Acres within Temporary Impacts Areas	Wetland Acres within Permanent Impacts Area	Wetland Acres within Temporary Impacts Areas
	Slope	821.59	0	808.15	0
	Total Wetland Acres	*4,731.71*	*0*	*4,625.99*	*0*
Construction Impact - Temporary	Depressional	0	51.69	0	40.68
	Organic Soil Flats	0	485.80	0	309.51
	Riverine	0	17.42	0	16.10
	Slope	0	40.76	0	40.05
	Total Wetland Acres	*0*	*595.67*	*0*	*406.34*
Dredge Disposal	Estuarine Fringe	100.00	0	0	0
	Marine	0	0	200.00	0
	Total Wetland Acres	*100.00*	*0*	*200.00*	*0*
Facility Pad	Depressional	13.58	0	13.58	0
	Organic Soil Flats	84.01	0	84.01	0
	Riverine	0.01	0	0.01	0
	Slope	1.37	0	1.37	0
	Total Wetland Acres	*98.97*	*0*	*98.97*	*0*
HDD Crossing	Depressional	0	1.48	0	1.48
	Organic Soil Flats	0	0.24	0	0
	Riverine	0	25.17	0	19.29
	Total Wetland Acres	*0*	*26.89*	*0*	*20.77*
HDD Entry Pad	Depressional	0.11	0	0	0
	Organic Soil Flats	1.26	0	0	0
	Riverine	0.06	0	0.06	0
	Total Wetland Acres	*1.43*	*0*	*0.06*	*0*
HDD Exit Pad	Organic Soil Flats	1.37	0	0	0
	Riverine	1.38	0	1.38	0
	Total Wetland Acres	*2.75*	*0*	*1.38*	*0*
HDD False ROW	Depressional	0	31.01	0	30.96

Project Component	HGM Functional Class	Alternative 1		Alternative 2	
		Wetland Acres within Permanent Impacts Area	Wetland Acres within Temporary Impacts Areas	Wetland Acres within Permanent Impacts Area	Wetland Acres within Temporary Impacts Areas
	Organic Soil Flats	0	8.98	0	0.76
	Riverine	0	13.41	0	13.41
	Slope	0	16.92	0	13.12
	Total Wetland Acres	*0*	*70.32*	*0*	*58.25*
Ice Access Road	Depressional	0	5.68	0	5.68
	Lacustrine Fringe	0	1.23	0	1.23
	Organic Soil Flats	0	55.36	0	55.61
	Riverine	0	19.21	0	19.21
	Slope	0	1.35	0	1.35
	Total Wetland Acres	*0*	*82.82*	*0*	*83.08*
Material Source	Depressional	54.36	0	54.36	0
	Mineral Soil Flats	271.71	0	271.71	0
	Organic Soil Flats	1,052.97	0	1,051.77	0
	Riverine	395.18	0	395.18	0
	Slope	165.85	0	165.85	0
	Total Wetland Acres	*1,940.07*	*0*	*1,938.85*	*0*
Pipe Storage Yard	Depressional	5.74	0	5.74	0
	Organic Soil Flats	68.57	0	89.24	0
	Riverine	1.96	0	1.96	0
	Slope	5.41	0	5.41	0
	Total Wetland Acres	*81.69*	*0*	*102.36*	*0*
Pipeline Stream Crossing	Depressional	0	0.02	0	0.02
	Mineral Soil Flats	0	0	0	0
	Organic Soil Flats	0	0.02	0	0.02
	Riverine	0	2.24	0	2.26
	Slope	0	0.04	0	0.04
	Total Wetland Acres	*0*	*2.32*	*0*	*2.34*

Project Component	HGM Functional Class	Alternative 1		Alternative 2	
		Wetland Acres within Permanent Impacts Area	Wetland Acres within Temporary Impacts Areas	Wetland Acres within Permanent Impacts Area	Wetland Acres within Temporary Impacts Areas
Railroad Siding	Depressional	1.25	0	1.25	0
	Organic Soil Flats	2.90	0	2.90	0
	Riverine	0.85	0	0.85	0
	Slope	0.22	0	0.22	0
	Total Wetland Acres	*5.22*	*0*	*5.22*	*0*
Sea Ice Pad	Estuarine	0	0	0	1.81
	Marine	0	145.93	0	243.37
	Total Wetland Acres	*0*	*145.93*	*0*	*245.18*
Sea Ice Road	Marine	0	104.18	0	70.74
	Total Wetland Acres	*0*	*104.18*	*0*	*70.74*
TAPS ROW	Riverine	0.05	0	0.05	0
	Total Wetland Acres	*0.05*	*0*	*0.05*	*0*
Temporary Workspace	Depressional	0	0.67	0	0.67
	Mineral Soil Flats	0	0.10	0	0.10
	Organic Soil Flats	0	4.22	0	4.22
	Riverine	0	0.53	0	0.53
	Slope	0	1.36	0	1.36
	Total Wetland Acres	*0*	*6.88*	*0*	*6.88*
GCF Vertical Support Members	Depressional	0	0	0	0
	Organic Soil Flats	0.01	0	0.01	0
	Total Wetland Acres	*0.02*	*0*	*0.01*	*0*
West Dock Barge Bridge and Base	Estuarine Fringe	1.39	0	0	0
	Total Wetland Acres	*1.39*	*0*	*0*	*0*
West Dock Dredge Area	Estuarine	0	0	0.36	0
	Marine	59.29	0	115.86	0
	Total Wetland Acres	*59.29*	*0*	*116.21*	*0*
	Estuarine Fringe	0.04	0	0	0

Project Component	HGM Functional Class	Alternative 1		Alternative 2	
		Wetland Acres within Permanent Impacts Area	Wetland Acres within Temporary Impacts Areas	Wetland Acres within Permanent Impacts Area	Wetland Acres within Temporary Impacts Areas
West Dock Mooring Dolphin	*Total Wetland Acres*	*0.04*	*0*	*0*	*0*
West Dock New Fill	Estuarine Fringe	9.33	0	5.83	0
	Marine	0.55	0	0	0
	Total Wetland Acres	*9.88*	*0*	*5.83*	*0*
West Dock Temporary Barge Bridge Rake	Estuarine Fringe	0	0.12	0	0
	Total Wetland Acres	*0*	*0.12*	*0*	*0*
Yukon River Suspension Bridge Access Road and Anchor	Depressional	0	0	1.30	0
	Lacustrine	0	0	0.07	0
	Organic Soil Flats	0	0	3.59	0.02
	Riverine	0	0	0	5.88
	Total Wetland Acres	*0*	*0*	*4.96*	*5.90*
	Total Wetland Acres	*8,014.78*	*1,690.05*	*8,046.60*	*1,658.66*

Sources: AGDC GIS wetlands data provided 12-14-2017 and modified by USACE 3-23-2018, AGDC GIS Project infrastructure data provided 10-31-2017
Note that the totals differ slightly compared to other tables in this section due to rounding of individual values.

Table 4.9-9 Wetland Impacts (Acres) by Ecoregion with MPs and Project Component in the Permanent Impacts Area and Temporary Impacts Areas

Ecoregion	Project Component	Alternative 1		Alternative 2	
		Wetland Acres within Permanent Impacts Area	Wetland Acres within Temporary Impacts Areas	Wetland Acres within Permanent Impacts Area	Wetland Acres within Temporary Impacts Areas
Offshore Beaufort Sea (North of MP 0)	Access Road	0	0	0.10	0
	Dredge Disposal	100.00	0	200.00	0
	West Dock Dredge Area	59.29	0	116.21	0
	West Dock Mooring Dolphin	0.04	0	0	0
	West Dock New Fill	9.88	0	5.83	0
	West Dock Temporary Barge Bridge	1.39	0	0	0
	Sea Ice Pad	0	145.93	0	245.18
	Sea Ice Road	0	104.18	0	70.74
	West Dock Temporary Barge Bridge Rake	0	0.12	0	0
	Total Wetland Acres	*170.6*	*250.23*	*322.15*	*315.92*
Beaufort Coastal Plain (MP 0 – 61.5)	Access Road	108.36	0	108.24	0
	Camp	21.45	0	21.45	0
	Construction Impact - Permanent	67.37	0	0.56	0
	Facility Pad	90.59	0	90.59	0
	Material Source	520.46	0	520.46	0
	Pipe Storage Yard	15.41	0	36.07	0
	Vertical Support Member	0.02	0	0.01	0
	Bridge	0	0.72	0	0.60
	Construction Impact - Avoidance	0	639.47	0	743.41
	Construction Impact - Temporary	0	185.56	0	0
	Ice Access Road	0	45.19	0	45.45

Ecoregion	Project Component	Alternative 1		Alternative 2	
		Wetland Acres within Permanent Impacts Area	Wetland Acres within Temporary Impacts Areas	Wetland Acres within Permanent Impacts Area	Wetland Acres within Temporary Impacts Areas
Brooks Foothills (MP 61.5 – 142.9)	Pipeline Stream Crossing	0	0.01	0	0
	Total Wetland Acres	*823.66*	*870.95*	*777.38*	*789.47*
	Access Road	91.29	0	91.28	0
	Camp	6.09	0	6.09	0
	Construction Impact - Permanent	1,157.97	0	1,157.39	0
	Material Source	733.26	0	733.26	0
	Pipe Storage Yard	15.19	0	15.19	0
	Construction Impact - Avoidance	0	5.75	0	6.61
	Construction Impact - Temporary	0	1.56	0	0
	Ice Access Road	0	0.29	0	0.29
	Pipeline Stream Crossing	0	0.09	0	0.09
	Temporary Workspace	0	2.29	0	2.29
	Total Wetland Acres	*2,003.80*	*9.97*	*2,003.21*	*9.28*
Brooks Range (MP 142.9 – 251.3)	Access Road	47.91	1.44	47.91	1.44
	Camp	11.69	0	11.69	0
	Construction Impact - Permanent	1,233.21	0	1233.18	0
	Existing Road	0.12	0	0.12	0
	Facility Pad	1.89	0	1.89	0
	Material Source	200.29	0	200.29	0
	Pipe Storage Yard	14.69	0	14.69	0
	TAPS ROW	0.05	0	0.05	0
	Construction Impact - Avoidance	0	0.36	0	0.36
	Pipeline Stream Crossing	0	1.36	0	1.36

Ecoregion	Project Component	Alternative 1		Alternative 2	
		Wetland Acres within Permanent Impacts Area	Wetland Acres within Temporary Impacts Areas	Wetland Acres within Permanent Impacts Area	Wetland Acres within Temporary Impacts Areas
	Temporary Workspace	0	2.82	0	2.82
	Total Wetland Acres	*1,509.83*	*5.97*	*1,509.80*	*5.97*
Kobuk Ridges and Valleys (MP 251.3 – 256.5)	Access Road	17.52	0	17.52	0
	Construction Impact - Permanent	73.38	0	73.38	0
	Existing Road	0.01	0	0.01	0
	Material Source	19.32	0	19.32	0
	Construction Impact - Avoidance	0	0.08	0	0.08
	Pipeline Stream Crossing	0	0.00	0	0.00
	Temporary Workspace	0	0.07	0	0.07
	Total Wetland Acres	*110.23*	*0.15*	*110.23*	*0.15*
Ray Mountains (MP 256.6 – 428.8)	Access Road	171.45	0.70	171.44	0.70
	Camp	32.89	0	32.88	0
	Construction Impact - Permanent	1,179.78	0	1180.52	0
	HDD Entry Pad	1.37	0	0	0
	HDD Exit Pad	1.37	0	0	0
	Material Source	183.71	0	183.71	0
	Pipe Storage Yard	14.85	0	14.85	0
	Yukon River Suspension Bridge Access Road	0	0	0.20	0
	Yukon River Suspension Bridge Anchor	0	0	4.76	0
	Construction Impact - Avoidance	0	0.17	0	0.17
	Construction Impact - Temporary	0	3.64	0	3.64
	HDD Crossing	0	6.11	0	0
	HDD False ROW	0	3.48	0	0

Ecoregion	Project Component	Alternative 1		Alternative 2	
		Wetland Acres within Permanent Impacts Area	Wetland Acres within Temporary Impacts Areas	Wetland Acres within Permanent Impacts Area	Wetland Acres within Temporary Impacts Areas
	Pipeline Stream Crossing	0	0.21	0	0.21
	Temporary Workspace	0	0.85	0	0.85
	Yukon River Suspension Bridge	0	0	0	5.90
	Total Wetland Acres	*1,585.41*	*15.18*	*1,588.36*	*11.48*
Tanana-Kuskokwim Lowlands (MP 428.8 – 441.3 and MP 453.5 - 514.9)	Access Road	138.48	0.76	138.48	0.76
	Construction Impact - Permanent	286.44	0	286.43	0
	Existing Road	0.04	0	0.04	0
	Facility Pad	2.51	0	2.51	0
	HDD Entry Pad	0.06	0	0.06	0
	Material Source	77.03	0	77.02	0
	Pipe Storage Yard	0.48	0	0.48	0
	Railroad Siding	0.97	0	0.97	0
	Construction Impact - Temporary	0	343.03	0	343.02
	HDD Crossing	0	6.40	0	6.40
	HDD False ROW	0	0.94	0	0.94
	Ice Access Road	0	24.81	0	24.81
	Pipeline Stream Crossing	0	0.13	0	0.13
	Temporary Workspace	0	0.19	0	0.19
	Total Wetland Acres	*506.02*	*376.28*	*506.01*	*376.26*
Yukon-Tanana Uplands (MP 441.3 – 453.5)	Access Road	92.02	0	92.02	0
	Camp	19.87	0	19.86	0
	Construction Impact - Permanent	91.56	0	91.56	0
	Facility Pad	3.98	0	3.98	0

Ecoregion	Project Component	Alternative 1		Alternative 2	
		Wetland Acres within Permanent Impacts Area	Wetland Acres within Temporary Impacts Areas	Wetland Acres within Permanent Impacts Area	Wetland Acres within Temporary Impacts Areas
	Material Source	45.60	0	45.60	0
	Pipe Storage Yard	5.85	0	5.85	0
	Railroad Siding	0.28	0	0.28	0
	Construction Impact - Temporary	0	19.54	0	19.54
	Pipeline Stream Crossing	0	0.02	0	0.02
	Temporary Workspace	0	0.14	0	0.14
	Total Wetland Acres	*259.16*	*19.70*	*259.16*	*19.70*
Alaska Range (MP 514.9 – 613.9)	Access Road	108.92	0.70	73.63	0
	Camp	29.55	0	29.55	0
	Construction Impact - Permanent	450.06	0	410.89	0
	Existing Road	0.01	0	0.01	0
	Material Source	149.63	0	148.43	0
	Pipe Storage Yard	12.94	0	12.94	0
	Railroad Siding	3.96	0	3.96	0
	Bridge	0	1.05	0	1.36
	Construction Impact - Avoidance	0	0.09	0	0.09
	Construction Impact - Temporary	0	12.22	0	10.06
	HDD Crossing	0	0.35	0	0.35
	HDD False ROW	0	8.62	0	0.03
	Pipeline Stream Crossing	0	0.31	0	0.34
	Temporary Workspace	0	0.35	0	0.35
	Total Wetland Acres	*755.07*	*23.69*	*679.41*	*12.59*
Cook Inlet Basin	Access Road	83.29	0.79	83.29	0.79

Ecoregion	Project Component	Alternative 1		Alternative 2	
		Wetland Acres within Permanent Impacts Area	Wetland Acres within Temporary Impacts Areas	Wetland Acres within Permanent Impacts Area	Wetland Acres within Temporary Impacts Areas
(MP 613.9 – 733.5)	Camp	1.29	0	1.29	0
	Construction Impact - Permanent	192.08	0	192.08	0
	HDD Exit Pad	1.38	0	1.38	0
	Material Source	10.76	0	10.76	0
	Pipe Storage Yard	2.28	0	2.28	0
	Bridge	0	2.80	0	2.80
	Construction Impact - Temporary	0	30.07	0	30.07
	HDD Crossing	0	14.02	0	14.02
	HDD False ROW	0	57.28	0	57.28
	Ice Access Road	0	12.52	0	12.52
	Pipeline Stream Crossing	0	0.19	0	0.19
	Temporary Workspace	0	0.18	0	0.18
	Total Wetland Acres	*291.09*	*117.85*	*291.08*	*117.84*
	Total Wetland Acres	*8,014.78*	*1,690.05*	*8,046.60*	*1,658.66*

Sources: AGDC GIS wetlands data provided 12-14-2017 and modified by USACE 3-23-2018, AGDC GIS Project infrastructure data provided 10-31-2017
Note that the totals differ slightly compared to other tables in this section due to rounding of individual values.

Acreage tables from the 2012 FEIS (USACE, 2012a) are included below as Tables 4.9-10, 4.9-11, 4.9-12, and 4.9-13. These tables show only the wetland acres that would have been within the construction ROW (100 feet) and the permanent variable width ROW (between 30 and 52 feet); these tables do not show acres of impact from any associated proposed Project features such as access roads or material sites. The proposed Project has wider ROWs than the 2012 FEIS; in most cases, the temporary construction ROW would be 120 feet wide and the permanent operations ROW would be 53 feet wide. As a rough comparison, the 2012 FEIS would have impacted 1,861.7 acres of wetlands in their permanent variable width ROW and the currently proposed Project would impact 8,014.8 acres of wetlands in its permanent operations ROW, a difference of 6,153.1 acres.

Table 4.9-10 2012 FEIS Table 5.4-2 NWI Wetland Classes within the Construction ROW

Wetland Class	MP 0 – MP 540		Fairbanks Lateral		MP 540 – MP 555		Denali National Park Route Variation		MP 555 - End	
	Acres	% Comp	Acres	% Comp	Acres	% Comp	Acres	% Comp	Acres	% Comp
Forested Wetlands										
Broadleaf Forest (PFO1)	0	0	0	0	0	0	0	0	0.5	1.1
Needleleaf Forest (PFO4)	199.1	100	8.7	100	2.6	100	0	0	44.7	98.9
Mixed Forest (PFO)	0	0	0	0	0	0	0	0	0	0
Subtotal Forested Wetlands (PFO)	199.1	4.9	8.7	2.6	2.6	1.5	0	0	45.2	17.9
Scrub Shrub Wetlands										
Broadleaf Scrub/Shrub (PSS1)	1871.1	76.6	115.6	42.9	109.2	67.2	1.5	100	103.7	80.3
Needleleaf Scrub/Shrub (PSS4)	571.5	23.4	145.0	53.8	53.3	32.8	0	0	25.4	19.7
Mixed and Other Scrub/Shrub (PSS)	0	0	8.7	3.2	0	0	0	0	0	0
Subtotal Scrub Shrub Wetlands (PSS)	2442.6	60.1	269.3	81.6	162.5	91.7	1.5	34.3	129.1	51.1
Emergent Wetlands										
Subtotal Emergent Wetlands (PEM)	1337.5	32.9	49.6	15.0	9.7	5.5	0.5	10.2	57.3	22.7
Other Wetlands and Waters										
Palustrine Waters (P)	14.4	16.6	1.4	58.3	0.8	0.5	0	1.2	7.2	34.4
Riverine Waters (R)	70.6	81.3	1.0	41.7	1.7	1.0	2.4	98.8	13.6	65.1
Lacustrine Waters (L)	1.9	2.2	0	0	0	0	0	0	0.1	0.5
Subtotal Other Wetlands and Waters	86.9	2.1	2.4	0.7	2.5	1.4	2.4	55.5	20.9	8.3
Total										
All Wetlands and Waters	4066.1		330.0		177.3		4.4		252.5	

Source: AES, 2012
a Classification of Wetlands and Deepwater Habitats (Cowardin *et al.*, 1979).
b Denali NPP Route Variation source data is from preliminary data and mapping performed by AGDC and ASRC Energy Services Alaska (AES), 2011.
Key: PFO = Palustrine Forested; PSS = Palustrine Scrub/Shrub; PEM = Palustrine Emergent; P = Palustrine, R = Riverine; L = Lacustrine.
% Comp = Percent Composition is the percentage of each wetland subclass (broadleaf forest, needleleaf forest, etc.) within each primary wetland class (Forested Wetlands).
Totals might not equal sums of values due to rounding.
All ROW wetland acreage calculations are derived from spatial analysis completed by Cardno ENTRIX (AES, 2012).

Table 4.9-11 2012 FEIS Table 5.4-5 HGM Functional Classes of Wetlands within the Construction ROW

Wetland Class	MP 0 – MP 540		Fairbanks Lateral		MP 540 – MP 555		Denali National Park Route Variation		MP 555 - End	
	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent
Mineral Soil Flats	3139.0	45.8	316.5	4.6	169.2	37.7	0.3	0	131.2	6.0
Slope	597.5	8.7	0	0	0	0	0	0	1.9	0.1
Depressional	170.2	2.5	9.7	0.1	6.5	1.4	0.5	0	93.6	4.3
Riverine	148.1	2.2	3.8	0.1	1.7	0.4	2.7	1.0	24.3	1.1
Lacustrine Fringe	2.4	0	0	0	0	0	0	0	1.5	0.1
Extended Peatlands	0	0	0	0	0	0	0	0	0	0
Estuarine Fringe	0	0	0	0	0	0	0	0	0	0
Total	4057.2	59.1	330.0	79.1	117.4	39.5	3.5	1.9	252.5	11.5

Source: AES, 2012
a Hydrogeomorphic classification (Magee and Hollands, 1998).
b Total acres and percent of segment that is wetlands. For specific wetland type, percent is also of the total segment.
c Denali NPP Route Variation source data is from preliminary data and mapping performed by AGDC and AES, 2011.
Totals might not equal sums of values due to rounding.
All ROW wetland acreage calculations are derived from spatial analysis completed by Cardno ENTRIX (AES, 2012).

Table 4.9-12 2012 FEIS Table 5.4-4 NWI Wetland Classes within the Permanent ROW (Variable Width)

Wetland Class	MP 0 – MP 540		Fairbanks Lateral		MP 540 – MP 555		Denali National Park Route Variation		MP 555 - End	
	Acres	% Comp	Acres	% Comp	Acres	% Comp	Acres	% Comp	Acres	% Comp
Forested Wetlands										
Broadleaf Forest (PFO1)	0	0	0	0	0	0.4	0	0	0.2	1.4
Needleleaf Forest (PFO4)	90.5	100	2.9	100	0.3	7.8	0	0	13.8	98.6
Mixed Forest (PFO)	0	0	0	0	0	0	0	0	0	0
Subtotal Forested Wetlands (PFO)	90.5	5.4	2.9	2.9	0.3	8.2	0	0	14	18.2
Scrub Shrub Wetlands										
Broadleaf Scrub/Shrub (PSS1)	835.4	76.6	33.2	40.4	13.9	58.8	0.1	100	31.6	80.2
Needleleaf Scrub/Shrub (PSS4)	254.8	23.4	46.3	56.4	6.5	24.5	0	0	7.8	19.8
Mixed and Other Scrub/Shrub (PSS)	0	0	2.6	3.2	0	0	0	0	0	0
Subtotal Scrub Shrub Wetlands (PSS)	1090.2	65.6	82.1	81.9	20.4	82.9	0.1	11.1	39.4	51.3
Emergent Wetlands										
Subtotal Emergent Wetlands (PEM)	453.9	27.3	14.7	14.7	1.5	6.5	0.2	22.2	16.3	21.2
Other Wetlands and Waters										
Palustrine Waters (P)	4.8	17.4	0.2	40	0.1	0.4	0	0	2.4	33.8
Riverine Waters (R)	22.3	80.8	0.3	60	0.2	0.8	0.6	100	4.7	66.2
Lacustrine Waters (L)	27.6	1.8	0	0	0	0	0	0	<0.1	0
Subtotal Other Wetlands and Waters	27.6	1.7	0.5	0.5	0.3	1.2	0.6	66.7	7.1	9.2

Wetland Class	MP 0 – MP 540		Fairbanks Lateral		MP 540 – MP 555		Denali National Park Route Variation		MP 555 - End	
	Acres	% Comp	Acres	% Comp	Acres	% Comp	Acres	% Comp	Acres	% Comp
Total										
All Wetlands and Waters	1662.2		100.2		22.5		0.9		76.8	

Source: AES, 2012
a Classification of Wetlands and Deepwater Habitats (Cowardin *et al*., 1979).
b Denali National Park Route Variation source data is from preliminary data and mapping performed by AGDC and AES, 2011.
Key: PFO = Palustrine Forested; PSS = Palustrine Scrub/Shrub; PEM = Palustrine Emergent; P = Palustrine, R = Riverine; L = Lacustrine.
% Comp = Percent Composition is the percentage of each wetland subclass (broadleaf forest, needleleaf forest, etc.) within each primary wetland class (Forested Wetlands).
Totals might not equal sums of values due to rounding.
All ROW wetland acreage calculations are derived from spatial analysis completed by Cardno ENTRIX (AES, 2012).

Table 4.9-13 2012 FEIS Table 5.4-5 HGM Functional Classes of Wetlands within the Permanent ROW (Variable Width)

Wetland Class	MP 0 – MP 540		Fairbanks Lateral		MP 540 – MP 555		Denali National Park Route Variation		MP 555 - End	
	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent
Mineral Soil Flats	1223.4	47.1	96.1	3.7	21.2	37.5	0	0	40.0	6.0
Slope	316.9	12.2	0	0	0	0	0	0	0.7	0.1
Depressional	62.5	2.4	2.8	0.1	1.0	1.8	0	0	28.0	4.2
Riverine	54.0	2.1	1.1	0	0.2	0.4	0.7	1.1	7.7	1.2
Lacustrine Fringe	0.6	0	0	0	0	0	0	0	0.4	0.1
Extended Peatlands	0	0	0	0	0	0	0	0	0	0
Estuarine Fringe	0	0	0	0	0	0	0	0	0	0
Total	1657.4	63.9	100.0	79.9	22.4	39.6	0.7	1.2	76.8	11.6

Source: AES, 2012
a Hydrogeomorphic classification (Magee and Hollands, 1998).
b Total acres and percent of segment that is wetlands. For specific wetland type, percent is also of the total segment.
c Denali NPP Route Variation source data is from preliminary data and mapping performed by AGDC and AES, 2011.
Totals might not equal sums of values due to rounding.
All ROW wetland acreage calculations are derived from spatial analysis completed by Cardno ENTRIX (AES, 2012).

4.9.4.1.1. Pipeline ROW – Mainline and Fairbanks Lateral

Several proposed Project activities during construction associated with the pipeline ROW could impact wetland resources in the area. These activities and their impacts to wetlands are described below.

4.9.4.1.1.1. Placement of Gravel Fill

Gravel fill would be placed during construction of the proposed Project for building access roads, camps, PSYs, and facility pads, pipeline trench backfill, West Dock modifications, and HDD entry and exit pads, but it would only be placed in wetlands, where necessary; efforts to avoid placing gravel fill in wetlands have been made to the greatest extent practicable. Filling wetlands or parts of wetlands result in a direct and permanent impact to the wetland, converting it to an upland or disturbed site. Approximately 5,908.5 acres of wetlands would receive gravel fill during the construction phase of the proposed Project, and these would remain filled during the operations phase of the proposed Project.

Ice roads and ice pads are proposed instead of gravel roads and gravel pads for pipeline construction from MP 0-62 in the Beaufort Coastal Plain ecoregion. As a result, permanent wetland fill and associated impacts (*e.g.*, wetland fragmentation of adjacent wetlands) would be reduced by 332.9 acres.

Construction of access roads may allow public access via All-terrain vehicles (ATVs) to wetland areas that were previously inaccessible. However, the proposed Project would be parallel to existing ROWs (*e.g.*, highways, the TAPS ROW, and utility lines) for the majority of its length; therefore, additional access to wetlands would be minimal.

The impacts to wetlands due to placement of gravel fill during the construction phase would be moderate, as it would result in the direct and permanent loss of the wetland. Impacts would be widespread throughout the entire ROW, where fill is placed in wetlands.

4.9.4.1.1.2. Clearing/Mowing

As discussed in Section 4.8, Vegetation, for construction and operations purposes, vegetation in the ROWs would be initially cleared for construction, and then regularly mowed for operations. Forested vegetation in the Permanent ROW would be removed and maintained in a herbaceous state or as converted upland due to gravel fill. Forested wetlands within the permanent Maintenance ROW would likely convert into scrub/shrub, emergent, or another wetland type. Scrub/shrub and herbaceous vegetation would be allowed to grow back, to some extent. Vegetation that was cleared or mowed within the construction ROW (temporary impacts) areas would be allowed to fully reestablish after construction is completed; though, succession to forested vegetation could take a very long time (100 years or more). Approximately 906.2 acres of forested wetlands would be cleared or filled and subsequently converted to another wetland type or upland (see Table 4.9-5).

For riparian vegetation clearing, vegetation would be cut off at ground level to leave the existing root systems in place to provide streambank stability. In riparian areas, the pulling of tree stumps and rooting for grading activities would be limited to the area directly over the trench line. Where conditions allow, riparian vegetation would be restored with native plant species.

Slope wetlands would be the most susceptible HGM wetland class to a change in function resulting from the clearance of forested vegetation. The lack of vegetation could alter water-holding capacity, a function that would be slow to recover. Thus, clearing of slope wetlands would result in a long-term, and in many instances, permanent impact. During the construction phase, approximately 60.6 acres of slope wetlands in the construction ROW (temporary impacts) area and 1,118.2 acres of slope wetlands in the maintenance and permanent ROW (permanent impacts) area would be either cleared, mowed and/or filled for the proposed Project.

The spread of non-native and invasive plant species could occur from transporting and traversing the mowing equipment from one location to another along the ROW. However, the Project's mitigation measures would minimize the introduction and spread of non-native and invasive species (see Mitigation Measure No. 10 in Section 4.8.3).

Vegetation clearing, especially in areas with permafrost, would reduce insulation and cause warming of soils, which in extreme cases, would cause permafrost to thaw. The surface layer, which serves to insulate deeper thaw-susceptible soils, would be removed during the clearing and trenching phases of construction, which could affect the depth of the active layer and thereby, the depth to permafrost and the drainage patterns of the site. In areas where mineral soil is exposed, the active layer is likely to be considerably deeper than in areas with good vegetative cover. As stated in the AGDC planning document, *Segregation of the Surface Layer* (AGDC, 2017g), "During the construction of the Haul Road to the North Slope (Dalton Highway) in 1974, the crews quickly learned that disturbing the surface layer caused rapid and uncontrolled melting of the underlying permafrost, and the practice was halted immediately." The proposed Project is proposing disturbance of the surface layer and similar issues may result.

Mitigation measures for soils and geology are discussed in Section 4.6.3. As stated in Section 5.1.2.1 of the EED "Depending on the content of massive ice in the vicinity, some sections of inundated trench may propagate permafrost thaw into the surrounding area, especially where stretches of flooded trench intersect ice wedge troughs" (AGDC, 2016b). Massive ground ice, up to and greater than 50 percent by volume (Kreig and Reger, 1982), is found along the northern portion of the proposed pipeline route. Propagation of permafrost thaw results in melting of the massive ice. This directly results in a decrease in the volume of the impacted soil and frequently reduces the bearing capacity of the soil to near zero. This could result in a decrease in the elevation of the ground surface. Saturated soil tends to be darker than dry soil. Thus, permafrost thaw could result in a decrease in the albedo of the soil causing further propagation of

the thaw. If the surface layer were segregated and replaced on top of the trench as the last layer, some but not all of the impacts to permafrost may be reduced. The surface layer would initiate revegetation earlier and therefore shorten the duration that the trench is without its protective thermal insulation layer. The magnitude/intensity of impacts to permafrost underlying wetlands would be lessened if the surface layer was replaced.

Particularly in areas lacking an insulating mat of vegetation, such as the proposed Project's trench line, repeated frost action could result in cryoturbation. In areas of low centered polygons, the ice wedges between the polygons may extend from a few feet to 20 feet or more in depth. When surface hydrology alters the availability of water for the ice wedges, the result may become high centered polygons with deep fissures between them, which could expose a pipeline. This is likely to alter vegetative communities towards a dryer regime. Additionally, headward erosion and severe gully and fissure development could drain adjacent wetlands (R&M Consultants, Inc., 1973). In areas with large rocks mixed with finer material, the frost action may create sorted circles, in which the larger stones are forced upwards to the surface and may disrupt buried objects. In areas of very coarse material (*e.g.*, along rivers and deltas), there may be no permafrost and very little vegetation, so disturbance is less likely to have long lasting impacts (Geisler, 2012; Rieger *et al.*, 1979).

Clearing of the permanent ROW may allow public access via ATVs to wetland areas that were previously inaccessible, potentially causing damage to wetlands and waterbodies. Because the proposed Project ROW generally follows existing or officially designated transportation and utility corridors, including the Dalton Highway/TAPS corridor and Parks Highway, an increase in user access would not be expected in these areas. However, increased access in areas that do not follow existing transportation or utility corridors, particularly between the TAPS corridor and Parks Highway in the Minto Flats vicinity, could see increased use. Additional access to wetlands would be minimal because the proposed Project would parallel existing ROWs for the majority of its length.

The impacts to wetlands due to clearing and mowing of vegetation during the construction phase would be moderate, as it would result in the direct and permanent removal of forested vegetation, or would convert forested wetlands to another wetland type, and may exacerbate permafrost thaw. Impacts would be widespread throughout the ROW, and in areas where permafrost thaw may extend beyond the ROW as described in Appendix E, Part II, Indirect Impacts to Wetlands.

4.9.4.1.1.3. Grading, Trenching, Blasting, and Backfilling

Construction activities in wetlands would primarily occur during winter months and would involve HDD for some waterbody crossings (*i.e.*, the Yukon River, Tanana River, Honolulu Creek, Troublesome Creek, Chulitna River, Kashwitna River, and Willow Creek). In areas where HDD is not possible, the pipeline centerline (trench line) would

be graded, trenched, blasted (where necessary), the pipe would be laid, and then the trench would be backfilled.

Grading of land in the proposed ROW would occur during pre-construction activities. Grading would not include separating the surface layer (including the vegetative layer and roots) from the subsoil mineral layer to create a flat working surface for construction, as was originally proposed in the 2012 FEIS. Pre-construction activities would begin in the summer prior to the first season of pipeline construction. It is expected that construction would occur for up to 4 months in duration from surveying to rehabilitation (Chapter 2, Table 2.2-7, Alternative 1: ASAP Construction Spread Plan [Schedule]). Subsoil exposed to the physical environment before construction could result in erosion and sedimentation impacts and the extent of impacts would depend on the length of time the soil is exposed. An agency-approved SWPPP that would be developed prior to construction would minimize or mitigate such impacts.

Grading would occur directly over the centerline (trench line). Impacts from trenching and blasting would include temporary disturbance to subsurface soil, the surface layer, vegetation, and surface hydrology from heavy equipment use and excavation. The trench would be lined with fine-grained material before pipe placement and filled with the original subsoil and additional clean gravel fill when necessary. Preserving the vegetative rootstock and soil strata in the wetland would be beneficial for wetland recovery success. The surface layer would be segregated and stored for rehabilitation use in agricultural areas and in select continuous and discontinuous permafrost areas and non-permafrost areas (as discussed in the AGDC planning document, *Segregation of the Surface Layer* [AGDC, 2017g], and in the Revegetation Plan [Appendix E, Part I]). Table 1 in Appendix E, Part III shows the minimum MPs where AGDC would conduct surface layer segregation and replacement on the trench. The surface layer would be salvaged in at least 186 miles of the 733-mile pipeline (approximately 25 percent). The wetland would be contoured to its preconstruction state as close as possible after backfilling is complete; however, leftover trench spoil piles adjacent to the trench and/or "crowns" of soil on the trench line could create barriers to surface water flow and alter hydrology across the local landscape.

In some instances, a trench in wetlands could cause a "French drain effect," where the trench drains the wetland if not properly constructed. Construction methods, such as trench breakers and ditch plugs, would be used to reduce the likelihood of the French drain effect occurring in wetlands (Mitigation Measure Nos. 7 and 8). Within the Beaufort Coastal Plain, pipe would be installed in a general direction paralleling sheet water flow to assist in mitigation of impacts to natural active-layer flow regimes. Ice-rich soils and soils containing permafrost (especially discontinuous permafrost areas) could thaw and create slurry sediment plumes, or exacerbate thawing to adjacent areas. This could lead to excessive runoff within and adjacent to the trench. Construction of a pipeline and other facilities in active layer soils above permafrost may result in propagation of permafrost thaw and alternations to drainage patterns. If propagation of permafrost thaw begins, it may be difficult to control. Decreased soil volume (due to

thaw of ice-rich soils) could result in reduced support for the pipeline. Thaw and development of frost bulbs could alter the thermal regime and change drainage patterns. AGDC documents indicate that propagation of thaw into surrounding soils may occur. AGDC's Analysis of Potential Indirect Impacts to Wetlands Related to Buried Pipeline Construction (Appendix E, Part II) discusses which pipeline segments are most at risk to permafrost thaw. They suggest that areas with discontinuous permafrost are the most at risk (466 miles of the proposed Project, MP 168 to MP 634). Of these 466 miles, 191.4 miles have high thaw susceptibility potential, 65.5 miles have moderate potential, and 178.3 have low potential. The highest risk area begins at MP 250, near Coldfoot, Alaska (Appendix E, Part II: Analysis of Potential Indirect Impacts to Wetlands Related to Buried Pipeline Construction, Figure 26). Up to 1,170 acres of additional indirect impacts to wetlands were modeled in this AGDC document. A detailed discussion regarding a buried pipeline and the potential impacts to soils, permafrost, and, therefore, also wetlands is included above in Soils and Geology Alternative 1, Section 4.6.4.

With the implementation of the USACE DA permit conditions discussed in Section 4.9.3.2, trenching impacts to wetlands would be lessened because trenches would be constructed so that they do not drain waters of the U.S., natural drainage patterns would be maintained to prevent ponding or drying, relocated stream channels would mimic the original stream channel, and buffers would be maintained around waters and at stream crossings during construction. Both the geographic extent and magnitude of impacts to wetlands would be reduced with these conditions implemented. Some wetlands classes would be expected to recover more quickly than others due to the length of time it would take succession to occur. Scrub/shrub wetland disturbance could transform into an emergent wetland class temporarily from impounding effects until the vegetation recovers, assuming previous hydrologic function and access is restored. This could alter wetland function temporarily and the recovery of this vegetation would be slow (likely decades). Forested wetland removal would result in much longer recovery (100 years or more) due to the loss of mature canopy and may also result in permanent loss. In northern areas such as the Beaufort Coastal Plain, Brooks Foothills, and Brooks Range, recovery of wetland vegetation would be expected to be slower than in other areas due to the extremely short growing season, or the area may never recover due to altered hydrology.

The EPA requested that a discussion be added regarding the Yukon River Basin, which they have designated an Aquatic Resource of National Importance (EPA, 2017). The Yukon River, Nenana River, Tanana River, and their associated tributaries and wetlands provide a unique and important resource that sustain fisheries, wildlife, subsistence, and commercial and recreational uses in the region. This region is underlain by discontinuous permafrost, and impacts to wetlands in such areas can have far-reaching effects on the aquatic ecosystem.

Given the importance of Yukon basin wetlands and water resources for the support of fisheries, wildlife, and subsistence, commercial and recreational uses by humans, the EPA concludes that these resources are Aquatic Resources of National Importance for

the purposes of the 1992 Section 404(q) of the Clean Water Act Memorandum of Agreement between the EPA and Department of the Army (EPA, 2017).

The impacts to wetlands due to grading, trenching, blasting, and backfilling of the landscape during the construction phase and the resulting fragmentation of wetlands would be major for the entire Project route, after implementation of BMPs, as it would result in the direct, with some temporary and some permanent, alterations of the wetland vegetation, soil, and hydrology. Trenched wetlands may drain and convert to uplands, or they may convert to a different wetland type. Impacts would be widespread throughout the entire ROW, where the ROW would be trenched and backfilled for pipeline installation in wetlands. Rehabilitation activities discussed in the Revegetation Plan (Appendix E, Part I) to regrade the landscape to the pre-construction topography, the utilization of subsoil to backfill the trench, and replanting and reseeding of the disturbed area would aid in wetland recovery.

4.9.4.1.1.4. Fragmentation

The linear nature of the proposed Project has a large potential to divide wetland systems, disrupting or altering vegetation, subsoil, and hydrology. Fragmentation in wetlands would occur permanently with construction of access roads and aboveground facilities, temporarily during the post-construction and rehabilitation phase, and potentially through trenching (either permanent or temporary fragmentation) of the proposed Project. Temporary impacts could persist, dependent on the success of BMPs and mitigation measures. Water logging could occur due to substantial disturbance to the active peat layer, resulting in reduced water infiltration.

Wetland hydrology could be impacted by changes to the thermal regime of the subsoil from laying pipe (frost and permafrost penetration in winter) and potential erosion from thaw in the summer. Opportunistic plant species could invade the disturbance areas and persist if not extirpated. Impacts could occur based on the tolerance of wetland species to the potential changes in hydrology, soils, and the thermal regime. AGDC proposes to replace the surface layer in agricultural areas and in select continuous and discontinuous permafrost areas and non-permafrost areas (as discussed in the AGDC planning document, *Segregation of the Surface Layer* [AGDC, 2017g], and in the Revegetation Plan [Appendix E, Part I]). If BMPs are successful, it would be expected that once soils subside over the buried pipeline, surface hydrology would resume and disturbed vegetation would recover. If BMPs are unsuccessful, hydrology may be permanently altered and the wetland could convert to an upland or lose functionality. For example, on the Beaufort Coastal Plain, soils would likely subside below surface levels on the trench line and create ponding, which could also alter adjacent wetlands and their functionality. Vertical subsidence could create a downward vertical ground surface displacement and an avenue for drainage of surface water from saturated soils. The potential for wetlands to be indirectly impacted due to subsidence and subsequent drainage of saturated soils varies according to region and permafrost type. Wetlands underlain by discontinuous permafrost soils (*i.e.*, MPs 168 – 634) are expected to receive

the most significant negative impacts from permafrost thaw, subsidence, and associated altered hydrology.

The proposed pipeline would be buried to the appropriate depth, consistent with USDOT PHMSA standards, for its entire length, with the exception of fault zones, elevated bridge stream crossings, pigging facilities, and block valve locations where it would be constructed aboveground. Burial of the pipeline should allow wetland vegetation to reestablish and surface flow to function naturally over the permanent ROW, in areas without permafrost soils. Slope wetlands often occur along elevation gradients and have the greatest potential of the wetland types for being impacted by subsurface soil disturbances. Changes in the permeability of the surface or subsurface soil of a slope wetland could result in increased drainage and altered functionality, temporarily or permanently. Foreign material used as fill in the trench line could cause additional fragmentation impacts from discontinuity of the subsurface material. This in turn could alter vegetative growth if the subsurface soils are discontinuous. Original material excavated from the trench would be used as backfill as much as would be practicable.

An ice road instead of a gravel road is planned for pipeline construction of MP 0-62 in the Beaufort Coastal Plain ecoregion to eliminate the need for gravel fill here and reduce wetland fragmentation. Ice road and ice pad development is not expected to fragment wetlands if BMPs are adhered to throughout the winter construction season. Ice roads and ice pads would melt during break up.

Construction of access roads would create permanent fragmentation to wetlands that are crossed by the roads. However, roads would be placed in the most practicable position to reduce impacts to wetlands. Wetland acreage affected by access road development would be relatively small in relation to the extent of available wetland habitat. Habitat fragmentation would impact wildlife dependent on the type of wetland habitat being disconnected by road development. Fragmentation could persist longer in areas with slow-growing or long-lived vegetation (*i.e.,* forested), or in areas more susceptible to hydrologic modifications (*i.e.,* slope wetlands). Habitat fragmentation is discussed in detail in Section 4.10, Wildlife.

Access road construction could also alter hydrology by causing ponding on one side and desiccation on the other. Culvert installation in access roads placed in wetlands would aid in maintenance of wetland hydrology, but would not fully mitigate the impacts of road construction and are dependent on appropriate sizing and placement on the landscape to function adequately.

Within the wetland mapping corridor, a conservative total of 81,635.4 acres of wetlands would be fragmented by proposed Project development, such as through divisions by access roads and the permanent ROW. The impacts to wetlands, due to OC trenching and the resulting fragmentation during construction of the pipeline ROW, is considered major for the entire Project route, as it would result in the direct and permanent alteration and division of wetlands. Trenched wetlands may drain and convert to

uplands, or they may convert to a different wetland type. Impacts would be localized to wetlands and surrounding areas which are divided by access roads, the pipeline trench, or other proposed Project features.

4.9.4.1.1.5. Soil Compaction and Erosion

Heavy equipment access during construction of the ROW could compact soils and create ruts along the ROW, which could inhibit seed germination, reduce water infiltration, inhibit root establishment, and result in bare soil exposure. Soil erosion and fill placement could lead to increased sedimentation and turbidity in nearby waterbodies, which could then reduce water storage capacity, smother vegetation, and decrease oxygen concentration. These effects would be particularly applicable in areas of steep terrain and could extend beyond the construction ROW (*e.g.,* slope wetlands). Soil erosion could also alter water flow rates into and out of wetlands, thereby impacting local hydrologic processes. However, soil compaction and erosion impacts would likely be localized and temporary because timber and geo-textile mats (or similar) would be used during the summer construction season in some areas to reduce the impacts to wetlands. Timber mats and geo-fabric disperse the weight of the heavy equipment use across the ground. Ice roads and ice pads would be developed for use in the winter, with wide tracked vehicles, which would also disperse the weight of the equipment over wetlands. Ice roads and pads would be temporary in nature and not maintained through the growing season.

Erosion issues could be substantially greater in areas with permafrost soils, such as the Beaufort Coastal Plain ecoregion; trenching the pipeline in this ecoregion could cause major impacts to the soils and geology of the region, as discussed in Section 4.6, Soils and Geology. Ecoregions with continuous or discontinuous permafrost could have major impacts to wetlands because of impacts to soils, geology, and altered hydrology. Impacts to wetlands due to soil compaction and erosion during construction of the pipeline ROW would be considered moderate in areas lacking permafrost, as it would result in direct disturbance to wetland vegetation and soils potentially in widespread areas, and would likely not be reversed within the same construction season through rehabilitation measures. If soils were unstable or were not de-compacted prior to revegetation efforts, native seeds would struggle to germinate, root establishment would be hindered, and water infiltration of the soil would be reduced.

4.9.4.1.1.6. Dust Deposition

Dust deposition could impact wetlands and their vegetation adjacent to the construction ROW, primarily from hauling backfill and lining material to the construction areas, and from crew vehicles accessing the construction sites daily. Dust would be generated from development of new gravel access roads and the use of existing gravel roads. Gravel would be placed as fill to construct access roads, and the transportation of gravel with heavy trucks from material sites to road construction areas would create dust deposition onto the surrounding area. Heavy vehicle use on existing gravel roads, including dump

trucks, would introduce more dust into the air than regular passenger vehicles. Additionally, numerous trips would be made between the material sites and the construction areas. Dust deposition would be greater during the summer months due to the dryer conditions and exposure of gravel on the road versus snow and ice. Dust would be produced at material sites from the mining of gravel and sand, which would potentially land on surrounding wetlands and their vegetation. However, these impacts would be localized and temporary because of the construction sequence of the proposed Action. The ROW would be constructed and rehabilitated in sequence along the pipeline in segments. Impacts from the construction of the ROW would be expected to be temporary and localized to the construction activity for that segment of the proposed Project. Long-term dust deposition could potentially cause thermokarst effects in permafrost areas along access roads. Melting snow along roadsides is accelerated as dust is deposited over time. Thermokarst areas cause a depression in the ground from thawing permafrost, which could alter vegetation growth and species composition. Impacts would occur by pipeline segment and season, as the proposed Project is constructed. Impacts would depend on dust particle size, wind processes, wetting of the ground, duration and frequency of traffic, and speed of travel. Dust deposition could extend beyond the construction ROW and could interfere with plant photosynthesis and respiration (Farmer, 1993; Prajapati, 2012). USFWS notes that on the Beaufort Coastal Plain, impacts from dust can extend to distances of 100 to 300 feet, depending on road direction and prevailing winds (USFWS, 2017b). The magnitude and duration of dust deposition dictates the intensity of potential impacts (Auerbach *et al.,* 1997), and in extreme cases, leads to the loss of more sensitive species, altering the composition of the plant community. Dust suppression mitigation measures would be implemented to control fugitive dust impacts to wetlands and other resources (see Vegetation Mitigation Measure No. 5, in Section 4.8.3.1).

Dust deposition in the construction ROW would result in temporary, local impacts to wetlands and their vegetation communities. AGDC conducted a fugitive dust impacts analysis to calculate an acreage estimate for vegetation using the NLCD (MRLC Consortium, 2016). The analysis conservatively assumes that dust can travel up to 50 feet from gravel roads and up to 350 feet from material sites depending on the prevailing wind direction (Auerbach *et al.*, 1997; Walker *et al*., 1980; Western Regional Climate Center, 2002; AEA, 2014). AGDC estimates that 7,629 acres of vegetation would be impacted by dust from proposed Project features; a portion of these acres of vegetation are wetlands. AGDC would implement BMPs during construction to reduce the impacts of fugitive dust (Section 4.22.3).

The impacts to wetlands and their vegetation, due to dust deposition during construction of the pipeline ROW, is considered moderate in ecoregions with permafrost and minor in ecoregions without permafrost as it could result in direct loss and disturbance to wetlands and their vegetation, but only in localized areas of construction work (*i.e.,* access roads, material sites, and existing gravel roads). If not properly controlled with mitigation measures (*e.g.,* road watering, covering gravel loads in

trucks), long-term dust deposition could result in thermokarsting of permafrost or the loss of sensitive species, which cannot be reversed in one growing season and may continue for the life of the proposed Project.

4.9.4.1.1.7. Alteration of Physical and Chemical Processes

Development of access roads to connect aboveground facilities would cause surface hydrologic disturbance to the natural system. Disturbances could create surface impoundments if water flow is inhibited or could result in an increase in water outflow if natural impoundments degrade. Increased water impoundment would decrease water circulation resulting in increased water temperature, lower dissolved oxygen levels, changes in salinity and pH, altered nutrient outflow, and increased sedimentation (EPA, 1993). Conversely, decreases in water impoundment could lower water tables, degrade peat layers, change vegetation, and ultimately result in a reduction or loss of wetland functions.

Trenching and the resulting leftover piles of trench spoils and "crowns" on the trench line would alter surface elevation and could create barriers to surface water flow and alter hydrology across the local landscape.

Thermokarsting could occur at impoundments in areas where permafrost is present. In thermokarst areas, soil temperatures rise with thaw depth, and primary productivity could shift the species composition from changes in soil characteristics. Culvert placement and frequency along roads would be a very important variable to allow natural drainage between wetlands, especially in highly saturated wetlands. This would apply to all areas including roads to facility pads where dust could be deposited on wetlands from vehicle use.

Altered water levels could change soil exposure and water-dependent plant species composition. Wetlands could become channelized from road development, which could change the rate and character of surface flow (Darnell, 1976). Erosion of soil in wetlands results in increased sedimentation and turbidity, which affects photosynthesis of wetland plants.

Chemicals reaching wetlands from vehicle leaks and anti-icing/de-icing during winter months could change the water quality of adjacent wetlands. The ADOT&PF uses salt or a salt brine solution on highways in winter (*i.e.,* potassium acetate, magnesium chloride, or sodium chloride; ADOT&PF, 2012). These chemicals could alter the soil's chemical composition, which could in turn alter species composition and richness.

With the implementation of the USACE DA permit conditions discussed in Section 4.9.3.2, the alteration of physical and chemical processes would be lessened because no stockpiling of fill would occur in wetlands, excavated material sidecast into wetlands would be underlain by geotextile or similar and then would be removed, and alterations to water circulation patterns would be minimized. These conditions would reduce sedimentation of wetlands and waters of the U.S. thereby preventing some negative impacts that the proposed Project may cause.

The impacts to wetlands due to the alteration of physical and chemical processes during the construction phase would range from minor to moderate, after implementation of BMPs, as it would result in the direct and either temporary or permanent alteration of the wetlands functionality. Impacts due to thermokarsting would be localized to impoundment areas and are a particular concern in the Beaufort Coastal Plain and other ecoregions with underlying permafrost. Impacts due to chemical alteration could be widespread throughout the entire ROW, where runoff from access roads and other proposed Project features infiltrates wetlands. Impacts due to water level changes would be localized to the specific wetland that has been altered.

4.9.4.1.1.8. Non-Native and Invasive Plants

Proposed Project construction could introduce invasive and non-native wetland plants through multiple pathways:

- Spread of non-native, invasive, and noxious plants already associated with existing ROWs (*i.e.,* ARRC, TAPS, and highways) by construction equipment, personnel, and waterways;
- Transport of non-native, invasive, and noxious plant material from other areas within the state or outside of Alaska via machinery, footwear and clothing, hand tools, vehicle tires, and waterways;
- Pollinators such as bees and birds; and
- Seed mixtures used to revegetate exposed soils could contain non-native, invasive, and noxious plants seeds. However, mixtures have a maximum allowable weed seed limit.

Several non-native wetland plants (such as Canadian waterweed [*Elodea canadensis*], rock snot [*Didymosphenia geminata*], reed canary grass [*Phalaris arundinacea*], cattail [*Typha* sp.], and purple loosestrife [*Lythrum salicaria*]) are known invaders of Alaska's wetlands. These species thrive and establish quickly in recently disturbed wetland areas. White sweet clover (*Melilotus albus*) is known to take over riparian areas. These wetland plants are aggressive in growth and reproduction, are generalists, and are tolerant to many environmental conditions. Thus, they outcompete and displace native wetland vegetation once exposure allows establishment causing a reduction in biological diversity and community composition. Changes in the composition of wetland structure and function could in turn affect wildlife habitat (see Section 4.10, Wildlife). Impacts from invasive plants in pristine wetlands include altered diversity and abundance of native species, as invasive plants out-compete native plants for breeding areas, nutrients, and soil. They could also disrupt food webs, and degrade habitat and biodiversity.

The impacts to wetlands due to the introduction of invasive and non-native species during the construction phase would be minor, after implementation of BMPs, as it could result in the indirect and either temporary or permanent alteration of the wetlands

functionality, depending on the species introduced. Impacts of invasive and non-native species would be localized to the specific wetland with the infestation, unless the species spreads or is introduced throughout the ROW, in which case the impacts would be moderate or major.

4.9.4.1.1.9. Rehabilitation

Rehabilitation of the construction ROW area would include cleanup of the construction debris such as timber mats and geo-fabric, and the ROW would be contoured as close as possible to preconstruction conditions. During the post-construction phase, the construction ROW area would likely revert to a wetland type and function, similar to what had existed prior to the proposed Action with the exception of ROW corridors that received gravel fill, Beaufort Coastal Plain tundra, and forested wetland types. Portions of the ROW that received gravel fill in wetlands are not expected to revert to a wetland habitat, but to a disturbed/upland habitat after revegetation efforts take place. Continuous or discontinuous permafrost areas may drain with the thaw of the underlying permafrost and convert to upland, or may convert to another wetland type. Forested wetlands cleared of their mature vegetation would result in a different wetland type and function than what had existed previously. Wetlands impacted along the construction ROW would be expected to recover to an early successional stage soon after ADNR-approved seed is planted over the backfilled grade, assuming the water regime is the same post-construction. AGDC would consult with BLM and follow ADNR's PMC Revegetation Manual for Alaska, and the proposed Project's Revegetation Plan (Appendix E, Part I) would be used as a guide for seed application and fertilization. Fertilization and/or seeding would occur in sensitive and erosive areas immediately, other areas would be allowed to revegetate naturally. If the reclamation standard of 30 percent cover over a 3-year period does not occur, then additional revegetation efforts would commence, per the Revegetation Plan. Review of proposed Project documents published by the Alaska Plant Materials Center indicates that attaining the reclamation standard could be challenging (Czapla and Wright, 2012; Nolen, 2008; Wright, 1995a, 1995b). Success often varies significantly across even a small site, depending on soil properties and degree of saturation.

Final stabilization and revegetation relates directly to the soil resource in that the vegetation and surface layer protect frozen soils from thaw and prevent subsidence. ADGC provides two examples for successfully revegetating similar sites, including a site in the interior of Alaska and a North Slope site. At the Interior Alaska site, 4 years after fertilizer application and seeding, total plant cover ranged between 52 percent and 59 percent (Nolen, 2008). For the North Slope site, 2 years following revegetation, ground cover values ranged from less than 5 percent to 90 percent, with an overall cover of approximately 50 percent (Wright, 1995b).

If the surface layer were segregated and replaced as the topmost layer, revegetation may require less effort. The geographic extent of revegetation may be reduced because some areas may not need any additional revegetation treatments if the surface layer is

replaced. The magnitude/intensity and duration would be reduced because less seed, fertilizer, time, and effort would be needed for revegetating the majority of the trench line. Native, site-specific species would likely return to the trench faster if the site-specific surface layer was replaced. If less activity is required for revegetation, it is reasonable to assume there would be less traffic along the pipeline corridor and less potential to introduce invasive and non-native vegetation species.

Disturbed soils are optimal locations for invasive plants as noted above. Invasive seeds could be transferred from equipment completing final grading of contours onto exposed wetland soils along the ROW. Alaska regulations only prohibit movement of material containing prohibited noxious weeds. Restricted noxious weed seed are permissible for planting in Alaska up to the tolerance per pound established under 11 AAC 34.020(b).

The impacts to wetlands due to the rehabilitation process after the construction phase would be minor, after implementation of BMPs, as it would result in the overall restoration of the wetland post-construction, but may be a vector for other issues such as erosion or invasive species introduction, as discussed previously. Impacts due to rehabilitation would be widespread throughout the entire ROW, where rehabilitation takes place in wetlands. The proposed Project's rehabilitation methods are discussed in the Revegetation Plan (Appendix E, Part I).

4.9.4.1.2. Gas Conditioning Facility

During construction, placement of gravel fill, dust deposition and the potential to introduce non-native and invasive species would be possible at the GCF. These activities and their impacts to wetlands are described below.

4.9.4.1.2.1. Placement of Gravel Fill

Gravel fill would be placed in tundra wetlands to construct the GCF. Filling wetlands or parts of wetlands result in a direct and permanent impact to the wetland, converting it to an upland or disturbed site. The GCF facility pad would directly impact approximately 90.6 acres of tundra wetlands with its gravel fill. The GCF's access roads and camp would impact an additional 77.3 acres of tundra wetlands.

The impacts to wetlands due to placement of gravel fill during the construction phase would be moderate, as it would result in the direct and permanent loss of the wetland. Impacts would be localized to the site of the GCF, where fill is placed in wetlands.

4.9.4.1.2.2. Dust Deposition

Regular vehicle use during construction of the proposed Action (Alternative 1) would create dust at the GCF. Dust generation during construction would be short term, opposed to long term during operations. On-site driving rules would aid in reducing dust deposition surrounding the GCF. During construction, long-term dust deposition could potentially cause thermokarst effects in permafrost areas. Melting snow along roadsides and pads is accelerated as dust is deposited over time. Thermokarst areas

cause a depression in the ground from thawing permafrost, which could alter wetlands and their vegetation growth and species composition. Accelerated snowmelt along roadsides and pads exposes vegetation earlier than surrounding non-dusted vegetation, which could attract wildlife near the road or pad, potentially causing increased mortality from vehicle collisions (Section 4.10, Wildlife). Additional information regarding dust generation and applicable minimization measures are discussed further in Section 4.22, Air Quality, Climate Change, and Greenhouse Gas Emissions.

The impacts to wetlands and their vegetation due to dust deposition during construction activities at the GCF is considered moderate as it could result in direct loss and disturbance to vegetation, but only in the localized area of the GCF. If not properly controlled with mitigation measures (*e.g.,* road and pad watering and covering gravel loads in trucks), long-term dust deposition could result in thermokarsting of permafrost or the loss of sensitive species, which cannot be reversed in one growing season and may continue for the life of the proposed Project.

Construction plans of the GCF would be coordinated with both state and federal agencies to minimize disturbance.

4.9.4.1.2.3. Non-Native and Invasive Plants

Proposed Project construction at GCF could introduce invasive and non-native wetland plants, similarly to potential introductions along the pipeline ROW.

The impacts to wetlands due to the introduction of invasive and non-native species during the construction phase would be minor, after implementation of BMPs, as it could result in the indirect and either temporary or permanent alteration of the wetlands functionality, depending on the species introduced. Impacts of invasive and non-native species would be localized to the specific wetland with the infestation, unless the species spreads or is introduced throughout the ROW, in which case the impacts would be moderate or major.

4.9.4.1.3. Yukon River Crossing (HDD)

In the proposed Action (Alternative 1), HDD methods would be utilized to cross the Yukon River. An entry and exit pad for HDD equipment would be constructed for temporary use on either side of the river, which is included in the temporary construction ROW footprint discussed in Section 4.9.5.1.1. All activities with impacts to wetlands within the pipeline ROW at the HDD Yukon River Crossing are discussed previously, including: placement of gravel fill; clearing and mowing; grading, trenching, blasting, and backfilling; fragmentation; soil compaction and erosion; dust deposition; alteration of physical and chemical processes; non-native and invasive plant introduction; and rehabilitation impacts. No structures would be placed in the Yukon River channel.

Because no structures would be placed in the river, and other wetland impacts on either side of the river crossing are already included in the impacts associated with the ROW, wetland impacts at the Yukon River Crossing would be negligible.

4.9.4.1.4. West Dock (Dock Head 3) and Causeway Upgrades

Gravel fill placement, dredging, and screeding activities proposed at DH3 of West Dock would directly impact 169.2 acres of marine and estuarine wetlands and waters of the U.S. (9.9 acres of gravel fill, 59.3 acres of dredged area, and 100 acres at the nearshore dredge placement area).

The impacts to marine and estuarine wetlands and waters of the U.S. due to placement of gravel fill during the construction phase at West Dock would be moderate, as it would result in the direct and permanent loss of the wetlands and waters. Impacts would be localized to West Dock, the dredging and screeding areas, and the dredge placement area.

4.9.4.2. Operations and Maintenance

The permanent impacts area (or operations ROW) has a variable width, but in most areas, it is 120 feet wide (Chapter 2, Alternatives). Permanent impacts include the proposed Project ROW and other permanent features such as access roads, camps, PSYs, railroad siding, facility pads, material source sites, the GCF, dredge disposal locations, and VSMs.

Approximately 58.9 percent of the wetlands and waters of the U.S. in the permanent impacts area are scrub/shrub; 24.9 percent are emergent; 8.9 percent are forested; 4.6 percent are riverine; and 2.8 percent are estuarine, marine, lacustrine, and other palustrine (Figure 4.9-3). Mapped wetland acres in the permanent impacts area and their NWI classifications are presented in Table 4.9-5. Approximately 68.2 percent of the wetlands and waters of the U.S. in the permanent impacts area have a HGM class of organic soil flats, 14.0 percent are slope, 6.7 percent are riverine, 5.0 percent are mineral soil flats, 3.9 percent are depressional, 0.8 percent are marine, and 1.4 percent are lacustrine or estuarine fringe (Figure 4.9-4). Mapped wetland acres in the permanent impacts area and their HGM functional classification are presented in Table 4.9-6.

Figure 4.9-3 NWI Classes of Wetlands and Waters within the Permanent Impacts Area

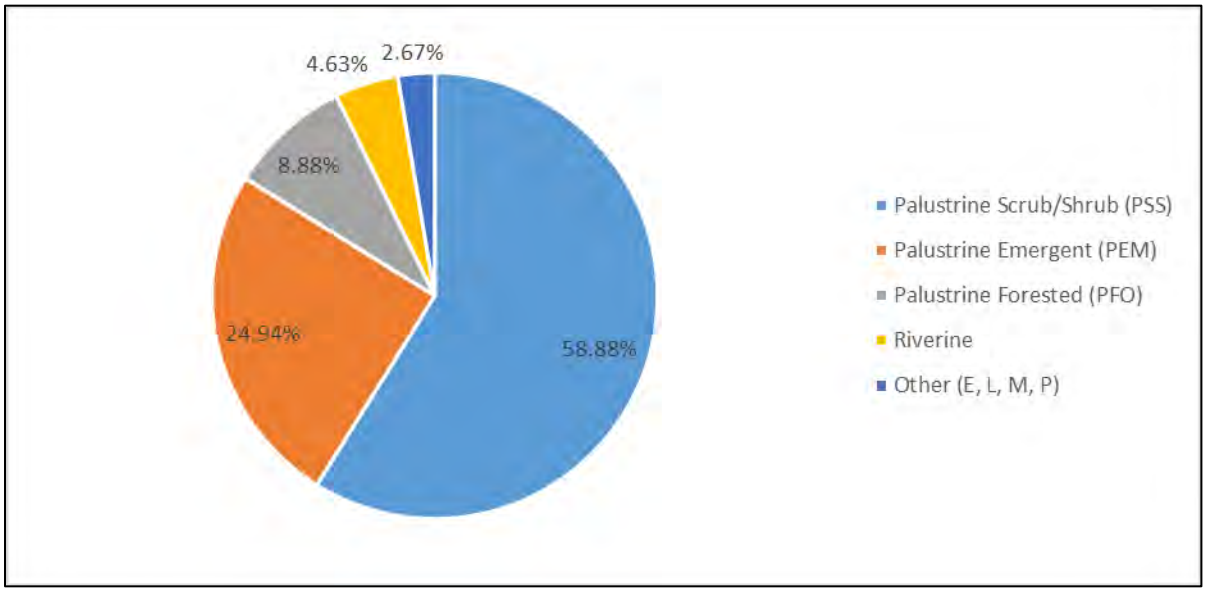
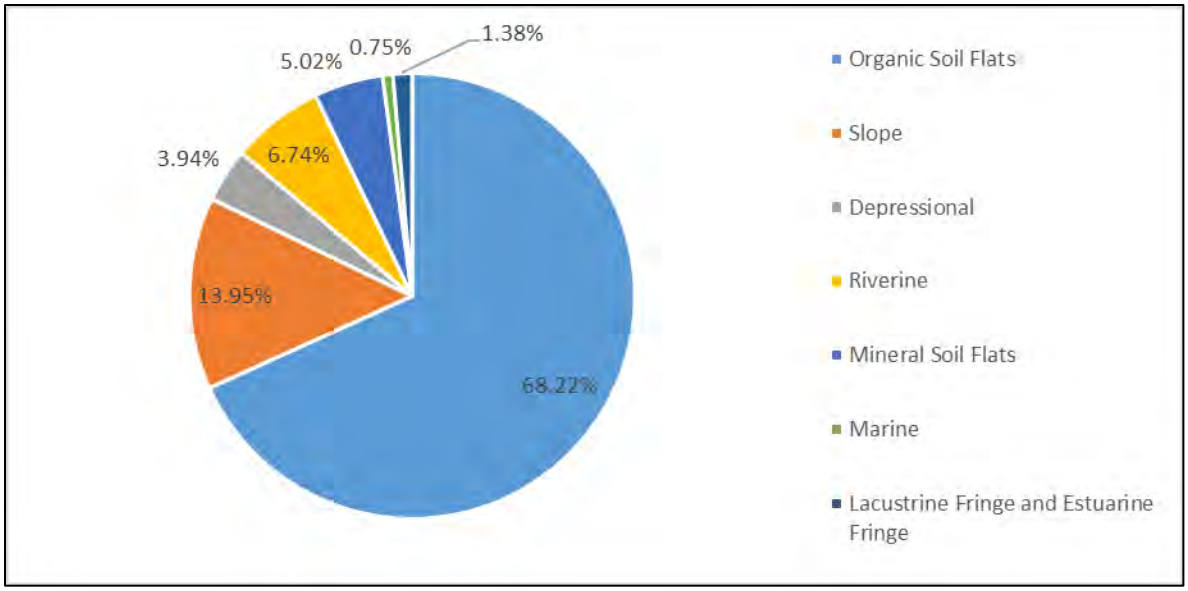


Figure 4.9-4 HGM Functional Classes of Wetlands and Waters within the Permanent Impacts Area



Vegetation type percentages described in Section 4.8, Vegetation, are reported based on land cover type as reported by the USGS NLCD classification system. The NLCD provides a higher-level classification than NWI or HGM in Section 4.9, Wetlands, of this SEIS. The NWI classification system is based largely on biotic characteristics and the HGM functional classifications describe the wetland's position in the landscape and its function using geomorphic and hydrologic characteristics.

The following sections discuss the potential effects of proposed Project-related activities that would occur during the operations and maintenance phase. The potential impacts discussed below are considered common to all pipeline segments, alternatives, options, aboveground facilities and extra work areas outside the ROW.

4.9.4.2.1. Pipeline ROW – Mainline and Fairbanks Lateral

Several proposed Project activities during operations associated with the pipeline ROW could impact wetland resources in the area. These activities and their impacts to wetlands are described below.

4.9.4.2.1.1. Placement of Gravel Fill

The impacts to wetlands due to placement of gravel fill during the operations phase would be not be applicable, as it would have already been accounted for during the construction phase. No placement of gravel fill is proposed to occur during the operations phase.

4.9.4.2.1.2. Mowing

As discussed in Section 4.8, Vegetation, for construction and operations purposes, vegetation in the ROWs would be initially be cleared for construction, and then regularly mowed for operations. The spread of non-native and invasive plant species could occur from transporting and traversing the mowing equipment from one location to another along the ROW.

Mowing of the permanent ROW may allow public access via ATVs to wetland areas that were previously inaccessible. However, the proposed Project would be parallel to existing ROWs (*e.g.*, highways, the TAPS ROW, and utility lines) for the majority of it length; therefore, additional access to wetlands would be minimal.

The impacts to wetlands due to mowing of vegetation during the operations phase would be minor, as the initial vegetation clearing impacts would have already taken place and accounted for during the construction phase. Impacts would be widespread throughout the entire ROW, where vegetation is cleared in wetlands. Clearing and mowing would result in continued direct and permanent suppression of forested and scrub/shrub vegetation.

4.9.4.2.1.3. Fragmentation

Additional wetland fragmentation in the Beaufort Coastal Plain ecoregion is possible during the operations and maintenance phase of Alternative 1 due to the likelihood that repairs would be made to the trench, pipe, or through revegetation work. These maintenance activites would require re-accessing the Project ROW, which could damage wetlands. Depending how intrusive the work would be, access could be accomplished via low-pressure equipment (*e.g.*, rolligon), by helicopter, or potentially by new gravel or ice access roads. Given that long stretches of pipeline are not located adjacent to existing roads, accessing sections to repair damage associated with changes to the thermal

regime or due to other factors could require access for heavy equipment over long distances. Impacts from these maintenance measures could degrade the integrity of wetlands, occur over wide areas, and could last more than 3 years.

The impacts to wetlands throughout the Project during operations and maintenance would be considered minor. Fragmentation from operations and maintenance would result in the direct and permanent alteration and division of wetlands. Wetlands, especially those with continuous or discontinuous permafrost, may drain and convert to uplands, or they may convert to a different wetland type. Impacts would be localized to wetlands and surrounding areas, which are divided by access roads, or other proposed Project features.

4.9.4.2.1.4. Soil Compaction and Erosion

Heavy equipment access during operations and maintenance of the ROW could compact soils and create ruts along the ROW and anywhere the ROW is accessed from existing roads, which could inhibit seed germination, reduce water infiltration, inhibit root establishment, and result in bare soil exposure. Soil erosion and fill placement could lead to increased sedimentation and turbidity in nearby waterbodies, which could then reduce water storage capacity, smother vegetation, and decrease oxygen concentration. These effects would be particularly applicable in areas of steep terrain and could extend beyond the construction ROW. Soil erosion could also alter water flow rates into and out of wetlands, thereby impacting local hydrologic processes. However, soil compaction and erosion impacts would likely be localized and temporary because timber and geo-textile mats (or similar) would be used during the summer construction season in some areas to reduce the impacts to wetlands. Timber mats and geo-fabric disperse the weight of the heavy equipment use across the ground. Ice roads and ice pads would be developed for use in the winter, with wide tracked vehicles, which would also disperse the weight of the equipment over wetlands.

The impacts to wetlands due to soil compaction and erosion during the operations phase would be minor, after implementation of BMPs, as it would result in direct and temporary alterations of the wetland. Impacts would be localized to specific sites, likely to slope wetlands.

4.9.4.2.1.5. Dust Deposition

Regular vehicle use during operations of the proposed Action would create dust along roadsides and facilities. Dust generation during operations would be long-term, as opposed to short-term during construction. On-site driving rules and other control measures included in the Fugitive Dust Control Plan (see Appendix S) would aid in reducing dust deposition surrounding roads and facilities. During operations, long-term dust deposition could potentially cause thermokarst effects in permafrost areas along access roads. Melting snow along roadsides is accelerated as dust is deposited over time. Thermokarst areas cause a depression in the ground from thawing permafrost, which could alter wetlands and their vegetation growth and species composition. Accelerated

snowmelt along roadsides exposes vegetation earlier than surrounding non-dusted vegetation, which could attract wildlife near the road, potentially causing increased mortality from vehicle collisions (Section 4.10, Wildlife). Additional information regarding dust generation and applicable minimization measures are discussed further in Section 4.22, Air Quality, Climate Change, and Greenhouse Gas Emissions.

The impacts to wetlands and their vegetation due to dust deposition during proposed Project operation activities are considered moderate in ecoregions with permafrost and minor in ecoregions without permafrost, as it could result in direct loss and disturbance to vegetation, but only in localized areas of operations work (*i.e.,* access roads and existing gravel roads). If not properly controlled with mitigation measures (*e.g.,* road watering and covering gravel loads in trucks), long-term dust deposition could result in thermokarsting of permafrost or the loss of sensitive species, which cannot be reversed in one growing season and may continue for the life of the proposed Project.

Operations activity plans of the Mainline would be coordinated with both state and federal agencies to minimize disturbance.

4.9.4.2.1.6. Non-Native and Invasive Plants

Proposed Project operations and maintenance activities could introduce invasive and non-native wetland plants through multiple pathways:

- Spread of non-native, invasive, and noxious plants already associated with existing ROWs (*e.g.,* ARRC, TAPS, and highways) by maintenance equipment, personnel, and waterways;
- Transport of non-native, invasive, and noxious plant material from other areas within the state or outside of Alaska via machinery, footwear and clothing, hand tools, vehicle tires, and waterways;
- Pollinators such as bees and birds; and
- Seed mixtures used to revegetate exposed soils could contain non-native, invasive, and noxious plants seeds. However, mixtures have a maximum allowable weed seed limit.

Several non-native wetland plants (such as Canadian waterweed, rock snot, white sweet clover, reed canary grass, cattail, and purple loosestrife) are known invaders of Alaska's wetlands. These species thrive and establish quickly in recently disturbed wetland areas. These wetland plants are aggressive in growth and reproduction, are generalists, and are tolerant to many environmental conditions. Thus, they outcompete and displace native wetland vegetation once exposure allows establishment causing a reduction in biological diversity and community composition. Changes in the composition of wetland structure and function could in turn affect wildlife habitat (see Section 4.10, Wildlife). Impacts from invasive plants in pristine wetlands include altered diversity and abundance of native species since invasive plants out-compete native plants for

breeding areas, nutrients, and soil. They could also disrupt food webs, and degrade habitat and biodiversity.

The impacts to wetlands due to the introduction of invasive and non-native species during the operations phase would be minor, after implementation of BMPs, as it could result in the indirect and either temporary or permanent alteration of the wetlands functionality, depending on the species introduced. Impacts of invasive and non-native species would be localized to the specific wetland with the infestation, unless the species spreads or is introduced throughout the ROW, in which case the impacts would be moderate or major.

4.9.4.2.1.7. Rehabilitation

Rehabilitation of the construction ROW area would include cleanup of the construction debris such as timber mats and geo-fabric, and the ROW would be contoured as close as possible to preconstruction conditions. During the post-construction and operations/maintenance phase, the construction ROW area would likely revert to a wetland type and function, similar to what had existed prior to the proposed Project with the exception of areas that receive gravel fill, areas with continuous or discontinuous permafrost, and forested wetland types. Portions of the ROW that received gravel fill in wetlands are not expected to revert to a wetland habitat, but to a disturbed/upland habitat after revegetation efforts take place. Continuous or discontinuous permafrost areas may drain with the thaw of the underlying permafrost and convert to upland, or may convert to another wetland type. Forested wetlands cleared of their mature vegetation would result in a different wetland type and function than what had existed previously. Wetlands impacted along the construction ROW would be expected to recover to an early successional stage quickly, as ADNR-approved seed is planted over the backfilled grade, assuming the water regime is the same post-construction. AGDC would consult with BLM and follow ADNR's PMC Revegetation Manual for Alaska, and the proposed Project's Revegetation Plan (Appendix E, Part I) would be used as a guide for seed application and fertilization. Fertilization and/or seeding would occur in sensitive and erosive areas immediately, other areas would be allowed to revegetate naturally. If the reclamation standard of 30 percent cover over a 3-year period does not occur, then additional revegetation efforts would commence, per the Revegetation Plan.

Disturbed soils are optimal locations for invasive plants as noted above. Invasive seeds could be transferred from equipment completing final grading of contours onto exposed wetland soils along the ROW. Alaska regulations only prohibit movement of material containing prohibited noxious weeds. Restricted noxious weed seed are permissible for planting in Alaska up to the tolerance per pound established under 11 AAC 34.020(b).

Rehabilitation monitoring activities would take place along the ROW during the operations phase. ROW access with equipment, vehicles, and personnel to perform the

monitoring activities could introduce invasive and non-native species or cause localized erosion, without implementation of BMPs.

The impacts to wetlands due to the rehabilitation process during the operations phase would be minor, after implementation of BMPs, as it would result in the overall restoration of the wetland post-construction, but may be a vector for other issues such as erosion or invasive species introduction, as discussed previously. Impacts due to rehabilitation would be widespread throughout the entire ROW, where rehabilitation takes place in wetlands. The proposed Project's rehabilitation methods are discussed in the Revegetation Plan (Appendix E, Part I).

4.9.4.2.2. Gas Conditioning Facility

During operations, dust deposition and the potential to introduce non-native and invasive species would be possible at the GCF. These activities and their impacts to wetlands are described below.

4.9.4.2.2.1. Dust Deposition

Regular vehicle use during operations of the proposed Project would create dust at the GCF, similar to dust deposition along the pipeline ROW.

The impacts to wetlands and their vegetation due to dust deposition during operations activities at the GCF is considered moderate as it could result in direct loss and disturbance to vegetation, but only in the localized area of the GCF. If not properly controlled with mitigation measures (*e.g.,* road and pad watering and covering gravel loads in trucks), long-term dust deposition could result in thermokarsting of permafrost or the loss of sensitive species, which cannot be reversed in one growing season and may continue for the life of the proposed Project.

Operations activity plans of the GCF would be coordinated with both state and federal agencies to minimize disturbance.

4.9.4.2.2.2. Non-Native and Invasive Plants

Proposed Project operations and maintenance activities at the GCF could introduce invasive and non-native wetland plants similarly to potential introductions along the pipeline ROW.

The impacts to wetlands due to the introduction of invasive and non-native species during the operations phase would be minor, after implementation of BMPs, as it could result in the indirect and either temporary or permanent alteration of the wetlands functionality, depending on the species introduced. Impacts of invasive and non-native species would be localized to the specific wetland with the infestation, unless the species spreads or is introduced throughout the ROW, in which case the impacts would be moderate or major.

4.9.4.2.3. Yukon River Crossing (HDD)

In Alternative 1 (proposed Action), HDD methods would be utilized to cross the Yukon River and no structures would be placed in the river channel. There would be no operations activities necessary for the portion of pipeline HDD under the channel.

Operations and maintenance activities on either side of the Yukon River would include those similar to along the pipeline ROW: clearing and mowing; soil compaction and erosion; dust deposition; non-native and invasive plant introductions; and rehabilitation activities.

Because no structures would be placed in the river, and other wetland impacts on either side of the river crossing are already included in the impacts associated with the ROW, wetland impacts at the Yukon River Crossing would be negligible.

4.9.4.2.4. West Dock (Dock Head 3) and Causeway Upgrades

West Dock would only be used for the proposed ASAP Project during construction phases; therefore, no operational phase impacts would occur.

4.9.5. Alternative 2 – Denali NPP Route Variation Including Dock Head 2, Ocean Disposal, and Aboveground Pipeline Mode

Alternative 2 (Denali NPP Route Variation) is described in Chapter 2 in detail. The 36-inch, 733-mile-long pipeline and 12-inch, 30-mile lateral pipeline would cross various wetland habitats and communities from the North Slope to the existing ENSTAR pipeline system in the Mat-Su Borough. This route would traverse 7 miles of Denali NPP, would have ocean disposal of dredge material, would have an aerial crossing of the Yukon River, and would be aboveground on VSMs for the northernmost 62 miles. This section discusses the analysis of impacts to wetlands along the route.

The following sections discuss activities that are proposed for the operations and construction phases of the Project with associated potential impacts.

Mitigation measures 1 through 8 and 10 through 13 apply to the entire Alternative 2 route.

4.9.5.1. Construction (Temporary Impacts Area)

Similar to Alternative 1, the temporary impacts area in Alternative 2 would be for additional construction areas, such as temporary work areas, HDD crossings, pipeline stream crossings, ice roads and pads, and bridges. Temporary work areas would be required for construction at road crossings, railroad crossings, crossings of existing pipelines and utilities, pipe stringing truck turnaround areas, wetland crossings, points of inflection, and waterbody crossings.

4.9.5.1.1. Pipeline ROW – Mainline and Fairbanks Lateral

Effects to wetlands along the pipeline ROW during construction are the same as those discussed above in Alternative 1, except where the Alternative 2 differs from Alternative 1: the Denali NPP Route Variation, using DH2 instead of DH3, the aerial Yukon River Crossing, and the first 62 miles where the pipeline would be suspended on VSMs rather than buried. These differences are discussed in detail in the following sections.

4.9.5.1.1.1. Placement of Gravel Fill and VSMs

Impacts to wetlands due to placement of gravel fill along the pipeline ROW Mainline and Fairbanks Lateral during construction are the same as those discussed above in Alternative 1 for the proposed pipeline route, except for the first 62 miles where the pipeline would be suspended on VSMs. I In Alternative 2, 7 miles of the pipeline ROW is located within Denali NPP instead of to the east of the park, as proposed in Alternative 1.

The use of VSMs for the first 62 miles of the route would increase the permanent physical footprint of impacts to wetlands by 0.49 acres; however, these impacts would be substantially less than the potential issues involved with trenching and backfilling in permafrost soils. The impact associated with each VSM anchor is based on 24-inch-diameter VSMs, and each VSM glide/slide support is based on 12-inch-diameter supports (3.14 and 0.79 square feet each, respectively). This would result in a very small permanent footprint, even when approximately 6,400 VSMs would be installed. VSM usage would replace open-cut trenching for these 62 miles. The impact to wetlands would be small, but permanent, as the VSMs would be permanent structures displacing wetland soil and vegetation. VSM impacts would be substantially less than the potential issues involved with trenching and backfilling in permafrost soils. Gravel fill usage for the first 62 miles would be the same as in Alternative 1.

Fewer acres of wetlands would be filled if the 7-mile segment of the pipeline in Denali NPP was utilized, because at this time, there are no access roads, material sites, or other additional proposed Project features, proposed along this segment.

Impacts to wetlands due to placement of gravel fill during the construction phase would be moderate, as it would result in the direct and permanent loss of the wetland. Impacts would be widespread throughout the entire ROW, where fill is placed in wetlands.

4.9.5.1.1.2. Clearing/Mowing

Impacts to wetlands due to clearing and mowing along the pipeline ROW Mainline and Fairbanks Lateral during construction are the same as those discussed above in Alternative 1 for the pipeline route, with the exception of the first 62 miles, which would be suspended on VSMs for this alternative. Little to no mowing or clearing would be necessary on the tundra portion of the route. In Alternative 2, 7 miles of the pipeline ROW is located within Denali NPPP instead of to the east of the park, as proposed in Alternative 1. Forest and scrub/shrub vegetation would be cleared out and kept short

within the permanent operations ROW, but would be allowed to grow back in the temporary construction ROW, the same as Alternative 1.

4.9.5.1.1.3. Grading, Trenching, Blasting, and Backfilling

Alternative 2 would result in less open-cut trenching and backfilling during construction than Alternative 1, because the first 62 miles of the Mainline would be aboveground on VSMs and therefore would result in significantly fewer impacts to wetlands and their vegetation and hydrology on the Beaufort Coastal Plain. Open-cut trenching and backfilling would be implemented for the remaining 671 miles of the proposed Project (except at elevated bridge crossings, fault crossings, pigging facilities, and valves, described in Chapter 2). Potential impacts to wetlands remain the same as in Alternative 1 for these 671 miles of pipeline ROW.

Use of VSMs for the first 62 miles of the pipeline would reduce potential impacts to permafrost in the Beaufort Coastal Plain ecoregion. Trenching would be avoided along this stretch; the only permanent impact to wetlands would be the small VSM footprints.

4.9.5.1.1.4. Fragmentation

Impacts to wetlands due to fragmentation along the pipeline ROW Mainline and Fairbanks Lateral during construction are the same as those discussed above in Alternative 1 for the pipeline route, except for the first 62 miles where the pipeline would be suspended on VSMs in this alternative. There would be substantially fewer impacts to wetland habitats, vegetation, and hydrology especially during breakup over these first 62 miles. In Alternative 2, 7 miles of the pipeline ROW is located within Denali NPP, instead of to the east of the park, as proposed in Alternative 1. The impact of habitat fragmentation would be similar in all ecoregions crossed by pipeline ROWs.

4.9.5.1.1.5. Soil Compaction and Erosion

Impacts to wetlands due to soil compaction and erosion along the Mainline and Fairbanks Lateral during construction are the same as those discussed above in Alternative 1 for the entire proposed pipeline route, with the exception of the first 62 miles pipeline, which would be suspended on VSMs in this alternative. Because these first 62 miles of pipeline would not be trenched, the likelihood of issues arising due to erosion and thawing permafrost are greatly reduced. In Alternative 2, a total of 7 miles of the pipeline ROW is located within Denali NPP, instead of to the east of the park, as proposed in Alternative 1.

4.9.5.1.1.6. Dust Deposition

Impacts to wetlands due to dust deposition along the pipeline ROW Mainline and Fairbanks Lateral during construction are the same as those discussed above in Alternative 1 for the entire pipeline route, even though the pipeline would be suspended on VSMs for the first 62 miles in this alternative. However, in Alternative 2, 7 miles of

the pipeline ROW is located within Denali NPP instead of to the east of the park, as proposed in Alternative 1.

4.9.5.1.1.7. Alteration of Physical and Chemical Processes

Impacts to wetlands due to alteration of physical and chemical processes along the pipeline ROW Mainline and Fairbanks Lateral during construction are the same as those discussed above in Alternative 1 for the entire pipeline route, except for the first 62 miles where the pipeline would be suspended on VSMs in this alternative. In Alternative 2, 7 miles of the pipeline ROW is located within Denali NPP instead of to the east of the park, as proposed in Alternative 1.

The use of VSMs for the first 62 miles of the pipeline would reduce potential impacts to permafrost and wetland hydrology in the Beaufort Coastal Plain ecoregion, and therefore, the physical and chemical processes that the wetlands contribute. Trenching would be avoided along this stretch and the only permanent impact to the wetlands would be the small VSM footprints.

4.9.5.1.1.8. Non-Native and Invasive Plants

Impacts to wetlands due to the introduction of non-native, invasive, and noxious plants along the pipeline ROW Mainline and Fairbanks Lateral during construction are the same as those discussed above in Alternative 1 for the entire proposed pipeline route, even though the pipeline would be suspended on VSMs for the first 62 miles in this alternative. The risk of introduction of non-native, invasive, or noxious plants remains the same at VSM construction sites. However, in Alternative 2, 7 miles of the pipeline ROW is located within Denali NPP instead of to the east of the park, as proposed in Alternative 1.

4.9.5.1.1.9. Rehabilitation

Impacts to wetlands due to rehabilitation activities along the proposed pipeline ROW Mainline and Fairbanks Lateral during construction are the same as those discussed above in Alternative 1 for the entire pipeline route, even though the pipeline would be suspended on VSMs for the first 62 miles in this alternative. In Alternative 2, however, 7 miles of the proposed pipeline ROW would be located within Denali NPP instead of to the east of the park, as proposed in Alternative 1.

The *Native Plant Revegetation Manual for Denali NPP* (Densmore *et al.*, 2000), and other Alaska revegetation manuals listed in Section 4.8, Vegetation, would be utilized where appropriate for the development of the site-specific Revegetation Plan (Appendix E, Part I).

4.9.5.1.2. Gas Conditioning Facility

Impacts to wetlands at the GCF are the same as those discussed above in Alternative 1. Direct loss of wetlands due to gravel fill placement, dust deposition, and the potential to

introduce non-native and invasive species are the main impacts that the proposed Project could induce at the GCF.

4.9.5.1.3. Denali NPP Route Variation

The Denali NPP Route Variation would traverse 7 miles of Denali NPP lands, of which the majority is located adjacent to the Parks Highway ROW. Approximately 89.3 percent of the Denali NPP Route Variation is either upland or currently developed land, according to the proposed Project's wetland mapping data. The remaining 10.7 percent of the Denali NPP Route Variation is wetland: the majority is scrub/shrub (8.4 acres), 0.4 acres is emergent, 1.3 acres is forested, 0.6 acres is riverine, and less than 0.002 acre is other palustrine (ponds). Detailed maps for the Denali NPP Route Variation are provided in Chapter 2 (Figure 2.4-1). There is no difference between the construction and operations ROWs along this segment.

In comparison with the Mainline route segment that would be avoided if Alternative 2 was selected, the Denali NPP Route Variation would result in fewer impacts to wetland resources, primarily by development of approximately 86.8 fewer acres of wetland. The Denali NPP Route Variation would also result in 98.0 fewer acres impacted of upland or currently developed land; however, at this time, there are no access roads, material sites, or other extra proposed Project features proposed along the Denali NPP Route Variation.

4.9.5.1.4. Yukon River Crossing (Aerial)

In Alternative 2, new construction of an aerial suspension bridge would be used to cross the Yukon River (Figure 2.4-3). A small access road on the north side of the river, cable anchors on both sides of the river, and a construction material storage area on the south side of the river, would be needed for this alternative. All of these development features would be included within the permanent operations ROW footprint. All activities with impacts to wetlands at the aerial Yukon River Crossing are discussed previously in Section 4.9.5.1.1, Pipeline ROW – Mainline and Fairbanks Lateral. The access road and pads for anchors would be constructed using gravel fill; the ROW would be cleared and graded; wetlands may be fragmented; there may be soil compaction and erosion; dust may be deposited; there may be alteration of wetlands physical and chemical processes; and non-native and invasive species may be introduced.

4.9.5.1.5. West Dock (Dock Head 2) and Causeway Upgrades

Gravel fill placement, dredging, and screeding activities proposed at DH2 of West Dock would directly impact 333.7 acres of marine and estuarine wetlands and waters of the U.S. (17.5 acres of fill, 116.2 acres of dredged area, and 200 acres at the ocean dredge placement area). A figure showing the difference in the Alternative 1 and Alternative 2 dredge placement impact footprints is included in Chapter 2, Figure 2.2-4.

4.9.5.2. Operations and Maintenance (Permanent Impacts Area)

Effects to wetlands along the pipeline ROW during operations are the same as those discussed above in Alternative 1, except where the Alternative 2 differs from the Alternative 1: the Denali NPP Route Variation, using DH2 instead of DH3, the aerial Yukon River Crossing, and the first 62 miles where the pipeline would be suspended on VSMs rather than buried. These differences are discussed in detail in the following sections.

4.9.5.2.1. Pipeline ROW – Mainline and Fairbanks Lateral

Several proposed Project activities during operations associated with the pipeline ROW could impact wetland resources in the area. These activities and their impacts to wetlands are described below.

4.9.5.2.1.1. Placement of Gravel Fill and VSMs

The impacts to wetlands due to placement of gravel fill during the operations phase would be not be applicable, as it would have already been accounted for during the construction phase. No placement of gravel fill is proposed to occur during the operations phase. Wetland communities located directly under raised portions of the pipeline could experience negative impacts as a result of continuous shading from the pipe and VSMs. Impacts from shading, however, would be minimal and limited to vegetation directly under the pipeline.

4.9.5.2.1.2. Mowing

Impacts to wetlands due to mowing along the pipeline ROW Mainline and Fairbanks Lateral during operations are the same as those discussed above in Alternative 1 for the entire proposed pipeline route, with the exception of the first 62 miles pipeline, which would be suspended on VSMs in this alternative. Little to no mowing would be necessary for the tundra portion of the route. However, in Alternative 2, a total of 7 miles of the pipeline ROW is located within Denali NPP instead of to the east of the park, as proposed in Alternative 1. Forest and scrub/shrub vegetation would be kept short within the permanent operations ROW, but would be allowed to grow back in the temporary construction ROW, the same as Alternative 1.

4.9.5.2.1.3. Fragmentation

Impacts to wetlands due to fragmentation along the pipeline ROW Mainline and Fairbanks Lateral during operations would be the same as those discussed above in Alternative 1 for the majority of the proposed pipeline route, except where the pipeline would be suspended on VSMs for the first 62 miles in this alternative. In the first 62 miles of the Project in Alternative 2 (on the Beaufort Coastal Plain), wetland fragmentation would be negligible during operations because the pipeline would be suspended on VSMs. Additionally, 7 miles of the pipeline ROW in Alternative 2 would

be located within Denali NPP instead of to the east of the park, as proposed in Alternative 1.

4.9.5.2.1.4. Soil Compaction and Erosion

Impacts to wetlands due to soil compaction and erosion along the pipeline ROW Mainline and Fairbanks Lateral during operations are the same as those discussed above in Alternative 1 for the entire proposed pipeline route, even though the pipeline would be suspended on VSMs for the first 62 miles in this alternative. However, in Alternative 2, 7 miles of the pipeline ROW is located within Denali NPP instead of to the east of the park, as proposed in Alternative 1.

4.9.5.2.1.5. Dust Deposition

Impacts to wetlands due to dust deposition along the pipeline ROW Mainline and Fairbanks Lateral during operations are the same as those discussed above in Alternative 1 for the entire proposed pipeline route, even though the pipeline would be suspended on VSMs for the first 62 miles in this alternative. However, in Alternative 2, 7 miles of the pipeline ROW is located within Denali NPP instead of to the east of the park, as proposed in Alternative 1.

4.9.5.2.1.6. Non-Native and Invasive Plants

Impacts to wetlands due to the introduction of non-native, invasive, and noxious plants along the pipeline ROW Mainline and Fairbanks Lateral during operations are the same as those discussed above in Alternative 1 for the entire proposed pipeline route, even though the pipeline would be suspended on VSMs for the first 62 miles in this alternative. The risk of introduction of non-native, invasive, or noxious plants remains the same at VSM construction sites. However, in Alternative 2, 7 miles of the pipeline ROW is located within Denali NPP instead of to the east of the park, as proposed in Alternative 1.

4.9.5.2.1.7. Rehabilitation

Impacts to wetlands due to rehabilitation activities along the pipeline ROW Mainline and Fairbanks Lateral during operations are the same as those discussed above in Alternative 1 for the entire proposed pipeline route, even though the pipeline would be suspended on VSMs for the first 62 miles in this alternative. However, in Alternative 2, 7 miles of the pipeline ROW is located within Denali NPP instead of to the east of the park, as proposed in Alternative 1.

The *Native Plant Revegetation Manual for Denali NPP* (Densmore *et al.,* 2000), and other Alaska revegetation manuals listed in Section 4.8, Vegetation, would be utilized where appropriate for development of the site-specific Revegetation Plan (Appendix E, Part I).

4.9.5.2.2. Gas Conditioning Facility

Impacts to wetlands at the GCF are the same as those discussed above in Alternative 1. Direct loss of wetlands due to placement of gravel fill and VSMs, dust deposition, and the potential to introduce non-native and invasive species are the main impacts that the proposed Project could induce at the GCF for Alternative 2.

4.9.5.2.3. Denali NPP Route Variation

Impacts to wetlands along the Denali NPP Route Variation are the same as those discussed above for the proposed pipeline ROW; however, these 7 miles of pipeline impacts occur within Denali NPP.

4.9.5.2.4. Yukon River Crossing (Aerial)

The suspension bridge over the Yukon River would not create additional impacts to wetlands during the operations phase of the proposed Project (Alternative 2). Any mowing, dust deposition, soil compaction, or non-native plant introductions are discussed above for operations of the pipeline ROW and are included within the permanent operations ROW footprint.

4.9.5.2.5. West Dock (Dock Head 2) and Causeway Upgrades

West Dock would only be used for the proposed ASAP Project during construction phases, so no operational phase impacts would occur.

4.9.6. Alternative 3 – No Action

Under Alternative 3 (No Action), the proposed Project would not be developed and there would, therefore, be no impacts to wetland habitats for construction or operational phases.

4.9.7. Conclusions and Comparison of Alternatives

Alternatives 1 and 2 would result in similar impacts to wetland resources during both construction and operations phases of the proposed Project, with differences discussed below. Proposed Project construction and operations activities would be the same for both Alternatives 1 and 2 (*e.g.,* gravel fill placement, clearing/mowing, grading/trenching/blasting/backfilling, fragmentation, soil compaction, dust deposition, alteration of physical and chemical processes, potential noxious plant species introduction, and rehabilitation activities), except for the first 62 miles that would be placed on VSMs in Alternative 2. A summary of the primary differences Alternative 1 and 2 effects to wetlands is as follows:

- More impacts to the seafloor in Prudhoe Bay (marine waters of the U.S.) would result with Alternative 2 because a larger area would require dredging.

- The aerial suspension of the Yukon River crossing in Alternative 2 would not have significantly more or less impacts to wetlands than Alternative 1, because all the proposed Project work would be contained within the ROWs in either option.
- Less open-cut trenching would occur with Alternative 2 because the first 62 miles of the Mainline would be supported on VSMs. Suspending the pipe on VSMs is intended to preserve the integrity of soils, hydrology, wetlands, and vegetation in the first 62 miles of the route.
- The VSMs for the first 62 miles of the proposed Mainline in Alternative 2 would be constructed within the operations ROW. These VSMs would be a permanent physical feature on the tundra; however, the impacts of their very small footprints (0.49 acres total) would be substantially less than the potential issues involved with trenching and backfilling in permafrost soils.
- The Denali NPP Route Variation (Alternative 2) would result in fewer acres of wetland impact than the Mainline ROW segment outside of the Denali NPP (Alternative 1); 86.8 fewer wetland acres would be developed in Alternative 2, primarily because there are no access roads, material sites, or other additional proposed Project features proposed within Denali NPP.
- Alternative 2 would result in 127.76 fewer acres of wetland impacts than Alternative 1 within the first 62 miles of the project (See Beaufort Coastal Plain in Table 4.9-9).
- As shown in Tables 4.9-7, 4.9-8, and 4.9-9, Alternative 2 has 0.43 more acres of total wetland impacts than Alternative 1. Alternative 2 would have more permanent impacts but fewer temporary impacts than Alternative 1.

In the No Action alternative (Alternative 3), the proposed Project would not be developed, and therefore, no impacts to wetland habitats for construction or operational phases would occur.

Table 4.9-14 shows the rankings of affects that Alternative 1 (proposed Action) and Alternative 2 would have on the wetland resources.

Wetland loss and/or disturbance was ranked as a moderate and direct impact to wetland resources during construction of both Alternatives 1 and 2. Wetland loss and/or disturbance would be widespread throughout the entire pipeline ROW, impacts would be long-term, and forested wetlands would be converted to scrub/shrub or another wetland type. During operations, it is ranked as minor and direct, as most loss of wetlands would occur during construction, but dust deposition could still occur during operations and may impact wetlands long-term in either alternative.

Wetland fragmentation would occur similarly with both the proposed Action (Alternative 1) and the Denali NPP Route Variation (Alternative 2) during construction phases. It was given a ranking of major throughtout the entire Project, and direct for the construction phase. Wetland fragmentation would be minor during the operations phase

in both alternatives, except for in the Beaufort Coastal Plain in Alternative 2, where it would be negligible. Fragmentation could continue throughout the buried Project footprint during operations when maintenance and repair work is needed. Wetland fragmentation could be widespread throughout the pipeline ROW, would be long-term, and would likely be irreversible. The use of VSMs would reduce impacts to wetland soil and hydrologic resources because a large trench would not be required for that portion of the pipe; this reduces the need for borrow material and the need to dispose of excavated, thaw-susceptible soil.

There is potential for the proposed ASAP Project to change the function, value, or water type code of wetlands, similarly with both Alternatives 1 and 2. This was ranked as ranging from minor to moderate and direct for the construction phase of both alternatives, as BMPs would reduce the risks of wetland function alteration. It ranked as minor and direct for the operations phase, as chemicals from vehicles and salts used for de-icing could drain into wetlands, destroying and/or degradation of permafrost, and dust deposited on vegetation could occur for the long-term during operations.

Figures 4.9-5 and 4.9-6 illustrate some of the key findings from the impact analysis. The figures intend to provide context for the description of potential impacts of alternatives, as described in detail in this section. By illustrating the potential impacts on the proposed Project map using a consistent color scheme consistent with Table 4.9-14, Comparison of Alternatives Summary for Impacts to Wetlands, we can begin to draw a few conclusions. Examples are provided below:

- The results indicate the above listed impacts would be greater in the Beaufort Coastal Plain ecoregion and other ecoregions that have permafrost soils.
- The most significant impacts to wetlands would be those associated with trenching, wetland fragmentation, and soil compaction/erosion.

4.9.8. Summary of Differences if USACE Conditions are Implemented

In the potential scenario where AGDC follows the request from USACE to fulfil mitigation measures and BMPs under regulatory obligations of the CWA (as discussed in Section 4.5.2.1), overall impacts to wetlands would be slightly different. Some differences between impacts include:

- Impacts to underlying permafrost would be lessened;
- Revegetation time would be shorter when placing the native, site-specific surface layer back onto the top of the trench;
- Less fertilizer and seed (possibly none in some areas) needed for revegetation;
- Higher likelihood of native, site-specific species returning to the trench faster;
- Less work needed for revegetation (possibly none in some areas); also a potential reduction in traffic and therefore less opportunity for introducing invasive and non-native species;

- Impacts to wetlands would be lessened overall via several of the USACE conditions:
  - No stockpiling of fill would occur in wetlands;
  - Trenches would be constructed so they do not drain waters of the U.S.;
  - Excavated material sidecast into wetlands would be underlain by geotextile or similar and then would be removed;
  - Revegetation would occur earlier to prevent erosion;
  - Natural drainage patterns would be maintained to prevent ponding or drying;
  - Alterations to water circulation patterns would be minimized;
  - Relocated stream channels would mimic the original stream channel; and
  - Buffers would be maintained around waters and at stream crossings during construction.

Inclusion of USACE DA permit conditions, including the segregation of the surface layer, would decrease impacts to wetland resources though the magnitude of these reductions cannot be determined based on available information. The segregation and replacement of the surface layer as the topmost layer on the trench would reduce the overall revegetation duration and effort, reduce impacts to permafrost, and reduce impacts to wetlands. The geographic extent of the impacts to wetlands may also be reduced by some of the conditions involving trenching and revegetation.

Table 4.9-14 Comparison of Alternatives Summary for Impacts to Wetlands (Direct & Indirect)

Biological Resource Effect	Potential Impact Description	Alternative 1		Alternative 2		Alternative 3
		Construction	Operations	Construction	Operations	Construction/Operations
		Impact Rating	Impact Rating	Impact Rating	Impact Rating	Impact Rating
Loss of wetlands • # of acres (temporary loss) • # of acres (permanent loss)	Permanent or temporary loss of wetland habitats due to addition of gravel fill or altered vegetation, soils, or hydrology.	*Moderate*	*Minor*	*Moderate*	*Minor*	*Negligible*
Wetland fragmentation (fill dividing a wetland into segments)	Division of a wetland into smaller sections (*e.g.*, by construction of an access road through a wetland).	*Major*	*Minor*	*Major, Moderate on the Beaufort Coastal Plain*	*Minor, Negligible on the Beaufort Coastal Plain*	*Negligible*
Changed function, value (geomorphic or hydrologic), or Water Type Code (from the January 2015 AGDC Approved Jurisdictional Determination Report). Impacts to other resources (*e.g.*, wildlife, threatened and endangered species, fish, water resources, soils and geology, visual resources)	Proposed Project development changes the function or value or water type code by altering vegetation, soils, or hydrology. Functional changes of wetlands could result in impacts to other resources.	*Ranging from Minor to Moderate*	*Minor*	*Ranging from Minor to Moderate*	*Minor*	*Negligible*

Attaining the USACE conditions discussed in Section 4.9.3.2 would segregate the surface layer from mineral subsoil, use the surface layer as the uppermost layer of backfill to provide a seed bed for native species, prohibit stockpiling of fill in wetlands, prevent trenches from draining waters of the U.S., have revegetation occur earlier, keep natural drainage patterns to prevent ponding or drying, minimize alterations to water circulation patterns, have relocated stream channels mimic the original channel, and maintain buffers around waters and at stream crossings during construction. These steps would help protect the wetlands resource.

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- City or Village
- Mileposts
- Beaufort Coastal Plain Ecoregion
- Other Ecoregions with Permafrost: Brooks Foothills, Brooks Range, Kobuk Ridges and Valleys, Ray Mountains, Tanana-Kuskokwim Lowlands, and Yukon-Tanana Uplands
- Ecoregions Lacking Permafrost: Alaska Range and Cook Inlet Basin
- Fairbanks v4.1 Lateral

Effect Rating

- Major Positive
- Moderate Positive
- Minor Positive
- Negligible
- Minor Negative
- Moderate Negative
- Major Negative

Effect Indicators

GRA: Placement of gravel fill
CLR: Clearing/mowing
TRN: Grading, trenching, blasting, and backfilling
FRG: Fragmentation
DUST: Dust deposition
SOIL: Soil compaction and erosion
ALT: Alteration of physical and chemical processes
INV: Non-native and invasive plants
REHAB: Rehabilitation

Beaufort Sea

MP 0
MP 62
MP 100
MP 200
MP 300
MP 400
MP 500
MP 600
MP 700
MP 733

Anaktuvuk Pass
Wiseman
Bettles
Stevens Village
Rampart
Livengood
Minto
Two Rivers
Pleasant Valley
Fairbanks
Four Mile Road
Nenana
Anderson
Ferry
Healy
McKinley Park
Cantwell
Petersville
Talkeetna
Skwentna
Willow
Susitna
Anchorage

Beaufort Coastal Plain Ecoregion

Construction	
	GRA
	CLR
	TRN
	FRG
	DUST
	SOIL
	ALT
	INV
	REHAB

Operations	
	CLR
	FRG
	DUST
	SOIL
	INV
	REHAB

Other Ecoregions with Permafrost

Construction	
	GRA
	CLR
	TRN
	FRG
	DUST
	SOIL
	ALT
	INV
	REHAB

Operations	
	CLR
	FRG
	DUST
	SOIL
	INV
	REHAB

Ecoregions Lacking Permafrost

Construction	
	GRA
	CLR
	TRN
	FRG
	DUST
	SOIL
	ALT
	INV
	REHAB

Operations	
	CLR
	FRG
	DUST
	SOIL
	INV
	REHAB

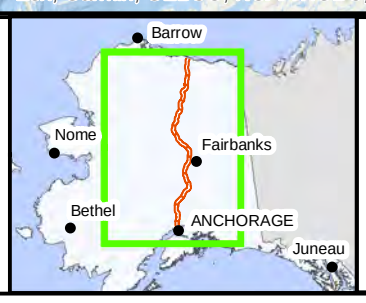
Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

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Figure 4.9-5: WETLANDS IMPACTS CONTEXT MAP, ALTERNATIVE 1 ALASKA STAND ALONE PIPELINE

0 25 50 100 150 Miles



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- City or Village
- Mileposts
- Beaufort Coastal Plain Ecoregion
- Other Ecoregions with Permafrost: Brooks Foothills, Brooks Range, Kobuk Ridges and Valleys, Ray Mountains, Tanana-Kuskokwim Lowlands, and Yukon-Tanana Uplands
- Ecoregions Lacking Permafrost: Alaska Range and Cook Inlet Basin
- Fairbanks v4.1 Lateral

Effect Rating

- Major Positive
- Moderate Positive
- Minor Positive
- Negligible
- Minor Negative
- Moderate Negative
- Major Negative

Effect Indicators

GRA: Placement of gravel fill
CLR: Clearing/mowing
TRN: Grading, trenching, blasting, and backfilling
FRG: Fragmentation
DUST: Dust deposition
SOIL: Soil compaction and erosion
ALT: Alteration of physical and chemical processes
INV: Non-native and invasive plants
REHAB: Rehabilitation

Beaufort Sea

MP 0
MP 62
MP 100
MP 200
MP 300
MP 400
MP 500
MP 600
MP 700
MP 733

Anaktuvuk Pass
Wiseman
Bettles
Stevens Village
Rampart
Livengood
Minto
Two Rivers
Pleasant Valley
Fairbanks
Four Mile Road
Nenana
Anderson
Ferry
Healy
McKinley Park
Cantwell
Petersville
Talkeetna
Skwentna
Willow
Susitna
Anchorage

Beaufort Coastal Plain Ecoregion

Construction	
	GRA
	CLR
	TRN
	FRG
	DUST
	SOIL
	ALT
	INV
	REHAB

Operations	
	CLR
	FRG
	DUST
	SOIL
	INV
	REHAB

Other Ecoregions with Permafrost

Construction	
	GRA
	CLR
	TRN
	FRG
	DUST
	SOIL
	ALT
	INV
	REHAB

Operations	
	CLR
	FRG
	DUST
	SOIL
	INV
	REHAB

Ecoregions Lacking Permafrost

Construction	
	GRA
	CLR
	TRN
	FRG
	DUST
	SOIL
	ALT
	INV
	REHAB

Operations	
	CLR
	FRG
	DUST
	SOIL
	INV
	REHAB

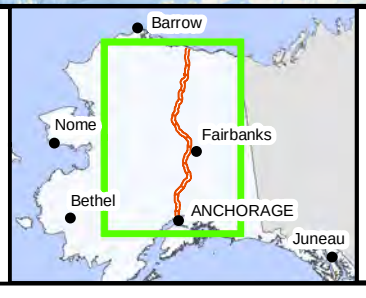
Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

ERM
825 W. 8th Ave., Anchorage, AK 99501, (907) 258-4880

DATE: MAR 2018
CHKD: K.J.
DRWN: A.V.K.
PROJ. No.: 0416166

Figure 4.9-6: WETLANDS IMPACTS CONTEXT MAP, ALTERNATIVE 2 ALASKA STAND ALONE PIPELINE

0 25 50 100 150 Miles



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4.10. Wildlife

4.10.1. Introduction

This section assesses potential impacts to terrestrial wildlife resulting from all aspects of the proposed Project construction and operations. Note that the potential proposed Project-related impacts on polar bears are addressed in Section 4.14, Threatened & Endangered Species. The three alternatives evaluated are described in detail in Chapter 2. The section describes how incomplete or unavailable information may have influenced this analysis, describes the methods for determining the level of impact to terrestrial wildlife, and presents the results of the assessment. This section also describes some of the mitigation measures that would aid in avoiding or minimizing the potential impacts. Information on proposed mitigation and monitoring is provided in Section 4.10.3 and in Appendix M.

The information used in this section builds on the 2012 FEIS (USACE, 2012a) and incorporates new data and information relevant to environmental concerns associated with the alternatives that have become available since the original 2012 FEIS document. While this assessment tiers from the 2012 FEIS, importantly, the proposed changes in route and design described for Alternative 1 are emphasized. In some instances, information from the 2012 FEIS is replicated with relatively minor changes and updates, while other material is entirely new or substantially altered. For this SEIS, the following elements have been added to the assessment of impacts to terrestrial wildlife resources:

- A new methods section (Section 4.10.2) was added to explain the procedures used to evaluate the potential impacts associated with the proposed Project and alternatives;
- Mitigation measures incorporated from the 2012 FEIS have been expanded to include recommendations from federal and state agencies (see Section 4.10.3 and Appendix M for additional detail); and
- Updates to impacts based on new alternatives and a summary of those results.
- Most Alaskan terrestrial wildlife is either protected by federal regulation or managed by the Alaska Department of Fish and Game (ADF&G). Federal regulations protecting various bird species include the Migratory Bird Treaty Act (MBTA), and the Bald and Golden Eagle Protection Act (BGEPA). See Section 3.6.2, Regulatory Setting, for a detailed discussion of the regulatory measures applicable to the wildlife discussed in this SEIS, including the MBTA, BGEPA, and other state and federal regulations or protection responsibility such as the Endangered Species Act (ESA) or sensitive species designation.

4.10.1.1. Incomplete or Unavailable Information

In compliance with CEQ guidance (see Section 4.3), this section addresses incomplete or unavailable information pertinent to analyzing impacts of the alternatives on terrestrial wildlife. Various information sources have been used to assess impacts to the terrestrial

wildlife potentially affected by the proposed Project. One of the sources used to determine wildlife species present along the pipeline route was the digital version of the ADF&G Habitat Atlas for the Arctic, Interior, Southcentral regions (ADF&G, 1985; 1986a,b,c). The ADF&G Habitat Atlas includes range data exclusively for the following species or taxa groups: caribou, moose, brown bear, polar bear, Dall sheep, geese, and ducks. While additional sources were reviewed to determine the ranges of other species or taxa, when species-specific information could not be obtained, taxa-specific information (*e.g.,* the generalization of waterfowl or raptors) is incorporated for a generalized assessment. Assessments for this SEIS are made based on the most updated and accessible documents. Incomplete or unavailable information for specific species, or in general, create uncertainty of impacts; where data are lacking, professional judgment has been applied based on knowledge and experience of the authors, contacted experts, and generally accepted scientific methods.

4.10.2. Methods

Potential impacts to wildlife were analyzed by assessing the magnitude, extent, duration and likelihood of occurrence, as presented in Table 4.10-1, Impact Criteria for Terrestrial Wildlife. Effects assessed include:

- Direct mortality during construction and operation;
- Physical habitat loss, alteration, and fragmentation;
- Biological and behavioral responses to disturbance resulting from construction and operational activities that include vehicle traffic, low-level helicopter or airplane monitoring over flights;
- Changes to distributions resulting from anthropogenic practices (food waste from construction camps);
- Increase hunting pressure resulting from changes to access;
- Introduction of non-native, invasive and parasitic species; and
- Contaminants.

Potential impacts to wildlife are based on the evaluation of the wildlife resources and habitat along the proposed Project corridor, review of available proposed Project descriptions and reports, public comments received after the publication of the 2012 FEIS and during the public scoping period for the SEIS held in 2014, and review of public comments received on the Draft SEIS during the July/August 2017 public comment period.

Various information sources were used to assess impacts to wildlife potentially affected by the proposed Project or alternatives. Wildlife ranges and habitat descriptions were obtained from a combination of sources including:

- The 2012 FEIS (USACE, 2012a);
- The ADF&G Management and Harvest Reports;
- The AKNHP at the University of Alaska, Anchorage (UAA);
- The ADF&G Habitat Atlas for the Arctic, Interior, Southcentral regions (ADF&G, 1985; 1986a,b,c); and
- Various taxa- or species-specific publications, all of which are provided in Chapter 7, Literature Cited, of this SEIS.

Qualitative and quantitative assessments for this SEIS have been made based on the most updated and accessible documents.

4.10.2.1. Description of Effects

4.10.2.1.1. Direct Mortality during Construction and Operation

Direct mortality primarily involves collisions with moving vehicles, construction equipment, or collision with windows or on structures themselves (*e.g.*, GCF or temporary housing). Vehicle strikes are common sources of direct mortality or injury to both small and large wildlife species in Alaska. Alaska's mammals and certain avian species are attracted to roads for a variety of reasons including use as a source of minerals, preferred vegetation along roadways, areas of insect relief, and ease of travel along road corridors. Collisions with structures in low light conditions, or where lights are improperly shielded, are a particular concern on the North Slope (*e.g.*, the GCF).

Collision-related mortality also includes those with stationary construction and operational objects such as survey stakes and suspension lines in low visibility conditions and power lines. Entanglement in fences or other barriers could also be a source of mortality or injury to terrestrial mammals. Direct mortality may include mortality of young during vegetation removal. Young are often not capable of moving out of the direct path of equipment and debris during clearing activities, which usually results in mortality.

4.10.2.1.2. Physical Habitat Loss, Alteration, and Fragmentation

Habitat impacts are primarily physical perturbations that result in alterations in the amount or quality of a habitat. Fragmentation is the breaking down of continuous and connected habitat, impeding access to resources and mates. The majority of Alaska is in a relatively unfragmented state. The greatest impact on fragments occurs at their boundaries; small remnants and those with complex shapes experience the strongest "edge effects". Fragmentation could have positive or negative impacts depending on the species habitat requirements (Fahrig, 2003). Resident species requiring large areas of continuous habitat lose cover from predators and the elements due to the decreased canopy density; and edge effects could increase susceptibility to nest parasitism. An increase in aboveground proposed Project features can provide new perch sites for

predators and alter the populations of prey species in the area. Vegetation removal could also increase competition for forage or nesting resources in the adjacent contiguous habitat; cause a change in diet, resulting in reduced overall fitness; or cause an increase in invasive or pioneering plant species that compete with forage species, reducing the quality of forage habitat. In contrast, species that thrive on edge habitat move into new areas created by vegetation removal.

Habitat loss, like fragmentation could be both beneficial and detrimental. Habitat loss could result from both anthropogenic and natural impacts. The effects of habitat loss on nesting birds depend on original habitat structure, landscape context, and predator communities (Tewksbury *et al.,* 1998).

Habitat alterations could impact wildlife by creating physical barriers or disruptions to movement. Barriers like an elevated pipeline and access roads could prevent wildlife from accessing an optimal habitat (*e.g.,* breeding, forage or refuge), either by physically preventing use of a habitat, or by causing an animal to avoid a habitat either temporarily or long-term (Surrendi and DeBock, 1976; Hanson, 1981). Disruption of movement and migration between calving and winter-feeding areas could lead to decreased fitness, lower productivity, mortality, and eventually population decline.

Under some specific circumstances, such as if there is loss or degradation to limited, important habitats, impacts to populations or species could increase to moderate or greater.

4.10.2.1.3. Biological and Behavioral Responses to Disturbance

Anthropogenic disturbances, such as noise and physical presence, are changes to the environmental setting as a product of man-induced actions. Effects of disturbance on wildlife could be long or short-term and depends on the individual, the context of the disturbance and the life stage of the species. Responses to disturbance include physiological, physical and behavioral. Short-term disturbance is typically more reversible than long-term.

Disturbance during critical time periods including calving, lambing or breeding season could impact productivity. Noise could be a direct disturbance to wildlife, causing species to abandon activities such as nesting, feeding, or breeding due to loud disturbances. Noise could also affect communication by masking (*i.e.,* when the perception of one sound is affected by the presence of another sound); mortality may also increase when species are unable to detect predators through hearing.

Long-term disturbance could result in sensitive animals leaving the area, changing the normal distribution and occupancy rate of an area; prolonged elevated stress and hormone levels associated with disturbance may lead to decreased fitness and productivity.

4.10.2.1.4. Changes to Distributions Resulting from Anthropogenic Practices

Many animals are attracted to food waste generated by construction camps. Increased predator loads impact resident species like ground nesting birds and ungulate calves. Bears and other wildlife species (*e.g.*, fox, squirrels, microtines, and birds) attracted to food waste could become problematic and pose a health and safety hazard.

Artificially high concentrations of disease carrying wildlife could also impact an area and become a human safety hazard. Several species are known rabies carriers and could be drawn to human camps by food waste. These species could transmit the disease to other species, including humans.

Higher concentrations of predators, like foxes, bears and ravens, could affect the abundance and productivity of ground nesting birds and caribou and moose calves in the immediate area of camps. While taking advantage of human food waste, predators consume natural food sources as well. Inflated predator populations could have significant impacts to biological productivity in the immediate area.

4.10.2.1.5. Increased Hunting Pressure

Construction and maintenance of access roads and the cleared pipeline ROW provide easier access to hunters and other recreational users. Due to the lack of experience with previous hunting pressure, game species in newly opened geographical areas are more susceptible to disturbance as well as greater mortality as a result of harvesting. However, ADF&G manages take of wildlife on a sustained yield principle. The take in any given Game Management Unit is managed based on the take of a specific number of animals and closed when the maximum take has been achieved. Hunting mortality associated with increased access from the proposed Project would be sufficiently managed by ADF&G.

Hunting could also increase wildlife collision with recreational vehicles.

4.10.2.1.6. Introduced and Invasive Species

Non-native or invasive species are typically introduced into a system by human-related activity. The introduction of invasive species could have a dramatic effect on natural resources. Alaska as a whole has been minimally affected by invasive species because of factors including isolation, localized rather than widespread development, colder climate, and restrictive species import/transport regulations. Invasive, non-native, species disrupt natural communities and ecological processes; creating competition for limited resources (*e.g.,* food, water, shelter, etc.). Invasive species may also impact native species by predation.

4.10.2.1.7. Contaminants

The proposed Project has the potential to expose terrestrial wildlife and their habitat to contaminants, including hydrocarbon or petroleum fluids leaked from equipment during construction and operation, or spills of other hydrocarbons used in construction

and operation. Bears are also attracted to all petroleum products, like gas, oil, and grease. Magnitude, time of year, and duration of a spill determines the extent to which wildlife in the proposed Project Area are affected by potential contaminants. Accidental release of hydrocarbons and contaminants in the spring, summer, and early fall all have the potential to impact breeding, nesting, and young of multiple species of terrestrial and avian wildlife in the proposed Project Area. Direct contact with oil adversely affects feather integrity, preventing proper waterproofing of feathers and may lead to hypothermia, drowning, and death of the bird. Toxic effects of oil ingestion through feeding and preening activities may also result in mortality (Burger and Fry, 1993). Mortality after exposure to surface oil is common in aquatic birds (Albers, 2003). Although not necessarily fatal, ingestion as well as inhalation (Geraci and St. Aubin, 1982) and physical contact with petroleum may lead to gastrointestinal irritation, pneumonia, dehydration, red blood cell damage, impaired osmoregulation, immune system suppression, hormonal imbalance, inhibition of reproduction, retarded growth, and abnormal parenting behavior (Burger and Fry, 1993).

Contamination of the surrounding area and aquatic feeding areas during the nesting season would limit available habitat for potential nest and feeding sites. Spills occurring while wildlife are already on nests or rearing young could result in abandonment of eggs or young.

4.10.2.2. Impact Criteria

Table 4.10-1 summarizes the criteria used to determine the level of impact based on the magnitude, extent, duration, and likelihood of occurrence. Tables 4.10-2 through 4.10-4 define the types of effects the proposed Project and its activities may have on the wildlife resources that are assessed in this SEIS. The potential effects listed in these tables also consider the implementation of the mitigation measures described in Section 4.10.3, and in Appendix M. Potential impacts that remain after mitigation measures have been implemented are described for each alternative in the following sections.

Table 4.10-1 Impact Criteria for Terrestrial Wildlife

Impact Component	Impact Level			
	Major	**Moderate**	**Minor**	**Negligible**
Magnitude or Intensity	The impact is sufficient to cause population level or entire herd level changes to productivity, growth rate, survival rate, and range.	The impact is sufficient to cause sub-population level changes to productivity, growth rate, survival rate, and range.	The proposed Project would impact a few individuals in a population, but would not affect population productivity, growth rate, survival rate, and range.	There are no perceivable impacts or the mechanism for effects on population status (*i.e.*, productivity, growth rate, survival rate and range) are indistinguishable from baseline.

Impact Component	Impact Level			
	Major	Moderate	Minor	Negligible
Geographic Extent	Impacts are statewide, or over the entire range of the species or identified herd.	Impacts are at a regional or community level, on a limited portion of the study area.	Impacts are site specific or occur within a few isolated locations.	No measurable effects.
Duration or Frequency	The effect would cause chronic and long-term changes that are likely to be permanent.	The effect would cause periodic, temporary, or short-term changes that are reversed after 1 to 3 reproductive seasons (3 years).	The effect would cause periodic, temporary, or short-term changes that are reversed over one reproductive season (1 year).	No measurable effects.
Likelihood	Most likely (Impacts that have greater than 75% chance of arising from the action)	Likely (Impacts that have a 50% to 75% chance of arising from the action)	Somewhat likely (Impacts that have a 10% to 50% chance of arising from the action)	Unlikely (Impacts that have less than 10% chance of arising from the action)

Table 4.10-2 Types of Effects and Impacts on Wildlife Resources

Type of Effect	Proposed Action Causing Potential Impact	
	Construction	Operations and Maintenance
Mortality **Direct**: Mortality **Indirect**: Disturbance, disease, invasive species, hunter access and increased predation.	• Operation of equipment and vehicles during construction. • Wildlife attracted to area as a result of food waste from camps; gravel and winter salt on roads (killed by traffic). • Stresses from presence of vehicles, and train traffic on existing roadways and tracks, aerial activity, and equipment during construction disturbs animal. • Collision with temporary housing structures. • Activities that introduce disease, invasive species and increased predation. • Increased hunter access and harvest along newly developed access roads. • New perch sites for predatory birds changing the prey populations in the area.	• Ongoing operation and maintenance of aboveground facilities from presence of vehicles and equipment. • Indirect: Activities resulting in disturbance by noise (vehicles, surface noise, aerial noise), human presence avoidance, etc. • Maintenance of the permanent access roads and ROW (*e.g.*, mowing, refreshing / grading gravel, spreading salt on roads in winter). • Increased vehicular and train traffic on roadways and tracks. • Collision with permanent structures. • ROW aerial and ground based inspections of the pipeline during operation. • Increased hunter access and harvest along maintained access roads. • New perch sites for predatory birds changing the prey populations in the area.

Type of Effect	Proposed Action Causing Potential Impact	
	Construction	Operations and Maintenance
Reproductive Effects/ Function/Health/ Resilience: • Increase fragmentation of habitat. • Displacement of wildlife from noise and human activity during construction. • Changes to predator populations may affect prey abundance, distribution, and demography. • Disease, invasive species and predation. • Disturbances and, stresses from noise and presence of vehicles, aerial activity, and equipment during construction. • Habituation or food conditioning. • Exposure to toxic substances (*i.e.,* oil or hazardous materials spills). • Diminished juvenile recruitment.	• Construction activities, material sites and access road development. • Construction camps and associated support activities and worker activities.	• Access road use and normal operations and maintenance activities. • Increased access by non-Project activities (*e.g.,* hunting or recreation). • Permanent presence of pipeline (where elevated) or aboveground facilities and roads.

4.10.3. Proposed Design Features, Mitigation Measures, Best Management Practices, and Project Management Plans

4.10.3.1. Applicant-Proposed Design Features, Mitigation Measures, Best Management Practices, and Project Management Plans

This section describes the engineering design features, mitigation measures, BMPs, and Project Management Plans developed to avoid or minimize proposed Project impacts to terrestrial wildlife. These measures and plans were taken into consideration when evaluating potential impacts on terrestrial wildlife under Alternatives 1 and 2 during the construction and operations phases.

The following design features, mitigation measures, and BMPs are proposed by AGDC, presented by construction and operation measures below. A complete list of mitigation measures and BMPs are also provided in Appendix M.

1. Avoid placing pipeline facilities in sensitive wildlife habitats to the maximum extent practicable, including nesting, calving, or rearing habitats (*i.e.*, avoiding facility placement in sensitive wetland habitat may not be avoidable on the North Slope).
    - In areas where a lease is required from SPCS/or federal grant of ROW from BLM, the proposed Pipeline would be maintained to avoid significant alteration

of big-game movement patterns. SPCS/BLM may require additional measures to mitigate impacts to big-game movement. AGDC would coordinate with USFWS regarding any activity that has the potential to disturb polar bears. Prior to starting proposed Pipeline activities, AGDC would obtain the locations of known brown bear dens from ADF&G for the purpose of avoiding both human/bear interactions and disturbance of bear dens.

- Minimize the duration of open-ditch construction activities to mitigate the risk of animal entrapment in an open ditch, and develop systems or mechanisms to facilitate escape of wildlife from the pipeline trench in the event wildlife becomes trapped.
- Avoid or minimize construction and operational activities during sensitive periods in lifecycles such as calving/lambing, denning, nesting, seasonal feeding and migration, to the maximum extent practicable.

2. Further, Zones of Restricted Activity (ZRA) exist along the ROW - In areas requiring a lease from the SPCS and federal grant of ROW from BLM, during periods of wildlife breeding, nesting, lambing, or calving activity, and during major migrations of wildlife, AGDC's activities on state and/or federal land may be restricted by SPCS/BLM with written notice. In areas where a lease is required from the SPCS or federal grant of ROW from BLM, no blasting would be done underwater or within ¼ mile of streams or lakes with identified sensitive wildlife habitat without approval.
3. Revegetate and reclaim all areas of ground disturbance as soon as possible after disturbance is complete to minimize impacts to wildlife habitat. The Revegetation Plan (Appendix E, Part I) would guide the revegetation of all areas of ground disturbance.
4. Minimize the spread or introduction of non-native invasive plants through standard measures such as cleaning and inspection of equipment, and revegetating all areas of ground disturbance as soon as possible after construction.
5. Pollution control: AGDC would perform its activities in accordance with applicable air and water quality standards and related facility siting standards and plans. In areas where a lease is required from the SPCS or a federal grant of ROW is required from BLM, mobile ground equipment would not be operated in or on lakes, streams, or rivers on state/federal land unless approved by SPCS/BLM. Refueling of excavation equipment would take place at least 100 feet from any surface waterbody. AGDC would implement a preapproved SPCC Plan, as required by 40 CFR 112 to prevent discharges of oil to waters of the U.S. AGDC would avoid known contaminated site areas described in Chapter 3 and any newly discovered contamination would be reported to ADEC in accordance with their reporting requirements and handled in a manner to avoid transport of contaminated materials.

6. Locate fueling and fuel storage at least 100 feet from streams and waterbodies. When conditions require refueling within 100 feet of waterbodies, the contractor must implement a preapproved SPCC Plan.
7. Minimize vehicle and aircraft traffic to minimize disturbances to wildlife, where possible.
8. Where requested by the landowner, public access to the ROW would be limited for recreation or hunting by blocking entry areas with large boulders, berms, or fencing.
9. Eagle and Migratory Bird Protection - AGDC will be working closely with the U.S. Fish and Wildlife Service (USFWS) to minimize impacts to migratory birds by cooperatively developing a Migratory Bird Conservation Plan, which will be developed prior to construction. Bald and golden eagles and their nests are protected under the BGEPA. AGDC would work with federal and state agencies to employ appropriate mitigation measures to avoid or minimize impacts to eagles and comply with existing regulations. Clearing and grubbing would occur in accordance with the recommended times described in the USFWS' *Timing Recommendations for Land Disturbance & Vegetation Clearing* guidance to avoid disturbance or destruction of migratory bird nests (USFWS, 2017c). AGDC would work with federal and state agencies to employ appropriate mitigation measures to avoid or minimize impacts to eagles and comply with existing regulations.
10. Avoid placement of source material sites near raptor cliff nesting habitat, or remove source material outside the breeding season when adults are not in the area. It is anticipated that individual material sites would be in the vicinity of existing transportation routes or utility corridors. The location of material sites (*e.g.*, river floodplain, upland forest, adjacency to existing infrastructure) would influence potential impacts to wildlife along the proposed Project corridor. Birds can be found nesting within or adjacent to material sites (*e.g.*, swallows, peregrine falcons, and eagles). AGDC will work with USFWS during development of the Migratory Bird Conservation Plan.
11. To minimize human-wildlife interactions, ensure construction camp operations and pipeline facility construction activities comply with measures that avoid attracting wildlife. Adopt motor vehicle and aircraft procedures that minimize disturbances to wildlife. Identify and avoid or minimize situations in which wildlife may be killed in defense of life or property.
12. Food and waste management measures include:
    - Store food waste and other associated waste in containers until transferred for disposal at an approved disposal site.
    - Strictly prohibit employees from directly feeding animals, throwing food to animals, or improperly disposing of food wastes.

- Transfer sanitary waste from bathrooms, sewage sludge, and kitchen-associated garbage on a regular basis to control attractants.
- Identify kitchen grease as spoilable waste for treatment.

13. The buried pipeline would be designed to minimize changes to the thermal stability of the surrounding soil and water, and any associated waterbodies, which would in turn protect important bird habitat.
14. Removal of some aboveground facilities - Various compressor stations, the Straddle and Offtake Facility, and the natural gas liquid extraction plant were omitted from the proposed Project, eliminating vegetation and wildlife impacts from those proposed Project-related elements.
15. Barges entering the proposed Project Area as part of the sealift would be cleaned according to federal and state protocols to mitigate the potential spread of non-native species.

4.10.3.2. Agency-Recommended Mitigation Measures

A variety of mitigation measures and best practices have been recommended by the cooperating agencies (Appendix M). Many of these recommendations have been incorporated in the proposed Project and are included in Table 4.10-3 below. The impacts discussed in this chapter are based upon the Applicant-proposed measures. These additional agency recommended measures are not included in the impact analysis.

Table 4.10-3 Wildlife Resources Agency-Recommended Mitigation Measures

Additional Measure Consideration	Agency Proposing Mitigation Measure	Agency Jurisdiction	Authority (*i.e.*, CWA, RHA, ESA)	Affected Resources	Comment Code
If clearing of vegetation occurs on BLM-managed lands within the Central Yukon Field Office during the USFWS's regional time periods for avoidance, standard BLM permit requirements necessitate a nest search within a few days prior to the clearing.	BLM	USFWS	MBTA	Wildlife	MIT_23
Include considering fish and wildlife habitat needs in all reclamation work and provide new beneficial habitat in areas where the original habitat type cannot be fully restored.	USFWS	USFWS, ADF&G	Multiple Authorities	Wildlife, Fish	MIT_14
Include BMPs to address potential impacts to migratory birds from marine vessels, including small fuel releases from leaking and wrecked vessels and the release of rats (and other non-native rodents).	USFWS	USFWS	MBTA	Wildlife	WLD_23
To minimize wildlife entanglement and plastic debris pollution, erosion and sediment control products shall be plastic-free, such as netting manufactured from 100% biodegradable, nonplastic materials like jute, sisal, or coir fiber.	USFWS	ADEC	CWA	Wildlife	MIT 15
A large number of Applicant-proposed design features, mitigation measures, BMPs, and project management plans listed in the Draft SEIS contain the language, "In areas where a lease is required from the State Pipeline Coordinator's Section" or "a federal grant of ROW is required from BLM ..." These measures generally represent a best management approach that we recommend using to the maximum extent possible along the entire pipeline route, while acknowledging the outstanding need to complete coordination with private landowners.	EPA	--	--	Numerous	MIT_35

AAC = Alaska Administrative Code
ADF&G = Alaska Department of Fish and Game
ADEC = Alaska Department of Environmental Conservation
ADNR = Alaska Department of Natural Resources
AGDC = Alaska Gasline Development Corporation
APDES = Alaska Pollution Discharge Elimination System
BLM = Bureau of Land Management
BMP = Best Management Practice
CAA = Clean Air Act
CWA = Clean Water Act
DHSS = Alaska Department of Health and Social Services
EPA = U.S. Environmental Protection Agency
MBTA = Migratory Bird Treaty Act
NMFS = National Marine Fisheries Service
RHA = Rivers and Harbors Act of 1899
SEIS = Supplemental Environmental Impact Statement
USACE = U.S. Army Corps of Engineers
USFWS = U.S. Fish and Wildlife Service

4.10.3.3. Project Management Plans

The Revegetation Plan (Appendix E, Part I) would guide revegetation of all areas of ground disturbance to minimize impacts to wildlife habitat and reduce the spread of invasive plants. AGDC would develop several additional Project Management Plans prior to construction to guide proposed Project activities during construction and operations. Two management plans required by regulation are relevant to mitigating impacts to terrestrial wildlife: the SPCP and the Blasting Control Plan. The SPCP would outline measures to specify where and how hazardous substances and wastes, such as fuel, paint, and solvents, would be stored and handled. AGDC would develop the Blasting Control Plan for blasting and use of explosives along pipeline route, specifically in areas where a lease is required from the SPCS. The plan would include blasting techniques to reduce or minimize airblast overpressures and ground-borne vibration levels associated with blasting. Several additional non-regulatory management plans would be developed to guide implementation of mitigation measures and BMPs during construction and operation. These plans have not been drafted, and therefore, are not considered mitigation measures in this analysis.

4.10.4. Alternative 1 – Proposed Action

This section discusses and rates the potential impacts of construction and operation of Alternative 1 (proposed Action) on terrestrial wildlife. Results of the impact ratings are presented in Section 4.10.7 (Table 4.10-7). Alternative 1 is described in detail in Chapter 2; the components relevant to terrestrial wildlife are summarized below.

- Realignment of the Mainline pipeline route since 2012;
- Use of DH3 at West Dock;
- HDD at the Yukon River; and
- Burial of the pipeline for the extent of the route, except at elevated bridge crossings, fault crossings, pigging facilities, and valves, described in Chapter 2.

4.10.4.1. Construction

This section describes the potential impacts to wildlife during construction, as well as mitigation measures to avoid or minimize impacts (as summarized in Section 4.10.3). Table 4.10-4 depicts the evaluation of impacts to species and habitat that potentially occur along the proposed Project ROW if mitigation measures were not employed. Critical or sensitive time periods are described for taxa groups in Table 4.10-4, and include calving or lambing, nesting, denning, rutting, migration, winter feeding, and times of concentration (*e.g.,* berry season for bears).

The proposed construction spread (*i.e.,* schedule) for the pipeline is presented in Chapter 2, Table 2.2-7 (Alternative 1: ASAP Construction Spread Plan [dated January 19, 2018]). The construction schedule provides context for understanding how wildlife may interact with proposed Project activities. The primary construction seasons include "summer"

(May 1 to October 31) and "winter" (November 1 to April 30). Table 4.10-5 presents the proposed construction spread from Chapter 2 in the context of wildlife and corresponding critical or sensitive time periods by proposed construction spread.

For reference, the three construction seasons are described as follows:

1. The "early civil work season" includes activities such as opening material sites, placing access roads, and developing camp and PSY pads.
1. The "civil ROW work season" includes clearing, grading, grubbing, and preparation of the ROW for the pipeline construction season.
2. Pipeline construction is the stringing, welding, trenching, and lowering in of the pipe, then backfilling, regrading, and hydrostatic testing of the pipeline. The Mainline pipeline construction starts as early as summer.

In some cases, the civil ROW season would need to happen simultaneously with pipeline construction season, for instance when ice pads are use. In other cases, the civil ROW work can happen a season or two before Mainline pipeline construction. The seasons and years in which construction activities are listed in Table 4.10-5 are projections, but are subject to a variety of changing conditions and limitations that may force the proposed Project to adjust.

While Table 4.10-5 lists the construction season for certain spreads as occurring throughout the year, as mentioned in Section 4.10.3, AGDC would work to avoid or minimize construction and operational activities during these sensitive periods (see Mitigation Measure No. 1). Note that the pipeline crosses habitat designated by the ADF&G Habitat Atlas (ADF&G 1985; 1986a,b,c) as "general distribution" for several species (*e.g.,* brown bears, moose, and caribou). Therefore, recognizing that the pipeline crosses general habitat for several terrestrial mammals, only species and habitat associated with the critical or sensitive time periods are listed in Table 4.10-5.

Table 4.10-5 also presents the location and proposed construction timeframes for the crossing of areas of special designation, specifically: 1) BLM Areas of Critical Environmental Concern (ACEC); 2) ZRAs; and 3) Important Bird Area (IBA). Each of these specially designated areas were created to protect wildlife during sensitive time periods. The ACECs crossed were designated by BLM in part to protect Dall sheep lambing habitat and mineral licks, or raptor nesting habitat. ZRAs were established as part of permitting of TAPS and restricts activities during all fish and falcon breeding, nesting, spawning, and migration periods. IBAs are designated by Audubon to recognize places or habitats that either support a large concentration of birds, provide habitat for a threatened or rare species, or provide habitat for a bird with a very limited or restricted range. The impacts of construction on these specially designated areas, as well as other non-designated areas along the pipeline corridor are discussed in additional detail in Section 4.10.4.1.4, Pipeline Right-of-Way Mainline.

Migratory birds could be injured or die from collisions with the proposed Project facilities, equipment, or vessels, especially those that have lighting. When visibility is

impaired during inclement weather or darkness, birds are particularly at risk of collision with objects in their path (Weir, 1976). The risk of bird collision is largely determined by the timing and location of construction activities in relation to the presence of migratory birds in the proposed Project Area and the Beaufort Sea. Any required construction-related lighting (typically high mast lighting) would be installed at the start of construction and operate as required to maintain a safe working area. To avoid or reduce lighting effects during construction, localized task lighting would be used when possible. Light towers would be adjustable so that the height and direction could be altered for site-specific situations. Work-task lighting would be directed and shielded to illuminate the work areas while meeting minimum safety requirements, and to avoid/prevent excess lighting from extending outside the working footprint, including over and within water work areas. Light fixtures would be provided with diffusers, lenses, and shields so as to reduce glare and light radiation, including backscatter into the sky, as is practicable.

Summer construction associated with vegetation removal could disturb and impact the habitat of all terrestrial wildlife. Vegetation clearing and grading necessary for proposed pipeline construction and placement would result in removal of both upland and wetland forested, shrub, and emergent habitats. Permanent habitat alteration would leave habitat unsuitable for some wildlife. Revegetation of all temporarily disturbed areas would follow the proposed Project's Revegetation Plan (Appendix E, Part I). Mitigation Measure Nos. 3 and 9 would also help to reduce impacts to wildlife and wildlife habitat associated with vegetation clearing. Impacts to wildlife during construction associated with proposed Project-specific features are presented in the sections below.

Table 4.10-4 Construction - Evaluation of Potential Impacts to Species and Habitat

Common Taxa	Potential Impacts
Mammals	
Large Game Animals (Caribou, Moose, Sheep, Muskox)	Construction mortality, habitat loss, and alteration. Disturbance during critical or sensitive time events including calving or lambing seasons; avoidance of traditional feeding areas, mineral licks or disruption of migratory pathways resulting from disturbance. Increased mortality resulting from hunter access and changes of predator distributions. Habitat alteration resulting from introduction of invasive species.
Predators (Bear, Wolves)	Construction mortality, habitat loss, and alteration. Disturbance during critical or sensitive time events including denning season; disruption to range boundaries and avoidance of portions of range resulting from disturbance. Attraction to campsites, food waste, and petroleum products that could result in harassment or mortality as a result of defense of life and property. Increased mortality resulting from hunter access.

Common Taxa	Potential Impacts
Small Game Animals (Furbearers)	Construction mortality, habitat loss, and alteration. Disturbance during critical or sensitive time events including denning season. Attraction to campsites and food waste that result in hazing or lethal take. Increased mortality resulting from trapper access. Habitat alteration resulting from introduction of invasive species. Mortality or habitat loss to contamination. New perch sites for predatory birds changing the prey populations in the area.
Small Non-game Animals (Microtus)	Construction mortality, habitat loss, and alteration. Disturbance during critical or sensitive time events including denning season. Habitat alteration resulting from introduction of invasive species. Mortality or habitat loss due to contamination. New perch sites for predatory birds changing the prey populations in the area.
Birds	
Songbirds (Sparrows, Warblers, Finches and other Passerines)	Construction or collision mortality. Nesting habitat loss, disturbance to nest sites. Fire suppression, direct or indirect (through food web) exposure to contaminants. Habitat alteration resulting from introduction of invasive species. Mortality or habitat loss to contamination. Loss of cover habitat and mortality resulting from increased predation and less available shelter habitat. New perch sites for predatory birds changing the prey populations in the area.
Raptors (Eagles, Hawks, Osprey, Falcons and Owls)	Construction or collision mortality. Nesting habitat loss, disturbance to nest sites, reduced prey availability resulting from habitat loss and alteration and / or avoidance. Habitat alteration resulting from introduction of invasive species. Mortality or habitat loss due to contamination. Loss of cover habitat and mortality resulting from increased predation and less available shelter habitat.
Shorebirds (Plovers, Sandpipers, Phalaropes and Others)	Construction or collision mortality. Nesting, foraging and migration staging habitat loss, disturbance to nest sites. Habitat alteration resulting from introduction of invasive species. Mortality or habitat loss due to contamination. Loss of cover habitat and mortality resulting from increased predation and less available shelter habitat. New perch sites for predatory birds changing the prey populations in the area.
Waterfowl and Loons (Ducks, Swans and Loons)	Construction or collision mortality. Disturbance to nest sites, foraging or staging habitats, reduced habitat suitability due to altered water quality. Habitat alteration resulting from introduction of invasive species. Loss of cover habitat and mortality resulting from increased predation and less available shelter habitat. New perch sites for predatory birds changing the prey populations in the area.
Cranes	Construction or collision mortality. Nesting, foraging and migration staging habitat loss, disturbance to nest sites. Habitat alteration resulting from introduction of invasive species. Mortality or habitat loss due to contamination. Loss of cover habitat and mortality resulting from increased predation and less available shelter habitat.
Upland Birds (Ptarmigan and Grouse)	Construction or collision mortality. Nesting, foraging and migration staging habitat loss, disturbance to nest sites. Increased mortality resulting from hunter access and changes of predator distributions. Habitat alteration resulting from introduction of invasive species. Mortality or habitat loss due to contamination. Loss of cover habitat and mortality resulting from increased predation and less available shelter habitat. New perch sites for predatory birds changing the prey populations in the area.

Common Taxa	Potential Impacts
Seabirds (Gulls, Terns, Alcids)	Construction or collision mortality. Nesting habitat loss. Disturbance to nest sites and foraging habitats; reduced habitat suitability due to altered foraging quality. Habitat alteration resulting from introduction of invasive species. Loss of cover habitat and mortality resulting from increased predation and less available shelter habitat. New perch sites for predatory birds changing the prey populations in the area.

Table 4.10-5 Proposed Construction Seasons and Sensitive Locations and Periods for Wildlife

Spread[a]	Section[a]	Est. Milepost	Taxa/ZRA/ACEC/IBA	Description and Mileage	Proposed Construction Season[a]		
					Early Civil	Civil ROW	Pipeline
1	1AB	GCF; 0 to 62	Waterfowl	Nesting habitat in spring (GCF; 0-32)	May 1 – Oct 31	Nov 1 – April 30	Nov 1 – April 30
			Franklin Bluffs Peregrine Falcon ZRA	Nesting habitat (19-41)			
			Bear denning - Franklin Bluffs	Bear denning[c]			
			Caribou	Calving in spring/early summer (GCF; 0-33)			
				Feeding in winter (0-57)			
	1C	62 to 113	Waterfowl	Nesting habitat in spring (57-63)	May 1 – Oct 31	Year-round	Year-round
				Staging in spring and fall (75-84)			
			Caribou	Feeding in winter (57-113)			
			Sagwon Bluffs Peregrine Falcon ZRA	Nesting habitat (62-66 and 64-74)			
			Moose	Feeding in winter (68-118)			
	1D	113 to 161	Caribou	Feeding in winter (113-161)	May 1 – Oct 31	Year-round	May 1 – Oct 31
				Migration route – North/South, crosses pipeline route (115-125) and parallel to pipeline route (146-161)			
			Slope Mountain Peregrine Falcon ZRA	Nesting habitat in spring and summer (118-121)			
			Dall Sheep	Mineral lick area (122)			
			Waterfowl	Migration route – North/South, crosses pipeline route (124-126 and 150-161)			
			Galbraith Lake ACEC	Sensitive lambing areas and mineral licks for Dall sheep (143-152)			
			Atigun Pass	Nesting raptors (147-161)			
	1EF	161 to 185	Caribou	Feeding in winter (161-175 and 175-185)	May 1 – Oct 31	Year-round	May 1 – Oct 31
				Migration route – North/South, parallel to pipeline route (161-170 and 175-185)			
			Waterfowl	Migration route – North/South, crosses pipeline route (161-165)			
			Dall Sheep	Feeding in winter (155-175)			
				Mineral lick area (184)			

Spread[a]	Section[a]	Est. Milepost	Taxa/ZRA/ACEC/IBA	Description and Mileage	Proposed Construction Season[a]		
					Early Civil Work Season	Civil ROW Construction Season	Pipeline Construction Season
Main Line[b]							
			West Fork Atigun ACEC	Dall sheep lambing habitat and mineral licks (163-170)			
			Atigun Pass	Nesting raptors (161-176)			
2	2A	185 to 241	Waterfowl	Nesting habitat in spring	May 1 – Oct 31	Year-round	May 1 – Oct 31
			Caribou	Migration route – North, parallel to pipeline route (185-190)			
				Feeding in winter (185-241)			
			Brown Bear	Spring feeding and berry area (190-241 and 230-241)			
			Snowden Mountain ACEC	Dall sheep habitat and mineral lick area (197-207)			
			Nugget Creek ACEC	Dall sheep lambing habitat and mineral licks (223-228)			
			Poss Mountain ACEC	Dall sheep habitat and mineral lick area (224-226)			
	2B	241 to 285	Brown Bear	Spring feeding and berry area (241-257)	May 1 – Oct 31	Year-round	May 1 – Oct 31
			Caribou	Feeding in winter (241-285)			
			Brown Bear	Spring feeding and berry area (241-226)			
			Jim River ACEC	Raptor habitat (265-285)			
	2C	285 to 334	Caribou	Feeding in winter (285-314)	May 1 – Oct 31	Year-round	May 1 – Oct 31
			Jim River ACEC	Raptor habitat (285-288)			
			Moose	Feeding in winter (302-306)			
	2D	334 to 360	Yukon River Peregrine Falcon ZRA	Nesting habitat for falcons and other raptors (358-360)	May 1 – Oct 31	Year-round	May 1 – Oct 31
			Moose	Known Concentration Area			
3	3A	360 to 406	Yukon River Peregrine Falcon ZRA	Nesting habitat for falcons and other raptors (360-362)	May 1 – Oct 31	Year-round	May 1 – Oct 31
			Moose	Feeding in winter (360-390 and 396-406)			
			Waterfowl	Migration route – East/West, crosses pipeline route (400-405)			
	3B	406 to 448	Moose	Feeding in winter (406-409, 412-426 and 430-448)	May 1 – Oct 31	Nov 1 – April 30	Nov 1 – April 30
				Calving in spring (412-426, 430-442 and 445-448)			

Spread[a]	Section[a]	Est. Milepost	Taxa/ZRA/ACEC/IBA	Description and Mileage	Proposed Construction Season[a]		
					Early Civil Work Season	Civil ROW Construction Season	Pipeline Construction Season
Main Line[b]							
			Minto Flats State Game Refuge	Waterfowl production and migration staging; abundant moose, black bear, and furbearers (418-448)			
			Waterfowl	Nesting habitat (417-425, 430-434 and 438-441)			
				Staging spring and fall (446-447)			
	3C	448 to 489	Minto Flats State Game Refuge	Waterfowl production and migration staging; abundant moose, black bear, and furbearers (448-455)	May 1 – Oct 31	Nov 1 – April 30	Nov 1 – April 30
			Moose	Feeding in winter (448-471 and 475-489)			
				Calving in spring (448-471 and 475-489)			
	3D	489 to 530	Moose	Calving in spring (489-496 and 522-530)	May 1 – Oct 31	Year-round	May 1–Nov 30
				Feeding in winter (489-500 and 514-530)			
				Rut (breeding) in fall (496-500 and 514-522)			
			Caribou	Feeding in winter (493-530)			
				Migration route – East/West, crosses pipeline route (515)			
			Waterfowl	Migration route – North/South, parallel to pipeline route (501-530)			
	3E	530 to 535	Waterfowl	Migration route – North/South, parallel to pipeline route (530-532)	May 1 – Oct 31	Year-round	May 1–Nov 30
			Moose	Feeding in winter (530-535)			
				Calving in spring (530-535)			
			Alaska Range Foothills IBA	Golden eagle and other raptor nesting area (531-535)			
			Caribou	Known Distribution Area			
			Brown Bear	Known Spring Concentration Area			
	3F	535 to 542	Moose	Feeding in winter (535-542)	May 1 – Oct 31	Year-round	May 1–Nov 30
				Calving in spring (535-542)			
			Alaska Range Foothills IBA	Golden eagle and other raptor nesting area (535-542)			
			Brown Bear	Feeding in spring (535-540)			
			Wolf[d]	Denning and rendezvous habitat			
4	4A	542 to 605	Moose	Feeding in winter (542-559, 590 -597 and 602-605)	May 1 – Oct 31	May 1 – Oct 31	May 1 – Oct 31

Spread[a]	Section[a]	Est. Milepost	Taxa/ZRA/ACEC/IBA	Description and Mileage	Proposed Construction Season[a]		
					Early Civil Work Season	Civil ROW Construction Season	Pipeline Construction Season
Main Line[b]							
				Calving in spring (542-559)			
				Rut (breeding) in fall (602-605)			
			Alaska Range Foothills IBA	Golden eagle and other raptor nesting area (542-554)			
	4B	605 to 675	Moose	Feeding in winter (605-635 and 660-675)	Year-round	N/A	May 1 – Oct 31
				Rut (breeding) in fall (605-635)			
			Caribou	Calving in spring/early summer (674-675)			
			Kahiltna Flats – Petersville	Trumpeter Swan and Tule greater white-fronted geese (650-659)			
			Road IBA				
	4CD	675 to 733	Moose	Feeding in winter (675-718 and 724-736)	May 1 – Oct 31	N/A	Nov 1 – April 30
				Calving in spring (675-709, 713-716 and 718-724)			
			Waterfowl	Staging in fall (migration) (723-733)			
			Susitna Flats IBA	Spring and fall migrant ducks, geese, swans, and sandhill cranes (732-733)			
Fairbanks Lateral	1	0 to 30	Moose	Calving in spring (0-30)	May 1 – Oct 31		
				Feeding in winter (0-30)			

Source: Alyeska Pipeline Services Company (APSC), 2002; EA_119, Second Edition, May 2002; Audubon Alaska, 2008; TAPS Owners, Volume 1, 2001
a ASAP Construction Spread Plan dated January 19, 2018
b ADF&G Habitat Atlas (1:1,000,000 scale) Arctic, Interior, Southcentral (ADF&G 1985; 1986a,b,c)
c ADF&G, 2013
d Potential wolf denning habitat occurs throughout the entire proposed pipeline corridor, although specific denning sites were not identified for this SEIS. Wolf denning and rendezvous habitat was identified for the spread adjacent to Denali NPP, by Denali NPP staff.

4.10.4.1.1. Gas Conditioning Facility

Construction of the GCF would result in the permanent conversion of 90.6 acres of wetland/water habitat for the facility pad and workspace, and an additional 20.2 acres for the GCF work camp. Approximately 800 workers could be housed in the GCF construction camp in Prudhoe Bay. The proposed Project would need approximately 130 employees or contractors for the GCF during a 3.5-year period. The increase in human activity in the area would likely result in disturbance due to noise and presence of humans. Equipment staging prior to construction and post-construction grading during the summer would likely displace some wildlife from this area and potentially delay wildlife movements through the area around the GCF. Gravel placement for the GCF would occur exclusively during winter construction.

Construction lighting at the GCF could cause a structure collision hazard for birds. Construction lighting for the GCF would be installed at the start of construction and operate as required to maintain a safe working area. Temporary lighting would also be necessary to facilitate construction activities at times when natural light levels are insufficient. To avoid or reduce lighting effects during construction, localized task lighting would be used when possible.

Construction of the GCF would provide new perching sites for predatory birds. An increase in predator activity would alter predator-prey population cycles.

While the impacts to vegetation and soils would be permanent, the disturbance from noise and presence of humans would be temporary, but longer-term as it would last more than 3 years. This area is already used for industrial activity throughout the year and some wildlife species may already tolerate a certain level of human disturbance. Disturbance from noise or human presence could cause behavioral or physiological changes in wildlife, such as avoidance or stress response, but the likelihood that this type of effect could result in negative impacts on reproduction is unlikely. Mitigation Measure Nos. 1 through 3, 7, 9 through 12, and 14 are intended to reduce the impacts of human presence on wildlife in the proposed Project Area. Even if an individual animal or a small group of animals was affected such that reproduction was not successful for 1 or 3 years, the likelihood of a population level effect resulting from the proposed construction activities is low. Therefore, impacts to wildlife associated with GCF construction are expected to be minor given that while the activities may last more than a 3.5-year period, the magnitude of the effects (*i.e.,* behavioral changes) would likely be temporary.

4.10.4.1.2. West Dock Head 3 and Causeway Upgrades

The West Dock causeway would require widening and infrastructure modifications as described in Chapter 2. Activities would occur up to 1 year in advance of the sealift to prepare DH3 and the West Dock causeway to allow for module movement, as well as pile-driving and infrastructure improvements.

Improvements to West Dock would begin during the winter pre-construction season before the sealift arrival and would continue into the first summer season, through the following winter (dredging the navigation channel and turning basin), and be completed the next summer with sealift construction.

Barges would require a minimum water depth of 8.5 feet. Therefore, under Alternative 1, there would be a minimum winter dredge depth of -9 feet, and screeding may also be necessary because of the potential for the channel to be infilled by late summer (Niedoroda *et al.,* 1980). The proposed dredging and screeding are intended to maintain adequate depth for safe barge movement and to avoid the need for summer maintenance dredging.

Under Alternative 1, impacts from upgrades and proposed activities to DH3 and the causeway would primarily consist of disturbance due to human (*i.e.,* vessel) presence and be short-term, lasting only one winter. There is currently no undisturbed terrestrial habitat in this area. Wildlife may completely avoid the area or become habituated to localized activity. Assuming the areas are cleared for any nesting and bear activity prior to construction, impacts to terrestrial wildlife from proposed Project activities would likely be minor.

4.10.4.1.3. Yukon River Crossing

Alternative 1 includes a crossing at the Yukon River using HDD, as described in Chapter 2, Section 2.2.10. One-acre entry and exit boxes are proposed for each side of the river located within the construction ROW of the proposed line. An additional approximately 39.8-acre temporary construction work pad would be required for the HDD crossing of the Yukon River; of which, 2.7 acres is wetland habitat and the remainder is upland habitat. In winter, glycol or other antifreeze additives would not be required because of ongoing circulation of fluids in the bellhole resulting from the ongoing drilling activity. There is potential for wildlife to be exposed to small spills, such as fuels or oils from equipment, but given the spill management procedures proposed in Section 4.10.3 and Appendix M, the likelihood of a spill is considered low. Mitigation Measure Nos. 5 and 6 would also reduce the chance of exposure of wildlife to hazardous materials.

As with other construction, human presence and noise associated with construction of the HDD crossing at the Yukon River could cause changes including, but not limited to, stress response (*i.e.*, physiological changes), avoidance, or even attraction to the activity (*i.e.,* bears). However, the temporary nature of the construction of the crossing is likely to minimize exposure of animals to the disturbance, and would not likely cause impacts to reproduction given it would be short-term. While the work pads needed to complete this activity may cause some loss of vegetation, the impacts on habitat are expected to be minor. Overall, impacts on wildlife associated with HDD construction at the Yukon River is expected to be minor.

4.10.4.1.4. Pipeline Right-of-Way Mainline

This section discusses the impacts along the Mainline pipeline ROW, including access roads, marshalling yards (Seward and Fairbanks), and PSYs. The primary impacts to wildlife from construction of the Mainline ROW would be altered habitat (permanent or temporary), and disturbance from noise during critical reproductive periods. Other impacts would include increased direct mortality from vegetation removal and vehicle and train collisions with wildlife resulting from proposed Project-related construction. All of the mitigation measures listed in Section 4.10.3 would help to reduce impacts to wildlife and wildlife habitat along the proposed pipeline ROW.

Construction of the pipeline corridor and permanent access roads is proposed to occur over a 2.5-year period and would result in disturbance impacts to wildlife from associated noise and activity. Pipeline construction (including trenching) on the ACP (MP 0 to MP 62) is planned for winter construction. Specific sensitive periods for wildlife species and locations along the proposed route where these sensitive periods may occur are presented in Table 4.10-5. Species and sensitive periods evaluated include Dall sheep (mineral licks and lambing), raptors and waterfowl (nesting), brown bear (denning), moose (calving) and caribou (calving areas). Sources for the locations of these sensitive activities along the proposed route include the digitized version of the ADF&G Habitat Atlas (ADF&G, 1985; 1986a,b,c) and state and federal survey data (ADF&G, 2013). Potential wolf denning habitat occurs throughout the entire proposed pipeline corridor, although specific denning sites were not identified for this SEIS (given that wolves are considered abundant in the state and are highly adaptable to human activity [ADF&G, 2008b]).

Disturbance from construction activities could displace some wildlife, especially during sensitive breeding, denning, calving, and migration periods and from mineral lick sites. While construction activities are proposed to occur during both the summer and winter seasons as shown in Table 4.10-5, construction during specific sensitive timeframes (*e.g.*, nesting, denning, calving, and other sensitive periods) would be avoided when possible (as stated in Mitigation Measure No. 1).

Lighting due to pipeline construction could cause a structure collision hazard for birds. Work-task lighting would be directed and shielded to illuminate the work areas and meet safety requirements, as well as to avoid or prevent excess lighting from spilling outside the immediate working footprint. Only limited, discrete portions of the pipeline construction ROW would need to be lit at any one point in time, reducing the impact of lighting on birds. Under some specific circumstances, such as poor placement or design of aerial/elevated lines or towers resulting in a significant continuous collision hazard, impacts to populations or species could increase to moderate or greater.

Construction equipment staged along the pipeline ROW, buildings at work pads and camps, and aboveground portions of the pipeline would provide new perching sites for predatory birds. An increase in predator activity would alter predator-prey population cycles.

Additionally, the ROW corridor and access roads would open a travel corridor that could facilitate hunter access during construction and alter wildlife movements in newly cleared forest areas. This could lead to increased wildlife disturbance with the potential additive component of direct wildlife mortality from vehicle-animal collisions and legal and illegal harvest of wildlife. These new access corridors may increase indirect mortality through reduced reproduction resulting from avoidance of critical habitats, increased stress, and increased predation. All-terrain vehicle users would possibly utilize portions of the ROW, either legally or illegally. Certain areas are already closed to motorized use off existing highways, such as within the Dalton Highway Corridor Management Area. Additionally, the construction of new roads, upgrades to existing roads, and the subsequent use of those roads would generally result in negative impacts to a wide range of wildlife (Hinkle *et al.*, 2002; Jalkotzy, Ross, and Nasserden, 1997; TAPS Owners, 2001). Where requested by the landowner, public access to the ROW for recreation or hunting would be limited by blocking entry areas with large boulders, berms, or fencing (Mitigation Measure No. 8).

The impacts to wildlife from increased access include:

- Increases of direct mortality from collisions;
- Indirect mortality and reproductive effects from increased fragmentation of habitat;
- Displacement of wildlife from noise and human activity;
- Changes to wildlife movement in and adjacent to the cleared ROW;
- Changes to predator populations may affect prey abundance, distribution, and demography; and
- Stresses related to noise and the presence of vehicles, aerial activity, and equipment during construction.

4.10.4.1.4.1. Caribou

Caribou found throughout the ACP occur in the highest numbers during the summer near the coast when calving occurs. Development of the proposed Project is projected during both summer and winter months (see Table 4.10-4 above). Consultation and coordination with state and federal regulatory agencies would help guide the construction phases such that critical periods for breeding or calving are minimized. Construction activity may displace caribou migration during the winter near the proposed ROW. Proposed Project-related heavy equipment noise, activity, and pipe stringing may also cause caribou to divert from their path of travel, affecting subsistence resources for ACP residents (*e.g.,* Nuiqsut). To reduce impacts, AGDC would avoid construction in areas and during time periods that caribou are known to migrate (see Section 4.20, Subsistence).

Construction impacts to caribou are considered minor, as construction would cause periodic, temporary, or short-term changes to individuals or groups, which are reversed

over one reproductive season (1 year). Any disturbance would be short-term (during the construction phase in any given section of the route) and would not result in any population-level effects and geographic extent of activities would be localized.

4.10.4.1.4.2. Bear and Wolf Denning Habitat

Bears seek out remote, isolated areas and sites that accumulate enough snow to insulate them from cold winter temperatures (Reynolds *et al.*, 1974). Brown bear denning habitat has been identified in various areas. On the North Slope, denning habitat consists of small-scale elevated areas where the permafrost has thawed enough to allow the soil to dry several meters deep. Research suggests that preferred denning habitat is a combination of physical landscape features and the effects of snow and wind processes. Suitable habitat includes streambanks and riverbanks, sand dunes, pingos, and certain terrain breaks on low rolling hills where snow accumulates into drifts early in the winter providing insulation and protection. Bears can easily excavate their dens in these sandy soils in the fall; south-southwest facing openings, downwind from the prevailing north-northeast winds, accumulate snow drifts quicker and retain them longer (Shideler and Woodford, 2015). Franklin Bluffs has been identified a denning area (ADF&G, 2013). Elsewhere in the state, where available, natural cavities and caves located in mountainous areas with steep slopes and stable snowpack are utilized annually (Linnell *et al.*, 2000). ADF&G (2013) identified a general area from the Ray Mountains to the Kanuti River as denning habitat.

Wolf denning habitat exists throughout the proposed pipeline corridor, although specific den sites in the ROW are unknown. Denali NPP staff has indicated that there is potential for wolf denning and rendezvous habitat near MP 535 through 542. Sensitive periods for wolves include breeding (February to March) and denning (May to June) (ADF&G, 2008b).

The impacts to bear and wolves are considered minor, as construction would cause periodic, temporary, or short-term changes that are reversed over one reproductive season (1 year). Any disturbance would be short-term and not result in any population-level effects and geographic extent of activities would be localized. The proposed construction is unlikely to have population-level effects on bears and wolves.

4.10.4.1.4.3. Raptor Nest Habitat

Raptor species, including the golden eagle and peregrine falcon, primarily nest on isolated cliff habitat. Characteristics include open views, eyrie ledges that provide a moderate degree of overhang protection and that are inaccessible to ground predators. Franklin and Sagwon bluffs (ZRAs), Slope Mountain, and Yukon River areas have been identified as important raptor nesting areas (*e.g.*, peregrine falcon) between mid-April and early September. It is possible that there are concentrations of raptor nesting sites in these areas. Similar habitats throughout the Brooks Range include the Table, Snowden, Wiehl, Sukakpak, Kathabuk, Cathedral, Twelvemile Mountain areas; Smith Creek and Midnight Dome areas; the middle fork of the Koyukuk River south of Twelvemile

Mountain; and a section of the south fork Koyukuk River in which the proposed line crosses have also been identified as raptor nesting habitat. The ridges selected as a material source site at MP 280 just south of the Jim River, MP 299-300, MP 301 and west of MP 303 have been identified as raptor habitat areas. The ridges south of Olsons Lake (MP 312-315) again have been delineated as raptor nesting areas. Use of these nesting and habitat areas during critical time periods (*i.e.*, nesting) could impact regional productivity in the Brooks Range, resulting in violation of the MBTA, as well as the BGEPA.

Clearing of vegetation prior to pipeline installation would occur during agency-recommended time periods and outside of times for sensitive nesting activities. AGDC would comply with federal law regarding potential construction impacts to birds including the MBTA, as well as applications for other authorizations, such as permits for take. AGDC would continue to coordinate with USFWS regarding these issues leading up to the proposed construction. As such, the impacts to nesting raptors are considered minor, as construction would cause periodic, temporary, or short-term changes that are reversed over one reproductive season (1 year). Any disturbance would be short-term and is unlikely to have population-level effects on any species under consideration.

Bald eagles typically nest in large old trees, with a clear view and in close proximity to water sources (lakes and rivers) where a stable food base (primarily fish) is available (Hensel and Troyer, 1964; Robards and King, 1966; Lehman, 1978). This habitat has been identified along the proposed route in Minto Flats and along the Nenana, Chulitna, and Susitna rivers (Kessel *et al.*, 1982; Parker, 1988; Ritchie and Ambrose, 1996). Disturbance from construction activities in these areas during critical time periods (*i.e.*, nesting) could impact productivity in Minto Flats, resulting in violation of the MBTA as well as the BGEPA. The impacts to nesting eagles are considered minor, as construction would cause periodic, temporary, or short-term changes that are reversed over one reproductive season (1 year). Any disturbance would be short-term and is unlikely to have population-level effects on any species under consideration. Again, this is because all construction activities would be expected to occur outside critical time periods including nesting, and geographic extent of activities would be localized. Mitigation Measure Nos. 9 and 10 would also help to reduce impacts to raptors.

4.10.4.1.4.4. Dall Sheep Lambing Habitat and Mineral Licks

The proposed construction route may occur near habitats of concern for Dall sheep lambing or mineral lick areas. Construction activities would take place during the summer and winter primarily, outside lambing periods, thereby avoiding disturbance to lambs and ewes. The construction schedule proposed for the summer through the West Fork Atigun ACEC may be located near important Dall sheep lambing areas and mineral licks. Multiple mineral licks have been identified along the Oksrukuyik and Atigun rivers on the north side of the divide in the Brooks Range. Additional mineral licks are delineated south of the divide in close proximity to the proposed pipeline route, ending roughly at Nugget Creek (MP 221). Summerfield (1974) reported lambing and

mineral lick areas in the Atigun River valley are used primarily in late May through late June, but can vary from year-to-year.

The impacts to Dall sheep are considered minor, as construction would cause periodic, temporary, or short-term changes that are reversed over one reproductive season (1 year). Any disturbance would be short-term and is unlikely to have population-level effects on any species under consideration. AGDC would make efforts to minimize or avoid construction activities during critical time periods, including lambing, and geographic extent of activities would be localized.

4.10.4.1.4.5. Moose Calving and Summer Foraging Habitat

Moose are found throughout the proposed Project Area; however, calving and summer feeding areas are the habitats of concern. Important calving areas have been delineated in the general confluence of the middle and south forks of the Koyukuk River (ADF&G, 2013). Rutting season is also an important time period; the proposed construction activity would be scheduled to occur during moose rut periods in some sections. Some summer construction activities along the proposed Project route have the potential to impact summer moose feeding areas. North of the Brooks Range, moose are known to concentrate along riparian areas during the winter; drainages include the Ivishak, Lupine, Accomplishment, Oksrukuyik, Toolik, and Upper Sagavanirktok (Atigun) watersheds (ADF&G, 2013). In addition, intermittent blasting along the proposed Project ROW could result in temporary disturbance to moose.

Overall, the impacts to moose are considered minor, as construction would cause periodic, temporary, or short-term changes that are reversed over one reproductive season (1 year). Any disturbance would be short-term and is unlikely to have population-level effects on any species under consideration.

4.10.4.1.4.6. Waterfowl Habitat

Concentrations of waterfowl breeding areas are found along the proposed pipeline route. Sensitive species like swans often avoid waterbodies associated with high levels of disturbance. Responses to nest disturbance depends on the type of activity, and has been documented for trumpeter swans (Banko, 1960; Hansen *et al.*, 1971; Page, 1976; Shea, 1979; Bangs *et al.*, 1982); human presence near nests elicit the highest responses and may result in abandonment (Shea, 1979; Henson and Grant, 1991). Concentrations of nesting trumpeter swans and waterfowl are found in the Minto, Kahiltna, and Susitna Flats. Other waterfowl concentration areas have also been identified on the ACP. Disturbance from construction activities in these areas during critical time periods (*e.g.*, nesting or migration) could impact productivity, resulting in violation of the MBTA.

Clearing of vegetation prior to pipeline installation would occur during agency-recommended time periods and outside of times for sensitive nesting activities. Gravel placement on the North Slope would occur outside of nesting and breeding bird season, as construction is scheduled during winter months. For all areas along the ROW, to the

extent practicable, gravel placement would also occur outside of nesting and breeding bird season. AGDC would comply with federal law regarding potential construction impacts to waterfowl including the MBTA, as well as applications for other authorizations, such as permits for take. AGDC would continue to coordinate with USFWS regarding these issues leading up to construction.

USFWS has expressed concern about construction of the buried pipeline in thaw unstable permafrost located within the continuous permafrost areas of the Project footprint that could disrupt surfacewater, hydrology, wetland plant species composition, and the habitats associated with such features. Impacts to wetlands and waters, and associated hydrology due to construction of the buried pipeline and associated fill, could be temporary (during construction) or permanent (if permafrost and hydrology is significantly altered). While some thermokarsting is expected, the proposed mitigation measures and construction BMPs (see Section 4.10.3 and Appendix M) would be expected to minimize any permanent hydrologic alterations that would negatively impact wetland and water habitat for birds (also see the discussion of design measures to minimize changes to thermal stability in Section 4.10.4.1.4, Pipeline Right-of-Way Mainline).

After accounting for all proposed engineering designs, mitigation measures, and BMPs, the impacts to waterfowl are considered moderate, as construction could potentially disturb waterfowl nesting and migration in critical areas during active construction. However, the proposed construction is unlikely to have population-level effects on any species under consideration. Construction plans of the Mainline would be coordinated with both state and federal agencies to mitigate for disturbance.

4.10.4.1.4.7. Other Birds

Most birds in Alaska are protected by the MBTA, in which the take of any eggs, chicks, or adults would result in a violation of the MBTA. All considerations would be taken into account to prevent disturbance to migratory breeding birds during the construction of the ROW to avoid violation of the MBTA. Nesting areas would be avoided during sensitive time periods to the extent most practicable to prevent disturbance from the proposed Project. It may not be practicable to avoid nesting areas during sensitive time periods if construction could not occur during the planned time period due to weather, freeze thaw conditions, or other unforeseen circumstances that require construction to occur outside of the planned time period. AGDC would work with USFWS to mitigate any potential impacts caused by construction during the alternate period. Clearing of vegetation prior to pipeline installation would occur during agency-recommended time periods and outside of times for sensitive nesting activities. Gravel placement on the North Slope would occur outside of nesting and breeding bird season, as construction is scheduled during winter months. For all areas along the ROW, to the extent practicable, gravel placement would also occur outside of the nesting and breeding bird season.

Construction of the pipeline corridor and permanent access roads would result in the disturbance of some species, likely causing them to avoid the area. Temporary displacement of wildlife would be expected along the segment of pipeline where construction activities occur. In addition, intermittent blasting along the proposed Project ROW could result in temporary disturbance to birds. While some thermokarsting is expected on the ACP due to the buried pipeline, the proposed mitigation measures and construction BMPs (see Section 4.10.3 and Appendix M) would be expected to minimize any permanent hydrologic alterations that would negatively impact bird nesting habitat on the ACP (also see the discussion of design measures to minimize changes to thermal stability in Section 4.10.4.1.4, Pipeline Right-of-Way Mainline).

Migratory birds could be injured or die from collisions with the proposed Project facilities, equipment, or vessels, especially those that have lighting. When visibility is impaired during inclement weather or darkness, birds are particularly at risk of collision with objects in their path (Weir, 1976). The risk of bird collision is largely determined by the timing and location of construction activities in relation to the presence of migratory birds in the proposed Project Area and the Beaufort Sea. If injury or mortality due to collision occurred, the effects would be direct; however, impacts would occur at the individual level and not at the population level.

The impacts to most bird species are considered minor, as construction would cause periodic, temporary, or short-term changes that are reversed over one reproductive season (1 year). Any disturbance would be short-term and is unlikely to have population-level effects on any species under consideration.

4.10.4.1.4.8. Non-native and Invasive Species

Removal of vegetation increases the potential for the establishment and spread of non-native weeds and other invasive plants, which have little use or value for wildlife and that displace native plants resulting in degraded wildlife habitat values. Mitigation Measure No. 4 is intended to reduce the introduction and spread of invasive plants.

Impacts associated with the introduction of non-native species is expected to be moderate because although the likelihood of an invasive species being introduced is low given mitigation measures proposed (see Section 4.10.3 and Appendix M), the geographic extent of the proposed Project Area is large.

Under some specific circumstances, such as if populations of non-native species become established following accidental introduction, impacts to populations or species could increase to moderate or greater.

4.10.4.1.4.9. Camp and Work Site Food Waste Management

Many predatory mammals exhibit opportunistic feeding behaviors, an intelligent strategy that entails a high degree of curiosity and exploratory behavior. Curiosity is advantageous in young individuals who lack refined hunting and food seeking abilities. Bears are very curious and it is normal behavior for bears to investigate anything that is

new and/or unusual. Bears are also attracted to all petroleum products, like gas, oil, and grease. The proposed Project camps and construction sites may attract curious individuals, in particular young brown or polar bears, wolves, and fox. Animal attraction may impact the proposed Project by causing interruptions in work or camp activities or pose safety issues. As presented in Section 4.10.3 (Mitigation Measure Nos. 11 and 12) and in Appendix M, mitigation measures for minimizing the attraction of wildlife include:

- Developing food waste management plans for both construction and camp activities to reduce wildlife attraction;
- Developing a containment and storage system for petroleum products; and
- Training for crew awareness to help avoid wildlife interactions and maintain distance from wildlife.

In addition to interior lighting at the temporary construction camps, lighting would include area lighting for road access, parking, and bus loading. Work lighting would be required during food unloading, and in stairways and doorways. Lighting at the construction camps could cause a structure collision hazard for birds.

4.10.4.1.4.10. Contaminants

Construction activities could affect important habitat and degrade water quality by accidentally introducing minor amounts of contaminants, oils, fuels, and debris. All hazardous materials would be handled, stored, transported, and disposed of properly according to regulatory stipulation. Potential impacts from small spills and discharges would be partially mitigated through the establishment and implementation of the SPCC Plan described in Appendix M. While construction is proposed over a 2.5-year period, considering the BMPs and mitigation measures proposed under Alternative 1, the impacts associated with contaminant exposure to wildlife is considered minor.

Under some specific circumstances, such as if marine vessel-associated spills affect a significant portion of a population, species, or particularly important habitat, impacts to populations or species could increase to moderate or greater.

4.10.4.1.5. Fairbanks Lateral

The Fairbanks Lateral tie-in would be located approximately 2.5 miles south of the Mainline Chatanika River crossing at MP 440 of the Mainline. From the tie-in, the Fairbanks Lateral pipeline would traverse east, following the Murphy Dome and Old Murphy Dome roads, and then extend southeast into Fairbanks.

All of the impact types described for the Mainline in the sections above would be applicable to the Fairbanks Lateral route, including disturbance effects to sensitive wildlife and habitats (Table 4.10-4); camp and work site food waste management; non-native and invasive species; and contaminants. Furthermore, all mitigation measures listed in Section 4.10.3 would help to reduce impacts to wildlife and wildlife habitat

along the proposed pipeline ROW. Loss of vegetation from construction through the area would be reduced because much of the route is already in existence along existing roads. Widening of the already established road system would result in some loss of vegetation; however, fragmentation effects would be minimized using this route. Clearing timelines would comply with seasonal critical periods as discussed previously (Table 4.10-5). The impacts to wildlife associated with construction of the Fairbanks Lateral pipeline are considered minor, considering that the proposed route would be constructed primarily along existing ROWs. Moreover, the BMPs, mitigation measures proposed under Alternative 1, and the implementation of the Project Management Plans would help to reduce proposed Project-related impacts. All temporary construction impacts would be revegetated and reclaimed post-construction, per the Revegetation Plan (Appendix E, Part I).

4.10.4.2. Operations and Maintenance

This section discusses potential impacts to wildlife during the operations and maintenance phase of the proposed Project, within various areas of the proposed Project.

Post-construction, all ROW corridors would be revegetated according to the Revegetation Plan (Appendix E, Part I). Early successional vegetation would reestablish over time within the construction ROW after the construction phase of the proposed Project. Trees and tall shrubs, such as willow and alder, would not be allowed to reestablish within the permanent ROW, and the loss of forested habitats would be considered a permanent habitat impact. Although the development of the proposed Project would result in a small amount of habitat impacted in comparison to the surrounding environment, fragmentation of the habitat as a whole would be permanent. As described above, there are both benefits and detriments to fragmentation depending on the species. Depending on how close the new ROW is to the highway and TAPS line, fragmentation impacts would be less, as the condition already exists; the ROW would widen the influence, but keep the alteration centralized.

Vegetation within the permanent ROW would not be removed during the bird breeding season, as recommend by USFWS (2005) (Mitigation Measure No. 1). In general, May 1 to July 31 (for the Interior and Southcentral), May 5 to July 25 (Yukon-Kuskokwim Delta) and June 1 to July 31 (Northern Region, including the northern foothills of the Brooks Range) would be restricted to activities that do not require vegetation removal. Earlier restrictions for sensitive species that may begin breeding earlier (*e.g.,* owls and swans) would also be considered. Sensitive habitat, including nesting and breeding for birds and other wildlife, would be avoided to the extent most possible during operations (Mitigation Measure No. 1).

A portion of the proposed Project would be located within existing ROWs (highways, TAPS ROW, and utility lines). Impacts from access to and operations in sensitive wildlife habitat along the new access ROW would be mitigated by consultation with agencies and coordinating timeline guidelines similar to those already in place for the

existing ROWs. Where requested by the landowner, public access to the ROW would be limited for recreation or hunting by blocking entry areas with large boulders, berms, or fencing (Mitigation Measure No. 8).

In areas where the pipeline segments have no existing ROWs, including the areas from Willow to the southern terminus (MP 733) and the Minto Flats area, fragmentation of forested habitats would have more impact. With the implementation of the previously mentioned BMPs and mitigations (see Section 4.10.3 and Appendix M), impacts related to vegetation removal and fragmentation would likely be moderate for some species and minor for others depending on the species and habitat requirements. Mitigation Measure Nos. 1 through 3, 9 through 14 would also help to reduce impacts to wildlife during operations.

Re-accessing remote portions of the pipeline to mitigate design or construction issues may not always be practical and could result in long-lasting environmental consequences. The potential effects associated with pipeline repair and maintenance are evaluated in Section 4.6, Soils and Geology.

Potential impacts to wildlife during operations associated with proposed Project-specific features are presented in the sections below.

4.10.4.2.1. Gas Conditioning Facility

Operation of the GCF would result in personnel traffic to and from pads and camps. Traffic may impact caribou movement and increase area-wide collision mortality to foxes and birds. Mortality to wildlife from vehicle collisions is currently uncommon due to restricted driving speeds in the North Slope oilfields. Vehicle traffic would be minimized where possible to minimize disturbance (Mitigation Measure No. 7).

The GCF would need lighting for plant operations, perimeter security, access, and emergencies. During operations, lights would be used to illuminate workspaces and to promote the safety and security of GCF structures and operations. GCF lighting would meet regulatory requirements, codes, and standards for lighting for overall site operations and maintenance, safety, and security. To minimize potential impacts related to artificial lighting, the GCF's lighting design would include light reduction techniques, including the use of directed lighting, timers, and motion sensors where appropriate to avoid lighting during times of non-use. For example, tilted lights (*e.g.*, bracket and stanchion mounted lights) would be directed toward the center of the facility to minimize stray light. In addition, hoods would be specified where possible for lights on the facility exterior (except for navigation aids and security lights) to focus light where needed for operational purposes while minimizing stray light.

Existence of the GCF would provide new perching sites for predatory birds. An increase in predator activity would alter predator-prey population cycles.

During GCF operations, common raven populations may benefit by the development of additional infrastructure for nesting. Common ravens are considered subsidized

predators and may affect prey abundance, distribution, and demography (Kristan and Boarman, 2007). Common ravens in the Prudhoe Bay area feed on shorebird and waterfowl eggs, lemmings, fledglings, and garbage in dumpsters and landfills. Human-provided food resources are thought to be important drivers of raven population growth, and human developments add other features as well, such as nesting platforms (Kristan and Boarman, 2007).

The development of infrastructure may also result in an unnatural increase in Arctic and red fox populations. Materials and facilities needed for development of the proposed Project could provide artificial shelters as denning habitat for mothers with pups. The proposed Project includes the construction of the GCF, which would not likely substantially increase denning habitat or feeding opportunities for fox species beyond what currently exists in Prudhoe Bay. Human waste in garbage dumpsters or landfills could subsidize population growth of these species. Mitigation Measure No. 12 lists the waste management measures to be employed during operations to reduce attracting wildlife. There are also safety concerns with the potential for rabies outbreaks when fox populations reach unnaturally high levels and are associated with anthropogenic resources. Fox species and the common raven are opportunistic predators, which feed on bird eggs and young birds. Project Management Plans and mitigation measures would be developed between AGDC and state and federal regulatory agencies to prevent denning or nesting opportunities of subsidized predators (see Section 4.10.3 and Appendix M). This may include placing material (*e.g.,* netting, enclosed material) under and above beams where ravens like to nest and incorporating standardized food waste practices already in place in Prudhoe Bay.

Assuming mitigation measures agreed upon with agencies are followed (see Section 4.10.3 and Appendix M), the potential impacts during operations of the GCF are likely to be minor primarily because the area is already anthropogenically active and facility operations would be localized. The additional activity at the GCF would be expected to impact only individual animals, and to not be a significantly greater impact than currently experienced in the area.

4.10.4.2.2. West Dock Head 3 and Causeway

When all modules have offloaded and rolled over the bridge and off the West Dock causeway, the barges comprising the barge bridge would be de-ballasted and depart.

Operation of the DH3 and causeway would result in temporary increase to personnel traffic to and from the docks and staging pad. Vehicle traffic would be minimized where possible to minimize disturbance (Mitigation Measure No. 7). Traffic may impact caribou movement (if present in such a high use area), and increase area wide collision mortality to foxes and birds. Mortality to wildlife from vehicle collisions is currently uncommon as a result of restrictions that regulate driving speeds in the North Slope oilfields. Therefore, potential direct and indirect effects of operations off the causeway to

terrestrial wildlife are assessed as minor because of the temporary and localized extent of the proposed Project in this area.

4.10.4.2.3. Yukon River Crossing

After construction of the HDD crossing is complete, pads would be revegetated and reclaimed, and no impacts to wildlife are anticipated during proposed Project operations due to the Yukon River crossing.

4.10.4.2.4. Pipeline Right-of-Way and Access Roads – Mainline

Aerial and ground-based pipeline inspections would have the potential to cause some temporary disturbance to some wildlife if activities were to occur during sensitive periods (*e.g.,* calving, lambing or nesting periods). Monitoring activity may result in decreased habitat suitability along the proposed pipeline corridor for those species that may be particularly sensitive to and that avoid human activity. Monitoring would be intensive for the first 5 years post-construction, including fly-overs, site visits, and stabilization and maintenance efforts (often in wetland areas). After 5 years, monitoring efforts would begin to taper to long-term levels. Vehicle traffic would be minimized where possible to minimize disturbance (Mitigation Measure No. 7).

Lighting installed at the permanent facilities in Prudhoe Bay would be in compliance to standards already in place for the area, and therefore, are not likely to impact wildlife visually or physically, and the impacts are assessed as minor.

Operations and maintenance equipment staged along the pipeline ROW, buildings at permanent facilities, and aboveground portions of the pipeline would provide new perching sites for predatory birds. An increase in predator activity would alter predator-prey population cycles.

Maintenance of access roads in the winter may cause wildlife mortality from collisions if wildlife are attracted to salts spread on the road to accelerate snow melting. Wildlife, such as moose, may be attracted to grass planted along roadsides from hydro seed application to establish vegetative growth to prevent erosion. This may cause an increase in mortality to moose and other wildlife attracted to roads. Dust from road use causes the snow to melt along roadsides, exposing vegetation faster than the areas that do not receive dust from the road. Wildlife colliding with vehicles could increase, causing mortality due to the attraction of exposed vegetation.

The proposed Project would mitigate access of motorized ATVs to sensitive wildlife areas that were previously inaccessible. Where requested by the landowner, public access to the ROW would be limited for recreation or hunting by blocking entry areas with large boulders, berms, or fencing (Mitigation Measure No. 8). Fencing or road barriers and pillars may also be used to prevent the public from accessing wilderness areas to reduce the likelihood of impacts to wildlife from proposed Project development. Aircraft monitoring would operate under approved flight restrictions to avoid high-density areas or critical time periods whenever possible.

USFWS has expressed concern about the presence of a buried pipeline in the ACP and the potential effects it could have on nesting birds if construction of the pipeline impacts important nesting habitat (*e.g.,* draining or inundation of shallow waters or wetlands) as a result of hydrologic alterations or permafrost disturbance. In a letter to USACE dated March 4, 2016, USFWS stated:

> *Should the pipeline be buried in the ACP past experience and previous studies suggest a high potential for thermokarst and subsidence over the pipeline backfill, forming an extensive linear depression that will likely lead to changes in drainage patterns and adverse impacts to wetland resources and sensitive habitats.*

Recognizing this potential for impacts to permafrost and hydrology in the ACP, the pipeline would require specific design considerations to protect the thermal stability of the surrounding soil and water, and any associated waterbodies, which would in turn protect important waterfowl habitat (Mitigation Measure No. 13). As described in Chapter 2, Alternatives, the proposed pipeline is referred to as an 'ambient' pipeline, indicating that the gas temperature would reflect the surrounding subsurface thermal conditions. The pipeline would operate at below-freezing temperatures in predominantly permafrost terrains to protect the thermal stability of the surrounding soil. Similarly, the proposed pipeline would operate at above-freezing temperatures in predominantly thawed settings to minimize the creation of frost-bulbs around the pipe, which could lead to frost-heave displacement or adverse hydraulic impacts on drainages. The pipeline operating temperature would be governed by the combined influence of Joule-Thompson cooling associated with gas pressure drop and pipe-wall heat transfer between the pipeline and surrounding soil. While these design measures would be expected to minimize thermokarsting from the buried pipeline, some thermokarsting is expected. When thermokarsts are found during routine pipeline inspection, they may be remediated if it is expected to threaten pipe integrity or create substantial ongoing drainage.

The north-south alignment of a buried pipe through wetlands may minimize impediments to the general direction of North Slope sheet water flow (south to north), yet it could also cause drainage of wetlands in areas where the buried pipeline allows for rapid drainage along the pipeline corridor (particularly during breakup). Additional mitigation measures, such as ditch plugs, would be used to avoid a French drain effect. For a detailed evaluation of the proposed buried design on various resources, see the following relevant sections: Soils and Geology (Section 4.6); Vegetation (Section 4.8); and Wetlands (Section 4.9). While the engineering design (*e.g.,* alignment and thermal stability), and mitigation measures are expected to minimize hydrologic alterations of wetland and water habitat, there is still the potential for limited, localized impacts to the hydrology of wetlands and water habitat on the ACP due to the presence of the buried pipeline.

In contrast to Alternative 2, the trenched pipeline in the ACP proposed for Alternative 1 would require more long-term maintenance and repair. Trench maintenance activities were identified as having impacts to soil, wetland, vegetation, and in turn impacts to wildlife habitat or creating a disturbance to wildlife. Maintenance-related impacts that would be required in the ACP for the buried pipe include maintenance of hydrology to prevent ponding or other hydrologic alterations; as well as, the use of heavy equipment and potentially a helicopter to install thermosiphons, lift and level the pipe, or replace backfill.

In summary, outside of the ACP, the impacts to most wildlife species and habitat would be considered minor during the proposed pipeline operation, as proposed Project-related operation would cause periodic, temporary, or short-term disturbances to individual animals and habitat, and would not be expected to cause population-level effects. Within the ACP, the permanent burial of the pipeline would allow for unimpeded wildlife movement (potentially in contrast to an elevated pipeline, as discussed in Section 4.10.5.1.3). However, even with engineering design considerations and mitigation measures, there is the possibility that the buried pipeline could impact permafrost and hydrology, and in turn impact wetland and waters habitat.

The net impact of the presence of the proposed buried pipeline to wildlife mortality would be considered minor, while impacts to habitat would be expected to be moderate, assuming that the engineering design and mitigation measures are able to limit impacts to wetland and waters habitat to localized areas along the route, and for a limited distance from the pipeline trench. Fragmentation impacts are considered moderate for those species that require large undisturbed habitat; fragmentation would remain as a long-term change that could not be reversed.

4.10.4.2.5. Fairbanks Lateral

The Fairbanks Lateral access roads developed along the trail system, west of Murphy Dome, would most likely facilitate hunter access into Minto Flats. ATVs could potentially cause damage to surrounding wetlands and vegetation that are habitat for wildlife including moose and waterfowl. AGDC would block or remove access roads after construction to help prevent hunters from using the travel corridor. Signs restricting access would be erected to keep recreational vehicles out. The Fairbanks Lateral line would be maintained and operated in accordance with the same restrictions and procedures as the main ROW.

Assuming mitigation measures agreed upon with agencies are followed, and the post-construction removal or blockage of access roads, the potential impacts during operations along the Fairbanks Lateral are likely to be negligible. This is primarily because a large section of the route is disturbed and is already anthropogenically active. Additionally, maintenance activities would be temporary, disturbance would be short-term and not result in any population-level effects on any species, and maintenance operations would be phased so the geographic extent of activities would be localized.

4.10.4.3. Summary of Potential Impacts of Alternative 1

The assessment of impacts of Alternative 1 on terrestrial wildlife after consideration of all construction and operational BMPs and mitigations (Section 4.10.3) is provided in Table 4.10-7. Full descriptions of mitigation measures are provided in Appendix M. Most impact levels would be considered minor; however, permanent habitat loss and fragmentation in the new ROW alignments near sensitive areas may be moderate for species needing large expanses of uninterrupted habitat or sensitive species intolerant to edge effects or anthropogenic disturbance.

Within the ACP, the buried pipeline between MP 0 to MP 62 would allow for unimpeded movement of wildlife, yet has the possibility to impact permafrost and hydrology, in turn impacting wetland and water habitats. The net impact of the proposed buried pipeline to wildlife and habitat within the ACP would be expected to be moderate. While it is expected that the proposed engineering design and mitigation measures would reduce impacts to wetland and waters habitat resulting from hydrologic alteration, it is unknown to what degree the mitigation measures would limit hydrologic impacts (along the ROW or laterally extending from the pipeline trench). As stated in Section 4.6.8, under both Alternatives 1 and 2 restoring the surface layer would help minimize impacts along the trenched area. It would also help minimize the risk that permafrost thaw propagates into a larger area. Additional information on the potential effects of the Project and mitigation measures (both Applicant proposed and agency-proposed) on the trench area are presented througout Section 4.6.

Wildlife inhabiting the proposed construction areas that rely on forest vegetation would be impacted by a loss of forest habitat. Mitigations for seasonal vegetation removal would reduce mortality impacts associated with the activity. Although Alaska is a very large state and there is available habitat for many species, the continued development and activity in the state contributes to habitat reduction and fragmentation. Cumulative impacts from both anthropogenic and natural loss of habitat, due to development, fire, and climate change, should be considered.

Under some specific circumstances, impacts to populations or species could increase to moderate or greater. Examples include:

- Loss or degradation of limited, important habitats;
- Poor placement or design of aerial/elevated lines or towers resulting in a significant, continuous collision hazard;
- Marine vessel-associated fuel spills affecting a significant proportion of a population or species or a particularly important habitat; and/or
- Populations of non-native species becoming established following accidental introduction.

4.10.5. Alternative 2 – Denali NPP Route Variation

This section discusses and rates the potential impacts of proposed Project construction and operation of Alternative 2 on terrestrial wildlife. Results of the impact ratings are presented in Table 4.10-7. Alternative 2 is described in detail in Chapter 2; however, the components relevant to terrestrial wildlife are summarized below.

- Use of DH2 at West Dock;
- Aboveground pipeline from MP 0 to MP 62;
- Denali NPP Route Variation between MP 535.8 and MP 543; and
- Aerial crossing at the Yukon River.

Potential impacts to terrestrial wildlife related to construction and operation of Alternative 2 are expected to be the same as those described for Alternative 1 above, with the following exceptions related to the Denali NPP Route Variation, the Yukon River crossing on an aerial suspension bridge, and the placement of the pipeline above ground between MP 0 and MP 62.

4.10.5.1. Construction

4.10.5.1.1. Denali NPP Route Variation

The Denali NPP Route Variation would route the pipeline through an approximately 7-mile segment of Denali NPP between MP 535.8 and MP 543 (Figure 2.4-1). In the northern portion of this route, the proposed pipeline would be constructed within the Parks Highway corridor, causing less impact to habitat and wildlife in this area than compared to Alternative 1. The southern portion of this route is not located within an existing ROW corridor. Construction of the Denali NPP Route Variation would remove approximately 40 percent less forested acreage and 12 percent less scrub/shrub acreage as compared to the corresponding proposed Mainline MP 535 to MP 543 segments. All of the mitigation measures listed in Section 4.10.3 would help to reduce impacts to wildlife and wildlife habitat along the proposed pipeline ROW.

Construction of the Denali NNP Route Variation corridor and permanent access roads would result in the disturbance of some species, causing them to avoid the area. Temporary displacement of wildlife would be expected along the segment of pipeline where construction activities occur. Table 4.10-6 presents the construction season proposed by the ASAP Project for the corresponding Mainline segment (using MP 535 to MP 542), and corresponding critical or sensitive periods for wildlife. As described for Alternative 1, critical or sensitive time periods are described for taxa groups in Table 4.10-4, and include calving/lambing, nesting, denning, rutting, migration, winter feeding, and times of concentration. Note that the Denali NPP Route Variation also crosses habitat designated by the ADF&G Habitat Atlas (ADF&G, 1985; 1986a,b,c) as "general distribution" for caribou; however, only species and habitat associated with the critical to sensitive time periods are listed in Table 4.10-6.

With the implementation of the fore mentioned BMPs and mitigation measures (see Section 4.10.3 and Appendix M), impacts to most species related to disturbance would likely be minor because construction could cause periodic, temporary, or short-term changes that are reversed over one reproductive season (1 year), and would not cause population-level effects. Any construction disturbance would be short-term and is unlikely to have population-level effects on any species under consideration. The geographic extent of noise disturbance activities would be localized. Construction plans would be coordinated with both state and federal agencies to mitigate for disturbance.

Table 4.10-6 Proposed Project Construction Seasons and Sensitive Periods for Wildlife for the Denali NPP Route Variation

Taxa / IBA	Description	Proposed Construction Season[a]		
		Early Civil Work Season	Civil ROW Construction Season	Pipeline Construction Season
Brown Bear	Feeding in spring	May 1 – Oct 31	Year-round	Year-round
	Denning fall/winter/spring	May 1 – Oct 31	Year-round	Year-round
Wolf	Denning and pup rearing spring/summer	May 1 – Oct 31	Year-round	Year-round
Caribou	Feeding in winter	May 1 – Oct 31	Year-round	Year-round
Moose	Feeding in winter	May 1 – Oct 31	Year-round	Year-round
	Calving in spring	May 1 – Oct 31	Year-round	Year-round
Alaska Range Foothills IBA	Golden eagle and other raptor nesting area (MP 535 to MP542)	May 1 – Oct 31	Year-round	Year-round

Sources: ADF&G Habitat Atlas (1:1,000,000 scale) Arctic, Interior, Southcentral (ADF&G, 1985; 1986a,b,c); NPS comment dated May 1, 2018
a SEIS Chapter 2, ASAP Construction Spread Plan dated January 19, 2018

4.10.5.1.2. Yukon River Crossing- Aerial

The Yukon River crossing for Alternative 2 would be an aerial suspension bridge, as opposed to installation by HDD in Alternative 1 (Figure 2.4-4) within 1.5 miles of the existing Yukon Bridge on the Dalton Highway. Approximately 6.2 acres of wetlands could be impacted with development of the suspension bridge (see Section 4.9, Wetlands, for a description of impacts to wetlands). Construction of the suspension bridge would result in the disturbance of some species, causing them to avoid the area. Temporary displacement of wildlife is expected along the segment of pipeline where construction activities occur. With the implementation of the fore mentioned BMPs and mitigations (see Section 4.10.3 and Appendix M), impacts related to disturbance would likely be minor, as they are temporary and would not result in population-level effects.

The impacts to most terrestrial wildlife species are considered minor, as construction would cause periodic, temporary, or short-term changes that are reversed over one reproductive season (1 year). However, collision-related impacts are considered moderate for bird species that fly over the Yukon River and are unfamiliar with a second obstruction. This would remain as a long-term change that would take far longer to be

reversed, as the aerial bridge would not be removed until gas was no longer flowing. Any disturbance would be short-term, localized, and unlikely to have population-level effects on any species under consideration.

4.10.5.1.3. Aboveground Section (MP 0 to MP 62)

Under Alternative 2, the pipeline would be elevated, approximately 7 feet from the ground surface between MP 0 and MP 62, within the region of the ACP (see Figure 2.4-2), where ice-rich, saturated soils and continuous permafrost are found. Shipping and trucking of the aboveground pipeline's VSM materials would involve more vehicle and vessel traffic than in Alternative 1. Additional traffic could lead to more collisions with wildlife. Construction of the pipeline on VSMs would reduce disturbance to permafrost, and in turn to the hydrology of wetland and waters habitats, as opposed to the construction disturbance caused by trenching and burying the pipe. VSMs and the aboveground section of pipeline would provide new perching sites for predatory birds; an increase in predator activity would alter predator-prey population cycles. Construction of the elevated pipeline on VSMs would be expected to cause minor localized, temporary (during active construction) impacts to individual animals. The proposed winter construction season for this section would also minimize impacts to migrating wildlife (*e.g.,* caribou). Mitigation Measure Nos. 1 through 3, 9 through 14 would also help to minimize impacts to wildlife within the aboveground section of the proposed pipeline.

4.10.5.1.4. Dock Head 2

Under Alternative 2, DH2 would be expanded to the east with new berths. This modification would require dredging (with marine disposal of dredged material), but would have a fairly minimal impact on the existing DH2 footprint. Summer dredging may be necessary at DH2 to keep the channel open for the duration of the mobilization effort. Impacts relating to activities associated with the marine environment are discussed in Sections 4.11, Fish, 4.12, Marine Mammals, and 4.13, Benthic. Impacts from all upgrades and proposed activities to the DH2 would primarily consist of disturbance from dredging as well as from activity associated with bringing modules on shore. Therefore, potential direct and indirect effects of modifications to DH2 to terrestrial wildlife are assessed as negligible because of the temporary and localized extent of proposed Project activities in this area.

4.10.5.2. Operations and Maintenance

4.10.5.2.1. Denali NPP Route Variation

The route through Denali NPP is currently highly developed and anthropogenic. As a result, operation of the proposed Project would not likely increase wildlife disturbance or habitat fragmentation beyond current levels. Operation of the proposed Project within the Denali NPP Route Variation could result in increased exposure to and spread of noxious weeds as compared to Alternative 1 between MP 536 and MP 543 because of

its location on the Parks Highway (and increased presence of noxious weeds). Non-native and invasive plants often have little use or value for wildlife and displace native vegetation, resulting in degraded wildlife habitats. Compounded exposure to and increased introduction events with invasive plants along the ROW would require more extensive mitigation and monitoring (see Section 4.10.3 and Appendix M). Mitigation Measure Nos. 4 and 15 would reduce the introduction and spread of non-native and invasive plants.

The potential impact of operations to wildlife and habitat along the Denali NPP Route Variation is considered minor, given current levels of development, and assuming proper implementation of the Revegetation Plan (Appendix E, Part I), mitigation measures, and BMPs described in Section 4.10.3.

4.10.5.2.2. Yukon River Crossing - Aerial

The aerial crossing of the Yukon River proposed in Alternative 2 would create a new permanent structure across the river. Therefore, collision-related mortality impacts are considered moderate for bird species that fly along the Yukon River and are unfamiliar with a second obstruction.

Any disturbance related to maintenance operations of the aerial crossing would be short-term and infrequent, and unlikely to have population-level effects on any species under consideration. This is because it is expected that all maintenance activities would be outside critical time periods (including nesting) and the geographic extent of noise disturbance activities would be localized. Maintenance plans of the Yukon River crossing would be coordinated with both state and federal agencies to mitigate for disturbance.

4.10.5.2.3. Aboveground Section (MP 0 to MP 62)

The aboveground section of the proposed pipeline (MP 0 to MP 62) would be placed near (but not directly adjacent to) the existing TAPS line between approximately MP 5 and MP 62, and elevated approximately 7 feet from the ground surface. An additional aboveground feature on the North Slope, in the same vicinity of TAPS, could potentially impact caribou, as well as other animals, behavior and movement as they attempt to avoid or cross beneath the elevated pipeline. Subsistence users have previously commented on the issue of aboveground features on the North Slope. Transcripts from the TAPS renewal Draft EIS Public Hearing in Utqiagvik Alaska (BLM, 2002) recorded NSB Mayor George Ahmaogak's public testimony, as he spoke on behalf of the NSB in regard to his concern about additional aboveground features that could impact wildlife on the North Slope (BLM, 2012):

> *Caribou migration patterns were altered, changed by construction of the Trans-Alaska Pipeline System and the associated Dalton Highway. Studies, scientific studies utilizing radio collars on caribou indicated that to a great extent, these obstacles continue to impede the free movement of the affected North Slope*

> *herds… Subsistence users in our communities of Nuiqsut and Anaktuvuk Pass have long noted these changes and they have to cope with the absence of game in traditional harvest areas.*

A BLM review of literature on the effect of pipeline height on caribou crossing success (Lawhead *et al.,* 2006) found that older aboveground pipelines constructed below 1.5 m could act as barriers to caribou crossing in the absence of crossing ramps, and that:

> *The available data on pipe-height selection by caribou demonstrate that pipelines elevated to the minimum height of 1.5 m are high enough to accommodate crossings by caribou during snow-free periods. The limited data on pipeline crossings by caribou in winter indicate that pipeline heights in the range of 2.1-2.5 m (7 to 8 feet) are more likely to be used by caribou than are lower heights.*

Several additional factors integrate with pipeline height to influence the degree of impact of elevated pipelines to wildlife. The most important factor being the proximity of traffic on nearby roads, with close proximity (closer than approximately 500 feet) to high traffic roads (15 or more vehicles per hour) having the most negative influence on pipeline crossing success. Within the proposed elevated section, the pipeline would be within 500 feet of a trafficked road (*e.g.*, Dalton Highway or other road with industrial traffic) for approximately 15 miles. It would be within 500 feet of exclusively access roads (away from a trafficked road) used only for maintenance and proposed Project-related activities for approximately 2.5 miles (ice roads excluded).

The proposed pipeline would be elevated to a height of 7 feet above ground, increasing the likelihood of successful crossing by caribou. However, recognizing the influence of compounding factors, such as proximity to roads, it is still possible for the aboveground section of pipeline to negatively impact caribou movement and migration patterns, particularly if snow is drifted under the elevated pipeline, reducing pipeline height above the snow surface.

There is also a limited chance that the elevated pipeline could increase the potential for collision related impacts for flying birds that are unfamiliar with an obstruction on the landscape. An elevated pipeline could also negatively impact small mammals and nesting birds by providing perching areas for avian predators.

In contrast to Alternative 1, the aboveground pipeline would not require trenching and would therefore require less long-term maintenance and repair activities that were identified as having impacts to soil, wetland, vegetation, and in turn impacts to wildlife habitat or disturbing wildlife (see the respective sections for Alternative 1 impacts to these resources). Maintenance-related impacts that would *not* be required under Alternative 2 include maintenance of hydrology to prevent ponding or other hydrologic alterations; as well as, the use of heavy equipment and potentially a helicopter to install thermosiphons, lift and level the pipe, or replace backfill.

Operations and maintenance equipment staged along the pipeline ROW, buildings at permanent facilities, VSMs, and aboveground portions of the pipeline would provide

new perching sites for predatory birds. An increase in predator activity would alter predator-prey population cycles.

Recognizing the potential for impeding wildlife movement, on the other hand, the elevated pipeline would not cause the impacts to permafrost and hydrology (and in turn wetland and waters habitat) within the ACP as compared to the buried pipeline proposed in Alternative 1. Overall, the elevated pipeline proposed for MP 0 to MP 62 would likely result in a minor impact to mortality rates, and a net moderate impact to wildlife habitat due to the cumulative impacts of other raised lines already in existence (*e.g.,* TAPS), and the permanence of the structures.

4.10.5.3. Summary of Potential Impacts of Alternative 2

The assessment of impacts of Alternative 2 on terrestrial wildlife after consideration of all construction and operational BMPs and mitigations is provided in Table 4.10-7. Full descriptions of mitigation measures are provided in Appendix M. Most impacts levels are considered minor; however, permanent habitat loss and fragmentation in new ROW alignments near sensitive areas may be moderate for species needing large expanses of uninterrupted habitat or sensitive species intolerant to edge effects or anthropogenic disturbance. The presence of the aboveground pipeline and VSMs (MP 0 to MP 62) and aerial suspension bridge crossing the Yukon River are also considered a moderate impact to wildlife habitat because of the long-term change to the habitat and the potential for impacts to caribou and birds (*e.g.,* through avoidance and behavior changes) respectively during critical time periods.

Wildlife inhabiting the proposed construction area that relies on forest vegetation would be impacted by a loss of forest habitat. Mitigations for seasonal vegetation removal would reduce mortality impacts associated with the activity. Alaska is largely undeveloped with large contiguous acreages of available habitat for many species, without development; however, activity in the state continues to reduce and fragment large swaths of the habitat. The continued assessment that there is available habitat elsewhere is not taking into account the cumulative impacts from both anthropogenic and natural loss of habitat. Habitat is also being reduced by development, fire, and climate change.

4.10.6. Alternative 3 – No Action

Under Alternative 3 (No Action), the proposed Project would not be developed and there would be no direct or indirect impacts to wildlife or their habitats.

4.10.7. Conclusions and Comparison of Alternatives

The potential impacts of the three alternatives on terrestrial wildlife (by biological resource effect) are presented in Table 4.10-7. As presented in Table 4.10-2, "mortality" could be direct or indirect, which includes mortality resulting from disturbance, disease, invasive species, hunter access, collision with vehicles or structures, and increased

predation. Reproductive effect or impacts to function, health, and resilience could result from:

- Increased fragmentation of habitat;
- Displacement of wildlife from noise and human activity during construction;
- Changes to predator populations that may affect prey abundance, distribution, and demography;
- Disease, invasive species, and predation;
- Disturbances and stresses from noise and presence of vehicles, aerial activity, and equipment during construction;
- Habituation or food conditioning;
- Exposure to toxic substances (*i.e.,* oil or hazardous materials spills); and
- Diminished juvenile recruitment.

Alternative 3 (No Action) is expected to have no impacts ("negligible") to wildlife. After accounting for engineering design and the proposed mitigation measures and BMPs (Section 4.10.3), Alternatives 1 and 2 were determined to have the same net impact to terrestrial wildlife during construction. For both alternatives, the potential construction impact to wildlife resulting in increased mortality was determined to be minor, as impacts would be expected to be short-term, limited in geographic scope, and limited to impacts to individual animals rather than populations. Potential construction impacts to reproduction, function, health, and resilience were considered moderate due to the potential for habitat fragmentation caused by construction.

During operations, impacts of both Alternatives 1 and 2 were considered minor for impacts to mortality, and moderate for impacts to reproduction, function, health, and resilience. The impact of Alternative 1 during operations was considered minor for mortality, as aboveground activity and structures would be limited post-construction. The impact of Alternative 1 during operations was considered moderate for impacts to reproduction, function, health, and resilience, due to permanent habitat fragmentation caused by vegetation clearing within the proposed pipeline corridor, and the potential for habitat alteration in the ACP associated with temperature changes resulting in hydrologic alterations to wetland habitats.

The operations period for Alternative 2 also received a minor impact rating for mortality, as bird collisions caused by the elevated pipeline in the ACP (MP 0 to MP 62) and the aerial suspension bridge crossing on the Yukon River would be expected to be unlikely. The moderate rating during Alternative 2 operations was determined based on the potential for changes in caribou behavior (*e.g.,* avoidance) due to the permanent presence of the elevated pipeline on the ACP, as the pipeline would cause an additional aboveground feature on the landscape near (but not directly adjacent to) the existing TAPS line. The degree of caribou disturbance would depend on the proximity of the

pipeline to roads, with disturbance expected to occur when the pipeline was within 500 feet of a trafficked road.

Table 4.10-7 Comparison of Alternatives Summary for Wildlife (Direct & Indirect)

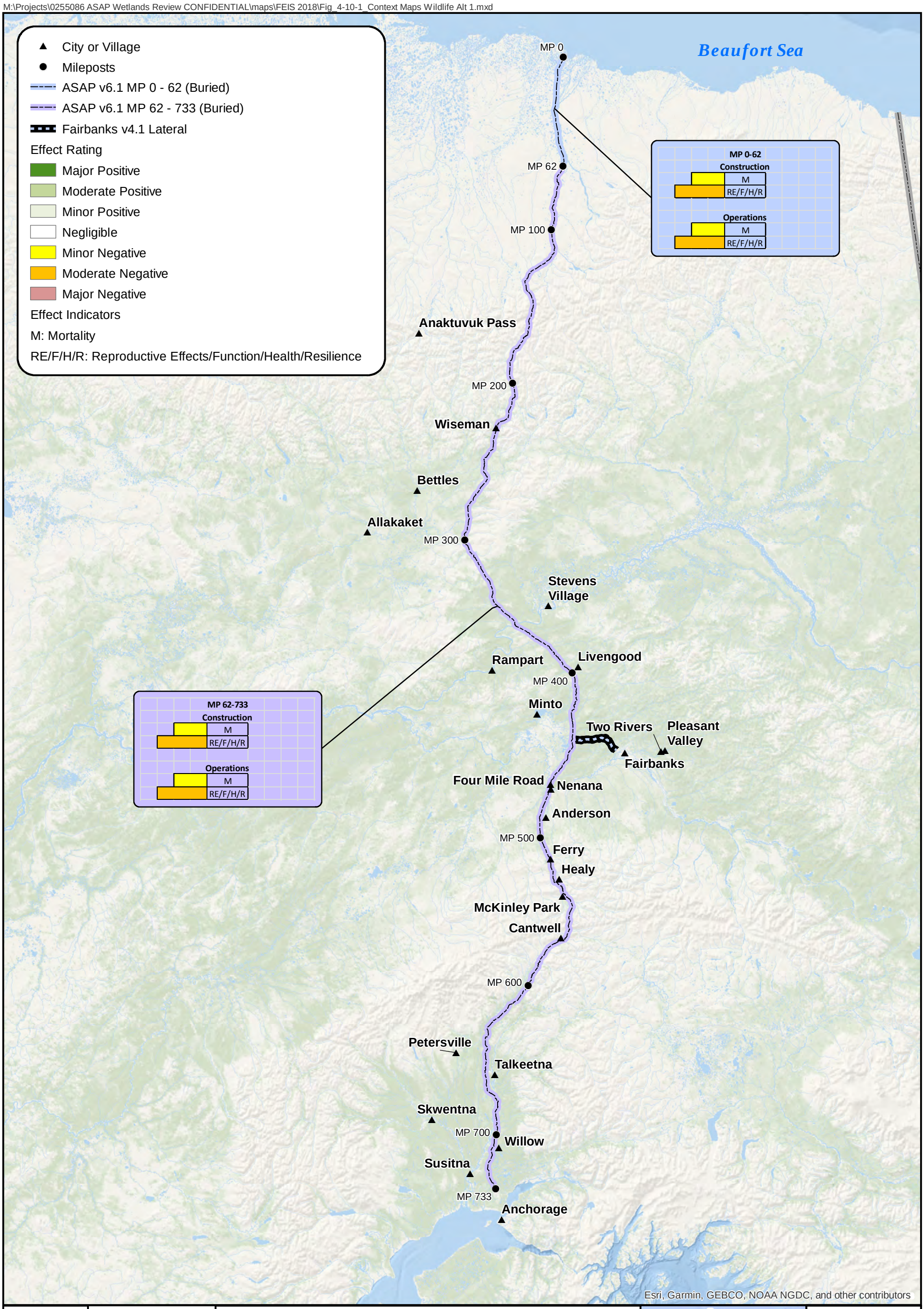
Biological Resource Effect	Alternative 1		Alternative 2		Alternative 3
	Construction	Operations	Construction	Operations	Construction / Operation
	Impact Rating		Impact Rating		Impact Rating
Mortality	*Minor*	*Minor*	*Minor*	*Minor*	*Negligible*
Reproductive Effects/Function/ Health/Resilience	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*Negligible*

Figures 4.10-1 and 4.10-2 illustrate some of the key findings from the impact analysis. These figures provide more detailed geographic context of the potential impacts of Alternatives 1 and 2, as described in detail in this section. Figure 4.10-1 presents impacts associated with two separate stretches of proposed pipeline: 1) the ACP (MP 0 and MP 62), where the pipeline would be buried through continuous permafrost, and 2) MP 62 and the end of the route. Figure 4.10-2 also presents these two stretches, but also presents the location of the Yukon River crossing, which would be above ground in Alternative 2. Impacts are summarized for each of these locations below, by Alternative 1 or 2.

- MP 0 to MP 62: In this segment, the aboveground construction in the ACP proposed in Alternative 2 would result in less permafrost and hydrologic alterations, and in turn changes to wildlife habitat, compared to the aboveground construction proposed in Alternative 1. However, depending on the proximity of the pipeline to roads (*e.g.*, within 500 feet), the Alternative 2 aboveground pipeline could result in disturbance to caribou movement and migration.
- MP 62 to End: Impacts from Alternatives 1 and 2 would be expected to be nearly identical for this stretch, with Alternative 2 having slightly greater mortality impact, if at all, due to the aerial crossing of the Yukon River, which could increase bird mortality due to collisions with the new structure over the river.

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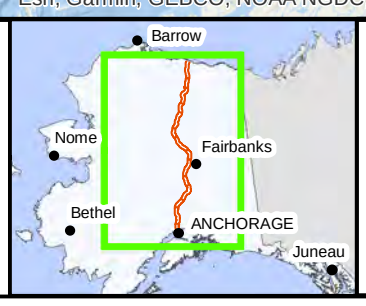
ERM

DATE: MAR 2018
CHKD: K.A.
DRWN: A.V.K.
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Figure 4.10-1: WILDLIFE IMPACTS CONTEXT MAP, ALTERNATIVE 1
ALASKA STAND ALONE PIPELINE

0 25 50 100 150 Miles



N

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City or Village
Mileposts
ASAP v6.1 MP 0 - 62 (Aboveground)
ASAP v6.1 MP 62 - 733 (Buried)
ASAP Yukon Crossing (Aerial)
Fairbanks v4.1 Lateral
Denali NPP Route Variation

Effect Rating
Major Positive
Moderate Positive
Minor Positive
Negligible
Minor Negative
Moderate Negative
Major Negative

Effect Indicators
M: Mortality
RE/F/H/R: Reproductive Effects/Function/Health/Resilience

Beaufort Sea

MP 0
MP 62
MP 100
MP 200
MP 300
MP 400
MP 500
MP 600
MP 700
MP 733

Anaktuvuk Pass
Wiseman
Bettles
Alatna
New Allakaket
Allakaket
Stevens Village
Rampart
Livengood
Minto
Two Rivers
Pleasant Valley
Fairbanks
Four Mile Road
Nenana
Anderson
Ferry
Healy
McKinley Park
Cantwell
Petersville
Talkeetna
Skwentna
Willow
Susitna
Anchorage

MP 0-62 (Aboveground)
Construction
M
RE/F/H/R
Operations
M
RE/F/H/R

Yukon Crossing (Aerial)
Construction
M
RE/F/H/R
Operations
M
RE/F/H/R

MP 62-733 (Aboveground)
Construction
M
RE/F/H/R
Operations
M
RE/F/H/R

Esri, Garmin, GEBCO, NOAA NGDC, and other contributors, Sources: Esri, GEBCO, NOAA, National Geographic, DeLorme, HERE, Geonames.org, and other contributors

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CHKD: K.A.
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Figure 4.10-2: WILDLIFE IMPACTS CONTEXT MAP, ALTERNATIVE 2
ALASKA STAND ALONE PIPELINE

0 25 50 100 150 Miles

Barrow
Nome
Fairbanks
Bethel
ANCHORAGE
Juneau

N

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4.11. Fish

4.11.1. Introduction

This section assesses potential impacts to freshwater, marine, and anadromous fishes and their habitat resulting from all aspects of the proposed Project construction and operations. The three alternatives evaluated are described in detail in Chapter 2, Alternatives. The section describes any incomplete or unavailable information and how that has influenced this analysis, describes the methods for determining the level of impact to fisheries, and presents the results of the assessment. Some of the mitigation measures that would aid in avoiding or minimizing the potential impacts are also described. Additional information on proposed mitigation and monitoring is provided in Appendix M. Section 4.7, Water, presents the results of the impact assessment to all waterbodies in the proposed Project Area.

The information used in this section builds on the 2012 FEIS (USACE, 2012a) and incorporates new data and information relevant to environmental concerns associated with the alternatives that have become available since the original 2012 FEIS document. While this assessment tiers from the 2012 FEIS, importantly, the proposed changes in route and design described for Alternative 1 are emphasized. In some instances, information from the 2012 FEIS is replicated with relatively minor changes and updates, while other material is entirely new or substantially altered. For this SEIS, the following elements have been added to the assessment of impacts to fish and fish habitat:

- A new section (Section 4.11.2, Methods) was added to explain the procedures used to evaluate the potential impacts associated with the proposed Project and alternatives;
- Mitigation measures incorporated from the 2012 FEIS (USACE, 2012a) have been expanded to include recommendations from federal and state agencies (see Appendix M for additional detail);
- Updates to impacts based on new alternatives and a summary of those results (Section 4.11.7, Conclusions and Comparison of Alternatives);
- Updates to impacts related to final proposed Project design as reported in the July 2016 ASAP EED (AGDC, 2016b), including pipeline routing and stream crossing construction modes; and
- Incorporation of the results of two reports prepared by AGDC, the ASAP Fish Stream List (Appendix J) and the ASAP Essential Fish Habitat (EFH) Report (Attachment 6 of the EED; AGDC, 2016b).

4.11.1.1. Fish Species and Habitat Assessed

Chapter 3, Section 3.7, Fish, presents the anadromous and resident fish species present within the proposed Project Area and their associated habitat. In this section, impacts to habitat are assessed for all waterbodies accessible to fish, including lakes, ponds, rivers, and wetlands, all of which are collectively referred to as waterbodies. Habitat is assessed

for impacts regardless of regulatory jurisdiction, including jurisdiction under Section 404 of the CWA (*e.g.,* waters of the U.S.); ADF&G's Catalog of Waters Important for the Spawning, Rearing or Migration of Anadromous Fishes (collectively referred to as the AWC) (Johnson and Litchfield, 2015a,b,c); or Magnuson–Stevens Act (*e.g.*, EFH). Throughout the document, the term "habitat" refers to both general habitat and EFH.

EFH is defined by the Magnuson–Stevens Act as "those waters and substrates necessary to fish for spawning, breeding, feeding, or growth to maturity" (National Oceanic and Atmospheric Administration [NOAA], 2016). EFH is designated only for species managed under a federal Fishery Management Plan (FMP). EFH within the proposed Project Area has been designated by the Arctic FMP (NPFMC, 2009) and the Pacific Salmon FMP (NOAA, 2012). All other fish-bearing, non-EFH waterbodies were considered "general habitat."

The ASAP EFH Report (Attachment 6 of EED; AGDC, 2016b) presents extensive information regarding EFH species within the proposed Project Area; descriptions of the habitat and species in the three hydrologic regions (Arctic, Interior, and Southcentral); and detailed figures of EFH waterbodies in each of the three regions within the proposed Project Area. Marine EFH for the proposed Project includes the limited portion of northwestern Prudhoe Bay in the area surrounding West Dock and in southern Prudhoe Bay. The remainder of the proposed Project Area includes freshwater EFH. To be considered a freshwater EFH, a waterbody must be accessible to one of the five Pacific salmon species (Pacific Fishery Management Council, 2010), and must be documented in the AWC (Johnson and Litchfield, 2015a,b,c).

4.11.1.2. Incomplete or Unavailable Information

In compliance with CEQ guidance (see Section 4.3), this section addresses incomplete or unavailable information pertinent to analyzing impacts of the alternatives on fish resources. Various information sources have been used to assess impacts to the fish potentially affected by the proposed Project. When species-specific information could not be obtained, taxa-specific information is incorporated for a generalized assessment. For example, fish resources and habitat have not been assessed within each individual waterbody that may be affected by the proposed Project or alternatives. In addition, as stated by Popper and Fay (1993), "The question of how sounds affect fishes is relatively new, and it is very difficult to do field studies on acoustic behavior of wild fishes despite this being a most important question." Assessments for this SEIS were made based on the most updated and publicly accessible documents as well as proposed Project-specific data provided. Incomplete or unavailable information for specific species or in general create uncertainty of impacts; where data are lacking, professional judgment has been applied based on knowledge and experience of the authors, contacted experts, and generally accepted scientific methods.

4.11.2. Methods

The evaluation of potential impacts were based on the evaluation of the fish resources and their habitat along the proposed Project corridor, review of available proposed Project descriptions and reports, public comments received on the 2012 FEIS (USACE, 2012a) and during the public scoping period for the SEIS held in 2014, and review of public comments received on the Draft SEIS during the July/August 2017 public comment period. Fish species and habitat descriptions were obtained from the following sources:

- USACE. 2012a. *Final Environmental Impact Statement, Alaska Stand Alone Pipeline*. October.
- ADF&G Catalog of Waters Important for the Spawning, Rearing, or Migration of Anadromous Fishes "Anadromous Waters Catalog" (Johnson and Litchfield, 2015a,b,c).
- Alaska Freshwater Fish Inventory Database (AFFID) (ADF&G, 2016l).
- ASAP Fish Stream List (Appendix J) developed through AGDC field and desktop efforts. This report was used as the most up-to-date inventory of fish-bearing waterbodies within the proposed Project Area, and was used for this SEIS. However, the AWC remains the jurisdictional document for agency review and consideration of impacts to anadromous fish bearing streams and supersedes data available from other sources.
- ASAP EFH Report (Attachment 6 of the EED [AGDC, 2016b]) presents the results of the analysis of potential effects of the proposed Action (Alternative 1) on NMFS-designated EFH.
- Various taxa- or species-specific publications.

Potential impacts to fish and fish habitat were analyzed by assessing the magnitude, extent, duration and likelihood of occurrence as presented in Table 4.11-1, Impact Criteria for Fish. The following sections identify and discuss potential impacts that could occur at sites or streams throughout the proposed Project Area. These effects have been adapted directly from NMFS-issued guidance (NMFS, 2011). General effects that were assessed include:

- Direct and indirect mortality during construction and operation;
- Reproductive, growth, health, and distribution effects from construction and operation activities; and
- Effects to habitat resulting in indirect impacts to fish (both general habitat and designated EFH).

4.11.2.1. Description of Effects

4.11.2.1.1. Direct and Indirect Mortality

Direct mortality of fish primarily involves alteration or disturbance of stream beds from construction activities. Direct mortality could occur to fish and embryos from excavation in streambeds either at the construction site or downstream where increased sedimentation may reduce viability by causing gill irritation or smother eggs (Reid *et al.*, 2004). In addition, water diversions and temporary dewatering of stream beds may cause desiccation or freezing of developing eggs and pre-emergent fry. Fish may be entrained in withdrawn waters or impinged on screened intake structures resulting in injury or mortality. Mechanical stress from activities, such as blasting and pile driving, could cause lethal damage to fish organs (Wright and Hopky, 1998). Fish could be injured or killed when their internal swim bladder is ruptured from shock waves propagating through the water. Potential fuel or hazardous material spills within or near waterbodies may also lead to direct mortality.

Indirect mortality to fish is typically a result of changes in water quality, stress from fleeing behavior, invasive species and disease. Due to their relative immobility, egg and larval life stages may be at greatest risk to be negatively affected by changes in water quality, including increases in turbidity and sediment deposition (Reid and Anderson, 1999). In addition to adverse physiological responses to stress, fleeing fish may injure themselves or be more at risk for predation (Simpson *et al*., 2016). Underwater noise associated with vessel noise in Prudhoe Bay, dredging or pile driving in and around West Dock, or pile driving at bridge crossings in freshwater environments, may also result in death (Fay and Popper, 2012) where fish are close to the sound source.

Non-native or invasive species are typically introduced into a system by human related activity. Introduced non-native species compete for food and space with native species and could transmit diseases (*e.g*., whirling disease [*Myxobolus cerebralis*]), which could adversely impact fish and sensitive life stages. Additionally, invasive species, such as northern pike, target native fish species as a primary food source. This direct mortality likely represents a significant population level impact in some Southcentral salmon streams.

4.11.2.1.2. Reproductive, Growth, Health, and Distribution effects

Water level fluctuations could alter fish behavior, distribution, and growth (Cott *et al*., 2008). High or low water flows could prevent fish movements to rearing, spawning, or overwintering habitats. Juvenile salmonids are particularly dependent on connectivity between tributaries and mainstem channel habitats (STB, 2011; Bramblett *et al*., 2002). Spawning fish that are unable to reach optimal spawning habitat may be required to use alternative suboptimal spawning habitat, which could result in reduced survival of eggs, larvae, and juvenile fish (STB, 2011).

Decreases in fish feeding efficiency, reduced levels of invertebrate (prey) species, smothering of incubating eggs, and decreases in fish spawning success could be impacts to fish populations from increased sedimentation in waterways (Reid and Anderson, 1999). Riparian vegetation is extremely important for fish as it helps control the effects of erosion which leads to increases in sedimentation. The loss of vegetation such as tree roots, logs, and shrubs could reduce available refuge habitat and invertebrate populations. Reduction in refuge and instream cover could result in higher risk of predation to fish species or alterations in water chemistry (*i.e.*, temperature, dissolved oxygen levels) resulting in increased mortality or displacement.

Fish species may be disturbed and vacate the area during construction activities. These disturbances may lead to a decrease in fecundity or survival rates for populations by displacing spawning salmon in suboptimal spawning habitat (STB, 2011). In-water construction activities during fish spawning periods could have adverse impacts especially on anadromous fish.

Underwater noise may also result in behavioral changes to fish occurring within the proposed Project Area as a result of vessel noise in Prudhoe Bay, dredging or pile driving in and around West Dock, or pile driving at bridge crossings in freshwater environments. Man-made sounds could cause a range of effects including no response (*i.e.*, where fishes ignore the sounds), to highly consequential effects, where behavior is altered or death occurs. Unlike mortality effects, behavioral effects may extend a great distance from the source (Fay and Popper, 2012).

4.11.2.2. Effects to Habitat Resulting in Indirect Effects to Fish

Effects to both general habitat, as well as habitat designated as EFH by NMFS (NOAA, 2016), were assessed as part of this impact assessment. As described in Chapter 3, Section 3.7.5, Essential Fish Habitat, EFH is designated only for species managed under a federal FMP. EFH within the proposed Project Area has been designated by the 2009 Arctic FMP and the 2012 Salmon FMP. Below is a description of potential proposed Project impacts to fish habitat.

Removal of riparian vegetation could alter instream habitat. Riparian vegetation is extremely important for fish as noted above (STB, 2011; Brown *et al*., 2002). The roots of riparian trees and shrubs prevent erosion by holding stream banks in place as well as trapping sediment and pollutants, which help to maintain water quality. During high stream flow periods, riparian vegetation, and woody debris slows and dissipates flood waters, which help to prevent or minimize erosion that could damage fish spawning areas and aquatic invertebrate habitats. Loss of riparian vegetation also reduces shading which could cause increased water temperature, reduced dissolved oxygen, reduced nutrient input, and increased predation of certain fish species due to reduced cover (STB, 2011; Brown *et al*., 2002). In cold climates, removal of riparian vegetation could lower water temperatures during winter which could increase ice formation and delay or damage the development of many newly spawned fish or incubating eggs (NMFS,

2011). Loss of riparian vegetation and disturbance to the bank and substrate could also alter benthic communities, changing prey availability for fish (Brown *et al*., 2002).

Alteration of stream hydrology, especially in the hyporheic zone where mixing of groundwater and surface water occurs could affect reproduction and development of salmon eggs (STB, 2011; Brown and Mackay, 1995; Baxter and McPhail, 1999). Changes to existing thermal regimes of waterbodies could affect fish behavior, survival, and productivity.

Fragmentation or barriers to fish passage could have long lasting effects to fish populations. Juvenile salmonids are particularly dependent upon connectivity between tributaries and main stem channel habitats (STB, 2011; Bramblett *et al*., 2002). Spawning fish that are unable to reach optimal spawning habitat may be required to use alternative suboptimal spawning habitat, which could result in reduced survival of eggs, larvae, and juvenile fish (STB, 2011). Habitat fragmentation could also impede a fish's ability to migrate between spatially compressed sensitive overwintering habitats and summer feeding habitats, particularly in interior and northern Alaska.

Invasive aquatic plant species have the potential to degrade fish habitats by changing natural habitat quality, preventing growth of endemic organisms, and altering community structure. Invasive aquatic plant species could be introduced into waterways and wetlands and spread by improperly cleaned vehicles and equipment operating in water, stream channel, or wetlands (Cowie and Robinson, 2003; Fuller, 2003).

Pollutants could also potentially be introduced into aquatic habitats during construction. Fuel leaks during construction would reduce water quality, potentially resulting in toxic effects to fish and aquatic invertebrates. Spills and leaks could enter the water either directly from in-stream equipment or indirectly from runoff from adjacent road beds.

4.11.2.3. Impact Criteria

Table 4.11-1 summarizes the criteria used to determine the level of impact based on the magnitude, extent, duration and likelihood of occurrence. Table 4.11-2 defines the types of effects the proposed Project and activities may have on the biological resources that are assessed in this SEIS. The known distribution of fish species inhabiting waterbodies crossed by the proposed Project is provided in Table 3.7-2. The potential effects listed in Table 4.11-2 consider the implementation of the mitigation measures described in Section 4.11.3 and in Appendix M of this SEIS.

Table 4.11-1 Impact Criteria for Fish

Impact Component	Impact Level			
	Major	**Moderate**	**Minor**	**Negligible**
Magnitude or Intensity	The impact is sufficient to cause population level changes to productivity, growth rate, survival rate, and range).	The impact is sufficient to cause sub-population level changes to productivity, growth rate, survival rate, and range.	The action would impact a few individuals in a population but would not affect population productivity, growth rate, survival rate, and range.	There are no perceivable impacts or the mechanism for effects on population status are indistinguishable from baseline (*i.e.*, productivity, growth rate, survival rate and range)
Geographic Extent	Impacts are statewide, or over the entire range of the species.	Impacts are at a regional or community level, on a limited portion of the study area.	Impacts are site-specific or occur within a few isolated locations.	No measurable effects.
Duration or Frequency	The effect would cause chronic and long-term changes that are likely to be permanent.	The effect would cause periodic, temporary, or short-term changes that are reversed after 1-3 reproductive seasons.	The effect would cause periodic, temporary, or short-term changes that are reversed over one reproductive season.	No measurable effects.
Likelihood	Most likely (Impacts that have greater than 75% chance of arising from the action)	Likely (Impacts that have a 25% to 75% chance of arising from the action)	Somewhat likely (Impacts that have a 5% to 25% chance of arising from the action)	Unlikely (Impacts that have less than 5% chance of arising from the action)

Table 4.11-2 Types of Effects and Impacts on Fisheries

Type of Effect	Proposed Action Causing Potential Impact	
	Construction	**Operations and Maintenance**
Mortality • Direct: o Entrainment in withdraw waters. o Impingement on intake structures o Contaminants run off into drainages altering water quality fouling gills, reducing oxygen absorption o Lethal damage to organs from acoustic energy o Collision with vessels/ equipment o Burial of less mobile species/ life stages o Stranding/desiccation in unsuitable or cut-off habitats • Indirect: o Disturbance and stress from fleeing behavior	• Water withdrawal from lakes for road and pad construction, and work camp use • Blasting and pile-driving • Equipment operation, maintenance, and use during construction • Development of gravel pads and roads • Increased marine vessel activity • Construction of causeways and deposition of dredge material • Ice Roads • Material site development in floodplains	• Equipment operation, maintenance, and use during operations and maintenance • Repairs on pipeline buried under streams. • Repair and removal of access road crossing structures

Type of Effect	Proposed Action Causing Potential Impact	
	Construction	Operations and Maintenance
o Disease o Invasive species o Changes in water quality (decrease O_2 levels, temperature, food sources) o Change in flow timing/duration/quantity		
Reproductive effects/ Growth/Health/Distribution: • Change in flow timing/duration/quantity causing a change in fish behavior, distribution, and growth • Reduction in invertebrate populations • Reduction in riparian vegetation availability as food, shelter and for egg deposition • Temporarily impeded fish passage causing a change in spawning and/or overwintering migrations; especially for ephemeral streams in the Arctic • Alteration of coastal circulation and mixing patterns resulting in inhospitable conditions for anadromous and marine fish • Behavioral disturbance due to underwater noise	• Water withdrawal from lakes for road and pad construction and work camp use • Ice road development across drainages • HDD drilling fluids unintentionally released into surface • Blasting and pile-driving • Construction of causeways and deposition of dredge material • Material site development in floodplains	• Maintenance of the permanent access roads and ROW • Repairs on pipeline buried under streams • Repair and removal of access road crossing structures
Effects to habitat resulting in indirect impacts to fish: • Barriers to fish passage • Release of contaminants • Increase in sedimentation/ turbidity, erosion along the stream bank, loss of riparian vegetation, altered channel morphology • Alteration of water temperatures • Alteration of coastal circulation and mixing patterns • Loss of habitat at road crossings, material extraction sites, and marine dredge sites	• All stream crossing methods used during construction of pipeline • Blasting and pile-driving • Mowing the ROW including riparian areas during construction • Water diversion during culvert installation for access road development • Water withdrawal from lakes for road and pad construction and work camp use • Ice road development across drainages • Construction of causeways and deposition of dredge material • Increased marine vessel activity • Material site development in floodplains	• Maintenance of the permanent access roads and ROW • Repairs on pipeline buried under streams. • Presence of buried pipeline near waterbodies • Culverts and road crossings

4.11.3. Proposed Design Features, Mitigation Measures, Best Management Practices, and Project Management Plans

4.11.3.1. Applicant-Proposed Design Features, Mitigation Measures, Best Management Practices, and Project Management Plans

This section describes the engineering design features, mitigation measures, BMPs, and Project Management Plans developed to avoid or minimize proposed Project impacts to fish and fish habitat. These measures and plans were taken into consideration when evaluating potential impacts on fish and fish habitat under Alternatives 1 and 2 during the construction and operations phases. For context, many of these mitigation measures are also included in the individual impact assessment sections below. A complete list of mitigation measures and BMPs are also provided in Appendix M. AGDC proposes to implement the following measures to mitigate effects on fish (USACE, 2012a):

1. Protection of Spawning, Rearing, and Overwintering Areas
    - Identify all known fish streams within the proposed Project construction and operations area where soil material is expected to be suspended in water as a result of proposed pipeline activities.
    - In consultation with ADF&G, avoid disturbance and sedimentation to fish spawning beds, rearing areas, and overwintering areas designated by SPCS/BLM. However, where disturbances could not be avoided, proposed modifications and appropriate mitigation measures would be designed by AGDC and approved by SPCS/BLM.
    - Settling basins or other sediment control structures would be constructed and maintained to intercept sediment before it reaches rivers, streams, or lakes.
    - Zones of Restricted Activity - proposed Project activities may be restricted during periods of fish spawning, rearing, and migration.
2. Riparian Vegetation Clearing and Revegetation
    - All temporarily cleared areas would be revegetated following the ASAP Revegetation Plan (Appendix E, Part I).
    - For riparian vegetation clearing, vegetation would be cut off at ground level to leave the existing root systems in place to provide streambank stability. Pulling of tree stumps and rooting for grading activities would be limited to the area directly over the trench line.
    - Riparian vegetation would be restored with native plant species (wherever possible), which typically provide greater bank stability than non-native species, per the ASAP Revegetation Plan (Appendix E, Part I). High gradient floodplains and areas where sufficient water might not be available are an example of where this measure may not be possible. Alternative revegetation methods would be considered to address erosion control.

- Monitor revegetation at the site for an appropriate time (per the Revegetation Plan [Appendix E, Part I] which states monitoring for a minimum of 5 years) to evaluate performance and implement corrective measures, if necessary.
- Logging near streams: Remove all debris that may block stream flow, delay fish passage, contribute to flood damage, or result in a streambed scour or erosion. Logs would not be skidded across any watercourse without approval. No log storage within 300 feet of any watercourse except with approval from the SPCS.

3. Material Sites
   - Site material sites with input from ADF&G, where appropriate; duration of disruption of surface water flows would be minimized
   - Outside of the North Slope, material sites would not be developed in riparian areas and floodplains providing habitat for EFH species, where possible. On the North Slope, the Sagavanirktok River floodplain is the only riverine material site being considered by the proposed Project. AGDC has worked with ADF&G on the possibility of developing sites on the Sagavanirktok River. There is existing access to these sites where material has been previously impacted. If allowed, development here would only occur under the strict guidance of ADF&G and ADNR; if permitted, the proposed Project would follow all mitigative measures required by these overseeing agencies to protect riparian areas and fish habitat.
   - Material sites located in floodplains should not result in fish access to habitats where entrapment and desiccation would likely occur. All floodplain material sites would be sloped and day-lighted to allow fish to leave the site.
   - Material removal activities occurring below the high water mark should avoid mining in flowing waters, active channels and hyporheic zones (areas where there is mixing of shallow groundwater and freshwater).
   - All gravel mining below the ordinary high water level of any fish-bearing rivers would be coordinated with federal and state agencies and comply with all ADF&G permit conditions and stipulations to protect EFH and maintain fish passage, where applicable.
   - Minimize the effects of sedimentation on fish habitat. Use methods such as the construction of settling ponds and curtains to control sediment transport.
   - Monitor turbidity for in-water activities during critical fish life history stages and cease operations if turbidity exceeds predetermined threshold levels.
   - Restore natural contours and use native vegetation to stabilize and restore habitat function, per the ASAP Revegetation Plan (Appendix E, Part I). Monitor the site for an appropriate time to evaluate performance and implement corrective measures if necessary.

- Minimize the aerial extent of ground disturbance (*e.g.*, through phasing of operations) and stabilize disturbed lands to reduce erosion.
- One material site location was requested by ADF&G to provide a launch location for a boat ramp, acute temporary impacts to hydrology and fish habitat would be mitigated by scalping rather than digging deep holes, unless otherwise authorized by ADF&G.
- If material sites are approved adjacent to or in certain lakes, rivers, or streams, the SPCS may require AGDC to construct levees, berms, or other suitable means to protect fish and fish passage and to prevent siltation of streams or lakes.

4. Screens would be used on withdrawal intakes to minimize fish uptake (follow appropriate federal and state guidelines to determine screen sizes).
5. Pile Driving and Installation at West Dock and Aerial Span Stream Crossings
   - Conduct impact driving at a time of year when non-mobile or less-mobile fish stages are not present.
   - Conduct impact driving when non-mobile or less-mobile fish stages are present, use the following mitigation measures:
     - Drive the pile as deep as possible with a vibratory hammer before using the impact hammer.
6. Dredging and Dredge Disposal at West Dock
   - Comply with any USACE and EPA requirements for sediment testing and disposal.
   - Manage disposal sites properly (*e.g.*, inspectors, the use of sediment capping and dredge sequencing) and monitored (*e.g.*, chemical and toxicity testing, benthic recovery) to minimize impacts associated with dredge material.
   - Dredge the marine area through the ice during the winter to minimize sedimentation effects on water quality.
   - Winter disposal would coincide with winter dredging activity. Winter activities would eliminate potential impacts to or conflicts with migratory fish routes.
7. Construction Timing
   - Each water crossing of a fish stream would require a Fish Habitat Permit from ADF&G. The Applicant would comply with site-specific ADF&G permit stipulations designed to protect fish and fish habitat.
   - In-stream pipeline construction would be completed in 1 to 3 days from initiation.
   - Necessary in-water activities would be scheduled when the fewest species/least vulnerable life stages of federally managed species would be present.

8. Stream Bank Stabilization
    - AGDC would collaborate with ADF&G to apply appropriate in-stream bank erosion structures to provide post-construction bank stability and minimize erosion.
    - To minimize erosion after the design grade is obtained, cut slopes would be stabilized immediately (*e.g.,* within 24 hours) after completion of the crossing, and stream banks would be returned to as close to pre-construction conditions as possible. The stream bank elevation should be re-established to tie into existing grade.
    - Bank and bed scour protection would be installed after the proposed pipeline is installed, as part of the trench backfilling. To protect stream banks and beds from scour erosion, site-specific BMPs would be implemented based on scour and erosion potential at each site.
    - Routine inspections would be used to identify areas of erosion, exposed pipeline, and nearby construction activities, to allow for early identification of bank stability problems, and to minimize the potential for continuing environmental effects during pipeline operation.
    - At stream crossings where permafrost persists, incorporate measures to achieve thermal stability as quickly as possible to inhibit thermal erosion and seepage into the pipeline ROW. These may include using additional backfill to account for excess settling if wet permafrost thaws after pipe installation, installing ditch plugs (blocks of tundra or other native sod, bentonite, or other appropriate material), or revegetating to aid in achieving thermal stability of the soil in the trench.
    - Natural materials and bio-engineered techniques would be implemented in engineered structures wherever feasible (*e.g.*, rootwad revetments, branch packing, log walls, live cribwall, boulder clusters, rock riprap revetments, gabion wall, spur dikes).
    - Stream crossing design would not rely on bank armoring or river training works to maintain pipeline integrity without substantive reasoning, such as impractical overbank construction, presence of adjacent facilities, or environmental concerns. If conditions dictate (*e.g.,* excessively steep, unstable banks or excessive flow velocities) engineered bank protection may be required. All engineered bank protection should be designed by the project engineer in consultation with a qualified fluvial geomorphologist and/or qualified fish biologist.
9. Agency Coordination
    - Activity schedules would be coordinated with ADF&G to minimize impacts to fisheries resources.

- ADF&G would apply Blasting Standards stipulations to both anadromous and resident fish stream crossings, as required by AS 16.
- A Fish Habitat Permit from ADF&G may be required for any blasting operations that occur either in or near the banks of a fish-bearing waterbody, as determined by AS 16 jurisdiction.
- Each fish-bearing stream crossing for access roads would be permitted by ADF&G, and work would be performed to comply with Title 16 permit stipulations.
- Construction activities would comply with all ADEC water quality regulations during construction.
- ADF&G and fisheries scientists would be consulted on installation of access road culverts and bridges, West Dock impacts, and proposed pipeline stream crossings. AGDC would be required to obtain a Fish Habitat Permit from ADF&G and would refer to ADF&G guidance documents for the design and maintenance of stream crossing structures.
- In areas where a lease is required from the SPCS or federal grant of ROW from BLM:
  - All proposed pipeline activities would be conducted as to ensure free passage and movement of fish in streams designated by SPCS/BLM, in consultation with ADF&G. Temporary blockages of fish necessitated by in-stream activities would be approved by ADF&G.
  - Pump intakes would be screened to prevent harm to fish and screening specifications approved by SPCS/BLM.
  - When abandoned, water diversion structures would be removed or plugged and stabilized unless otherwise approved by SPCS/BLM.

10. Water Quality

- Wastewater discharge locations would be planned at locations that avoid waterbodies and during periods that minimize potential impacts to fishery resources. Hydrostatic testing would occur in a manner that eliminates the potential for freeze depressants to be inadvertently discharged into a fish-bearing waterbody, as none would be used.
- As required by 40 CFR 112, AGDC would have an approved SPCC Plan before construction.
- No freeze depressants would be discharged into any streams.
- To the maximum extent practicable, locate fueling and fuel storage at least 100 feet from fish-bearing streams and waterbodies. When conditions require refueling within 100 feet of waterbodies, the contractor must implement a preapproved SPCC Plan.

11. Stream Crossings

- Use construction materials that do not introduce sediment or other harmful substances into waters when using IOC.
- Use existing bridges, where feasible.
- Use HDD or other trenchless technology to minimize disturbance to waterbodies, where feasible.
- Position flume pipe system discharges to prevent erosion or scouring.
- Use temporary bridges for transportation, unless the bridge would be necessary for operations and maintenance, in which case the bridge would be left in place. All other bridges would be removed.
- Avoid constructing crossings where redds (nests of fish eggs) are present; implement standard BMPs to protect any downstream habitats.
- IOC methods using flumes would only be used in waterbodies with flows that would not exceed the capacity of the flume.
- IOC crossings using pumps would only be used for stream crossings where pumps could adequately transfer streamflow volumes around the work area and there are no concerns about sensitive species passage.
- For all crossing methods requiring a pump (*e.g.*, IOC and OC methods), appropriate fish screening to minimize entrapment of fishes would be used.
- Stream simulation culverts, at least as wide as the crossing site, would be used at all road crossings too small to feasibly construct a bridge, in accordance with ADF&G consultation.
- Stream crossings using HDD would have the entry and exit workspaces set back from the waterbody to reduce the risk of drilling mud entering the stream.
- HDD drilling mud and slurry would be stored away from the waterbody in tanks, behind earthen berms, or by other methods that would prevent it from flowing off the work area.
- HDD activities would be continually monitored to immediately detect if any inadvertent release of drilling mud has occurred.
- Drill cuttings and drilling mud would be disposed of according to the discharge permit issued by ADEC.
- AGDC would comply with the requirements of Alaska Statutes (AS) (§16.05.841, Fishway Required, and §16.05.871, Protection of Fish and Game) regarding proposed Project-related winter ice-bridge crossings and summer ford crossings of all anadromous and resident fish streams.

- If necessary for winter ice-bridge crossings, natural ice thickness could be augmented if site-specific conditions, including water depth, are suitable for a crossing that would protect fish habitat and maintain fish passage.
- Maintain, to the maximum extent practicable, existing temperature and stream hydrologic regimes at fish stream crossings.

o Timing, location and mode of stream crossings would be selected, to the degree practicable, as determined by AGDC, to minimize impacts to fish and fish habitat.

12. Project Management Plans

o The following Project Management Plans would be developed prior to construction activities to guide the proposed Project activities during construction and operations. The goal of these plans would be to protect fish and fish habitat by creating standardized guidelines for minimizing noise disturbance; ensuring proper revegetation and reclamation of disturbed riparian and stream site areas; limiting erosion and sedimentation to streams; ensuring proper handling and disposal of waste; and minimizing the spread of aquatic invasive species.

- Blasting Control Plan, as required by the SPCS, and in compliance with ADF&G blasting regulations (Timothy, 2013)
- Revegetation Plan (Appendix E, Part I)
- SWPPP, as required by 18 AAC 83
- Fugitive Dust Control Plan

13. West Dock and Vessel Operations

o To stabilize the barges during offload at DH3, barges would be ballasted to the seafloor. This would require internal barge compartments to be filled with seawater by using portable pumps and hoses inserted into utility holes on the barge decks. Stability would be verified before the modules are offloaded.

o A rotational three-barge offload would be implemented during GCF module offload to minimize the total offload time and reduce environmental impacts:

o Modules would be moved from the barges onto DH3 using SPMTs

o Before the SPMTs are put into operation, all components would be checked for leaks and pressure-tested to the maximum operating pressure. Hoses would be wrapped in absorbent material, and drip trays would be placed under the power packs.

o Extra absorbent material and absorbent booms would be available for each SPMT unit used while in transit.

o During vessel operations:

- Minimize contamination from vessel bilge waters, antifouling paints, shipboard accidents, shipyard work, maintenance dredging and disposal, and nonpoint source contaminants from upland facilities related to vessel operations and navigation;
- Maintain the barge-bridge system in place the minimum time period needed to offload the modules each open water season.

4.11.3.2. Agency-Recommended Mitigation Measures

A variety of mitigation measures and best practices have been recommended by the cooperating agencies (Appendix M). Many of these recommendations have been incorporated in the proposed Project and are included in Table 4.11-3 below. The impacts discussed in this chapter are based upon the Applicant-proposed measures. These additional agency recommended measures are not included in the impact analysis.

Table 4.11-3 Fish Resources Agency-Recommended Mitigation Measures

Additional Measure Consideration	Agency Proposing Mitigation Measure	Agency Jurisdiction	Authority (*i.e.*, CWA, RHA, ESA)	Affected Resources	Comment Code
Include specific fugitive dust control measures, such as speed limits and frequency of watering during non-winter months, that would be implemented to achieve control limits.	EPA	EPA, ADEC	--	Vegetation, Wetlands, Fish, Public Health, Air Quality	MIT_34
(1) Waterway crossings should be designed, constructed, and installed according to the Anadromous Salmonid Passage Facility Design (NMFS, 2011), (2) bridges and culverts span waterways to not restrict adequate fish passage and to retain full access to spawning areas where streams are braided, and (3) all crossings should be based on site-specific information, such as anadromy, seasonal instream flows and peak discharge, and floodplain regime (50-year to 100-year flood events).	NFMS	USFWS, ADF&G	Fish and Wildlife Coordination Act, Fish and Wildlife Conservation Act, Anadromous Fish Act	Water, Fish	FISH_4
Include considering fish and wildlife habitat needs in all reclamation work and provide new beneficial habitat in areas where the original habitat type cannot be fully restored.	USFWS	USFWS, ADF&G	Multiple Authorities	Wildlife, Fish	MIT_14
Natural drainage patterns shall be maintained to the extent practicable by the installation of culverts or bridges in sufficient number and size under access roads and trails to prevent ponding, diversion, or concentrated runoff that would result in adverse impacts to adjacent wetlands and other fish and wildlife habitats.	USFWS	USACE, ADF&G ADEC	CWA, RHA	Water, Wetlands, Fish	MIT 15
A large number of Applicant-proposed design features, mitigation measures, BMPs, and project management plans listed in the Draft SEIS contain the language, "In areas where a lease is required from the State Pipeline Coordinator's Section" or "a federal grant of ROW is required from BLM ..." These measures	EPA	--	--	Numerous	MIT_35

Additional Measure Consideration	Agency Proposing Mitigation Measure	Agency Jurisdiction	Authority (*i.e.*, CWA, RHA, ESA)	Affected Resources	Comment Code
generally represent a best management approach that we recommend using to the maximum extent possible along the entire pipeline route, while acknowledging the outstanding need to complete coordination with private landowners.					

AAC = Alaska Administrative Code
ADF&G = Alaska Department of Fish and Game
ADEC = Alaska Department of Environmental Conservation
ADNR = Alaska Department of Natural Resources
AGDC = Alaska Gasline Development Corporation
APDES = Alaska Pollution Discharge Elimination System
BLM = Bureau of Land Management
BMP = Best Management Practice
CAA = Clean Air Act
CWA = Clean Water Act
DHSS = Alaska Department of Health and Social Services
EPA = U.S. Environmental Protection Agency
MBTA = Migratory Bird Treaty Act
NMFS = National Marine Fisheries Service
RHA = Rivers and Harbors Act of 1899
SEIS = Supplemental Environmental Impact Statement
USACE = U.S. Army Corps of Engineers
USFWS = U.S. Fish and Wildlife Service

4.11.4. Alternative 1 – Proposed Action

Alternative 1 is designated the proposed Action (proposed ASAP Project). This alternative is described in Chapter 2 in detail. This section discusses the analysis of impacts of the proposed Project to fish and fish habitat (including designated EFH) associated with Alternative 1. The components of Alternative 1 relevant to fish and fish habitat are summarized below. The proposed construction spread (*i.e.*, schedule) for the pipeline is presented in Chapter 2, Table 2.2-7 (Alternative 1: ASAP Construction Spread Plan). The construction schedule provides important context for understanding how proposed Project activities may interact with fish and fish habitat, particularly during sensitive time periods such as spawning and incubation. The following sections describe potential impacts associated with the proposed Project activities. A summary of impacts from Alternative 1 by impact type are presented in Table 4.11-4.

- Use of DH3 at West Dock and nearshore disposal of dredged material;
- Vibratory pile driving at West DH3;
- Potential blasting near the banks of fish-bearing waterbodies[5];
- HDD at the Yukon River;
- Pipeline would be buried for the extent of the route, except at elevated bridge crossings, fault crossings, pigging facilities, and valves.

The pipeline would cross three major hydrologic regions (Arctic, Interior, and Southcentral). Table 4.7-2 in Section 4.7, Water, presents all of the waterbody crossings and the construction type for each crossing. This section focuses exclusively on impacts to fish-bearing waterbodies.

Table 4.11-4 presents a summary of the number of fish-bearing waterbody impacts by proposed Project component. A total of 186 locations were identified as impacting fish-bearing waterbodies. Most (181) of these waterbody impact locations are crossing locations of the Mainline, Fairbanks Lateral, or access roads. An additional five locations are proposed in-river material extraction sites within the Sagavanirktok River. For a complete list of each waterbody crossed by the Mainline, Fairbanks Lateral, and access roads, see the ASAP Fish Stream List (Appendix J). For each crossing, the Fish Stream List also includes the proposed crossing method; impact type (permanent or temporary); year sampled (if sampled); listing on ADF&G AWC or AFFID; and fish species present in the waterbody.

[5] An ADF&G Fish Habitat Permit would be required for any blasting operations that occur either in or near the banks of a fish-bearing waterbody. A Blasting Control Plan would be developed in accordance with ADF&G blasting regulations (Timothy, 2013) to protect adult fish, juvenile fish, and developing fish eggs when blasting activities occur in or near streams (AGDC, 2016b).

Table 4.11-4 Alternative 1 Impacts to Fish-bearing Waterbodies

Project Component	Total Impact Locations	Anadromous / EFH	Resident / non-EFH	Impact Type
Mainline	147	57	90	Temporary
Fairbanks Lateral	1	0	1	Temporary
Access roads	33	13	20	Permanent
Material extraction (Sagavanirktok River only)	5	5	0	Temporary
Total	**186**	**75**	**111**	--

All of the anadromous streams within the proposed Project Area (with the exception of the Putuligayuk River) are designated as EFH; the non-anadromous fish-bearing waterbodies are considered general habitat supporting resident fish species.

The ASAP EFH Report (Attachment 6 of the ASAP EED; AGDC, 2016b) analyzes potential impacts to fish and EFH within the three hydrologic regions (Arctic, Interior, and Southcentral); and provides detailed figures of EFH waterbodies in each of the three regions along the Alternative 1 route. Impacts to EFH are summarized in the relevant sections below.

4.11.4.1. Construction

This section discusses the potential impacts to fish and fish habitat during proposed Project construction.

4.11.4.1.1. Use of DH3 at West Dock and Nearshore Disposal of Dredged Material

Alternative 1 proposes to use DH3 at West Dock. The following modifications and construction seasons have been defined for the use of West Dock:

- Dredging of a navigation channel and turn basin at West Dock (winter);
- Nearshore disposal of dredge material on bottomfast sea ice in Prudhoe Bay, landward of Territorial Sea Boundary (winter);
- Modification using vibratory pile driving to DH3 berths and widening of the causeway road (winter);
- Temporary bridge composed of two ballasted barges to facilitate offload and transport of large modules (remaining 72.5 feet of cumulative gap space for fish passage) (summer);
- 23-barge sealift importing prefabricated modules (summer).

The construction phase of the West Dock expansion has the potential to temporarily impact fish through direct impacts to marine organisms, increases in turbidity, release of contaminants, introduction of non-native species, and noise disturbance. However, much of the construction would occur in winter, minimizing the likelihood of affecting large populations of nearshore marine and anadromous fish species with the exception of Arctic cod and Saffron cod, which spawn in the winter. Specific activities potentially

impacting fish and fish habitat as a result of proposed Project activities at DH3 at West Dock are summarized below.

4.11.4.1.2. Dredging

Dredging at West Dock is described in detail in Chapter 2. Improvements to West Dock would begin during winter before the sealift arrival and would consist of dredging the navigation channel and turning basin. Barges would require a minimum water depth of 8.5 feet. Therefore, under Alternative 1, there would be a minimum winter dredge depth of -9 feet below the surface and screeding may also be necessary because of the potential for the channel to be infilled by late summer (Niedoroda *et al*., 1980). The proposed dredging and screeding are intended to maintain adequate depth for safe barge movement and to avoid the need for summer maintenance dredging.

Disposal of dredged material would occur in the nearshore environment, on bottomfast ice. Therefore, winter operations would avoid nearshore fish movements, which occur in the West Dock area in the late spring and early summer. However, winter construction would not avoid the Arctic cod and Saffron cod spawning season. Arctic cod feed on crustaceans, worms, small fish, and algae growing on the bottom of sea ice (Jones, 2006). They spawn during the winter under the nearshore pack ice (Pirtle and Mueter, 2011) and use shorefast pack ice to forage and shelter from predators (Pirtle and Mueter, 2011). Saffron cod spawn during the winter and are found under shorefast and nearshore sea ice, especially in areas with substrates of sand and gravel (NPFMC, 2009; Pirtle and Mueter, 2011). Eggs are broadcast dispersed over the bottom and hatch in the spring (Pirtle and Mueter, 2011). The descriptions of EFH for the Prudhoe Bay area identify Arctic cod and Saffron cod, as well as the marine life stages of pink salmon and chum salmon, as inhabiting the marine waters of the proposed Project Area (North Pacific Fishery Management Council [NPFMC], 2009; NPFMC, 2012). For a description of seasonal movement patterns of fish in the vicinity of West Dock see the *Assessment of Late Summer Fish Movements Near West Dock* (Moulton, 2015) provided as Attachment 3 to the ASAP West Dock Dredge and Disposal Plan (AGDC, 2016o).

Approximately 250,000 CYs of dredged material would be placed in the nearshore environment of Prudhoe Bay (see Figure 2.2-5 in Chapter 2). Dredging would be conducted beneath the shorefast ice. Dredged materials would be placed on top of the bottomfast ice in the nearshore areas and would, therefore, enter the water column intermittently as nearshore ice melts in the summer. The dredged material would then be intermittently released into the nearshore waters and sink to the benthic environment in the summer as the bottomfast ice melts. A portion of the dredged material may be transported outside of the proposed Project Area as currents mobilize the melting nearshore ice.

The impacts to fish resources from dredged material removal, disposal and increased turbidity would be expected to be minor, given the implementation of Mitigation Measure No. 6, listed in Section 4.11.3. Many species forage on benthic organisms that

may be removed or buried during dredging, dredge disposal, and placement of gravel. The impact of removal or burial of benthic organisms is expected to be minor, as the impacted areas are shallow and generally known to contain few biologically significant communities due to the presence of bottomfast ice for much of the year. In addition, during the ice-free open water season, nearshore sediments are repeatedly disturbed and mobilized by wave action from the coastal winds prevalent in the proposed Project Area. This wave action results in the continuous transport and redistribution of nearshore sediments along the coastline during the ice-free season. Therefore, fish species in this area are likely to be adapted to these processes, which disturb and redeposit sediments and benthic organisms regularly. For this reason, impacts to fish due to changes in prey distribution would likely be minor because of the short duration (*i.e.*, one summer).

Both Arctic cod and Saffron cod may be impacted during winter dredging. However, the dredging process is temporary and isolated to a specific lane at DH 3. The impact may cause periodic, temporary, or short-term changes that are likely reversed in one reproductive season. For this reason, impacts to fish due to winter dredging would likely be minor because of the short duration and isolated location (*i.e.*, one winter).

4.11.4.1.3. Construction of Bridges and Barges

As noted above, much of the construction would occur in winter, but a temporary bridge comprising two barges would be used to support and offload GCF modules in the ice-free summer season. The temporary bridge barge and offloading barges would be ballasted to the seafloor. Sheet piling and gravel would be used to develop abutments that would connect the temporary bridge to each side of the causeway breach. Constructing the temporary bridge from barges at the proposed time (beginning on August 1) and for the proposed duration (21 to 39 days) is not expected to have a substantial impact on fish movements (see Appendix F) (Moulton, 2015). Impacts on fish populations attributed to the temporary barge bridge are likely to be minor due to the following: the timing of bridge placement, the location and movements of migratory fish at the time the temporary bridge is used, the relatively short length of time the bridge would be in place (August 1 to mid-September), the remaining 72.5 feet of cumulative gap space for fish passage and water flow, and the fact that fish also move around the Seawater Treatment Plant at the terminus of West Dock during the fall migration (Moulton, 2015). Water would be pumped to stabilize barges; as with all other proposed Project water withdrawals, all water intakes would be equipped with properly sized screens to avoid fish entrainment.

Ballast water is a major source of non-native species introduction to aquatic ecosystems. Potential risk of invasive species would be minimized by using only local seawater during this process. Additionally, all ballast compartments would have been cleaned and verified by a Marine Warranty Surveyor prior to arrival at Prudhoe Bay (Appendix F); therefore, the likelihood of impacts to fish from invasive marine species is likely minor.

4.11.4.1.4. Pile Driving

For the marine construction activities, noise disturbance is primarily a concern with pile driving, vessel operations, dredging and screeding. According to NMFS (2014), fish often react to sounds, especially low frequency strong or intermittent sounds. Sound pulses at 180 dB may cause noticeable changes in fish behavior (Chapman and Hawkins, 1969; Pearson *et al*., 1992; Skalski *et al*., 1992 as cited in NMFS 2014). For pile driving activities, which are planned prior to the sealift, the use of vibratory methods rather than impact hammers would be used whenever possible to help mitigate sound impacts. Where vibratory methods are not possible and impact methods are required, Mitigation Measure No. 5, listed in Section 4.11.3, would be implemented to minimize noise impacts.

4.11.4.1.5. Vessel Use

The West Dock facility is commonly used to offload cargo in support of Prudhoe Bay oilfield activities. Although vessel traffic by itself does not represent an activity that is considered harmful to fish, there is an increased potential for release of contaminates into the aquatic environment with increased vessel use. During vessel operations, BMPs would be used to minimize the potential for contaminants to enter the aquatic environment, as described in Mitigation Measure No. 11, listed in Section 4.11.3 and provided in Appendix M. Additionally, the short duration of increased vessel activity at West Dock would reduce the likelihood of potential contaminant releases to the environment. Impacts on fish resources from vessel use at the West Dock facility are expected to be minor.

4.11.4.1.6. Water Withdrawals

Significant quantities of water would be used during proposed Project construction to maintain ice roads in the Arctic region, to supply construction camps; and for material compaction, dust abatement, hydrostatic testing of the pipeline, HDD at stream crossings and a variety of other uses. Water may be withdrawn from freshwater lakes, rivers, and streams throughout the three hydrologic regions. Estimated water withdrawal volumes are provided in Section 4.7, Water.

For the proposed Project, all pipeline hydrostatic testing would take place during the summer. This would avoid impacts to fish in overwintering areas. Summer hydrostatic testing also eliminates the need for antifreeze in the water. The water would either be recycled for use in another hydrostatic test segment of pipeline, or it would be released in accordance with ADEC disposal and discharge limits.

For HDD, there are seven streams selected for water sources. All of these streams are designated as anadromous and EFH. Three of these are rivers and creeks (Nenana River, Kashwitna River, and Willow Creek) would be used for water withdrawal in winter. The usual water source for the HDD is the waterbody that the HDD is crossing, but may

come from other sources depending on the water use permit from ADNR and the guidelines from ADF&G.

Overwintering has been identified as an especially sensitive period for fish inhabiting the Arctic and subarctic freshwater environments (Power, 1997; Reynolds, 1997; Moulton and George, 2000). Fish are susceptible to decreased oxygen levels from water withdrawals during winter months, when lakes are covered by ice. Ice thickness limits the amount of available habitat for overwintering fish when compared with open-water periods (Cott *et al*., 2008). At any fish-bearing crossing, fish and invertebrates could also be killed or injured through mechanical stress, entrainment in withdrawn waters and impingement on intake structures.

To reduce the potential for adverse effects on fish, ADF&G requires a Title 16 permit for water withdrawals in overwintering areas. This permit would limit water withdrawals from fish-bearing waterbodies, and regulate intake screen sizes to minimize potential entrainment in intake structures. Winter water withdrawal proposals are carefully reviewed and permitted by ADF&G and ADNR for all water withdrawal in fish-bearing water. Winter water withdrawal from the Arctic region's flowing waters (streams and rivers) is generally not permitted by ADF&G to protect critical overwintering fish habitat. However, water withdrawals from Arctic region lakes are permitted by ADF&G and ADNR, but must follow strict criteria discussed in the 2012 FEIS (USACE, 2012a). The Interior and Southcentral regions have differing criteria, but also require a Title 16 permit.

With BMPs, such as compliance with rigorous ADF&G and ADNR water withdraw permits, and implementation of Mitigation Measure Nos. 1 and 4, listed in Section 4.11.3 and Appendix M, the impacts to fish populations from water withdraw activities is likely to be site-specific and minor.

4.11.4.1.7. Ice Roads

Ice roads would be constructed in the Arctic and Interior regions and ice bridges could persist across rivers and streams from ice road use. As described in the 2012 FEIS, ice bridges may melt slowly and could delay fish movements, cause flooding of riparian and fish habitats, and change invertebrate community structure.

Ice road construction across all fish-bearing streams would require an ADF&G Title 16 permit, with stipulations to minimize impacts to fishery resources. AGDC would work with ADF&G to determine site-specific ice bridge planning. For example, if necessary for winter ice-bridge crossings, natural ice thickness could be augmented (through snow removal and water application to increase ice thickness, or other techniques) if site-specific conditions, including water depth, are suitable for a crossing that would protect fish habitat and maintain fish passage as described in Mitigation Measure No. 12, listed in Section 4.11.3. Thus impacts to fishery resources are expected to be temporary and site-specific with minor impacts.

4.11.4.1.8. Mainline Pipeline

Construction impacts of the Mainline pipeline are discussed individually by potential impact type below. The pipeline construction would be conducted in a manner and during a time period to avoid or minimize potential effects on fisheries resources and EFH and apply the following mitigation measures:

- Each water crossing would be individually permitted and all in-stream pipeline crossing construction methods would avoid or minimize impacts during the anadromous and resident fish migration and spawning time periods for in-stream work (see Mitigation Measure No. 7, listed in Section 4.11.3).
- In-stream pipeline construction would be completed in 1 to 3 days from initiation (see Mitigation Measure No. 7, listed in Section 4.11.3).
- Necessary in-water activities would be scheduled when the fewest species/least vulnerable life stages of federally managed species would be present (see Mitigation Measure No. 7, listed in Section 4.11.3).

4.11.4.1.8.1. Stream Crossings

The pipeline alignment changes since publication of the 2012 FEIS have resulted in a decrease of total stream crossings (fish-bearing or non-fish-bearing) from 515 to 310 stream crossings for Alternative 1 (USACE, 2012a). This route would cross an estimated 147 fish-bearing waterbodies on the Mainline. The crossing method for each waterbody, as well as fish species present, is presented in the Fish Stream List (Appendix J). ADF&G requires a Fish Habitat Permit under AS, Title 16 Department of Fish and Game, for impacting freshwater habitat in streams and rivers that support anadromous and resident fish. Each stream crossing would be individually permitted under AS 16.05.840-871 and work would be performed to comply under these permits. Mitigation Measure Nos. 8 and 9 (listed in Section 4.11.3 and Appendix M) would help to minimize and avoid impacts from stream crossings on fish and fish habitat.

All pipeline stream crossings are considered a temporary impact to waterbodies, and in turn to fish and fish habitat, as impacts would be reclaimed after construction. Although temporary, the placement of buried pipeline across these fish-bearing waterbodies during construction is likely to have the greatest potential effect to the fish resources from proposed Project activities. The degree of construction-related impacts to fish would depend on the type of crossing method used, the timing of construction, duration of in-stream activity, life stage and type of fish present and the mitigation measures implemented.

Stream crossing modes have been proposed for each waterbody using one of the four crossing methods, as described in Chapter 2: OC, IOC, aerial spans or bridge crossings, and trenchless drilling using HDD. Crossing methods for each waterbody are presented in the Fish Stream List (Appendix J). The crossing locations have been selected by hydrologist and were based primarily on optimal hydrologic and geomorphologic

conditions for pipeline integrity, while also taking into account fish habitat. Any blasting that would occur near waterbodies would be conducted under a Fish Habitat Permit from ADF&G. A Blasting Control Plan would be developed in accordance with the most recent ADF&G blasting regulations (Timothy, 2013) to protect adult fish, juvenile fish, and developing fish eggs when blasting activities occur in or near streams (AGDC, 2016b). Potential impacts resulting from each of the crossing methods are discussed below.

The proposed construction timing would influence the degree of impact on fish and fish habitat (see ASAP Construction Spread Plan dated January 19, 2018). While winter construction that occurs in dry or frozen streams would have the least impact on fish, eggs, or alevin, it is possible that redds and their eggs could be crushed during winter construction. Placement of stream crossings in the Arctic region (specifically, MP 0 – MP 62) would occur primarily during the winter months or as stipulated under Title 16 permits, to protect the sensitive rivers and streams. Additionally, as a stipulation, all known overwintering fish habitat would be avoided. Overwintering fish habitat would be identified through close coordination with ADF&G, and review of existing fish distribution data.

The fish resources in the Interior and Southcentral hydroregion drainages may receive more potential impacts from construction activities due to the proposed primarily non-winter construction schedule versus the primarily winter schedule in the Arctic region. The potential likelihood of impacts from in stream construction would increase as a result of more open water fish habitat in the summer, and the increased presence of spawning fish. The exception is that the most southern portion of the pipeline, from the Susitna River crossing (MP 675) to the terminus, is proposed to be constructed during the winter.

4.11.4.1.8.2. Open-Cut and Isolated Open-Cut

OC and IOC crossing methods are proposed for both anadromous and resident fish-bearing waterbodies. The OC crossing method involves excavation of the pipeline trench across the waterbody, installation of a prefabricated segment of pipeline, and backfilling the trench with originally excavated soils and the surface layer. The OC crossings are usually for smaller streams and could be completed in winter or summer. The IOCs method isolates the open trench from the flowing water of the stream prior to and during the installation. The IOC crossings could be completed in winter or summer and are usually applied to crossings with more water than OC streams.

Crossings by OC and IOC methods could cause the following temporary impacts to fish resources: direct mortality to fish, fry, or incubating eggs; temporarily impeded fish passage; contaminant spills; erosion; sedimentation; alteration of stream habitat; impacts to riparian vegetation; increased noise; and impacts to water quality. These impacts are discussed in detail in the ASAP EFH Report (Attachment 6 of the EED; AGDC, 2016b).

The extent of these OC and IOC impacts would be mitigated by the implementation of project management plans, BMPs, and permit stipulations, as described here (see also Appendix M for additional detail). Prior to construction, a Stormwater Pollution Prevention Plan would be developed, as required by 18 AAC 83 to minimize erosion and sediment transport. Revegetation of stream banks would follow the proposed Project's Revegetation Plan (Appendix E, Part I); AGDC would collaborate with ADF&G on in-stream bank erosion structures and follow ADNR's Revegetation Manual and Stabilization, Rehabilitation, and Restoration Plan to return stream crossing sites to as close to pre-construction conditions as possible.

BMPs proposed for construction of stream crossings are presented in Mitigation Measure Nos. 1, 2, 7, 8, 9, 10, and 12, listed in Section 4.11.3, and in Appendix M. Assuming the proper implementation of management plans, BMPs, and permit stipulations, habitat impacts due to OC and IOC crossings are expected to be minor, as they would be temporary, geographically localized (*e.g.*, at the crossing and in a limited extent downstream); and limited to a small number of fish or redds (*i.e.*, spawning nest).

4.11.4.1.8.3. Aerial Span

Aerial spans constructed on either new or existing bridges have been proposed for crossing of six fish-bearing waterbodies along the Mainline (see the Fish Stream List, Appendix J) including: the Putuligayuk River (MP 3.1), Nenana River (MP 530.9), Lynx Creek (MP 536.7), Nenana River (MP 558.6), Susitna River (MP 637.5), and Montana Creek (MP 680.7). Existing bridges may be used for the proposed aerial span crossings of the Nenana River and the Susitna River.

Pile driving associated with new bridge construction could result in injury or disturbance to fish in the immediate vicinity of pile driving activity. BMPs such as the use of vibratory methods rather than impact hammers, and specific timing of pile driving to avoid sensitive periods for fish (*e.g.*, spawning and incubation) would minimize the number of fish exposed (Mitigation Measure No. 5, listed in Section 4.11.3). Behavioral responses due to noise disturbance could result in fish fleeing the area, stress, or auditory masking. Effects of masking could impact the ability of fish to communicate acoustically or perceive auditory inputs (Fay and Popper, 2012). Bridge crossings would be designed to provide natural hydro-geomorphic processes within the stream or river flood plain, promote natural sediment transport, allow natural debris movement, and maintain functional longitudinal continuity and connectivity of the watershed. No footings or piles would be placed below the ordinary high-water mark for bridge construction at any stream crossing.

Each aerial span over fish-bearing waters would be individually permitted under Title 16 with work compliant under that permit. Assuming BMPs and stipulations are followed, impacts to fish from aerial spans are expected to be isolated, temporary, and minor.

Implementation of Mitigation Measure Nos. 1, 2, 5, 7, 9, 10, and 12 (Section 4.11.3) would help to minimize impacts during construction of aerial span stream crossings. Assuming the proper implementation of management plans, BMPs, and permit stipulations, habitat impacts due to the construction of aerial span crossings are expected to be minor. The impacts would be temporary, geographically localized (*e.g.*, at the crossing and in a limited extent downstream); and limited to a small number of fish or redds (spawning nests).

4.11.4.1.8.4. Horizontal Directional Drilling

HDD is a trenchless crossing method that may be used to avoid direct impacts to waterbodies by directionally drilling beneath them. HDD involves installation of the pipeline beneath the ground surface by pulling the pipeline through a pre-drilled bore hole. This method works best for large waterbodies or in areas with exceptionally vulnerable ecosystems. AGDC proposes to use trenchless methods (likely HDD) at nine anadromous waterbody crossings (see the Fish Stream List provided as Appendix J) including: the Yukon River (also described separately below), Tanana River, Honolulu Creek, Troublesome Creek, Chulitna River, Kashwitna River, Willow Creek, and two unnamed creeks located just south of Willow Creek.

Impacts to fish resources from HDD could occur if contaminants, such as drilling fluids, are unintentionally released into surface waters (drill mud seepage) due to site geological conditions or if drilling fluids are not properly contained or disposed (58 FR 15284). Drilling mud seepage could occur in the presence of permeable zones with minimum cover between the drill path and the bed of the waterway and is most common in large-diameter pipelines (>24 inches) (see Pipeline Stream Crossing Mode Determination, Attachment 11 of the EED [AGDC, 2016b]). Containment of drilling fluid in aquatic environments (wetlands) are often difficult because drilling fluid readily disperses in flowing water and quickly settles in standing water. In addition to strict engineering and design BMPs, AGDC would develop and implement contingency plans for all HDD operations and would include, but are not limited to:

- HDD entry and exit workspaces set back at least 50 feet from the waterbody to reduce the risk of drilling mud entering the stream (Mitigation Measure No. 11, listed in Section 4.11.3).
- HDD drilling mud and slurry would be stored away from the waterbody in tanks, behind earthen berms, or by other methods that would prevent it from flowing off the work area (Mitigation Measure No. 12, listed in Section 4.11.3).
- HDD activities would be continually monitored to immediately detect if any inadvertent release of drilling mud has occurred (Mitigation Measure No. 12, listed in Section 4.11.3).

Impacts from HDD stream crossing are considered negligible to minor, assuming all mitigation measures and BMPs associated with HDD are followed.

4.11.4.1.8.5. Yukon River Crossing

As described in Chapter 2, Alternative 1 includes a crossing at the Yukon River using HDD. The proposed HDD crossing of the Yukon River would reduce potential impacts from a bridged crossing alternative, which was the preferred crossing method discussed in the 2012 FEIS (USACE, 2012a). A successful HDD crossing of the Yukon River would not require water work in the river channel or associated impacts. TWs associated with construction of the aerial crossing would be set back at least 50 feet from all waterbodies when practical, and no less than 30 feet from the water's edge when approved. All mitigation measures and BMPs described above would be applied for the HDD crossing of the Yukon River. Therefore, impacts to the fish and fish habitat in the river are considered negligible to minor.

4.11.4.1.8.6. Hydrostatic Testing and Wastewater Discharge

Water sources or discharge locations for hydrostatic testing have not been identified and thus impacts to fish cannot be fully analyzed. Impacts and BMPs for hydrostatic water withdrawals are the same as described in Section 4.11.4.1.6, Water Withdrawals. Discharges would comply with APDES procedure and permit requirements. Test water releases would either be recycled for use in another hydrostatic test segment of pipeline, or it would be released in accordance with ADEC disposal and discharge permits. No hydrostatic testing is planned for winter months; therefore, no freeze depressants would be required.

Effects to fish resources from hydrostatic testing and wastewater discharge are expected to be short-term, site-specific, and therefore, result in minor impacts.

4.11.4.1.8.7. Contaminants

The potential for the introduction of contaminants to waterbodies is present for all of the proposed Project activities. To minimize the potential introduction of contaminants during all construction activities, AGDC would have an approved SPCC Plan before construction and in accordance with all pertinent regulations and would follow BMPs. The SPCC Plan would identify material handling procedures and storage requirements and outline the actions to reduce spill potential including locating material storage, refueling activity, fuel, and related liquid storage at least 100 feet from the bank of a fish stream. The likelihood of a large spill is quite low given the measures proposed to minimize the potential for such an event. If a spill did occur, there could be direct mortality of fish (including all life stages and eggs), fish habitat or EFH could become contaminated, and therefore, not available to local fish, or fish prey could be contaminated or killed. However, given the low likelihood of contamination reaching waterbodies where fish could be affected, the potential effects are considered minor.

4.11.4.1.8.8. Pipe Burial and Temperature in Permafrost Areas

In Alternative 1, the pipeline would be buried in most areas except at specified locations, such as pigging facilities, block valves, fault crossings, and aerial crossings. As such, the

pipeline would require specific design considerations to protect the thermal stability of the surrounding soil and water, and any associated waterbodies, which would in turn protect fish and fish habitat. As described in Chapter 2, Alternatives, the pipeline is referred to as an 'ambient' pipeline, indicating that the gas temperature would reflect the surrounding subsurface thermal conditions. The pipeline would operate at below-freezing temperatures in predominantly permafrost terrains to protect the thermal stability of the surrounding soil. Similarly, the pipeline would operate at above-freezing temperatures in predominantly thawed settings so as to not create frost-bulbs around the pipe, which could lead to frost-heave displacement or adverse hydraulic impacts on drainages. The pipeline operating temperature would be governed by the combined influence of Joule-Thompson cooling associated with gas pressure drop and pipe-wall heat transfer between the gas pipeline and surrounding soil.

The north-south alignment of a buried pipe through wetlands helps to minimize impediments to the general direction of North Slope sheet water flow (south to north), and additional constructed mitigation measures, such as ditch plugs, would be used to avoid a French drain effect. By minimizing hydrologic impacts to wetlands, these measures would in turn minimize impacts to riverine and lacustrine wetlands that may provide fish habitat.

4.11.4.1.9. Fairbanks Lateral

The Fairbanks Lateral tie-in would be located approximately 2.5 miles south of the Mainline Chatanika River crossing at MP 440 of the Mainline. From the tie-in, the Fairbanks Lateral pipeline would traverse east, following the Murphy Dome and Old Murphy Dome Roads, and then extending southeast into Fairbanks. This re-route has reduced the number of fish-bearing waterbodies crossed by the Fairbanks Lateral pipeline to one waterbody, Goldstream Creek, which is not anadromous, but contains resident species, including Arctic grayling (Appendix J). Potential effects to fish and fish habitat at the Goldstream Creek IOC crossing are the same as described for all other IOC crossings, including direct mortality to fish, fry, or incubating eggs; temporarily impeded fish passage; contaminant spills; erosion; sedimentation; alteration of stream habitat; impacts to riparian vegetation; increased noise; and impacts to water quality. These impacts are discussed in detail in the ASAP EFH Report (Attachment 6 of the EED; AGDC, 2016b).

Any construction work would follow stipulations of a Title 16 permit for the proposed IOC crossing at Goldstream Creek. Given the single crossing of a fish-bearing stream, the effects to fish and fish habitat from construction of the Fairbanks Lateral would be site-specific, temporary, and considered minor. In addition, all of the management plans and BMPs described above for the Mainline would be implemented for construction of the Fairbanks Lateral.

4.11.4.1.10. Access Roads

The access roads would result in culverts (pipes) or bridges being placed in or over 33 fish-bearing waterbodies, 13 of which are anadromous (Appendix J) and designated as EFH. Culverts and bridges constructed for temporary access roads would be removed after construction (AGDC, 2016i). Regardless of whether the structure was removed, all bridges would be considered a temporary impact (causing impact only during bridge construction), while culverts would be considered a permanent impact to the waterbody. Potential implications for fish and fish habitat are described below. Mitigation measures and BMPs proposed to minimize impacts of access road construction on fish and fish habitat are presented in Section 4.11.3 above, and provided in Appendix M.

During road construction, in-stream habitat would be temporarily lost from water diversion to facilitate installation of culverts. Construction of crossings could also temporarily increase sedimentation and turbidity. Implementing stream simulation culverts in tributary streams would alleviate many impacts to fish from geomorphologic alteration. Stream simulation culverts replicate the geomorphology of the stream by maintaining stream width, slope, velocity, channel structure, hydraulic conditions, and bed composition. Stream simulation culverts, at least as wide as the crossing site, would be used at all road crossings too small to feasibly construct a bridge, in accordance with ADF&G consultation. Bridge crossings would be designed to provide natural hydro-geomorphic processes within the stream or river flood plain, promote natural sediment transport, allow natural debris movement, and maintain functional longitudinal continuity and connectivity of the watershed. All temporary or permanent culverts and bridge in fish streams would require Title 16 permits from ADF&G and would be required to maintain fish passage.

Access roads would be designed so as not to alter surface hydrology, ensuring the waterbody crossing structure is sized appropriately. As stated above, some long-term habitat alteration for fish would likely be inevitable; although adhering to permit stipulations and continued coordination with agencies would reduce the effects of habitat alterations and likely result in minor impacts.

Access roads could increase accessibility to previously isolated fish habitat increasing fishing pressure and potential release of contaminants or non-native species. Airborne dust resulting from vehicle traffic along access roads is a potential source of sediment introduction into streams. If necessary, the proposed Project would perform dust suppression BMPs (locations and water sources are to be determined). BMPs such as blocking or removing access roads after construction would help prevent fishers from using roads as a travel corridor.

Assuming the proper implementation of management plans, BMPs, and permit stipulations, habitat impacts due to the construction of access roads and crossings are expected to be minor. Impacts due to construction of access roads are expected to be temporary (during construction); geographically limited to the crossing location and a

limited extent downstream; and given the limited geographic extent are expected to impact only individual fish or redds.

4.11.4.1.11. Material Sites

A number of material sites have been identified that are associated with rivers and streams including the Sagavanirktok River, the Dietrich River, Middle Fork Koyukuk River, and Chulitna River (AGDC, 2016b). Five material extraction sites have been proposed for the Sagavanirktok River. In addition, limited removal of gravel in some areas within ordinary high water boundaries or in some small drainage would occur during the construction phase. Effects associated with material mining are expected to be site-specific such that no population level effects would be likely. Therefore, effects of material sites on fish and fish habitat would likely be minor. All gravel mining below the ordinary high water level of any fish-bearing rivers would be subject to federal and state agency review, would be coordinated with ADF&G, and would comply with all ADF&G permit conditions and stipulations to protect EFH. Any gravel removal would have short-term and temporary effects on surface water hydrology in the immediate vicinity of the removal site. AGDC continues to work with agencies to avoid fish habitat for these selected sites to minimize impacts to water quality and aquatic species while making use of the available material.

For all material extraction sites, AGDC would follow standard BMPs to minimize effects of sedimentation, habitat alteration, and disturbances to fish during critical life history stages as outlined in Appendix M. Mitigation measures and BMPs proposed to minimize impacts of the material extraction sites on fish and fish habitat are presented in Section 4.11.3 above.

4.11.4.2. Operations and Maintenance

4.11.4.2.1. West Dock Operations Activities

After construction, the barge and temporary barge bridge would depart from West Dock, while all other modifications would be left in place as their removal would result in greater disturbance to the surrounding environment including fish. The piling and infrastructure forming the offshoot and ramp to the temporary barge bridge would be left in place rather than pulling it out as this may result in erosion or weakening of the existing causeway. Mooring pilings would be cut below the sediment surface and removed, and then covered with surrounding sediment. The gravel layer placed under the temporary barge bridge would be left in place and covered with sediment after a short amount of time as nearshore sediments are repeatedly disturbed and mobilized by wave action from the coastal winds prevalent in the proposed Project Area. This wave action results in the continuous transport and redistribution of nearshore sediments along the coastline during the ice-free season. Given their limited footprint, impacts from these DH3 modifications are expected to be negligible given the relatively low level and localized propagation of underwater noise expected from cutting pilings. Although

the structures left in place would be permanent, they are not likely to have any effect on fish or fish habitat. Therefore, the potential effects of operations at West Dock on fish or fish habitat would be negligible under Alternative 1.

4.11.4.2.2. Maintenance of the ROW and Access Roads

During operation of the proposed Project, vegetation would be maintained along the ROW to a non-forested state, which would include mowing the riparian vegetation that grows along riverbanks and streams. As noted above, riparian vegetation has several crucial functions in fluvial systems. Outside of the trenchline (which would need to be dug out to install the pipe), vegetation would be cut off at ground level to leave the existing root systems in place to provide streambank stability. Streambanks would be the first areas to be stabilized and revegetated. The viability of the stream at crossing locations would depend on the level of erosion that may occur from regular vegetation maintenance of the ROW or in-stream construction effects. For more information on vegetation control impacts and mitigation, refer to Section 4.8, Vegetation, of this SEIS.

Mowing of the permanent ROW may allow motorized access of ATVs to anadromous streams that were previously inaccessible. This could increase harvest pressure on fisheries populations if not regulated appropriately. ATVs used to cross fish-bearing streams could do substantial damage to in-stream habitat such as altered substrate, increased turbidity, streambank erosion, rutting and altering stream discharge at crossing locations, all of which could reduce productivity of fish species. The proposed Project would be collocated with existing ROWs (*i.e.,* highways, TAPS ROW, and utility lines) the majority of it length. As a result, additional access to anadromous streams beyond what currently exists would be minimal.

Blocked culverts may result from undersized designs or inadequate maintenance to remove debris; however, under BMPs, culverts would be properly sized and maintained.

4.11.4.2.3. Repairs on Pipeline Buried Under Streams

Under Alternative 1, activities such as culvert replacements, modification of stream crossings, and excavations and replacement of pipeline components located near waterbodies, would result in impacts similar to those described for construction activities. When feasible, maintenance activities would be avoided during winter months in areas where overwintering fish may be affected, and during other critical life stages such as migration and spawning. Effective use of ADF&G permit review processes would minimize the adverse effects of normal operations and maintenance along the proposed Project ROW and access roads.

4.11.4.3. Summary of Potential Impacts of Alternative 1 on Fish Resources

Overall impacts of Alternative 1 on fish and fish habitat were determined after consideration of all proposed BMPs and mitigation measures and are discussed in the following sections.

4.11.4.3.1. Construction

Collective impacts from Alternative 1 during construction are considered minor, as most impacts would be temporary (*e.g.*, during construction); geographically limited; would be expected to impact only a small number of fish or redds; and would likely be limited to one reproductive season or less. A summary of impacts of Alternative 1 on fish and fish habitat is provided in Table 4.11-5. Descriptions of mitigation measures are provided in Section 4.11.3, and in Appendix M.

Construction of pipeline crossings (particularly using OC and IOC methods) and access road crossings were identified as causing the primary potential impact to fish and fish habitat, including EFH. Mitigation measures, management plans, and construction timing proposed for the construction of stream crossings would reduce mortality and potential reproductive, growth, and health impacts. Given mitigation measures, impacts to habitat associated with the disturbance at stream crossings would be expected to be limited to the area of the crossing itself, or to a limited area downstream.

Impacts due to the HDD crossing at the Yukon River were expected to be negligible, given the extensive BMPs and mitigation measures to protect water quality in the Yukon River and adjacent wetlands during construction.

Benthic organisms, Arctic cod and Saffron cod are present during winter dredging at DH 3. Benthic organisms may be removed or buried during dredging, dredge disposal, and placement of gravel. The impact of removal or burial of benthic organisms is expected to be minor, as the impacted areas are shallow and generally known to contain few biologically significant communities due to the presence of bottomfast ice for much of the year. Winter is the spawning season for Arctic cod and Saffron cod. However, the activity is temporary and isolated to a specific lane at DH 3. Hence, effects to marine fish and fish habitat during the construction of the modification of West Dock would be expected to be minor, limited to the area of West Dock with temporary impacts that would be reversed over one reproductive season.

4.11.4.3.2. Operations and Maintenance

Impacts to fish and fish habitat from Alternative 1 during operations and maintenance are considered negligible (Table 4.11-5). Potential impacts during operations could include spills of contaminants into waterbodies (considered unlikely); fugitive dust from access roads causing sedimentation in access roads; and potential hydraulic changes caused by bridges and culverts on access roads and pipeline aerial suspension bridges. All of these potential impacts are expected to be mitigated by the Project management plans, design considerations, mitigation measures, BMPs, and permit stipulations.

4.11.5. Alternative 2 – Denali NPP Route Variation

This section discusses and rates the potential impacts of construction and operation of Alternative 2 on fish and fish habitat. Results of the impact ratings are presented in

Table 4.11-5 below. Alternative 2 is described in detail in Chapter 2; the components relevant to fish are summarized below.

- Denali NPP Route Variation;
- Aboveground pipeline mode (MP 0 - MP 62) and belowground (buried) pipeline mode MP 62 – MP 733.5, as well as the Fairbanks Lateral;
- Use of DH2 at West Dock at Prudhoe Bay and ocean disposal of dredged material; and
- Aerial crossing at Yukon River.

Potential impacts to fish and fish habitat related to Alternative 2 are expected to be the same as those described for Alternative 1 above, with the exception that the increased dredged material disposed at West Dock under Alternative 2 may have moderate rather than minor impacts to marine fish and fish habitat as compared to Alternative 1. Specific impacts associated with Alternative 2 proposed Project features are presented in this section.

4.11.5.1. Denali NPP Route Variation

The Denali NPP Route Variation would route the proposed pipeline through an approximately 7-mile segment of Denali NPP between MP 535.8 and MP 543 (Figure 2.4-1). In the northern portion of this route, the pipeline would be constructed within the Parks Highway corridor. The southern portion of this route is not located within an existing ROW corridor.

This proposed pipeline route would have three crossings of fish-bearing streams (two crossings of the Nenana River, and one at Riley Creek), as opposed to six fish-bearing streams along the Alternative 1 route through this section (Lynx Creek, Montana Creek, the Yanert Fork, and three unnamed stream crossings). None of the waterbody crossings through the Denali NPP area or the Alternative 1 route are anadromous or have designated EFH. This route would cross the Nenana River twice (where no crossings were proposed for Alternative 1 in this section). One of the crossings would be constructed using the existing pedestrian bridge downstream of McKinley Village. Routing and design through Denali NPP have attempted to utilize uplands and minimize environmental impacts to fish and fish habitat to the extent practicable. It is not practicable to utilize uplands, for example, at the Nenana River crossing on the southern border of the park. In this location, the stream must be cut and equipment must be allowed to drive on any riparian vegetation. There would be temporary impacts to the stream by placing the pipeline under it. After covering the pipe with material, other sediment and gravel would be re-distributed over the trenchline in the river.

4.11.5.2. West Dock DH2 and Ocean Disposal of Dredged Material

DH2 is located in shallower waters and could not accommodate the weight and offloading of the modules without complete retrofitting, including the addition of a

third berth. Under Alternative 2, the existing channel from DH2 would need to be widened and deepened to the 10-foot depth contour to accommodate large vessels delivering the modules. Bathymetric data suggest the depth at DH2 could require more than 750,000 CYs of dredging to allow for the barges (approximately three times the dredging required at DH3 in Alternative 1). Alternative 2 may also require summer maintenance dredging to keep the channel open for the duration of the mobilization effort.

Under this alternative, dredge material would be disposed of in the ocean in the general location depicted on Figure 2.4-2 in Chapter 2 during the winter on ice. Currently, no specific offshore disposal sites have been designated by EPA near the proposed Project Area; therefore, the exact location would need to be determined based on criteria listed in 40 CFR 220-229. Dispersion of material would occur at break-up. Considering the Alternative 2 disposal site would be farther from shore than Alternative 1, ocean currents, wind and wave action would be expected to disperse dredge material relatively quickly. Still, given the large volume of dredge material that would need to be disposed, a plume in the open ocean could have a localized impact on marine water quality. Given the volume of dredge material to be disposed, species occurring in the area around the ocean disposal site could be affected by the increased turbidity, or limited/non-mobile species or life stages could be smothered, resulting in a moderate impact to fish and fish habitat.

Many species forage on benthic organisms that may be removed during dredging, and placement of gravel. The magnitude of impact of removal of benthic organisms is expected to be minor, as the DH2 dredge area is shallow and generally known to contain few biologically significant communities due to the presence of bottomfast ice for much of the year as described under Alternative 1. In addition, during the ice-free open water season, nearshore sediments are repeatedly disturbed and mobilized by wave action from the coastal winds prevalent in the proposed Project Area. This wave action results in the continuous transport and redistribution of nearshore sediments along the coastline during the ice-free season. Under Alternative 2, moderate impacts to fish and fish habitat would be expected given the volume of dredged material that would be removed as compared to Alternative 1.

4.11.5.3. Aerial Crossing at Yukon River

Alternative 2 includes aerial crossing of the pipeline across the Yukon River using a new suspension bridge. This option was analyzed in detail in the 2012 FEIS (USACE, 2012a) and is carried forward as part of Alternative 2 in the SEIS. No permanent structures, such as footings, would be installed within the Yukon River under this Alternative. Temporary impacts to fish and habitat could result from nearshore construction activities that could disturb soil and cause erosion, as well as from construction equipment that may be required to work within the river during installation of the new suspension bridge. Prior to construction, a SWPPP would be developed in accordance with 18 AAC 83 to minimize erosion. Revegetation of stream banks would follow the

proposed Project's Revegetation Plan (Appendix E, Part I). The implementation of the management plans, and the use of general construction BMPs (such as minimizing riverbank disturbance, immediate stabilization of disturbed river bank, and the use of sediment fence), would be expected to minimize these effects. TWs associated with construction of the aerial crossing would be set back at least 50 feet from all waterbodies when practical, and no less than 30 feet from the water's edge when approved. For these reasons, impacts to fish from construction of the aerial crossing would likely be minor.

4.11.5.4. Aboveground Section (MP 0-62)

Under Alternative 2 the pipeline would be elevated aboveground between MP 0 and MP 62, within the region of the ACP (see Figure 2.4-2) where ice-rich, saturated soils and continuous permafrost are found. The proposed aboveground section would cross five fish-bearing waterbodies (Appendix J). Of these, only the Putuligayuk River is anadromous, but it is not designated EFH, as it does not support salmon[6]. There would be no permanent impacts to these five waterbodies, as the proposed Project would not place VSMs in waterbodies, and all waterbodies would be crossed using aerial suspension. Where the installation of VSMs occurs near a fish-bearing waterbody, construction-related impacts could include soil erosion into streams, increased sedimentation, resulting in impacts to fish habitat. Under Alternative 2, water needs for constructing the ice pads associated with the aboveground portion of the route are approximately 10 percent greater than for the proposed belowground pipe installation. This would result in approximately 10 percent greater water usage. Assuming that installation of VSMs for Alternative 2 results in less ground disturbance than burying the pipeline (as under Alternative 1), fewer impacts to fish-bearing streams overall would be expected for the aboveground section as compared to Alternative 1. Impacts resulting from construction and operation of the above-ground portion of the pipeline would be expected to be minor.

4.11.5.5. Summary of Potential Impacts of Alternative 2 on Fish

Potential impacts to fish and fish habitat related to Alternative 2 are expected to be the same as those described for Alternative 1 above, with the following exceptions related to the difference in proposed Project features between the two alternatives. The increased dredged material disposed at West Dock under Alternative 2 may have moderate rather than minor impacts to marine fish and fish habitat as compared to Alternative 1. The Denali NPP Route Variation stream crossings are expected to cause a temporary impact to fish and fish habitat similar to those proposed in Alternative 1. The placement of the pipeline aboveground on VSMs in the Arctic (MP 0 to MP 62) under Alternative 2 would cause fewer temporary stream crossing impacts. The crossing of the Yukon River using

[6] The Putuligayuk River supports the following anadromous species: Dolly Varden, least cisco, Bering cisco, Arctic cisco, and rainbow trout smelt (Appendix J).

aerial methods under Alternative 2 is expected to have slightly greater impact to fish and fish habitat than the HDD crossing proposed under Alternative 1.

4.11.6. Alternative 3 – No Action

Under Alternative 3 (No Action), the proposed Project would not be constructed or developed, and therefore, no impacts to fish or fish-bearing streams would occur.

4.11.7. Conclusions and Comparison of Alternatives

A summary of the overall rating of proposed Project impacts to fish and fish habitat from the three alternatives is presented in Table 4.11-5, for each of the biological resource effects previously described in Table 4.11-2. Impacts were assessed separately for the construction versus operations periods. The degree of impacts to fish and fish habitat would depend on several factors such as the crossing type, construction timing, fish habitat types, construction techniques, and the effectiveness of the selected conservation measures.

The overall construction impacts from Alternatives 1 and 2 were determined to be minor for each of the biological resource effects. For both alternatives, proposed Project construction could cause site or reach-specific temporary impacts (reversed within a maximum of one reproductive season) to fish (reproduction, growth, health, and distribution) and fish habitat; and to impact a few individuals in a population, but not affect the population. Marine impacts would be caused by the modifications at West Dock, while freshwater impacts would primarily be caused during the construction of the waterbody crossings.

Impacts to fish and fish habitat during operations of Alternatives 1 and 2 were determined to be negligible, limited to the potential (unlikely) contamination due to spills during maintenance activities; fugitive dust from gravel access roads adjacent to waterbodies; and minor hydraulic changes in streams due to permanent structures at crossings (bridges or culverts). All of these potential impacts are expected to be mitigated by the Project Management Plans, design considerations, mitigation measures, BMPs, and permit stipulations.

Alternative 3 would not cause any impacts to fish or fish habitat during construction or operation, and therefore, impacts were rated as negligible.

Table 4.11-5 Comparison of Alternatives Summary for Fisheries (Direct & Indirect)

Biological Resource Effect	Alternative 1		Alternative 2		Alternative 3
	Construction	Operations	Construction	Operations	Construction/ Operations
	Impact Rating		Impact Rating		Impact Rating
Mortality	***Minor***	***Negligible***	***Minor***	***Negligible***	***Negligible***
Reproductive effects/ Growth/Health/ Distribution	***Minor***	***Negligible***	***Minor***	***Negligible***	***Negligible***
Effects to habitat	***Minor***	***Negligible***	***Minor***	***Negligible***	***Negligible***

Figure 4.11-1 illustrates some of the key findings from the impact analysis. The figure intends to provide geographic context for the description of potential impacts of alternatives as described in detail in this section. Although construction impacts for both Alternatives 1 and 2 received an overall rating of minor, each alternative could differentially impact three different areas along the proposed Project route: 1) the marine environment at West Dock; 2) fish habitat between MP 0 and MP 62; and 3) fish habitat between MP 62 and the end of the route.

- Marine environment at West Dock: In the marine environment at West Dock, Alternative 1 would be expected to have less impact on marine fish and fish habitat than Alternative 2, due to less dredging and material disposal required for the use of DH3 at West Dock.
- MP 0-62: In this section, Alternative 2 (aboveground) could potentially have slightly less impact to freshwater fish and fish habitat than Alternative 1 (below ground). The aboveground construction in the Arctic proposed in Alternative 2 would result in no disturbance at crossings for the five fish-bearing streams crossed in that section, as the pipeline would be constructed on VSMs, which would not be placed in fish-bearing waterbodies.
- MP 62-End: Alternative 2 (aerial crossing) could have slightly less impact than Alternative 1 (HDD crossing) as an aerial crossing could reduce the potential for water quality impacts associated with HDD methods. All other impacts for both Alternative 1 and 2 are considered the same for the remainder of this section.

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▲ City or Village

ASAP v6.1 MP 0 - 62 (below ground in Alt 1, above ground in Alt 2)

ASAP v6.1 MP 62 - 733

Fairbanks Lateral v4.1

West Dock Infrastructure

Effect Rating

Major Positive

Moderate Positive

Minor Positive

Negligible

Minor Negative

Moderate Negative

Major Negative

Effect Indicators

MOR: Mortality

RE/G/H/D: Reproductive Effects/ Growth/ Health/ Distribution

HAB: Effects to habitat

Beaufort Sea

MP 0

MP 62

MP 100

MP 200

MP 300

MP 400

MP 500

MP 600

MP 700

MP 733

Marine- West Dock
Construction
MOR
RE/F/H/R
HAB
Operations
MOR
RE/F/H/R
HAB

MP 0-62 (above ground in Alt 2)
Construction
MOR
RE/F/H/R
HAB
Operations
MOR
RE/F/H/R
HAB

MP 62 to end (below ground Alt 1 and 2)
Construction
MOR
RE/F/H/R
HAB
Operations
MOR
RE/F/H/R
HAB

Anaktuvuk Pass
Wiseman
Bettles
Alatna
New Allakaket
Allakaket
Stevens Village
Rampart
Livengood
Minto
Two Rivers
Pleasant Valley
Fairbanks
Four Mile Road
Nenana
Anderson
Ferry
Healy
McKinley Park
Cantwell
Petersville
Talkeetna
Skwentna
Willow
Susitna
Anchorage
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Circle Hot Springs
Big Delta
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Paxson
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Nelchina
Mendeltna

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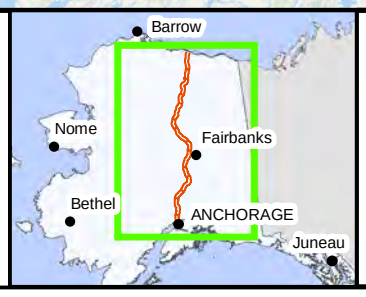
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Figure 4.11-1: FISHERIES IMPACTS CONTEXT MAP ALASKA STAND ALONE PIPELINE

0 25 50 100 150 Miles



N

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4.12. Marine Mammals

4.12.1. Introduction

This section describes the potential direct and indirect effects of the alternatives described in Chapter 2 on marine mammals, with specific focus on the proposed Project Area in the Beaufort Sea near Prudhoe Bay and the southern portion of the proposed Project Area around the Port of Seward. The section provides a summary of the proposed Project Area, definition of frequently used terms, identifies incomplete or unavailable information, and how the lack thereof influenced this analysis, describes methods for determining the level of impact to marine mammals, and presents the results of the assessment. This section describes some of the mitigation measures that would aid in avoiding or minimizing the potential impacts. Additional information on proposed mitigation and monitoring is provided in Section 4.12.3, Applicant-Proposed Design Features, Mitigation Measures, Best Management Practices, and Project Management Plans. The information used in this section builds on the 2012 FEIS (USACE, 2012a) and incorporates new data and information relevant to environmental concerns associated with the alternatives that have become available since the original 2012 FEIS document. While this assessment tiers from the 2012 FEIS, importantly, the proposed changes in route and design described for Alternative 1 are emphasized. In some instances, information from the 2012 FEIS is replicated with relatively minor changes and updates, while other material is entirely new or substantially altered. For this SEIS, the following elements have been added to the assessment of impacts to marine mammals:

- A new methods section was added to explain the procedures used to evaluate the potential impacts associated with the proposed Project and alternatives;
- Mitigation measures were carried over from the 2012 FEIS and expanded upon to include new proposed Project information and recommendations from federal and state agencies; and
- Updates to impacts based on new alternatives and a summary of those results.

Please note, on February 12, 2018, the Ninth Circuit Court of Appeals upheld the listing of ringed seals as threatened under the ESA. At the time of preparing this SEIS, this decision had not yet been determined. Therefore, the discussion of ringed seals is included with other marine mammal species not listed under the ESA. Ringed seals are also evaluated in the Biological Assessment attached as Appendix N, Part II.

4.12.1.1. Incomplete or Unavailable Information

In compliance with CEQ guidance (see Section 4.3), this section addresses incomplete or unavailable information pertinent to analyzing impacts of the alternatives on marine mammals. When specific species information could not be obtained, taxa-specific information is incorporated for a generalized assessment. For example, data on the occurrence of ice seals within the proposed Project Area are limited. Therefore, the

assessment of potential interaction with ice seals during ice road construction is based on the likelihood of encounter and the types of effects that could occur during such interaction. Another example relates to underwater noise. While sound source modeling to establish the acoustic profiles of ocean tugs in Prudhoe Bay near West Dock have not been undertaken, a more qualitative assessment of the likely effects of noise generated by these vessels is presented to evaluate potential effects to marine mammals that could occur.

4.12.2. Methods

The potential marine mammal impacts for the proposed Project presented below are based on the evaluation of the marine mammal resources and their habitat at Prudhoe Bay and the Port of Seward, review of available proposed Project descriptions and reports, and public comments received after the publication of the 2012 FEIS. Marine mammal ranges and habitat descriptions were obtained from a combination of sources including the 2012 FEIS, NMFS, AKNHP at the UAA various taxa- or species-specific publications, all of which are provided in Chapter 7, Literature Cited, of this SEIS.

Potential impacts were analyzed by assessing the magnitude, extent, duration and likelihood of occurrence as presented in Table 4.12-3, Impact Criteria for Marine Mammals. Effects that were assessed include:

- Direct mortality or serious injury during construction and operation;
- Physical habitat loss, alteration, and fragmentation;
- Biological and behavioral responses to disturbance, including changes to distributions, resulting from construction and operational activities that include vessel traffic, low-level helicopter or airplane over flights;
- Introduced non-native, invasive and parasitic species;
- Turbidity; and
- Contaminants.

4.12.2.1. Description of Effects

4.12.2.1.1. Direct Mortality or Serious Injury During Construction and Operation

Direct mortality primarily involves collisions with moving vessels. Vessel strikes are major sources of direct mortality or injury to large marine mammals, like whales. Jensen and Silber (2004) collected a total of 292 large whale vessel strike reports between 1975 and 2002. Eleven species were confirmed victims of vessel strikes. Finback whales are the most often reported species hit (75 records of strike), followed by humpback (44 records), North Atlantic right (38 records), gray (24 records), minke (19 records), southern right (15 records), and sperm whales (17 records). Far fewer reports exist of strikes to blue (eight records), Bryde's (three records), sei (three records) and killer whales (one record). Records from the vessel strike database (Jensen and Silber 2004)

show that 48 vessel strikes (16.4 percent) resulted in injury to the animal and 198 (68 percent) were fatal. In most cases the fate of whales injured in vessel strikes is not known. The average vessel speed in 58 of the reported strike cases was 18.6 knots, with speed ranges falling into one of three categories: 13 to 15 knots, 16 to 18 knots and 22 to 24 knots (Jensen and Silber, 2003). Presumably, due to their more agile nature, vessel strikes of smaller cetaceans and pinnipeds are much less common. Low vessel speed, in combination with the timing and location of activities, could reduce potential impacts resulting in mortality to whales.

4.12.2.1.2. Biological and Behavioral Responses to Disturbance

Anthropogenic disturbance could result from noise and physical presence. Effects of disturbance on marine mammals could be long- or short-term and depends on the individual, the context of the disturbance and the life stage of the species. Responses to disturbance include physiological, physical and behavioral. Short-term disturbances tend to be less invasive than long-term.

Disturbance during critical time periods may include calving, migration or feeding, which could impact productivity. Noise could affect communication by masking species signals. Masking could be described as acoustic interference where the effects of a general increase in background noise may reduce an animal's ability to detect relevant sounds important for sustaining life (NRC, 2003b). In cases where masking is significant, mortality may increase when species are unable to detect predators by sound.

Marine mammals exposed to high intensity sound repeatedly or for prolonged periods could experience hearing threshold shift (TS), resulting in the loss of hearing sensitivity at certain frequency ranges (Kastak *et al.*, 1999; Schlundt *et al.*, 2000; Finneran *et al.*, 2002; 2005). TS result in permanent TS (PTS), where loss of hearing sensitivity is unrecoverable, or temporary TS (TTS), in which case an animal may recover hearing sensitivity over time (Southall *et al.*, 2007).

Marine mammals have varying sensitivity to underwater noise as shown in Table 4.12-1.

Table 4.12-1 Marine Mammal Hearing Groups

Hearing Group	Generalized Hearing Range[a]
Low-frequency (LF) cetaceans (baleen whales)	7 hertz (Hz) to 35 kilohertz (kHz)
Mid-frequency (MF) cetaceans (dolphins, toothed whales, beaked whales, bottlenose whales)	150 Hz to 160 kHz
High-frequency (HF) cetaceans (true porpoises, Kogia, river dolphins, cephalorhynchid, *Lagenorhynchus cruciger* & *L. australis*)	275 Hz to 160 kHz
Phocid pinnipeds (PW) (underwater) (true seals)	50 Hz to 86 kHz
Otariid pinnipeds (OW) (underwater) (sea lions and fur seals)	60 Hz to 39 kHz

a Represents the generalized hearing range for the entire group as a composite (*i.e.*, all species within the group), where individual species' hearing ranges are typically not as broad. Generalized hearing range

chosen based on ~65 decibel (dB) threshold from normalized composite audiogram, with the exception for lower limits for LF cetaceans (Southall *et al.*, 2007) and PW pinniped (approximation).
Northern sea otter are not included here for a lack of data on the species (Southall *et al.*, 2007).

The NMFS criteria for acoustic thresholds[7] were recently revised in July 2016 and are presented in Table 4.12-2 for different marine mammal hearing groups. Level B thresholds for marine mammals are based on the interim NMFS criteria (NMFS, 2013) of 120 dB re 1 micropascal (µPa) sound pressure level (SPL) for non-impulsive and 160 dB re 1 µPa SPL for impulsive sound sources.

Species potentially occurring in the proposed Project Area include LF and MF cetaceans and phocid pinnipeds. Little data are available on the underwater hearing sensitivity of Pacific walrus; USFWS currently uses data based on Otariid species to guide decision-making regarding potential underwater noise impacts on walrus (Pers. Comm, Putnam, 2017).

Table 4.12-2 Summary of Permanent Threshold Shift Onset Acoustic Thresholds

	PTS Onset Acoustic Thresholds[a] (Received Level)	
Hearing Group	**Impulsive**	**Non-impulsive**
Low-Frequency (LF) Cetaceans (bowhead whales, gray whales)	$L_{pk,flat}$: 219 dB L_E, LF,24h: 183 dB	L_E, LF,24h: 199 dB
Mid-Frequency (MF) Cetaceans (belugas)	Lpk, flat: 230 dB L_E, LF,24h: 185 dB	L_E, MF,24h: 198 dB
High-Frequency (HF) Cetaceans (Dall's and harbor porpoise)	Lpk, flat: 202 dB L_E, HF,24h: 155 dB	L_E, HF,24h: 173 dB
Phocid Pinnipeds (PW) (Underwater) (bearded, ringed and spotted seals)	Lpk, flat: 218 dB L_E, PW, 24h: 185 dB	L_E, PW,24h: 201 dB
Otariid Pinnipeds (OW) (Underwater)	Lpk, flat: 232 dB L_E, OW, 24h: 203 dB	L_E, OW,24h: 219 dB

Source: NMFS 2016b
a Dual metric acoustic thresholds for impulsive sounds: Use whichever results in the largest isopleth for calculating PTS onset. If a non-impulsive sound has the potential of exceeding the peak SPL thresholds associated with impulsive sounds, these thresholds should also be considered.

Peak sound pressure (Lpk) has a reference value of 1 µPa, and cumulative sound exposure level (L_E) has a reference value of 1µPa. In this table, thresholds are abbreviated to reflect American National Standards Institute (ANSI) standards (ANSI, 2013). However, peak sound pressure is defined by ANSI as incorporating frequency weighting, which is not the intent for this Technical Guidance. Hence, the subscript "flat" is being included to indicate peak sound pressure should be flat weighted or unweighted within the generalized hearing range. The subscript associated with cumulative sound exposure level thresholds indicates the designated marine mammal auditory weighting function (LF, MF, and HF cetaceans, and PW and OW pinnipeds) and that the recommended accumulation period is 24 hours. The cumulative sound exposure level thresholds could be exceeded in a multitude of ways (*i.e.*, varying exposure levels and durations, duty cycle). When possible, it is valuable for action proponents to indicate the conditions under which these acoustic thresholds could be exceeded.

[7] Level A harassment may result in injury or death, whereas Level B only results in disturbance without the potential for injury. However, authorization of a Level A harassment take does not automatically imply that serious-injury to an animal has occurred.

Long-term disturbance could result in sensitive animals leaving the area, changing the normal distribution and occupancy rate of an area; and, prolonged elevated stress. Hormone levels associated with disturbance may lead to decreased fitness and productivity. There is some evidence that some marine mammals may habituate to frequent or constant underwater noise. For example, based on 25 years of observations of whale responses near Cape Cod to whale-watching boats and other vessels, Watkins (1986) reported that fin whales (*B. physalus*) changed from mostly negative to uninterested reactions. Responses from humpbacks (*Megaptera novaeangliae*) varied from negative to often strongly positive reactions, while right whales also had a variety of responses, which continued to vary over time. Gray whales wintering in San Ignacio Lagoon are less likely to flee from whale-watching boats later in the season than they are shortly after arriving in the lagoon (Jones and Swartz, 1984). In the Canadian Beaufort Sea, bowheads have been documented to return to the same areas year after year even though seismic surveys occurring at the same time are an annual feature of these areas (Richardson *et al.*, 1987). Watkins (1986 as reported in NRC, 2003b) suggests that several factors influence whether or not a marine mammal becomes habituated to a particular disturbance or stimuli. For example, animals may tolerate a stimulus they might otherwise avoid if the benefits in terms of feeding, mating, migrating to traditional habitat, or other factors outweigh the negative aspects of the stimulus.

Underwater noise associated with the alternatives could result from vessels (tugs) transporting the GCF modules into West Dock under Alternatives 1 and 2. The ASAP Dredge and Disposal Plan and ASAP Draft Marine Transit Plan describe the types of tugs likely to be used, which range from 70 to 400 feet in length. NRC (2003b) reported sound source levels for shipping vessels ranging between 170 – 210 decibels referenced to one micropascal (dB re 1µPa). Based on the Research Ambient Noise Directionality model, underwater noise from ships ranged from 195 dB re 1µPa for large, fast-moving supertankers to 140 dB re 1µPa or less for smaller boats such as fishing vessels. In the model, supertankers ranged in size from 244 to 366 m (approximately 800 to 1,200 feet), while fishing vessels ranged from 15 to 46 m (approximately 49 to 151 feet). Richardson *et al.* (1995) reported source levels ranging from 143 – 157 dB re 1µPa for a tug and barge underway at approximately 18 km per hour (km/h). According to Richardson and Williams (2002), underwater sound levels (reported as SPL) for tug activities for the Northstar facility located west of Prudhoe Bay were 145 dB re 1µPa recorded 116 m (381 feet) from a tug that was forcing a barge against a dock.

Occasional maneuvering of barges would require the assistance of tugboats, which would contribute to sounds underwater. Importantly, sounds produced underwater are influenced by many factors including geomorphology, substrate type, site-specific hydrodynamic conditions, and even equipment maintenance status (USACE, 2012a). The analysis presented in Sections 4.12.4 and 4.12.5 assumes barge thrusters would not be used while transiting, but only during berthing and close-in maneuvering.

Under Alternatives 1 and 2, the equipment used for dredging at West Dock would likely include excavators or excavators with extended booms (*i.e.*, backhoe). Sounds generated

from dredging would result from sediment excavation, transport and placement of dredged material at the disposal site. A ditch witch would be used to cut the ice in the excavation area and the ice would be removed with tracked excavators. Underwater data from a ditch witch and backhoe were measured while cutting a hole in land-fast ice and digging a trench for pipe (water depth was approximately 12 m) (Blackwell 2003 as reported in Spence *et al.* 2007). While no indication is given in Blackwell (2003), it is presumed that the major noise from the ditch witch resulted from the actual cutting of the ice. Possible noise generation mechanisms for the backhoe range from structure borne transmission to the ice with subsequent radiation from the ice to the water to noise associated with the digging action itself underwater, although sufficient information is not available to make a real determination.

As reported in Todd *et al.* (2015), noise levels from a backhoe dredger operating around the Shetland Islands, United Kingdom were recorded by Nedwell and Brooker (2008). Using a scaling of 10 log (R/1 m), the back-calculated source level was 163 dB re 1µPa@1m. However, the Shetland Islands project involved dredging hard rock materials that would produce more noise than fine sediment found in Prudhoe Bay. Machinery above the water surface would be responsible for most received sound underwater given the substrate consists predominantly of fine-grained sediment and silt (as reported in USACE, 1980). The source range for an excavator dredge reported by Reine *et al.* (2012) for a project in New York was 164.2 to 179.4 dB re 1µPA@1m. The 2012 study reported that the excavator dredge was somewhat quieter for most of the dredging processes when compared to source levels reported for cutterhead dredging (168 to 178 dB re 1 µPA@1m) and hopper dredging (186 dB re 1 µPA@1m). Stress is a physiological response that could result from exposure to noise and involves the release of the hormone adrenalin, which increases heart rate, gas exchange, acuity and an increase in blood flow to the brain and muscles for a fight-or-flight response. Studies reveal changes in behavior resulting from close proximity to vessels, and suggest that individuals may experience stress in response to these events (Watkins *et al.*, 1981; Baker *et al.*, 1983; Malme *et al.*, 1983; Bauer, 1986; Bauer and Herman, 1986; Baker and Herman, 1987; Richardson *et al.*, 1995; Jahoda *et al.*, 2003). Further, research suggests that human disturbance may elicit physical and physiological responses similar to those reactions attributed to predators (Harrington and Veitch, 1992; Lima, 1998; Gill and Sutherland, 2000; Gill *et al.*, 2001; Frid and Dill, 2002; Beale and Monaghan, 2004; Romero, 2004; Finley *et al.*, 1984a, 1984b, 1990; Miller and Davis, 1984). Responses include abandonment of sites (Bartholomew Jr., 1949; Allen, 1991; Sutherland and Crockford, 1993), reduced reproductive success (Giese, 1996; Müllner *et al.*, 2004), and individual mortality (Feare, 1976; Daan *et al.*, 1996).

Both impact and vibratory pile driving would be used in construction to make improvements to West Dock and may occur over two summers prior to the sealift when open water conditions may be present. In a study conducted by Greene *et al.* (2008), sounds from various industrial activities occurring at Northstar Island were recorded in the winter. The study concluded that vibratory sheet pile driving produced the strongest extended duration sounds, with broadband underwater levels of 143 dB re 1 µPa at

100 m. The dominant components of the sounds from vibratory pile driving were at infrasonic frequencies (25 Hz) barely audible to humans. Vibratory pile driving was detected as far as 2,930 m from the sound source.

Greene *et al*. (2008) concluded that broadband sounds from various Northstar Island winter construction activities and sources diminished into the range of the median background noise levels at distances ranging from 1 to 5 km at most, and usually less. In ice covered seasons, drilling noise was clearly detectible 5 km (3.1 mi) from the drill rig sound source, but fell into background noise levels by 9.4 km (5.8 mi) (Blackwell, Greene, Richardson, 2004, as cited in NMFS 2014). Blackwell, Greene, Richardson (2004) concluded that oil production at Northstar during the ice covered season did not increase the overall levels of underwater noise substantially. Sounds generated from drilling at Northstar are expected to diminish below 140 dB re 1 µPa at a distance of about 40 m (131 feet) from the center of activity; the 140 dB re 1 µPa radius for drilling noise is within the island and drilling sounds are attenuated to levels below 140 dB re 1 µPa in the water near Northstar (NMFS, 2014).

In the summer, open-water season at Northstar Island, Blackwell and Greene (2006) and Blackwell *et al*. (2009) (as cited in NMFS, 2014) deployed cabled hydrophones and directional autonomous seafloor acoustic recorders (DASARs) to record underwater sounds during the fall whale migration (late August – early October). They found that vessels were the main contributors to underwater sound at Northstar Island and that drilling and production sounds reached background noise levels at distances of 2-4 km (1.2-2.5 mi). As stated in NMFS (2014), "The range of broadband levels recorded during 2001-2008 for all percentiles is 80.8-141 dB re 1 µPa. The maximum levels are mainly determined by the presence of vessels and could be governed by one specific event. From 2004-2008, these levels ranged from 110-119.5 dB re 1 µPa at about 450 m (0.3 mi) from Northstar. Much of the variation in received levels was dependent on sea state, which is correlated with wind speed."

Few studies have actually determined the proportion of animals responding at varying levels of acoustic signal (NRC, 2003b). According to Richardson *et al.* (1995), migrating bowhead and gray whales divert around sources of noise (*i.e.*, such as those caused by industrial activities) with almost all bowheads reacting at received levels of 114 dB re 1 µPa. However, migrating bowhead whales have been documented to pass through an ensonified area to continue their migration if no other option is available. For example, during spring migration, bowheads were shown to continue through an area where the only available lead was within 200 m of a projector playing sounds associated with a drilling platform that produced received levels of 131 dB re 1 µPa (Richardson *et al.,* 1991 as reported in NRC, 2003b). The actual radius of behavioral effect is smaller than the radius of noise detectability (Richardson *et al*., 1995; Southall *et al*., 2007 as cited in NMFS, 2014).

The perceived motion of a sound source may also affect an animal's response in the water. For example, Watkins (1986) documented that fin and right whales are more likely to tolerate a stationary source than they are one that is approaching them. Humpback whales are more likely to respond at lower received levels to a stimulus with a sudden onset than to one that is continuously present (Malme *et al.*, 1985 as reported in NRC, 2003b). Beluga whales in the St. Lawrence River appear more tolerant of larger vessels moving in consistent directions than they are of small boats, fast-moving boats, or two boats approaching from different directions (Blane and Jaakson, 1994 as reported in NRC, 2003b). Species also may react differently if a sound source is more constant or generally noisier. For example, in noisy environments, gray whales were shown to increase the amplitude of their vocalizations, changed the timing of vocalizations, and used more frequency-modulated signals (Dahlheim, 1987), while beluga whales increased call repetition and shifted to higher peak frequencies in response to boat traffic (Lesage *et al.*, 1999).

Richardson *et al.* (1995) summarized several studies of bowhead whales that indicate typical changes in response to anthropogenic noise may include shorter surfacings, shorter dives, fewer blows per surfacing, and longer intervals between successive blows. Given these subtle changes, reactions to anthropogenic stimuli are difficult to observe and record. An important consideration is whether the reaction is biologically significant. In other words, although there may be statistically significant changes in some of these subtle behaviors, although changes in behavior have been documented, there is no evidence that these changes are biologically significant for the animals (*i.e.*, something that could lead to mortality or reproductive effects to the individual or the population). Edds (1988 as reported in Richardson *et al.*, 1995) documented that a fin whale continued to call with no change in rate, level, or frequency components as a container vessel went from idle to full power within a km of the whale. Some species have been documented to change the source level and output frequency and duration. For example, there is evidence that beluga whales adjust their echolocation clicks to higher frequencies and to higher source levels in the presence of background noise (Au *et al.*, 1985).

Noise disturbances could also impact marine mammal prey species such as fish. According to NMFS (2014), fish often react to sounds, especially low frequency strong or intermittent sounds. Construction activities produce both impulsive sounds (*e.g.*, pile driving) and longer-duration sounds. Short, sharp sounds could cause overt or subtle changes in fish behavior. Fish often react to sounds, especially strong or intermittent sounds of low frequency, but return to pre-exposure conditions thereafter, and catch rates could be increased or decreased depending upon location of predator (Streever *et al.*, 2016). Sound pulses at received levels of 160 dB re 1 µPa may cause subtle changes in behavior. Sound pulses at 180 dB may cause noticeable changes in fish behavior (Chapman and Hawkins, 1969; Pearson *et al.*, 1992; Skalski *et al.*, 1992 as cited in NMFS, 2014).

4.12.2.1.3. Introduced and Invasive Species

Introduced or nonindigenous species are typically introduced into a system by human related activity. Section 4.13, Benthic, provides more detailed discussion and analysis of the potential introduction of invasive species resulting from proposed activities. Alaska as a whole has been minimally affected by invasive species because of such factors that include isolation, localized rather than widespread development, a colder climate, and restrictive species import/transport regulations.

Natural or native community species co-evolve within an ecosystem; checks and balances limit the population growth of any one species. Checks and balances include predator-prey interactions, disease, competition for resources and limiting environmental factors. The native species community exists and evolves as a whole within a dynamic ecosystem. When non-native species are introduced into an ecosystem in which they did not evolve, they are not necessarily influenced by the same factors and their unimpeded population growth may impact the native community. Invasive, non-native, species disrupt natural communities and ecological processes; creating competition for limited resources (*e.g.,* food, water, shelter, etc.). Invasives may also impact native species by predation.

4.12.2.1.4. Turbidity

Disturbance of the bottom sediments due to activities proposed under Alternatives 1 and 2 around West Dock would increase turbidity in the area. Sediment plumes resulting from dredging would likely be short-term as shown in research summarized by Hitchcock and Bell (2004), and are confined mainly to an area of a few hundred meters from the point of discharge (Newell *et al.,* 1998; Hitchcock and Bell, 2004 as reported in Todd *et al*., 2015). Many marine mammals are accustomed to a turbid environment and utilize sophisticated sonar systems to sense the environment around them (Au *et al.,* 2000). Pinnipeds are more likely to use vision to detect prey (they are not known to use sonar) so an increase in turbidity could affect their ability to locate prey.

4.12.2.1.5. Contaminants

Contaminants, such as heavy metals, polychlorinated-biphenyls (PCBs), poly-cyclic aromatic hydrocarbons (PAHs), total petroleum hydrocarbons (TPH) or other contaminants, could be present in the West Dock and Port of Seward areas. Historical development activities, including vessel traffic, exploration, dredging as well as natural processes (such as input of freshwater from nearby rivers and streams), may have introduced these substances to these areas. Permits from USACE and ADEC would be required to allow for dredging along the West Dock approach channels proposed under Alternatives 1 and 2, which could result in suspension of contaminated sediments. Previous sediment and water samples from background or reference sites across the Alaska Beaufort Sea shelf between Harrison Bay and Camden Bay have been collected and analyzed by Trefry *et al.* (2003), Brown *et al.* (2005), and Neff (2010), as reported in

the Arctic Nearshore Impact Monitoring in the Development Area (ANIMIDA) project conducted by Bureau of Ocean Energy Management (BOEM) (2010).

Petroleum products spilled into the marine environment may enter benthic or pelagic food chains. Magnitude, time of year, and duration of a spill determines the extent to which marine mammals in the proposed Project Area are affected. Accidental release of hydrocarbons and contaminants in the spring, summer, and early fall have the potential to effect migration and feeding in the proposed Project Area. Direct contact with oil adversely affects marine mammals by ingestion through feeding activities, inhalation or absorption (Ober, 2016). Contamination of the surrounding marine feeding areas would limit available habitat. Historic sediment sampling in the proposed Project Area characterize the sediments on the eastern side of West Dock and show Prudhoe Bay and the West Dock area as generally free of contamination related to metals or hydrocarbons (AGDC, 2016o; URS, 2012). Based on a 2010 study, observed metals concentrations are within the natural variability of background values reported for Beaufort Sea coastal sediment (Brown *et al.*, 2005; Neff, 2010; and Trefry *et al.*, 2003 as reported in BOEM, 2010). Data collected for the ANIMIDA project did not indicate the presence of contamination from petroleum hydrocarbons (Kuhle, 2010 and OASIS, 2006 as reported in BOEM, 2010). ADEC maintains a database of oil and hazardous substance spill reports (http://dec.alaska.gov/spar/csp/db_search.htm); minimal spills in the West Dock area have escaped recovery or containment in the past 15 years (*i.e.,* less than 15 gallons lost). There have been no spills at the Port of Seward resulting from vessel grounding or unauthorized bilge discharges.

Operation and maintenance activities could affect important habitat and degrade water quality by accidentally introducing minor amounts of contaminants, oils, or fuels. The minor impacts from small spills and discharges could be partially mitigated through the establishment and implementation of a Hazardous Materials Control Plan described in Section 4.12.3.

4.12.2.2. Impact Criteria

Table 4.12-3 summarizes the criteria used to determine the level of impact based on the magnitude, extent, duration and likelihood of occurrence. Table 4.12-4 defines the types of effects the proposed Project and activities may have on the biological resources that are assessed in this SEIS. Mitigation measures are described in Section 4.12.3. Potential impacts that remain after mitigation measures have been implemented are described for each alternative in the following sections.

Table 4.12-3 Impact Criteria for Marine Mammals

Impact Component	Impact Level			
	Major	**Moderate**	**Minor**	**Negligible**
Magnitude or Intensity	The impact is sufficient to cause population level changes to productivity, growth rate, survival rate, and range).	The impact is sufficient to cause sub-population level changes to productivity, growth rate, survival rate, and range.	The action would impact a few individuals in a population but not affect population productivity, growth rate, survival rate, and range.	There are no perceivable impacts or the mechanism for effects on population status (*i.e.*, productivity, growth rate, survival rate and range) are indistinguishable from baseline.
Geographic Extent	Impacts are statewide, or over the entire range of the species or identified population.	Impacts are at a regional or community level, on a limited portion of the study area.	Impacts are site specific or occur within a few isolated locations.	No measurable effects.
Duration or Frequency	The effect would cause chronic and long-term changes that are likely to be permanent.	The effect would cause periodic, temporary, or short-term changes that are reversed after a 1-3 reproductive seasons (3 years).	The effect would cause periodic, temporary, or short-term changes that are reversed over one reproductive season (1 year).	No measurable effects.
Likelihood	Most likely (Impacts that have greater than 75% chance of arising from the action)	Likely (Impacts that have a 50% to 75% chance of arising from the action)	Somewhat likely (Impacts that have a 10% to 50% chance of arising from the action)	Unlikely (Impacts that have less than 10% chance of arising from the action)

Table 4.12-4 Types of Effects and Impacts on Marine Mammal Resources

Type of Effect	Proposed Action Causing Potential Impact	
	Construction	**Operations & Maintenance**
Mortality, disturbance, contaminants, invasive species, and increased predation.	• Operation of vessels during construction. • Stresses from presence of vessels during construction disturbs animal; • Activities that introduce contaminants, invasive species and increased predation. • Underwater noise during pile driving or dredging.	None.

Type of Effect	Proposed Action Causing Potential Impact	
	Construction	Operations & Maintenance
Reproductive Effects/ Function/Health/ Resilience: • Displacement or disturbance of marine mammals due to noise and human/vessel presence. • Introduction of non-natives and predation. • Disturbances and, stresses from noise and presence of vessels and activity during construction. • Exposure to toxic substances (*i.e.,* oil or hazardous materials spills). • Diminished reproduction.	• Vessel traffic and associated underwater noise while transiting. • Underwater noise during pile driving or dredging.	None.

4.12.3. Applicant-Proposed Design Features, Mitigation Measures, Best Management Practices, and Project Management Plans

The following design features, mitigation measures, and BMPs are proposed by AGDC and have been taken into consideration when evaluating potential impacts to marine mammals under Alternatives 1 and 2 during the construction and operations phases. A complete list of mitigation measures and BMPs are also provided in Appendix M.

In addition to specific design features described in the following sections, proposed mitigation measures would include:

1. Avoid concentrations of groups of whales by all vessels. Vessels would avoid multiple changes in direction and speed when within 300 yards (274 m) of whales. In addition, operators should check the waters immediately adjacent to a vessel to ensure that no whales would be injured. Vessels would reduce speed to below 10 knots when within 300 yards (274 m) of whales, and those vessels capable of steering around such groups would do so. Vessels would reduce speed when weather conditions require, such as when visibility drops, to avoid the likelihood of injury to marine mammals.
    - If a North Pacific right whale is observed at a distance greater than 800 m (874 yards [yd]) from the vessel's intended course line, or other marine mammal is observed within 91 m (100 yd) of the vessel's intended course line, monitoring of the marine mammal(s) location will continue, and for whales, the direction of the vessel will be altered to maintain these minimum distances from the observed whale(s). Course alterations made to avoid cetacean disturbance will be made in a manner that avoids sudden changes in revolutions per minute and cutting in front of their direction of travel.
    - If a North Pacific right whale is observed within 800 m (874 yd) of the vessel's intended course line, or other whale species is observed within 274 m (300 yd) of

the vessel's intended course line, vessel speeds will be reduced to no greater than 5 knots, sea conditions permitting, to minimize the risk of injurious collision. While avoiding collisions with marine mammals may necessitate sudden changes in vessel revolutions per minute and heading, course alterations made to avoid marine mammal disturbance will be made in a manner that avoids sudden changes in revolutions per minute and cutting in front of their direction of travel. Vessel speed may resume to normal operating speed when North Pacific right whales are greater than 800 m (874 yd) and other whale species are greater than 274 m (300 yd) from the vessel and its intended course.

- The vessel operator will avoid: i) direct approach of whales; ii) separating members of any group of whales from other members of that group; and iii) causing a whale of any species to make multiple changes in direction.
- If the vessel is taken out of gear, vessel crew will ensure that no whales are within 50 m of the vessel when propellers are re-engaged, thus minimizing risk of marine mammal injury.

2. AGDC vessels would adhere to several applicable marine mammal-disturbance reduction guidelines. While transiting through the region near Dutch Harbor or in North Pacific right whale critical habitat, vessel operators would either: avoid the critical habitat area or bring trained observers onboard and reduce speed to 10 knots, or reduce speed to 5 knots without trained observers onboard.
3. The proposed Project activities would not approach Pacific walrus on ice or land closer than 805 m (0.5 mile).
4. If a polar bear is observed in the water, within 305 m (1,000 feet), vessels would reduce speed and avoid changes in direction or excessive movement.
5. Vessels would stay at least 100 m away from any whale seen on the ship's trackline.
6. Vessels would deviate around a whale encountered on the trackline by going around the whale at the rear or tail end of the animal.
7. If a whale approaches the vessel and if maritime conditions safely allow, the engine would be put in neutral and the whale would be allowed to pass beyond (>100 m) the vessel.
8. Initiate construction of all ice roads and ice pads before March 1. If construction of ice roads or pads is initiated after March 1, an agency-approved method would be used to conduct surveys for ringed seal dens prior to construction work.
9. A protected species observer (PSO), able to accurately identify and distinguish species of Alaska marine mammals, would be present before and during all in-water construction activities.
10. Prior to in-water construction activities, an exclusion (*i.e.*, shut-down) zone would be established. For this proposed Project, the exclusion zone includes all marine waters

within 2,200 m (7,218 feet) of pile driving operations and within 1,000 m (3,281 feet) of dredging, ditch witch, and screeding activities. Underwater sound levels from all activities are below NMFS thresholds at a distance of 2,200 m (7,218 feet) from the source, and sound levels are likely to diminish to background levels at less than 5,000 m (16,404 feet or 3.1 mi.) from the source. AGDC would implement a monitoring strategy to shut down activities if marine mammals are approaching the zones/distances to NMFS thresholds for Level A and B underwater and airborne noise:

a. The distances for impact pile driving to the Level A peak thresholds are less than 5 m (16 feet) from the source.

b. The distances to the Level A thresholds for vibratory pile driving are approximately 1,500 m (4,921 feet) and less than 50 m (165 feet) for all non-pile driving activities. Received airborne levels would be less than 100 dB threshold at less than 50 m (165 feet) from the source.

c. The distance to the Level B threshold for impact pile driving is approximately 1,100 m from the source, and approximately 2,200 m (7,218 feet) for vibratory pile driving, and is less than 180 m (591 feet) for all other non-pile driving activities.

d. Underwater sound levels from all activities are below NMFS thresholds at a distance of 2,200 m (7,218 feet) from the source, and sound levels are likely to diminish to background levels at less than 5,000 m (16,404 feet or 3.1 mi.) from the source.

11. Pile-driving would not be conducted when visible observation of all waters within and surrounding the exclusion zone is not possible. If crews must be working during periods of darkness or bad weather, an additional PSO would be placed farther up the causeway (*e.g.*, at DH3 or STP) to ensure coverage of the entire zone and to provide a greater extent of visibility. In addition, during activities conducted at night, artificial lights directly around the observer would be kept absent or low, so that natural light reflecting off the ice or the surface of the water would allow for identification of the presence or absence of cetaceans or pinnipeds within the exclusion zone. Additional details on the observer protocols is provided in Appendix N, Part II (Biological Assessment).

12. AGDC would have an approved SPCC Plan before construction. The SPCC Plan would be developed in accordance with all pertinent regulations and would follow BMPs. The SPCC Plan would identify material handling procedures and storage requirements and outline the actions to reduce spill potential.

13. AGDC would consult with NMFS and USFWS regarding the need for an authorization for incidental harassment (*i.e.*, either an Incidental Harassment Authorization [IHA] or LOA under the Marine Mammal Protection Act [MMPA], depending on the duration and type of activities covered). If required, an IHA or LOA would include additional mitigation measures to reduce the potential for

impacts to marine mammals due to incidental or intentional (polar bears only) harassment, as defined under the MMPA.

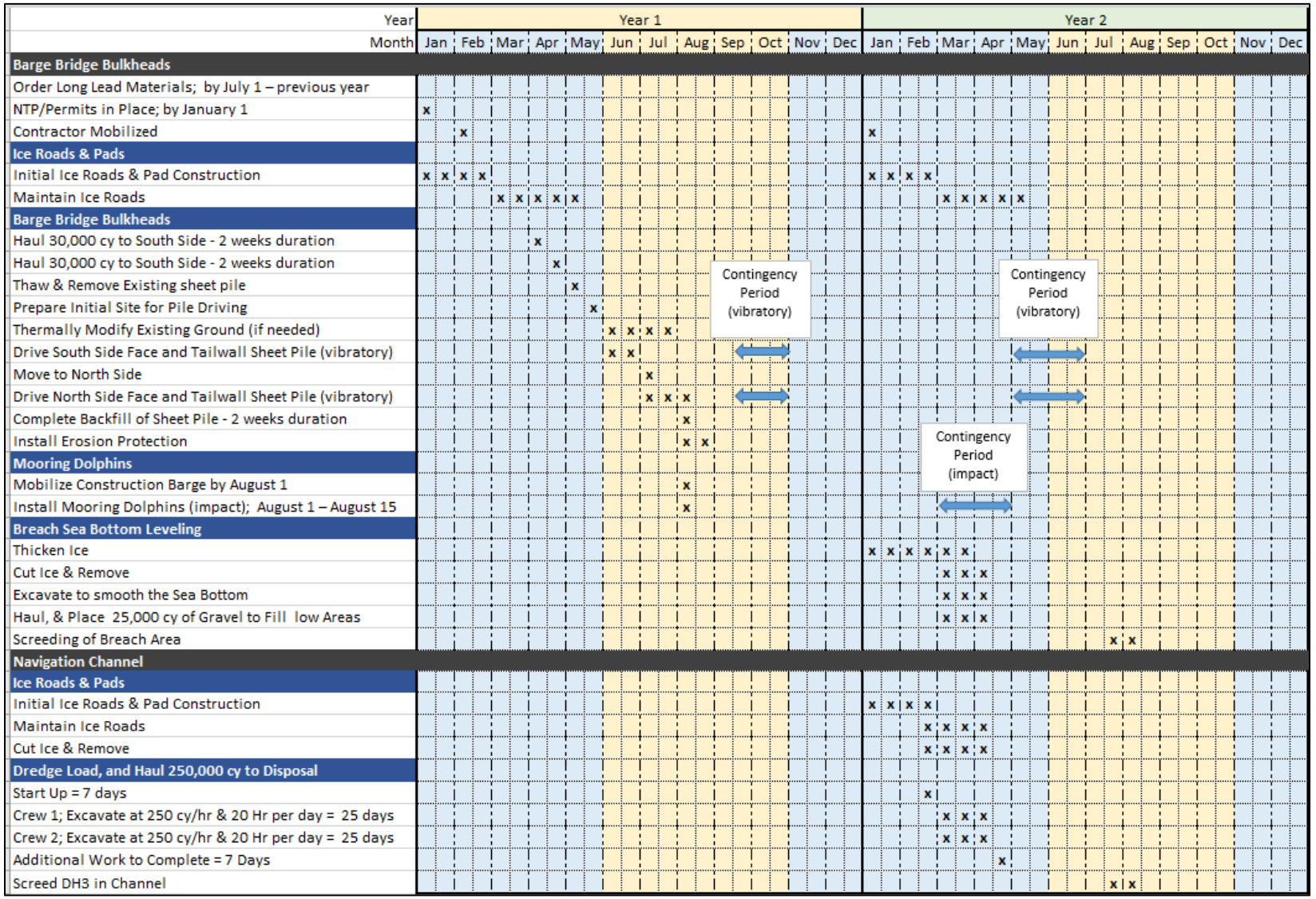
14. Consult with potentially affected communities (PACs) and appropriate subsistence user organizations to discuss potential conflicts with subsistence marine mammal hunting caused by the location, timing, and methods of proposed operations and support activities.
15. AGDC would dispose of hazardous wastes at approved facilities.

4.12.4. Alternative 1 – Proposed Action

Alternative 1 is designated the proposed Action (proposed ASAP Project). This alternative is described in detail in Chapter 2. The 733-mile-long, 36-inch-diameter Mainline pipeline and a 30-mile-long, 12-inch diameter lateral pipeline, terminating in Fairbanks, would cross various habitats and ecoregions from the North Slope to the existing ENSTAR pipeline system in the Mat-Su Borough. This section discusses the analysis of impacts to marine mammals along the route. The proposed activities would not result in damage or otherwise destruct marine mammal habitat (including any designated critical habitat) leading to habitat loss or modification.

The proposed construction spread (*i.e.*, schedule) for the terrestrial portions of the pipeline is presented in Chapter 2, Table 2.2-7, Alternative 1: ASAP Construction Spread Plan. In addition, a tentative schedule for modifications at West Dock is presented as Figure 4.12-1. The activities described include equipment mobilization, ice road and pad construction and maintenance, bulkhead construction (pile driving, back filling, erosion protection, etc.), mooring dolphin installation, ice cutting, gravel placement and screeding, dredging, hauling, and disposal of dredge material. The construction schedules provide important context for understanding how marine mammals may interact with proposed Project activities. The following sections describe potential impacts associated with the proposed Project activities based on the anticipated timeline described below for marine-related activities. The focus of this section centers around marine activities proposed in and around Prudhoe Bay and the Port of Seward. Impacts to common taxa are summarized in Table 4.12-4.

Figure 4.12-1 Tentative Construction Schedule for West Dock Modifications



4.12.4.1. Construction

The West Dock causeway would require widening and infrastructure modifications as described in Chapter 2 and in the ASAP West Dock Dredge and Disposal Plan (AGDC, 2016o). Over a 2-year construction period, activities would in advance of the sealift prepare DH3 and the West Dock causeway to allow pile driving, infrastructure improvements, and module movement. The aspects of the West Dock modification project that have the potential to incidentally harass marine mammals include the airborne and underwater noise associated with vibratory and impact pile driving, winter dredging, ice road construction and on-ice construction, as well as the general increased presence of humans, vessels, and trucks in the area.

4.12.4.1.1. Ice Road and Ice Pad Construction

Approximately 104 acres of ice roads and 110 acres of ice pads would be used during construction. Ice roads and pads would be used for dredge and disposal work at West Dock (see Chapter 2, Section 2.2.3) to create a safe construction area at the barge bridge, as well as for construction of the pipeline between MP 0 and 62. The location of all ice roads and pads are identified in the online interactive map viewer: http://asapgas.agdc.us/interactivemap.html. Ice road and ice pad construction would be initiated before March 1. If construction of ice roads or pads is initiated after March 1, an agency-approved method would be used to conduct surveys for ringed seal dens prior to construction work (Mitigation Measure No. 8).

4.12.4.1.2. West Dock: Dock Head 3 and Causeway Upgrades

West Dock improvements would begin during winter before the sealift arrival. Part of the improvements would involve dredging through the ice to create a 500-foot-wide by 5,400-foot-long navigation channel and turning basin. Barges would have a maximum draft of 7.6 feet and would require a minimum water depth of 8.5 feet; therefore, under Alternative 1, there would be a minimum winter dredge depth of -9 feet. Screeding may also be necessary due to potential infilling by late summer (Niedoroda *et al.,* 1979). The proposed dredge and screeding are intended to maintain adequate depth for safe barge movement and to avoid the need for summer maintenance dredging. Screeding would consist of a vessel towing a beam across the ocean bottom to create a smooth, flat surface.

When considering potential impacts to marine mammals, winter dredging is preferred over summer dredging because migrating whales, such as bowhead or beluga whales, would not be in the area. Mitigation Measure Nos. 1 through 11 (Section 4.12.3) would also reduce the potential for interaction with marine mammals. The Pacific walrus overwinters in the Bering Sea, far from Prudhoe Bay (USFWS, 2016); therefore, they are not likely to be in the proposed Project Area during winter construction activities. Additionally, proposed Project vessels in transit to Prudhoe Bay would remain in designated shipping lanes, away from shore, and would, therefore, not interfere with walrus haul outs. Still, as a precautionary measure to avoid walrus, Mitigation Measure

No. 3 states that proposed Project activities would not approach Pacific walrus on ice or land closer than 805 m (0.5 mi.).

From 1979–2016, the Aerial Surveys for Arctic Marine Mammals conducted by NOAA occurred annually in the summer and fall in the western Beaufort Sea. Based on these surveys, most bowhead whales occur offshore, although in the past few years some animals have been observed in nearshore areas (Clarke *et al.*, 2013a and b; 2014; 2015). Potential effects on bowhead whales and polar bears are addressed in Section 4.14, Threatened & Endangered Species.

Although beluga whales could occasionally be found in the area during winter, the likelihood of this occurring is rare. Belugas have been seen offshore from the Project Action Area near the barrier islands during the recent Aerial Surveys for Arctic Marine Mammals surveys (Clarke *et al.*, 2015). Between 1979 and 2011, a total of 62 belugas (31 sightings) were documented during aerial surveys nearshore and offshore from Prudhoe Bay as part of the Bowhead Whale Aerial Survey Project published on the NOAA website (http://www.afsc.noaa.gov/NMML/software/bwasp-comida.php). Most whale sightings during this period were in September and October, which is before dredging would begin.

Winter dredging also reduces potential conflicts with subsistence whaling activities that occur in late summer and early fall as described in Section 4.20, Subsistence. Disposal of dredge material on ice would help minimize the distribution of the sediment plume, reducing the effects of turbidity. Under Alternative 1, excavators would place dredged material into dump trucks, which would transport the dredge spoils to the selected disposal site (see Figure 2.2-5 in Chapter 2). Dredge material would then be placed into 1- to 2-foot piles over a 100-acre area. Three tracked excavators would be used to complete the work over one winter construction season.

In preparation for the barge bridge, two abutments would be built as approaches on either side of the existing breach and four mooring dolphins would be installed in the breach to protect the current bridge from the ballasted barges. Additionally, the temporary barge bridge area would be screeded twice. The West Dock causeway would be widened by the placement gravel fill.

Impact pile driving would be used to install the four mooring dolphins to protect the current bridge and hold the ballasted barges in place. Impact pile driving is scheduled for 5 days during the first half of August of the first year of construction (see Figure 4.12-1). The contingency time period for dolphin installation is March through April, working off of ice the following year, if the originally scheduled summer time period becomes infeasible due to unexpected logistical or other constraints. The mooring dolphins are 4-feet-diameter (48 inches), 110-feet-long piles that would be driven a minimum of 65 feet (19.8 m) into the seabed. The use of a vibratory hammer to remove the piles once they are no longer needed is not recommended because doing so is a much more hazardous operation than the installation process due to loads placed on the

crane. Therefore, at the end of construction, piles would be cut off below the sediment surface and removed.

No pile driving would occur during the Nuiqsut whaling period (August 25 through September 15). Assuming a 20-hour work day, actual impact pile driving would average 25 percent of a 20-hour period, or approximately 5 hours per day. Although the specific model of hammer is not yet known, an average strike per minute rate is 26, resulting in approximately 1,560 strikes per hour.

The sheetpiles required to build out the new bulkhead interfacing the temporary bridge with the causeway would be installed using a vibratory pile driver (Figure 4.12-1). It has not yet been determined what specific hammer would be utilized for this proposed Project. Vibratory work would be scheduled from early June through August 24 (year 1); however, if work is not completed during this time due to logistical or other constraints, vibratory hammering would be completed during the contingency period(s) of September 16 through October 31 of year 1 and/or May 1 through June 30 of year two (Figure 4.12-1). No pile driving would occur during the Nuiqsut whaling period of August 25 through September 15.

Vibratory hammering would occur over a period of approximately 60 days, assuming crews work consecutive 12-hour shifts each day with hammering occurring 40 percent of the time. This would result in approximately 576 hours of vibratory operation during the 60-day period. Additional details on the construction methods for the sheetpile installation, screeding, and gravel placement are provided in the Biological Assessment (Appendix N, Part II).

NMFS has required the use of practical spreading, or a propagation loss of 15 log R, in the absence of site-specific data. There is evidence from other studies to indicate that propagation loss of 25-30 log R is possible in the Beaufort Sea. For this proposed Project, a spreading loss of 20 log R was used to calculate exclusion zones during trenching, grading, and use of ditch witch. During vibratory and impact pile driving, 17.5 log R was used to calculated exclusion zones. Based on this approach, underwater sound levels from all activities would be below NMFS thresholds at a distance of 2.2 km (7,218 feet) from the source, and sound levels are likely to diminish to background levels at less than 5 km from the source.

The distances for impact pile driving to the Level A peak thresholds are less than 5 m (16 feet) from the source. The distances to the Level A thresholds for vibratory pile driving are approximately 1,500 m (4,921 feet) and less than 50 m (165 feet) for all non-pile driving activities. Received airborne levels would be less than 100 dB threshold at less than 50 m (165 feet) from the source. The distance to the Level B threshold for impact pile driving is approximately 1.1 km from the source, and approximately 2.2 km (7,218 feet) for vibratory pile driving, and is less than 180 m (591 feet) for all other non-pile driving activities. Table 4.12-5 presents the calculated distances to NMFS thresholds from underwater sources.

Table 4.12-5 Calculated Distance to NMFS Thresholds from Underwater Sources

			Level A LF Cetaceans			Level A MF Cetaceans			Level A Phocids			Level B Marine Mammals	
			Impulsive		Non-Impulsive	Impulsive		Non-Impulsive	Impulsive		Non-Impulsive	Impulsive	Non-Impulsive
			L_{pk}	SEL	SEL	L_{pk}	SEL	SEL	L_{pk}	SEL	SEL	rms	rms
Description	**Source Level (dB)**	**Source Distance (m)**	**219**	**183**	**199**	**230**	**185**	**198**	**218**	**185**	**201**	**160**	**120**
Impact – 48-inch pipe	205 pk, 195 rms, 185 SEL	10	1.50	2,549.92	--	0.34	134.37	--	1.72	1,469.31	--	1,145.05	--
Vibratory – sheet pile	143	100	--	--	30.67	--	--	3.62	--	--	19.77	--	2,253.93
Ditch witch	122	100	--	--	3.26	--	--	0.53	--	--	2.25	--	125.89
Underwater trenching	114	100	--	--	1.30	--	--	0.21	--	--	0.89	--	50.12
Underwater grading	125	100	--	--	4.61	--	--	0.75	--	--	3.17	--	177.83

Source: AGDC, 2017h
Assuming transmission loss of 20 log R for trenching, grading, and ditch witch; 17 log R for pile driving.
Impact pile driving assumes 5 hours/day; 1,560 strikes/hour.
Vibratory pile driving, ditch witch, trenching, and grading assumes 15 hours/day.

Other proposed Project activities that may cause disturbance to marine mammals include vessel transit from the marshalling area to West Dock. The 23 barges would stage at the marshalling yard, and three barges at a time would rotate in to offload at DH3. The barge marshalling area is located 3 to 5 miles (4.8 to 8 km) offshore of West Dock. Offloading is scheduled to occur between August 1 and September 15.

To evaluate potential effects of the marine and nearshore proposed Project activities described above, it is first important to understand which species may be encountered during specific times of year that may overlap with construction. Ringed seals and polar bears are the only marine mammals found in the proposed Project Area during winter months while the occurrence of bearded seals is considered very rare as they are typically farther offshore on pack ice. With the exception of ringed seals,[8] the other ESA-listed species of marine mammals (bowhead whales, humpback whales, polar bears, and bearded seals) are discussed in Section 4.14, Threatened & Endangered Species. Given the low likelihood of gray whales in the Beaufort Sea in summer, the analysis of summer activities for Alternative 1 focuses on beluga whales and ringed seals.

As described in Chapter 3, Section 3.8.5.2.2, ringed seal density surveys were conducted in the late 1990s and early 2000s approximately 6 miles west of West Dock to determine potential effects of construction of the Northstar Project (Moulton *et al.,* 2002). Seal densities close to the Northstar ranged from 0.39 to 0.63 seals per square km (Moulton *et al.,* 2002). According to these surveys, seal densities prior to construction (1997–1999), after two winters of winter construction and commencement of drilling operations (2000 and 2001, respectively), and finally after drilling and onset of full operations (2002) were not significantly affected by proximity to Northstar (Moulton *et al.,* 2005).

It should be noted that active lairs and breathing holes are almost unnoticeable and very difficult to locate (Smith and Stirling, 1975) so detection of seals under ice or in lairs is challenging. Ringed seals generally occur over water depths of 33 to 66 feet (10 to 20 m) on shorefast ice (ADNR, 2009); although, as stated earlier, have been observed in water 6 to 10 feet deep. Since pups are born in late March and April, there is potential for disturbance of seals if dredging and disposal operations are underway during these months. However, while the species may occur in the area, the likelihood of ringed seals establishing lairs in nearshore ice around West Dock is low given the existing industrial activities in this area. At Northstar Island in 2001, the closest suspected ringed seal lair was found 1,600 m (1 mi) from the island and 54 m (177 feet) from the ice road (Williams *et al*., 2006a, b as cited in NMFS, 2014).

[8] On February 12, 2018, the Ninth Circuit Court of Appeals upheld the listing of ringed seals as threatened under the ESA. At the time of preparing this SEIS, this decision had not yet been determined. Therefore, the discussion of ringed seals is included with other marine mammal species not listed under the ESA. Ringed seals are evaluated in the Biological Assessment attached as Appendix N, Part II.

Based on the available data summarized in Section 4.12.2.1.2, ringed seals and bearded seals have hearing sensitivity to impulse noise of 185 dB and 218 dB 1µPa for peak pressure levels and cumulative sound exposure levels, respectively (see Table 4.12-2). Impact pile driving at Northstar indicated mean underwater noise levels between 157 and 151 dB re 1 µPA and 145 dB re 1 µPA2x s at 63 m for SPL and SEL, respectively. Data from a 2012 study reported that excavator dredging could result in noise levels 168 to 178 dB re 1 µPA@1m. Blackwell, Lawson, and Williams (2004b) summarized ringed seal behavior observed during impact "pipe-driving" (*i.e.*, pile driving) and other construction sounds during the construction of Northstar Island in the Beaufort Sea in June and July 2000. Pulses were analyzed to determine unweighted peak and rms SPLs and sound exposure levels (SELs). Mean underwater noise levels for these activities reached 157 and 151 dB re 1 µPA and 145 dB re 1 µPA2x s at 63 m for SPL and SEL, respectively. In air values were 112 and 96 dB re: 20 µPa and 90 dB re: (20 microPa)2 x s, respectively. Underwater SPLs were <180 dB re 1 µPA at all distances. During the 55-hour observation period, 23 seals exhibited little or no reaction to any industrial noise except approaching Bell 212 helicopters. Ringed seals swam in open water near the island throughout construction activities and as close as 46 m from the pile-driving operation. The study concluded that none of the seals' reactions to helicopters were strong or long-lasting and that seals had probably habituated to industrial sounds and frequently occurring visible disturbances (Blackwell *et al*., 2004b as cited in NMFS, 2014).

Average received underwater noise levels for vibratory pile driving in open water were reported by Greene *et al.* (2008) to be 143 dB re 1 µPA at 100 m (approximately 328 feet). Dredging and vibratory pile driving activity under Alternative 1 could adversely affect ringed seals by exposing them to elevated noise levels in the vicinity of the proposed Project Area. Behavioral responses to increased sound levels from the proposed Project could include changing direction, changing durations of surfacing or dives, reduced/increased vocal activities, changes in socializing or feeding, startle, or avoidance (Richardson *et al.,* 1995).

Behavioral responses would be unlikely to result in anything more than minor, biologically insignificant consequences for any individual animals. For example, Kelly *et al*. (1986) reports that some ringed seals temporarily departed their lairs when sound sources were within 0.06 to 1.9 mi (97 to 3,000 m) but did return to their lairs later. However, considering the dredging and pile driving activities would be temporary, if seals in the area were exposed to elevated underwater noise, the effects are not likely to result in PTS or TTS. Pilings would be removed at the end of the season. To remove pilings, a diver would use a suction hose to remove sediment around the piling. Next, an underwater oxygen lance would cut piles below the surface and a crane stationed on top of a barge would remove the top portion of the piling. These activities would be brief and are not likely to propagate high levels of noise.

Although there may be behavioral changes due to disturbance, these changes would not be anticipated to affect reproduction. Changes to food availability are not likely to occur

as a result of vessel noise or movements. Mitigation Measure Nos. 7 and 8 would also help minimize potential impacts due to underwater noise.

The effects of dredging and pile driving on ringed seals is considered minor despite the potential for noise from dredging and whether impact pile driving is needed. Activities would be short-term (a few months), over a small geographic area and, therefore, not likely result in mortality or population-level effects associated with disturbance during reproduction (*i.e.*, pupping). Based on available data, noise levels are not expected to result in mortality. While injury or disturbance of marine mammals (namely ringed seals) could still be possible during winter activities, these effects are not likely to affect large numbers of animals or the overall population.

Once dredging and pile driving are complete and the temporary bridge is in place, six shallow-draft tugs ranging in size from 70 to 400 feet would be used to transport barges from the open water marshalling area 3 to 5 miles offshore into DH3. The tugs would be expected to operate at relatively low speeds (*i.e.*, below 10 knots), which has been shown to reduce the likelihood of whale strikes. A review of whale vessel strikes by Jensen and Silber (2003) reported that whale strikes occurred predominantly with vessel speeds between 13 and 24 knots. While the potential of a vessel-marine mammal strike is expected to be low due to lower vessel speed, the frequency of the barges (*i.e.*, 23 barges in one season) may increase the chance of a strike.

In a September 2016 humpback whale status review, NMFS concluded the following about vessel strikes in Alaska:

> *…it is difficult to conclude that ship strike levels are definitively increasing based on an increase in reports. For instance, in Alaska, following the implementation of a stranding hotline in 2009, many types of stranding reports increased, likely due to heightened public awareness. That said, large whale ship strikes reported to NMFS in Alaska have been fairly steady over the past decade (NMFS Alaska Region Stranding Program data). Most collisions in Alaska involve small recreational vessels or whale watch boats with no apparent long-term consequences for the whale. NMFS is actively working with sectors of the maritime industry on ship strike avoidance and awareness programs (81 FR 62259).*

Mitigation Measure Nos. 1 through 11 would also help minimize the likelihood of interacting with marine mammals in the area and reduce potential for vessel strikes with animals in the water. For these reasons, the chance of mortality associated with vessel traffic is considered minor.

Vessel activity would increase between the marine marshalling area and DH3, which would also increase underwater noise in the area. Vessel traffic and increased noise levels may result in changes to marine mammal behavior such as changes in the duration of surfacing or dives, reduced/increased vocal activities, changes in socializing or feeding, startle response, or avoidance as described above.

Aircraft including fixed wings and helicopters could result in short-term behavioral responses by cetaceans; responses appear to depend on the animal's activity (NMFS, 2014). Some of the response types include sudden dives or rapidly swimming away from the aircraft track (Richardson *et al*., 1995 and Patenaude *et al*., 2002 as cited in NMFS, 2014). Cetaceans tend to react more when the aircraft is flying low (*e.g*., 75-150 m [250-500 feet]) (NMFS, 2014).

Under Alternatives 1 and 2, it is assumed that the tugs proposed for bringing GCF modules to shore would not use dynamic positioning (*i.e*., thrusters) while transiting but only during berthing and close-in maneuvering. Given the relatively shallow water depth at the Dock (9 feet below mean lower low water after dredging) the tugs are not expected to contribute substantially to underwater noise. Underwater noises from tugs and barges used in Northstar ranged from 143 – 157 dB re 1µPa (Richardson and Williams, 2002). These levels are below ringed seal sensitivity for PTS; however, they would exceed the NMFS threshold for Level B take of 120 dB (NMFS, 2016b).

As noted in NMFS 2013, slow moving vessels within several hundred meters may be tolerated by some marine mammal species, especially when the vessel is not directed toward the animal and when there are no sudden changes in direction or engine speed (Wartzok *et al.,* 1989; Richardson *et al.,* 1995). Given that existing vessel traffic in and out of West Dock during summer months is high, it is anticipated that while animals could be disturbed due to human activity, they would not likely be affected to the point where disturbance results in a population-level effect.

The construction and use of ice roads and pads has the potential to impact ringed seals that may occur in the proposed Project Area. In late fall or early winter, ringed seals start to construct and maintain a series of breathing holes as soon as ice begins to form (Smith and Stirling, 1975; Frost and Burns, 1989 as reported in Williams *et al.,* 2006a). Pups are typically born in lairs between mid-March through April, and mothers nurse their pups in the lairs for five to eight weeks (Smith, 1973; Hammill and Smith, 1991; Lydersen and Hammill, 1993 as reported in Williams *et al*., 2006a). Data from a study conducted for Northstar Island Production Facility documented that of 181 subnivean structures (*i.e*., ringed seal lairs) 118 (65 percent) were actively used by late May 2001. Northstar is located 9.5 km from the mainland on a manmade gravel island in 12 m of water; this region is covered by landfast ice, an important overwintering and spring breeding habitat for ringed seals. Landfast sea ice in this region extends from 25 to 40 km offshore, where water is 18 to 27 m deep (Kovacs and Mellor, 1974; Stringer, 1974; Wadhams, 2000 as reported in Williams *et al*., 2006b). Williams *et al.* (2006b) concluded that within a few meters of the Northstar Island oil development, ringed seal breathing holes and lairs were established in the landfast ice before and during development and construction activities. Despite the presence of low frequency industrial noise and vibration due to construction and use of ice roads, many of these structures were maintained by seals for up to 163 days. While the construction and use of ice roads may result in mortality (due to crushing) or disturbance from vibration or noise, these studies indicate that ringed seals may tolerate the presence of low frequency industrial noise and vibration.

Therefore, assuming Mitigation Measure No. 8 is implemented to initiate ice road and pad construction prior to March 1 or to clear the area for ringed seal lairs prior to construction that must occur after this period, the potential for effects associated with Alternative 1 on ringed seals in lairs (including pups) is considered minor.

4.12.4.1.3. Port of Seward

According to the proposed Project proponent (AGDC, 2017c):

> *The procurement of pipe and materials would influence the transportation logistics for delivering these items to Seward (i.e., the number and types of vessels necessary for equipment delivery). The pipe is likely to come from either Asia directly into Seward or from the Gulf Coast via the Panama Canal. There would be some incremental freight that comes into Seward from other international or U.S. ports. The number of the vessels coming into the Port of Seward would depend on where pipe and materials come from, how ships are loaded, the size of the vessels that can be used out of those ports, and the timing of availability of those vessels. The pipe would arrive in port over multiple years in all seasons, but would probably peak during two summers.*

Based on the expected use of the Port of Seward, anticipated impacts to marine mammals from increased vessel traffic would consist of disturbance due to vessel presence and underwater noise, and strike hazard. Vessel traffic during the summer would be short-term, and provided standard mitigations (as described in Mitigation Measure Nos. 1 through 4 in Section 4.12.3) for vessel speed and activities are in place, impacts to marine mammals from proposed Project activities would be minor. Similar to West Dock activities, underwater noise would increase with vessel traffic, but is not expected to result in mortality. Noise may cause short-term behavioral changes, but these effects would not result in a reduction in reproduction or changes to the population. Mitigation Measure No. 1 may help to minimize potential effects. While the activities would contribute to increased disturbance in the area, disturbance from increased traffic or underwater noise would be minor as vessels would use existing shipping lanes, which currently have high vessel activity in the Port of Seward.

Vessels do have the potential to introduce invasive species to marine mammal habitat in Prudhoe Bay and Seward. Ballast-water discharge, fouled vessel hulls, or equipment placed overboard (*e.g.*, anchors, piles, etc.), are vectors for introducing invasive species. In Alaska, vessels are subject to U.S. Coast Guard regulations (33 CFR 151 Subpart D) intended to reduce the transfer of invasive species by "removal of fouling organisms from hull, piping, and tanks on a regular basis and dispose of any removed substances in accordance with local, state, and federal regulations." A non-native marine amphipod (*Caprella mutica*) has spread widely in Alaska harbors, ranging from Ketchikan in Southeast Alaska to Dutch Harbor in the Aleutian Islands (Ashton *et al.*, 2008). Warmer waters near Seward may be more susceptible to these types of events than Prudhoe Bay. Given that winter dredging and summer vessel activities would effectively be

accomplished in two seasons, the duration of activities that could introduce invasive species is considered low. The effects of invasive species on marine mammals would be negligible given the low likelihood of an invasive species infesting and surviving in the area, and being the type of invasive species to cause significant harm to marine mammals.

Vessel spills could occur during vessel transit into the Port of Seward. While the potential for a small spill from the vessel exists, the likelihood is low. If a spill were to occur, procedures would be in place to respond quickly, thereby minimizing any potential impact to resources in the area (see Mitigation Measure No. 10 in Section 4.8.3). Runoff from equipment used to transfer materials from barges to the Seward Marshalling Yard may also contribute contaminants including hydrocarbons, lubricants, or other chemicals. Any impacts would be considered minor, short in duration, and no population level impacts would be expected.

4.12.4.2. Operations and Maintenance

All operation and maintenance activities for the proposed Project would be land-based, and given that activities would consist of infrequent human presence, are not likely to affect marine mammals.

4.12.4.2.1. Summary of Potential Direct and Indirect Effects of Alternative 1 (Proposed Action) on Marine Mammals

Descriptions of mitigation measures are provided in Section 4.12.3 and have been taken into consideration with respect to analyzing impacts. Winter dredging could result in minor impacts to marine mammals associated with short-term disturbance from vessel presence and underwater noise depending on how noise would propagate in Prudhoe Bay during the use of excavators for dredging. Importantly, although there may be behavioral changes, they would not be anticipated to affect reproduction. Changes to food availability are not likely to occur as a result of vessel noise or movements. Potential effects of increased turbidity during dredging would be negligible given the short-term duration and small geographic extent of the effect. Ringed and bearded seals are also expected to be somewhat tolerant of some amount of turbidity associated with frequent ice scour and storms in the area. The chance of mortality associated with vessel traffic is considered minor due to low vessel speed and low likelihood of occurrence. Given the existing vessel traffic in and out of both West Dock and the Port of Seward, marine mammals would not be expected to remain in the area if there is a disturbance significant enough to result in long-term harm (*i.e.*, noise levels exceeding the threshold for PTS). Marine mammal behavior is not likely to change such that reproductive success or any population-level effect would result. Mitigation measures described in Section 4.12.3 would also contribute to minimizing potential effects. Overall, the anticipated effects of Alternative 1 on marine mammals would be expected to be minor depending, in large part, on how underwater noise may propagate in bottomfast ice and shallow water.

4.12.5. Alternative 2 – Denali NPP Route Variation

4.12.5.1. Construction

4.12.5.1.1. West Dock: Dock Head 2 and Causeway Upgrades

DH2 is located in shallower waters and could not accommodate the weight and offloading of the modules without complete retrofitting, including the addition of a third berth. Under Alternative 2, the following infrastructure improvements would likely be needed to accommodate offloading the modules: the existing channel from DH2 would need to be widened and deepened to a total depth of -9 feet to accommodate large vessels (resulting in approximately 750,000 CYs of material for subsequent disposal); vibratory pile driving and sheet pile installation would occur to expand the dock and create a third berth; and more than 750,000 CYs of dredging would need to occur. In addition, the rate of infill at DH2 is conceivably faster than at DH3 due to its location, introducing the likelihood of summer maintenance dredging following winter dredging. If summer dredging is necessary, some amount of dredge materials would need to be disposed of which would require vessels to transport material to the disposal site.

Impacts from all upgrades and proposed activities to the DH2 are similar to Alternative 1 for DH3, and would primarily consist of disturbance from dredging, vibratory pile driving, and vessel presence and noise. As in Alternative 1, dredging activities would be scheduled during the winter months; therefore, impacts to most species would be minimized. There is potential to affect ringed seals that may occur in the proposed Project Area, although given the existing level of vessel traffic and human activity in this area, the likelihood that a ringed seal would remain in the area long-term is low. If seals were present during operations, the effects of disturbance would not likely result in a population level effect on the species or local populations. Given the amount of dredging proposed under Alternative 2, there would be an increase in underwater noise above what would be expected under Alternative 1. If marine mammals were exposed to increased levels of underwater noise from dredging, the duration of noise exposure could extend over a few winter months but then again over a few subsequent summer months given the rate of infill due to the location. The level of noise from dredging would not result in mortality of marine mammals; however, behavioral responses to increased noise from dredging could be similar to what may occur under Alternative 1, including changing direction, changing durations of surfacing or dives, reduced/increased vocal activities, changes in socializing or feeding, startle, or avoidance. A minor increase in vessel traffic to dispose of material from the summer dredging operation could pose an increased risk for interactions with marine mammals. Vessels disposing of material would be expected to follow the mitigation measures to minimize impacts including reduced vessel speed and avoiding quick changes in direction. Disposal of dredge material during summer would also introduce sediments into the water column, at least temporarily. This short-term change due to increased turbidity would not likely cause long-term changes in the ability of marine mammals

(*i.e.*, seals or small cetaceans such as beluga whales) to forage or reproduce. Assuming these measures are implemented, vessel traffic would likely only cause short-term behavioral responses. Behavioral changes due to dredging or increased vessel traffic would be expected to cause minor effects on marine mammals as the potential effects are not expected to be biologically significant (such as resulting in changes to reproduction, long-term effects on foraging or long-term stress).

Disposal of dredge material would be accomplished using ice roads. There would be potential to impact ringed seals if lairs were located within the area proposed for ice roads. Underwater noise would propagate farther under Alternative 2 given that vessels would be transiting to the ocean disposal site; however, the level of noise exposure to marine mammals from this activity is currently unknown as a specific site would be determined at a later date. As stated for Alternative 1, According to Richardson and Williams (2002), underwater sound levels (reported as SPL) for tug activities for the Northstar facility located west of Prudhoe Bay were 145 dB re 1µPa recorded 116 m (381 feet) from a tug that was forcing a barge against a dock. These levels are below ringed seal sensitivity for PTS however, would exceed the NMFS threshold for Level B take of 120dB (NMFS, 2016b).

Vibratory pile driving associated with DH2 improvements would result in increased exposure of marine mammals to underwater noise given the extent of dock improvements that must be made as compared to improvements needed under Alternative 1. As with Alternative 1, both impact and vibratory pile driving are likely to be used to modify West Dock to meet proposed Project needs. Data from Northstar indicated mean underwater noise levels between 157 and 151 dB re 1 µPA and 145 dB re 1 µPA2x s at 63 m for SPL and SEL, respectively for pile driving. For this proposed Project, a spreading loss of 20 log R would be used to calculate exclusion zones during trenching, grading, and use of ditch witch. During vibratory and impact pile driving, 17.5 log R would be used to calculated exclusion zones. Based on this approach, underwater sound levels from all activities would be below NMFS thresholds at a distance of 2.2 km (7,218 feet) from the source, and sound levels are likely to diminish to background levels at less than 5 km from the source. Pile driving during open water conditions that may be present between July and late October may expose marine mammals (ringed seals, beluga whales, and potentially bowhead whales) to underwater noise levels that exceed NMFS regulatory thresholds (see Section 4.12.4 for additional detail). Bowhead whales would be considered rare within the range that could exceed noise thresholds. Notably, ringed seals exposed to construction noise associated with Northstar in 2000 seemed to indicate some level of tolerance (Williams *et al.,* 2006b).

If a seal did establish a lair in the proposed Project Area, and a pup were born in late March to mid-April, a pup would remain in the lair another 5 to 9 weeks to nurse. The propagation of noise through the ice into the lair is unknown, but is not expected to exceed thresholds for PTS or TTS. If noise was audible to the seal pup, it could disturb the seal; however, this would not likely result in mortality. The noise could cause increased stress or disrupt nursing. As described under Alternative 1, based on a study

conducted at Northstar, despite the presence of low frequency industrial noise and vibration due to construction and use of ice roads, many of these structures were maintained by seals for up to 163 days (Williams *et al.,* 2006b). Mitigation Measure No. 8 may help reduce impacts due to noise by initiating construction before seals begin establishing lairs or by clearing the area for seals if ice road or pad work must occur after March 1. Ideally, impacts to marine mammals would be greatly minimized if the DH2 improvements were completed in one winter. If construction occurs during the open water season of years 1 and/or 2, some amount of disturbance to marine mammals, namely ringed seals, bearded seals, and beluga whales, may occur. The magnitude of these effects is likely minor assuming Mitigation Measure Nos. 1 through 11 are implemented.

Vessel traffic and associated underwater noise in the Port of Seward would be the same under Alternative 2 as anticipated for Alternative 1. While the activities would contribute to increased disturbance in the area, disturbance from increased traffic or underwater noise would be minor because vessels would use existing shipping lanes, which currently have high vessel activity in the Port of Seward.

4.12.5.2. Operations and Maintenance

All operation activity for the proposed Project would be land-based and not affect marine mammals.

4.12.5.2.1. Summary of Potential Direct and Indirect Effects of Alternative 2 on Marine Mammals

Descriptions of mitigation measures are provided in Section 4.12.3 and have been taken into consideration with respect to analyzing impacts. Winter dredging would likely result in minor impacts to marine mammals associated with short-term disturbance from vessel presence and underwater noise. Although there may be behavioral changes, they would not be anticipated to affect reproduction. Changes to food availability are not likely to occur as a result of vessel noise or movements. Potential effects of increased turbidity during dredging would be minor given that sediments would be disposed of at an ocean site where particles would be quickly dispersed or settle. Given that dredging at DH2 may be needed over two seasons (*i.e.*, during winter and again during summer months), incidental harassment of marine mammals may result in changes in behavior that are not expected to be biologically significant (such as changes in reproduction or ability to forage). Increased vessel traffic and an increase in turbidity at the ocean disposal site would not likely result in mortality, and any effects on behavior would be short-term. These effects are expected to be greater than anticipated for Alternative 1 given the longer period for dredging. The chance of mortality associated with vessel traffic is considered minor due to low vessel speed and low likelihood of occurrence. Given the existing vessel traffic in and out of both West Dock and the Port of Seward, marine mammals would be likely to avoid the area or their behavior is not likely to change such that reproductive success or any population-level effect would result.

Similar to Alternative 1, the proposed mitigation measures described in Section 4.12.3 help to reduce the likelihood of interacting with marine mammals, attempt to minimize underwater noise propagation and propose best practices to help reduce the potential effects of a spill. The amount of dredging, tug and barge traffic, and pile driving would contribute to higher levels of underwater noise in the area although the extent of the ensonified area due to noise cannot be determined at this time. Given that more dredging would be required for using DH2 and assuming that would mean that in-water work would occur over a longer period, effects of dredging and improvements to DH2 would be greater under Alternative 2 than Alternative 1. Overall, assuming Mitigation Measure Nos. 1 through 16 are implemented, the anticipated effects on marine mammals would be expected to be minor.

4.12.6. Alternative 3 – No Action

Under Alternative 3 (No Action), the proposed Project would not be constructed, and therefore, there would be no direct or indirect impacts to marine mammals.

4.12.7. Conclusions and Comparison of Alternatives

Alternatives 1 and 2 are similar in terms of the types and magnitude of effects expected for marine mammals. These effects primarily consist of increased disturbance due to vessel traffic and presence, increased underwater noise associated with vessels, dredging, short-term increases in turbidity, and vibratory pile driving and cutting of mooring piles. There is very low likelihood that any marine mammal mortality would occur under either alternative during winter dredging and dock improvements that are planned at that time. Construction, including pile driving, that would occur during the open water season could result in behavioral harassment to marine mammals under Alternatives 1 and 2. Dredging and DH2 improvements necessary under Alternative 2 is expected to result in minor impact due to the amount of dredging required. These effects are likely to be greater than Alternative 1 but would still be minor.

Summer vessel traffic under both Alternatives 1 and 2 would increase the chance of a strike given the number of barges expected (23) in one season. However, as stated earlier, a slower transit speed has been shown to decrease the likelihood of a strike as well as mortality due to a strike (NMFS, 2013). Vessels would use existing shipping lanes under both alternatives. Alternative 3 No Action would not result in any impacts on marine mammals. The risk of invasive species causing effects under any alternatives is negligible and while spills of diesel fuel or other toxic substances could occur, the duration of vessel activities (two seasons) decreases the likelihood of such an event. The effects of a spill would be minor under Alternatives 1 or 2 considering they would also likely be small and procedures would be in place to respond quickly (see Section 4.12.3). Alternative 2 would result in greater impacts due to a greater level of activity (*i.e.,* more pile driving, dredging requirements and increased vessel traffic to the ocean disposal site) though these are likely to be minor. This does depend, however, on the potential extent of the ensonified areas resulting from vessel traffic, dredging and pile driving.

Alternative 2 would require additional dredging and therefore, additional dredge material would be disposed of at the ocean disposal site. The increased amount of material to be disposed of would result in higher levels of turbidity at the disposal site as compared to Alternative 1 given the increased volume of material. However, the ocean disposal site is located offshore where ocean currents and wave action would likely dissipate dredged materials within a relatively short period of time. Therefore, the impacts of increased turbidity on marine mammals that may be within the Project area would still be considered minor.

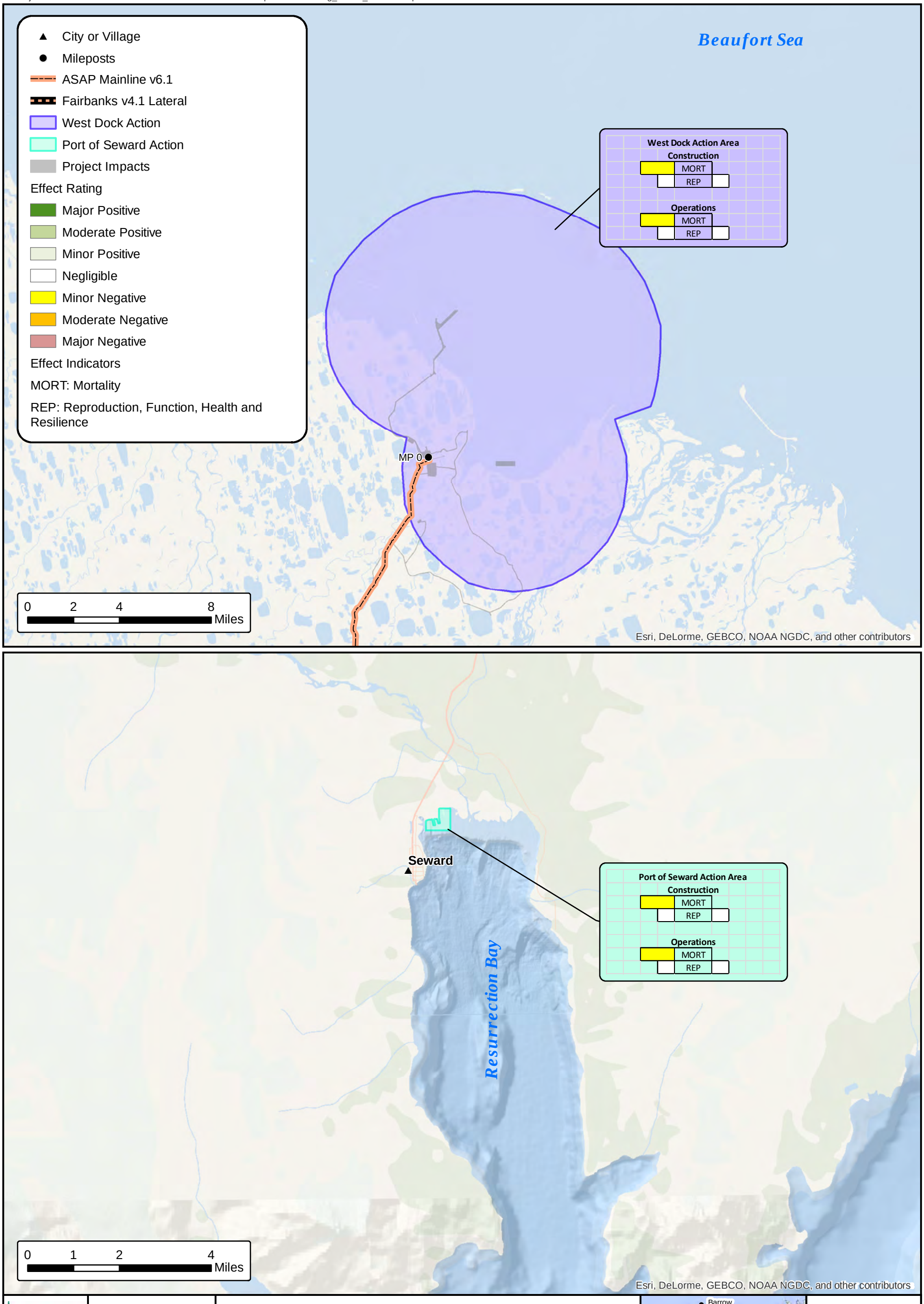
At West Dock, Alternative 1 would involve filling 9.9 acres of marine habitat with gravel; Alternative 2 would require less gravel fill because DH2 is closer to shore than DH3, with 5.8 acres filled. Fill placement would occur in the winter, when marine mammals are not present in the Project area.

Alternative 1 would result in minor impacts on marine mammals, but would also depend on the extent of the ensonified area associated with underwater noise. Table 4.12-6 provides a summary of potential impacts on marine mammals associated with the alternatives. Figure 4.12-2 places the key findings from the impact analysis into a geographic context. The impact ratings presented in Table 4.12-3 and Figure 4.12-2 are similar in terms of potential effect (*i.e.*, minor). The key differences between the proposed Project Area (Prudhoe Bay and the Port of Seward) relate to the potential sources of disturbance. More noise-producing activities, as well as dredging, are proposed under both Alternatives 1 and 2 at West Dock. The Port of Seward impacts would only be associated with vessel transit. Potential impacts during operations would be negligible for marine mammal communities under any alternative.

Table 4.12-6 Comparison of Alternatives for Impacts to Marine Mammals

Biological Resource Effect	Potential Impact Description	Alternative 1		Alternative 2		Alternative 3
		Construction	Operations	Construction	Operations	Construction/Operations
		Impact Rating		Impact Rating		Impact Rating
Mortality	• Vessel strike • Disturbance, disease, invasive species, and increased predation	*Minor*	*Negligible*	*Minor*	*Negligible*	*Negligible*
Reproductive Effects/ Function/ Health/ Resilience	• Displacement or disturbance of marine mammals due to noise and human/vessel presence • Diminished reproduction	*Minor to Moderate*	*Negligible*	*Minor to Moderate*	*Negligible*	*Negligible*
	• Disease, invasives, and predation • Exposure to toxic substances (*i.e.*, oil or hazardous materials spills)	*Negligible*	*Negligible*	*Minor*	*Negligible*	*Negligible*

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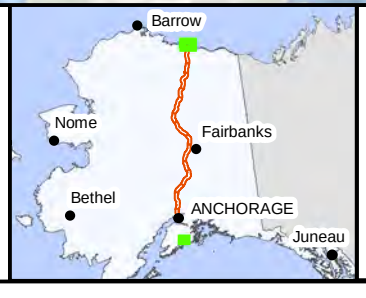


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Figure 4.12-2: MARINE MAMMAL IMPACTS CONTEXT MAP ALASKA STAND ALONE PIPELINE



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4.13. Benthic

4.13.1. Introduction

This section describes the potential direct and indirect effects of the alternatives described in Chapter 2 on the benthic community at Prudhoe Bay and the Port of Seward. Aspects of freshwater benthic systems are also discussed in Section 4.11, Fish. This section outlines the proposed Project Area, defines frequently used terms, identifies incomplete or unavailable information, and how the lack, thereof, influenced the analysis, describes the methods for determining the level of impact to the benthic community, and presents the results of the assessment. Also described are some of the mitigation measures that would aid in avoiding or minimizing the potential impacts of the proposed Project. Additional information on proposed mitigation and monitoring is provided in Appendix M. The information provided here is new and was not previously included in the 2012 FEIS (USACE, 2012a).

4.13.1.1. Incomplete or Unavailable Information

In compliance with CEQ guidance (see Section 4.3), this section addresses incomplete or unavailable information pertinent to analyzing impacts of the alternatives on the benthic community. Recent site-specific information on the benthic community and sediment sampling results within the proposed Project Area are not available. Therefore, older impact assessments, sampling studies, and literature have been used to assess impacts to the benthic community. Professional judgment was applied based on knowledge and experience of the authors and generally accepted scientific methods.

4.13.2. Methods

The potential impacts on the benthic community for the proposed Project and alternatives are based on available proposed Project details for Alternative 1, design features proposed under Alternative 2 and publicly available literature on the resources and their habitat in Prudhoe Bay and the Port of Seward. Potential impacts were analyzed by assessing the magnitude, extent, duration and likelihood of occurrence as presented in Table 4.13-1, Impact Criteria for Benthic.

Effects that were assessed include:

- Direct mortality during construction and operation;
- Physical habitat loss, alteration, and fragmentation;
- Introduced non-native, invasive, and parasitic species; and
- Contaminants.

4.13.3. Applicant-Proposed Design Features, Mitigation Measures, Best Management Practices, and Project Management Plans

The following design features, mitigation measures, BMPs, and Project Management Plans are proposed by AGDC, and have been taken into consideration when evaluating potential impacts on benthic resources under Alternatives 1 and 2 during the construction and operations phases. A complete list of mitigation measures and BMPs are also provided in Appendix M.

Proposed measures would include:

1. Minimize contamination from vessel bilge waters, antifouling paints, shipboard accidents, shipyard work, maintenance dredging and disposal, and nonpoint source contaminants from upland facilities related to vessel operations and navigation.
2. Dredged materials would be placed on top of the ice in the nearshore areas and enter the water column intermittently as nearshore ice melts in the summer.

4.13.3.1. Description of Effects

4.13.3.1.1. Direct Mortality during Construction and Operation

Direct mortality primarily involves the removal, destruction, contamination or smothering of benthic organisms by dredging and screeding activities. Van Dalfsen and Essink (2001) assessed the direct effects of dredging on a benthic community, and its subsequent recovery. Results of the study determined that colonization takes place almost instantaneously by immigration and recruitment. The response of the benthic community after the disturbance appeared to follow this pattern:

1. Rapid development of 'opportunistic' species.
2. Subsequent recovery of community composition and structure.

Van Dalfsen and Essink (2001) determined that recovery time of the benthic community in terms of abundance took roughly 2 years at the North Sea study location. In terms of biomass and diversity, pre-disturbance values were regained within 2 to 4 years.

Conclusions from the 2001 van Dalfsen and Essink evaluation were based on benthic responses to dredging activities occurring at depths between 5 and 8 m in the southern North Sea. The study site was located at geographic latitude 53° 20′ N off the coast of the Netherlands in waters influenced by Atlantic Ocean currents. Winter water temperatures here average 4 degrees Celsius (°C) (van Dalfsen and Essink, 2001).

In contrast, Prudhoe Bay is located at geographic latitude 70° 19′, where waters are shallow (<6 m in depth) and relatively protected from the ocean waters of the Beaufort Sea. The bay begins to ice over in September, and is frozen from the shoreline to a depth of roughly 6 m and does not completely thaw until June (Spight, 1979). The North Sea assessment is site-specific and may not completely reflect conditions found in Arctic benthic communities. Differences in depth, water temperature, seasonal daylight, and

the extent and duration of ice cover may result in extended recovery times for benthic communities in Prudhoe Bay in comparison to those evaluated in the North Sea.

Ice scouring is a natural process that could result in the direct mortality of the benthic community; ice scour disturbance to soft sediments is a regular, predictable event within nearshore waters of the Beaufort Sea. This process typically entails ploughing and overturning of sediments, altering seabed topography sometimes considerably. Impacts of ice scour may be similar to the effects of other anthropogenic physical disturbances, such as, dredging (Messieh *et al.,* 1991; Thrush *et al.,* 1995; Currie and Parry, 1996). Conlan *et al.* (1998) studies in the Arctic found the ice scours were dominated by the disturbance-tolerant fauna. Prevalence of these species associated within areas subjected to ice scour indicates that ice disturbance is an important factor that molds coastal benthic zonation.

4.13.3.1.2. Physical Habitat Loss and Alteration

Habitat impacts are primarily physical perturbations that result in alterations in the amount or quality of a habitat. Dredging and screeding activities disturb the sea floor altering the habitat conditions. A Dunton, Schonberg, and Cooper (2012) study along the Arctic coast of Alaska indicates that the benthic infauna living within lagoon systems, similar to the shallow Prudhoe Bay, are limited in mobility, and therefore, subjected to changes in physical processes common to all estuaries. Processes include sedimentation, resuspension events, and advection, which affect seasonal nutrient and recruitment fluxes, and eventually, biological processes (Montagna and Kalke, 1992).

4.13.3.1.3. Introduced and Invasive Species

Non-native or invasive species are typically introduced into a system by human-related activity. The introduction of invasive species could have a dramatic effect on natural resources. When non-native species are introduced into an ecosystem in which they did not evolve, they are not necessarily influenced by the same factors and their unimpeded population growth may impact the native community. Invasive and non-native species disrupt natural communities and ecological processes; creating competition for limited resources (*i.e.,* food, water, shelter, etc.) or through predation.

Alaska has been minimally affected by invasive species because of factors that include isolation, localized rather than widespread development, a colder climate, and restrictive species import/transport regulations. However, Chinese mitten crabs have been documented in the White Sea near Arkhangelsk, Russia, which is at a similar latitude to Prudhoe Bay (Petterson, 2010 as reported in USACE, 2012b). This species is listed as injurious wildlife under the Lacey Act and could cause negative ecological and economic impacts (Jakubowska and Normant, 2011). No mitten crabs have been documented in Prudhoe Bay and while their occurrence in Russia provides evidence this could occur, the likelihood remains low. Invasive plants could be introduced through construction equipment used on land.

4.13.3.1.4. Contaminants

Petroleum products spilled into the marine environment may enter benthic food chains. Magnitude, time of year, and duration of a spill determine the extent to which benthic species in the proposed Project Area are affected. Accidental release of hydrocarbons and contaminants in the spring, summer, and early fall all have the potential to affect species in the proposed Project Area. Contamination of the surrounding marine feeding areas would limit available habitat. Contaminants, such as petroleum-based compounds, have the potential to affect the growth, reproduction, and development of animals at different age classes. Other potential elements that may impact the benthic community include mercury and zinc released from dredged material from deposit sites. Turbidity changes resulting from dredge material disposal sites also impact the benthic community.

4.13.3.2. Impact Criteria

Table 4.13-1 summarizes the criteria used to determine the level of impact based on the magnitude, extent, duration, and likelihood of occurrence. Table 4.13-2 defines the types of effects the proposed Project and alternatives may have on the biological resources assessed in this SEIS. The potential effects listed in these tables do not consider the implementation of the mitigation measures described in Appendix M of this SEIS. Potential impacts that remain after mitigation measures have been implemented are described for each alternative in the following sections.

Table 4.13-1 Impact Criteria for Benthic

Impact Component	Impact Level			
	Major	Moderate	Minor	Negligible
Magnitude or Intensity	The impact is sufficient to cause population level changes to productivity, growth rate, survival rate, and range.	The impact is sufficient to cause sub-population level changes to productivity, growth rate, survival rate, and range.	The action would impact a few individuals in a population but not affect population productivity, growth rate, survival rate, and range.	There are no perceivable impacts or the mechanism for effects on population status (*i.e.*, productivity, growth rate, survival rate and range) are indistinguishable from baseline.
Geographic Extent	Impacts are statewide, or over the entire range of the species or identified population.	Impacts are at a regional or community level, on a limited portion of the study area.	Impacts are site specific or occur within a few isolated locations.	No measurable effects.
Duration or Frequency	The effect would cause chronic and long-term changes that are likely to be permanent.	The effect would cause periodic, temporary, or short-term changes that are reversed after 1-3 reproductive seasons (3 years).	The effect would cause periodic, temporary, or short-term changes that are reversed over one reproductive season (1 year).	No measurable effects.

Impact Component	Impact Level			
	Major	Moderate	Minor	Negligible
Likelihood	Most likely (Impacts that have greater than 75% chance of arising from the action).	Likely (Impacts that have a 50% to 75% chance of arising from the action).	Somewhat likely (Impacts that have a 10% to 50% chance of arising from the action).	Unlikely (Impacts that have less than 10% chance of arising from the action).

Table 4.13-2 Types of Effects and Impacts on the Benthic Community

Type of Effect	Proposed Action Causing Potential Impact	
	Construction	Operations and Maintenance
Mortality • **Direct:** Mortality • **Indirect:** Disturbance, contaminants, and invasive species	• Dredging and screeding activities • Installation of sheet piles/mooring dolphins • Vessel traffic	None
Reproductive Effects/ Function/Health/ Resilience: • Introduction of non-natives • Exposure to toxic substances (*i.e.*, spills) • Turbidity and inundation. • Diminished juvenile recruitment	• Dredging and screeding activities • Vessel traffic	None

4.13.4. Alternative 1 – Proposed Action

Alternative 1 (proposed ASAP Project) is described in Chapter 2 in detail. The ASAP West Dock Dredge and Disposal Plan provides additional detail on dredging methods and disposal of dredge material, nearshore. The Draft ASAP Marine Transit Plan for GCF Modules provides information on vessel and barge transit activities associated with delivery of the GCF modules to West Dock. The following sections describe potential impacts associated with proposed Project-related activities under Alternative 1.

4.13.4.1. Construction

4.13.4.1.1. West Dock: Dock Head 3 and Causeway Upgrades

The West Dock causeway would require widening and infrastructure modifications as described in Chapter 2 and in the ASAP West Dock Dredge and Disposal Plan. Work at West Dock would involve the addition of gravel fill, dredging, dredge disposal, and the installation of mooring dolphins and sheet piles. Activities would occur over a 2-year construction period in advance of the sealift to prepare DH3 and the West Dock causeway for module movement, as well as pile-driving and infrastructure improvements.

Dredging at West Dock is necessary for the proposed activity to occur in a single summer sealift at West Dock DH3. Improvements to West Dock would begin during winter before the sealift arrival and consist of dredging the navigation channel and

turning basin. Barges would have a draft depth of 8 feet and require at least 6 inches of clearance between the barge keel and the seafloor, thus requiring a minimum water depth of 8.5 feet. The proposed Project is targeting a winter dredge depth of -9 feet, which would mean removal of 250,000 CYs of material. Screeding may also be necessary because of the potential for the channel to be infilled by late summer (Niedoroda *et al.,* 1980).

Dredging is proposed during the winter construction season and would involve using a Ditch Witch to cut the ice in the excavation area and remove it using two to three tracked excavators. Dredged material would be placed in dump trucks, transported to the selected disposal site (see Figure 2.2-5) and placed into 1- to 2-foot piles over a 100-acre area. In preparation for the barge bridge, two abutments would be built as approaches on either side of the breach. Four mooring dolphins would be installed in the breach to protect the current bridge from the ballasted barges. Mooring dolphins and sheet pile for the approaches would be driven into the sediment in the two summer construction seasons prior to construction of the temporary barge bridge. Impact pile driving and vibratory pile driving is described in Chapter 2, Section 2.2.3.

Prior to offloading materials at DH3, the seabed at the offloading dock would need to be sufficiently leveled (screeding) to allow the barges to be ballasted to the seafloor. Screeding barges pulling beams would be used to level the seafloor, transferring high spots to low spots. Screeding would be conducted at each barge berth at DH3.

Depending on the nature of the seabed at the barge bridge, some minor screeding may also be required to keep the barge decks level with the dock abutments. Prior to offloading the first module, an examination of the seafloor at both locations would occur, and a determination made as to whether or not maintenance dredging would be required.

Dredging and screeding of the nearshore environment during winter could cause mortality to marine invertebrates inhabiting or overwintering in the local substrate. Screeding to level barge landing areas could cause additional mortality. Most non-mobile benthic organisms would likely be destroyed in areas excavated by dredging. Scavengers and predators may feed on dead or injured organisms (Feder *et al.,* 1976; Bushdosh *et al.,* 1979). In spite of periodic losses to ice gouging, shove, storm surge, and sediment freezing, these organisms are typically resilient and would be expected to return to previous densities after construction. Infaunal populations may require a significantly longer recolonization time, especially since many do not reproduce with planktonic larvae (Feder *et al.,* 1976). Densities of benthic species would not likely be diminished given the regular ice scour that occurs in this area and that species in such locations typically recolonize quickly as described in van Dalfsen and Essink (2001). Changes in food availability or salinity would likely contribute to a stronger response by epifaunal organisms (Bushdosh *et al.,* 1979 as reported in USACE, 2012b), but dredging operations would result in a negligible impact on benthic food availability.

Dredged material would be disposed on nearshore ice in the area shown on Figure 2.2-5. Material would be dispersed through 1- to 2-foot piles over a 100-acre area. Deposition of the dredged material could cause:

- Increased sedimentation nearshore;
- Transportation of windblown dried sediments to adjacent areas (*i.e.,* fugitive dust);
- Movement of the dredged material by storm-driven waves.

Sediments have not yet been tested within the dredge prism, but are assumed to be similar to the native substrate at the disposal site, primarily based on the proximity of the site to DH3. USACE and EPA require sediment sampling and testing of the dredge prism prior to permit issuance providing dredge and disposal authorization, as a required for compliance with the 404(b)(1) Guidelines. AGDC has elected to defer sampling of the prism to a future date (to be determined) with the understanding that they would not receive permit authorization for this activity. For the purposes of this SEIS, the sediment is assumed to be free of contaminants. Invertebrates could be buried by dredged materials if a large amount of sediment is deposited by ice or waves at once into the nearshore zone. However, given the proposed plan to disperse the materials in 1- to 2- foot piles, the amount of sediment that would be deposited in any specific area is small, and therefore, would more likely be dispersed into the water column that result in suffocating or encapsulating benthic infauna.

Gravel fill would be placed in the benthic environment to widen the West Dock causeway. Approximately 9.9 acres of marine and estuarine waters would be filled with gravel for the work. Placement of the gravel fill would crush or smother any benthic organisms beneath it. The impacts to the benthic community in the marine and estuarine waters due to placement of gravel fill during the construction phase at West Dock would be negligible because the fill would be localized to West Dock in a small area (9.9 total acres) and the relatively small number of benthic species that are likely to be affected.

Ballast water that may be released from tugs or barges could have potential to introduce invasive species, such as, bacteria, viruses, and non-native crabs, mussels and fish into the nearshore environment. For most potentially invasive species, the extremely harsh environment of the proposed Project Area would likely not allow the substantial proliferation of native benthic communities.

Turbidity, resulting from dredging operations, would reduce light penetration, thus reducing photosynthesis. It would also flocculate phytoplankton, and decrease food availability for visual feeders. However, given the short-term duration of dredging and that natural conditions in the area are dynamic whereby ocean processes are constantly mixing the water column, the effects of increased turbidity on benthos would be negligible.

The Prudhoe Bay shoreline is relatively stable because it is protected by adjacent landforms; this protection dampens the current flow within the bay, which is evident from the small accumulation of sediment at the West Dock shore junction. The preferred

disposal location for dredge material from the West Dock navigational channel would be landward of the Territorial Sea boundary in the nearshore environment over bottomfast ice within Prudhoe Bay. These nearshore areas adjacent to West Dock generally would be too perturbed an environment to promote large populations of aquatic marine plant or algae communities. While dredged spoils could cover benthic biota at the proposed location, the likelihood of this resulting in population-level mortality of benthic species is low because of the constantly changing seabed and the preexisting occurrence of ice gouging and natural seasonal sedimentation of the area. The continual formation and retreat of ice throughout the season moves sediments through the area regularly over time.

Dredging and screeding activities are expected to be similar in nature to the natural processes occurring seasonally in the Prudhoe Bay nearshore areas, including ice scouring, and wind and wave action. Dredging and screeding activities would be short-term and localized to the West Dock area and nearshore environment; therefore, impacts to the benthic community from dredging and screeding are expected to be minor for Alternative 1.

Placement of the temporary ballasted barges and the associated placement of gravel to support them would likely result in disturbance or mortality of benthic organisms. This activity is expected to occur over one summer and would be in a localized area. As previously stated, considering organisms in this region are used to wind, ice-scour and wave action, they would likely recolonize this area once the barges are removed. Given the small area affected and the relatively small number of benthic species that are likely to be affected, the impact would be negligible.

There is potential for relatively small spills of petroleum products, lubricants and other toxic chemicals that may be used for operating dredging equipment or tugs. The effect of a small spill could alter growth, reproduction, or development of benthos at different age classes. Other potential elements that may impact the benthic community include mercury and zinc released from dredging material from deposit sites. Vessel activity is expected to occur over two seasons (*i.e.,* one winter and one summer) and is therefore, relatively short-term. The likelihood of a spill is low (*i.e.,* less than 10 percent) given the spill prevention measures that would be in place during these phases (see Appendix M). If a spill were to occur, there could be adverse effects on immobile benthos including mortality or injury. Any affected benthic communities would be expected to recolonize relatively quickly (over a few seasons) assuming normal circulation and other environmental conditions are not affected. Therefore, the impact of a potential spill of hazardous material on benthic organisms would be negligible.

4.13.4.1.2. Waterbody Crossings

As stated in Chapter 2, Section 2.2.11, Waterbody Crossings, the proposed Project footprint would potentially impact 491 waterbodies at 496 locations, including 310 stream locations and 181 inundation areas that do not meet USACE's definition of a

stream or wetland (see Chapter 3, Section 3.3.5.1, Types of Surface Waterbodies). Locations where the pipeline would cross a waterbody that does meet USACE's definition of a stream are included in Appendix F, Stream Crossings. The 496 waterbody crossings can be broken down as follows:

- 430 waterbody impact locations (pipeline)
- Seven Fairbanks Lateral waterbody crossings
- 61 access road waterbody crossings
- Five in-river material site extraction locations at the Sagavanirktok River

Construction activities associated with these waterbody crossings have the potential to generate some degree of impact to benthic communities. Invasive plants could be introduced through construction equipment used on land; therefore, the likelihood that invasive plants could affect the benthic environment within the proposed Project Area would be negligible.

Primary foreseeable impacts to freshwater benthic communities are physical in nature and result from sedimentation and increased total suspended solids (TSS) and physical disturbances to communities. Trenching, dredging, erosions, construction of roads and bridges, installation of culverts, and run-off from adjacent upland activities all have the potential to increase sedimentation in nearby waterbodies.

Impacts resulting from increases in TSS and turbidity include reduction in the rate of primary production through reduced light penetration, increased water temperatures, altered pH, alkalinity, and conductivity, decreased oxygen availability, and increased transportation of contaminants (including heavy metals). In turn, benthic invertebrate species production and abundance may be reduced and/or species compositions altered (Lloyd, 1985).

The duration of exposure and concentration of TSS would determine the degree of impact to freshwater benthics. Waterbody crossing activities associated with this proposed Project would affect crossings at a particular location for a short period of time. It is possible that equipment may cross a waterbody multiple times during construction; however, the crossing zone would likely be a small portion of a waterbody. Therefore, while mortality may result from crushing or smothering due to crossing equipment, the number of benthic organisms affected over even a localized population, would be minor. Once construction at a specific site moves on, benthos are expected to recolonize the area within 1 year. Additionally, construction activities occurring during the winter months would have a reduced impact on these systems, as benthic activity and waterbody volumes are reduced. When appropriate, HDD construction methods would also be used to mitigate impacts.

4.13.4.1.3. Port of Seward

According to AGDC, under Alternative 1, the procurement of pipe and materials would dictate the transportation logistics for delivering proposed Project equipment and pipe into Seward. Pipe materials are likely to come from either Asia or from the Gulf Coast via the Panama Canal directly into Seward. There would be some incremental freight that comes into Seward from other international or U.S. ports. The number of the vessels is dependent upon where pipe and materials come from, how ships are loaded, the size of the vessels that could be used out of those ports, and the timing of availability of those vessels. The pipe would arrive in Seward over multiple years in all seasons, but would likely peak during two summers (AGDC, 2017c).

Vessel activity in and out of the Port of Seward would follow established shipping lanes that receive frequent traffic. Vessels could introduce invasive species that may have attached to hulls or through bilge water. Runoff from equipment used to transfer materials from barges to the Seward Marshalling Yard may also contribute contaminants including hydrocarbons, lubricants, or other chemicals. Mitigation Measure Nos. 1, 2 and 3, listed in Section 4.13.3, would help to reduce the potential for the spread of invasive species or hazardous runoff from equipment used on land that could affect benthic organisms within the Port of Seward. The magnitude of potential infestation of invasive species through vessel transit or bilge water depends on the number of vessels that may come into the port.

While specific numbers are not currently available, the number of ships and barges is likely to be notable given the amount of pipe and materials required for constructing a 733-mile pipeline. Based on this information, the potential for invasive species being introduced is considered a moderate risk. ADF&G considers oil tankers' ballast water in the Port of Valdez to be the greatest risk of introducing invasive aquatic species to Alaska's waters (ADF&G, 2002); barges entering the Port of Seward pose a similar risk. The survival of invasive species in the Port of Seward depends on several factors, but given the existing daily vessel traffic in and out of the Port of Seward and the relatively slow rate of infestation of invasive species currently, the overall impact associated with Alternatives 1 and 2 is considered minor.

While there is the potential for small spills of contaminants to water, the likelihood that enough volume would be released to cause mortality or affect reproduction to benthos at a population scale would be minor under Alternative 1.

4.13.4.2. Operations and Maintenance

All operation activity for the proposed Project would be land-based and not affect the marine benthic community. Increased access to waterbodies via newly installed road systems, potentially increase human access to previously undisturbed areas. Where applicable, access would be limited to the public to mitigate this impact. Brush clearing near permanent water crossings, required for routine operation access, may effect benthic communities by reducing previously shaded waterbodies and increase water

temperatures, aquatic plant development, and alter benthic species makeups. Access roads also may result in runoff of sediments to nearby waters and contribute to increases in aquatic sediment loads (Levy, 2009). Conservative brush clearing practices would be in place to mitigate potential impacts, which are considered negligible.

4.13.4.2.1. Summary of Potential Direct and Indirect Effects of Alternative 1 (Proposed Action) on the Benthic Community

Dredging of the nearshore environment during winter would result in direct loss of some productive benthic habitat. There would be some mortality to marine invertebrates inhabiting or overwintering in the local substrate. The same is true year-round for freshwater benthic invertebrates inhabiting ponds, streams, rivers, and other waterbodies requiring crossings. Screeding to level barge landing areas could cause additional mortality. The impacts would be limited to the dredging, screeding, gravel fill, and dredge placement areas. Gravel fill at West Dock would directly and permanently affect 9.9 acres of marine and enstuarine benthic habitat. Freshwater benthic impacts would be generally limited to short periods during construction of access roads, permanent and temporary bridges, and culvert installation. Epifauna would use permanent structures; however, immediately following work completion, infauna would likely recolonize within 1 year. Dredging operations would result in a negligible effect on benthic food availability. The effects of increased turbidity or potential spill of hazardous materials on benthos would also be negligible considering Mitigation Measure No. 3 would reduce the likelihood of these substances reaching benthos.

4.13.5. Alternative 2 – Denali NPP Route Variation

4.13.5.1. Construction

4.13.5.1.1. West Dock: Dock Head 2 and Causeway Upgrades

DH2 is located in shallower water and could not accommodate the weight and offloading of the modules without complete retrofitting, including the addition of a third berth. Under Alternative 2, the existing channel from DH2 would need to be widened to 500 feet and deepened to the 10-foot depth contour to accommodate large vessels delivering the modules. Under this alternative, 750,000 CYs of dredge material would be disposed of in the ocean at the location depicted on Figure 2.2-5. In coordination with EPA and AGDC, USACE would identify and designate a site where materials would be disposed, as specified in the conditions under Section 103 of an individual Marine Protection, Research and Sanctuaries Act permit. Similar to Alternative 1, Alternative 2 would include development, approval, and implementation of a sampling and analysis plan and an assessment of compliance with the ocean disposal criteria (40 CFR 220-229).

Impacts from all upgrades and proposed activities to the DH2 would include mortality of benthos and loss of benthic habitat due to dredging. Summer screeding and

potentially dredging activities would be short-term; impacts to the benthic community are not expected to differ significantly from the natural process of wind-generated waves and the natural currents found in the Prudhoe Bay area. Since dredged material would be disposed of in the open ocean, the likely impacts of sediments smothering the benthic environment would be negligible. Instead, dredged material would be expected to disperse over a larger area quickly given wave and wind action farther from shore. Given that 750,000 CYs of material containing benthic organisms would be dredged under Alternative 2, the impact would be greater than under Alternative 1, but is still considered minor given the natural processes in the area (*i.e.*, organisms recolonize fairly rapidly given frequent ice scouring and dynamic coastal processes).

4.13.5.1.2. Waterbody Crossings

Alternative 2 waterbody crossing impacts would be similar to those described in Alternative 1, Section 4.13.4.1.2. Absent from Alternative 1 is the construction of a permanent suspension bridge crossing the Yukon River, as described in Chapter 2, Section 2.4.3, Aboveground Pipeline Mode, Dock Head 2, Ocean Disposal of Dredge Material, Aerial Crossing at the Yukon River and Pipeline Constructed According to 49 CFR 192. No permanent bridge structures are to be placed within the river and impacts associated with the Yukon River crossing are considered negligible.

4.13.5.1.3. Port of Seward

Potential impacts to benthic organisms would be the same under Alternative 2 as described under Alternative 1. Introduction of invasive species would be negligible assuming Mitigation Measure No. 2 would be implemented to reduce the likelihood these non-native species could be introduced. Vessel activity in and out of the Port of Seward would follow established shipping lanes that receive frequent traffic. Therefore, the vessel activity associated with Alternative 2 is not likely to affect benthos in any measurable way. The impacts to benthos in the Seward area would be negligible.

4.13.5.2. Operations and Maintenance

All operation activity for the proposed Project would be land-based and not affect the benthic community. Alternative 2 operational impacts would be the same as those described in Alternative 1, Section 4.13.4.2.

4.13.5.2.1. Summary of Potential Direct and Indirect Effects of Alternative 2 on the Benthic Community

Impacts anticipated under Alternative 2 would be the same as described for Alternative 1; however, given the volume of dredging required to accommodate the barges, the impact would be minor.

4.13.6. Alternative 3 – No Action

Under Alternative 3 (No Action), the proposed Project would not be constructed; there would be no direct or indirect impacts to the benthic community.

4.13.7. Conclusions and Comparison of Alternatives

Given that Alternative 2 would require dredging more than 750,000 CYs as compared to 250,000 CYs under Alternative 1, the effects of Alternative 2 would be minor, while Alternative 1 would be negligible, as described below.

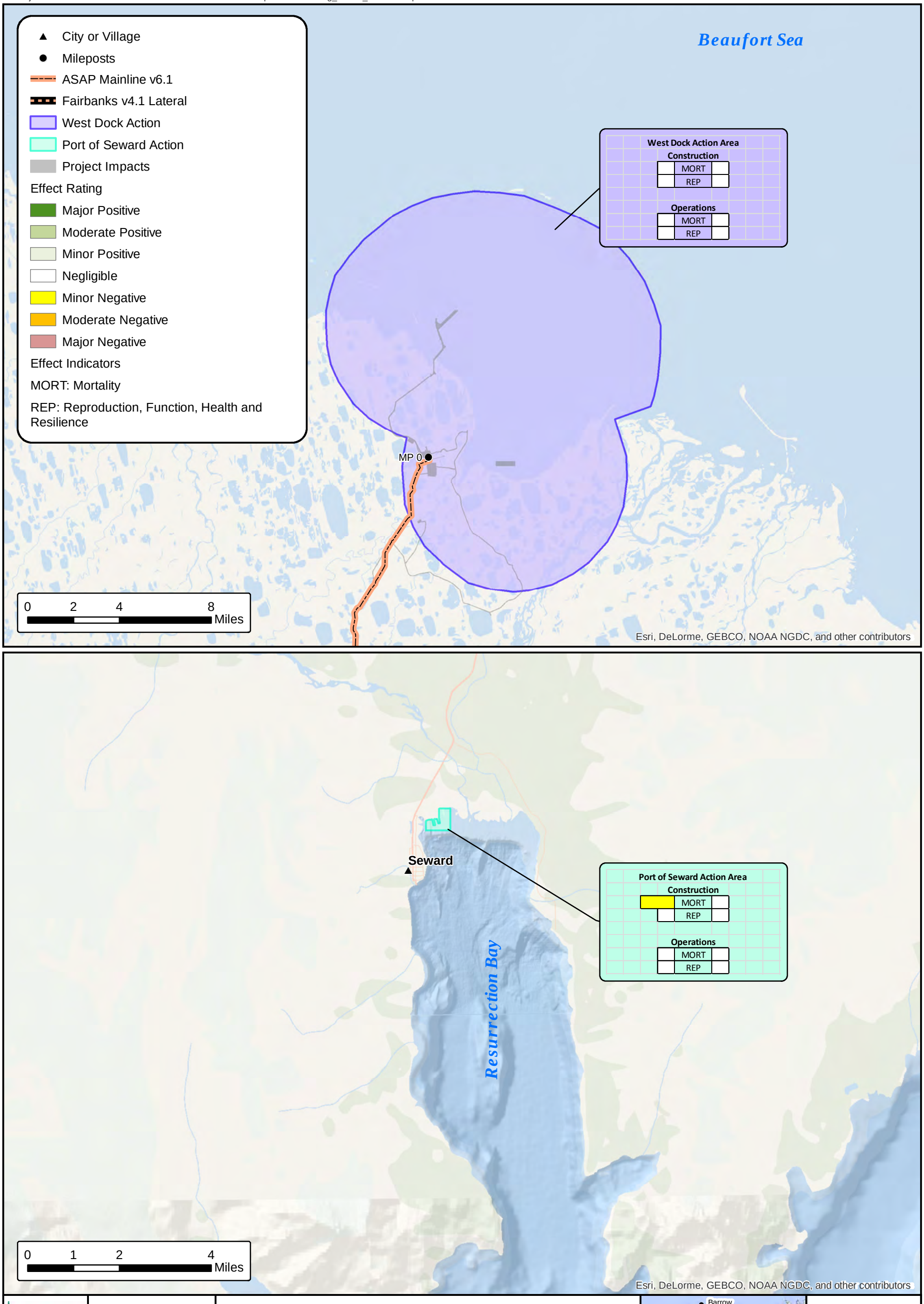
Dredging of the nearshore environment during winter would result in direct loss of some productive benthic habitat under both Alternatives 1 and 2. Under both alternatives, there would be mortality of marine invertebrates inhabiting or overwintering in the local substrate due to dredging and screeding. Disposal of dredged material under either alternative is not expected to affect benthos on a population or even localized scale given the natural coastal processes that regularly scour the nearshore environment (Alternative 1) and that material disposed in the open ocean would be dispersed relatively quickly (Alternative 2). Dredging operations would result in a negligible effect on benthic food availability under any alternative. The effects of increased turbidity or due to a potential spill of hazardous materials on benthos would also be negligible assuming Mitigation Measure No. 3 is implemented.

Table 4.13-3 compares the impacts to the benthic community for Alternatives 1, 2, and 3. Figure 4.13-1 places the key findings from the impact analysis into a geographic context. The single difference between the impact ratings presented in Table 4.13-3 and Figure 4.13-1 is the minor adverse rating resulting from the higher volume of dredge material that would be removed and disposed of Alternative 2. This would occur in Prudhoe Bay where modifications to DH3 would occur. The impact ratings for all other indicators for benthos are identical for all other construction activities. Potential impacts during operations would be negligible for benthic communities under any alternative.

Table 4.13-3 Comparison of Alternatives Summary for Impacts to Benthic (Direct & Indirect)

Biological Resource Effect	Potential Impact Description	Alternative 1		Alternative 2		Alternative 3
		Construction	Operations	Construction	Operations	Construction/ Operations
		Impact Rating		Impact Rating		Impact Rating
Mortality	• **Direct**: mortality • **Indirect**: Disturbance, contaminants, and invasive species.	*Negligible*	*Negligible*	*Minor*	*Negligible*	*Negligible*
Reproductive Effects/ Function/ Health/ Resilience	• Introduction of non-natives. • Exposure to toxic substances (*i.e.*, oil or hazardous materials spills). • Turbidity and inundation. • Diminished juvenile recruitment.	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*

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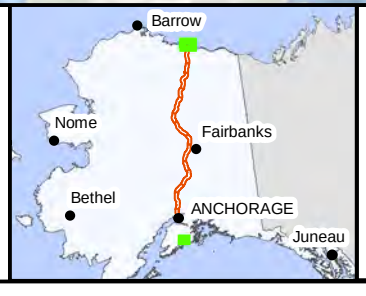


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Figure 4.13-1: BENTHIC IMPACTS CONTEXT MAP
ALASKA STAND ALONE PIPELINE



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4.14. Threatened & Endangered Species

4.14.1. Introduction

This section describes the potential direct and indirect effects of the alternatives described in Chapter 2 on threatened, endangered, and candidate species. This section begins by outlining the proposed Project Area and defining frequently used terms. The section then describes what information was incomplete or unavailable and how that has influenced this analysis, describes the methods for determining the level of impact to threatened, endangered, and candidate species, and presents the results of the assessment. This section describes some of the mitigation measures that would aid in avoiding or minimizing the potential impacts.

The information used in this section builds on the 2012 FEIS (USACE, 2012a) and incorporates new data and information relevant to environmental concerns associated with the alternatives that have become available since the original 2012 FEIS. Importantly, the proposed changes in route and design described in Alternative 1 are the focus of this assessment. While this assessment tiers from the 2012 FEIS, the proposed changes in route and design described for Alternative 1 are emphasized. In some instances, information from the 2012 FEIS is replicated with relatively minor changes and updates, while other material is entirely new or substantially altered. For this SEIS, the following elements have been added to the assessment of impacts to threatened, endangered, and candidate species:

- A new section (Section 4.14.2, Methods) was added to explain the procedures used to evaluate the potential impacts associated with the proposed Project and alternatives;
- On February 12, 2018, the Ninth Circuit Court of Appeals upheld the listing of ringed seals as threatened under the ESA. At the time of preparing this SEIS, this decision had not yet been determined. Therefore, the discussion of ringed seals is included with other marine mammal species not listed under the ESA. Ringed seals are also evaluated in the Biological Assessment attached as Appendix N, Part II[9];
- The bearded seal is a threatened species under the ESA as of October 24, 2016. Despite a series of appeals regarding this listing, on January 22, 2018, the Supreme

[9] NMFS listed the Arctic subspecies of ringed seals and the Beringia DPS of bearded seals as threatened under the ESA on December 28, 2012 (77 FR 76706 and 77 FR 76740 respectively). In two separate decisions, the U.S. District Court for the District of Alaska vacated the Beringia DPS bearded seal listing and the Arctic subspecies of ringed seal listing (Alaska Oil and Gas Association v. Pritzker, Case No. 4:13-cv-00018-RPB; Alaska Oil and Gas Association v. NMFS, Case No. 4:14-cv-00029-RRB). NMFS appealed both decisions to the Ninth Circuit. On October 24, 2016, the Ninth Circuit reversed the district court's decision with regard to the bearded seal listing, so it currently has threatened species protection. On February 13, 2018, the Ninth Circuit of Appeals ruled that the ringed seal shall receive threatened species protection.

Court rejected the appeal of the bearded seal listing, thus the species remains listed as threatened under the ESA;

- As of October 4, 2017, the Pacific walrus has no status under the ESA, so the impacts discussion regarding this species has been moved to Section 4.12, Marine Mammals;
- Mitigation measures incorporated from the 2012 FEIS have been expanded to include recommendations from federal and state agencies, as proposed by AGDC; and
- Impacts have been updated based on new alternatives and a summary of those results is provided.

4.14.1.1. Incomplete or Unavailable Information

In compliance with CEQ guidance (see Section 4.3), this section addresses incomplete or unavailable information pertinent to analyzing impacts of the alternatives on threatened, endangered, and candidate species. Various information sources have been used to assess impacts to the threatened, endangered, and candidate species potentially affected by the proposed Project. When specific species information could not be obtained, taxa-specific information is incorporated for a generalized assessment. Generally, where data are lacking, professional judgment has been applied based on knowledge and experience of the authors, contacted experts, and generally accepted scientific methods.

4.14.2. Methods

The potential threatened, endangered, and candidate species impacts for the proposed Project and alternatives presented below are based on the evaluation of the threatened, endangered, and candidate resources and their habitat at Prudhoe Bay and the Port of Seward; review of available proposed Project descriptions and reports; public comments received after the publication of the 2012 FEIS and during the public scoping period for the SEIS held in 2014; and review of public comments received on the Draft SEIS during the July/August 2017 public comment period. Threatened and endangered species ranges and habitat descriptions were obtained from a combination of sources, including the 2012 FEIS, NMFS, USFWS, the AKNHP at UAA, and various taxa- or species-specific publications, all of which are provided in Chapter 7, Literature Cited, of this SEIS.

Potential impacts for this SEIS were analyzed by assessing the magnitude, extent, duration and likelihood of occurrence as presented in Table 4.14-2, Impact Criteria for Threatened and Endangered Species. Effects that were assessed include:

- Direct mortality or serious injury during construction and operation;
- Physical habitat loss, alteration, and fragmentation;
- Biological and behavioral responses to disturbance, including changes to distributions, resulting from construction and operational activities that include vessel traffic, low-level helicopter or airplane over flights;

- Changes to predator distributions due to anthropogenic practices (*e.g.,* food waste from construction camps);
- Introduction of non-native, invasive and parasitic species;
- Turbidity; and
- Spills and contaminants.

4.14.2.1. Description of Effects

The threatened, endangered, and candidate species that could occur in the proposed Project Area include seven marine mammal and two avian species (Table 4.14-1). No federal- or state-listed plants are found to occur in the proposed Project Area based on inventories conducted to date. Polar bear terrestrial denning and sea ice critical habitat areas would be impacted by proposed Project features near Prudhoe Bay. Approximately the first 5 miles (8 km) of the proposed Project would fall within the polar bear terrestrial denning critical habitat area. The proposed work at West Dock would fall within the polar bear sea ice critical habitat. The GCF, a material source, approximately the first 2 miles of the Mainline, and several access road segments near Prudhoe Bay would fall within the "no disturbance zone" of the polar bear barrier islands and denning critical habitat area. No other critical habitat would be intersected by proposed Project activities.

Table 4.14-1 Threatened and Endangered Species that Could Occur in the Proposed Project Area

Common Name	Scientific Name	Federal Status	Where Found in Relation to Proposed Project Area
Bearded seal (Beringia DPS)	*Erignathus barbatus*	Threatened	Prudhoe Bay
Bowhead whale	*Balaena mysticetus*	Endangered	Prudhoe Bay
Fin whale	*Balaenoptera physalus*	Endangered	Resurrection Bay
Humpback whale[a] • WNP DPS • Hawaii DPS • Mexico DPS	*Megaptera novaeangliae*	Endangered Not Listed Threatened	Resurrection Bay and Prudhoe Bay
Polar bear	*Ursus maritimus*	Threatened	Prudhoe Bay and ACP (Beaufort)
Ringed seal (Arctic DPS)[b]	*Phoca hispida*	Threatened	Prudhoe Bay
Steller sea lion (Western DPS)	*Umatopias jubatus*	Threatened	Resurrection Bay
Spectacled eider	*Somateria fischeri*	Threatened	Prudhoe Bay and ACP (Beaufort)
Steller's eider	*Polysticta stelleri*	Threatened	Prudhoe Bay, ACP (Beaufort), and Resurrection Bay
Eskimo Curlew	*Numenius borealis*	Endangered	No Affect (Considered Extinct)

a One of the three humpback whale DPSs that occur in the Gulf of Alaska and Resurrection Bay was delisted in September 2016 as a result of NOAA's 2015 Status Review the species (NOAA, 2015b). The Hawaii DPS was delisted, but the WNP DPS remains endangered and the Mexico DPS remains threatened.
b The ringed seal is discussed in greater detail in Section 4.12, Marine Mammals.

4.14.2.1.1. Direct Mortality or Serious Injury during Construction and Operation

Direct mortality primarily involves collisions with moving vessels for marine mammals. As discussed in Section 4.12, Marine Mammals, vessel strikes are major sources of direct mortality or injury to large threatened, endangered, and candidate marine species, like whales. Jensen and Silber (2004) collected a total 292 large whale vessel strike reports. Eleven species were confirmed victims of vessel strikes. Fin whales are the most often reported species struck (75 records of strike), followed by humpback whales (44 records). Records show that 48 vessel strikes (16.4 percent) resulted in injury to the animal and 198 (68.0 percent) were fatal. In most cases, the fate of whales injured in vessel strikes is not known.

Noise disturbance during a polar bear's denning period could lead to abandonment of the den site. If the mother polar bear moves young cubs from the den before they can walk or withstand the cold, cub mortality may increase (Amstrup and Durner, 1995).

Direct mortality for adult eiders primarily involves collisions with stationary construction and operational objects such as survey stakes and suspension lines in low visibility conditions. Entanglement in fences or other barriers could also be a source of mortality or injury. Adult eiders could also collide with marine vessels (*e.g.*, Steller's eider in Resurrection Bay). Flight characteristics of eiders over water place them at risk for collisions with man-made structures (Day *et al.*, 2005). Johnson and Richardson (1982) reported that 88 percent of eiders in their study flew below 32.8 feet, and greater than 50 percent below 16.4 feet. High intensity lights on vessels attract seabirds, including eiders, and result in collisions with the vessel and rigging, especially in poor weather conditions (Russell, 2005). Collisions by eiders with fixed objects, including towers and antennas in the winter range and along migration routes, depend on the proximity of the structure to migration flight paths.

Finally, direct mortality may include presence of nests or young during vegetation removal. Young are often not capable of moving out of the direct path of equipment and debris during clearing activities, which usually results in mortality.

4.14.2.1.2. Physical Habitat Loss and Alteration

Habitat impacts are primarily physical perturbations that result in alterations in the amount or quality of a habitat. Habitat destruction on the ACP was not identified as a significant factor resulting in the decline of spectacled eiders (USFWS, 1993) and remains a non-significant threat to eider populations (USFWS, 2010a). Within the first 25 miles of proposed Project construction on the Beaufort Coastal Plain, a total of 367.2 acres of tundra habitat would be permanently altered due to gravel fill and a total of 459.7 acres would be temporarily impacted during construction.

In late October and November, pregnant female polar bears find an area to den on land or sea ice; such as a snow bank, slope or an area of rough ice that is a stable location to excavate a depression (Durner *et al.*, 2001; Durner *et al.*, 2003). Polar bears do not use the same dens or denning locations from year to year; therefore, a female could potentially

den within the proposed Project Area in the future (Durner *et al.,* 2003). Polar bear dens have been documented within the proposed Project Area (Durner *et al.,* 2010; Sanzone *et al.,* 2010).

4.14.2.1.3. Biological and Behavioral Responses to Disturbance

Anthropogenic disturbance could result from noise and physical presence. Effects of disturbance on marine mammals could be long- or short-term and depend on the individual, the context of the disturbance and the life stage of the species. Responses to disturbance include physiological, physical and behavioral. Short-term disturbance is typically more reversible than long-term.

Disturbance during critical time periods may include calving, migration, or feeding, which could impact productivity. Noise could affect communication by masking; mortality may also increase when species are unable to detect predators by sound. Marine mammals exposed to high intensity sound repeatedly or for prolonged periods could experience hearing threshold shift (TS) resulting in the loss of hearing sensitivity at certain frequency ranges (Kastak *et al.,* 1999; Schlundt *et al.,* 2000; Finneran *et al.,* 2002; 2005). TS could result in permanent threshold shift (PTS), where loss of hearing sensitivity is unrecoverable, or temporary threshold shift, in which case an animal may recover hearing sensitivity over time (Southall *et al.,* 2007).

Section 4.12, Marine Mammals, addresses effects of disturbances on marine mammals, including threatened, endangered, and candidate species. Additionally, Table 4.12-1 shows the sensitivity of marine mammals to underwater noise. Baleen whales are low-frequency cetaceans with a generalized hearing range of 7 Hz to 35 kHz, while bowhead and fin whales have a mid-frequency hearing range of 150 Hz to 160 kHz. Table 4.12-2 presents NMFS criteria (revised in July 2016) for acoustic thresholds for different marine mammal hearing groups. The behavioral responses described in Section 4.12 are applicable to all marine species in a given hearing group, regardless of threatened or endangered status.

4.14.2.1.4. Changes to Predator Distributions Resulting from Anthropogenic Practices

Tundra nesting birds are subjected to predation pressure from Arctic and red foxes, grizzly bears, gulls, jaegers, common ravens (*Corvus corax*), and snowy owls (*Nyctea scandiaca*) (Day, 1998). Some predators, such as ravens, gulls, Arctic foxes, and bears, may be attracted to areas of human activity where they find anthropogenic sources of food and denning or nesting sites (Eberhardt *et al.,* 1982; Day, 1998; Burgess, 2000; Powell and Bakensto, 2009). The availability of anthropogenic food sources associated with villages or North Slope development, particularly during the winter, may increase winter survival of Arctic foxes and contribute to increases in the Arctic fox population. Anthropogenic sources of food at dumpsters and refuse sites may also help to increase populations of gulls and ravens above natural levels. Increased levels of predation due to elevated numbers of predators could affect nesting and brood-rearing eiders.

Similarly, marine mammal prey species, such as Northern sea otter, bearded seal, Pacific walrus, and juvenile whales, may experience changes in predation due to the increased presence of vessels.

4.14.2.1.5. Introduced and Invasive Species

Introduced or nonindigenous species are typically introduced into a system by human-related activity. The introduction of invasive species could have a dramatic effect on natural resources. Alaska as a whole has been minimally affected by invasive species because of factors including isolation, localized rather than widespread development, colder climate, and restrictive species import/transport regulations.

Natural or native community species co-evolve within an ecosystem; checks and balances limit the population growth of any one species. Checks and balances include predator-prey interactions, disease, competition for resources and limiting environmental factors. The native community exists and evolves as a whole within a dynamic ecosystem. When non-native species are introduced into an ecosystem in which they did not evolve, they are not necessarily influenced by the same factors and their unimpeded population growth may affect the native community. Invasive, non-native, species disrupt natural communities and ecological processes creating competition for limited resources (*i.e.,* food, water, shelter, etc.). Invasive species may also affect native species by predation.

Vessels have the potential to introduce invasive species to marine habitat in Prudhoe Bay and Seward. Ballast-water discharge, fouled vessel hulls, or equipment placed overboard (*e.g.*, anchors, piles, etc.), are vectors for introducing invasive species. In Alaska, vessels are subject to U.S. Coast Guard (USCG) regulations (33 CFR 151 Subpart D) intended to reduce the transfer of invasive species by "removal of fouling organisms from hull, piping, and tanks on a regular basis and dispose of any removed substances in accordance with local, state, and federal regulations." A non-native marine amphipod (*Caprella mutica*) has spread widely in Alaska harbors, ranging from Ketchikan in Southeast Alaska to Dutch Harbor in the Aleutian Islands (Ashton *et al.,* 2008). Warmer waters near Seward may be more susceptible to these types of events than Prudhoe Bay.

4.14.2.1.6. Turbidity

Disturbance of the bottom sediments due to potential one-summer screeding activities proposed under Alternatives 1 and 2 around West Dock would increase turbidity in the area. Sediment plumes resulting from dredging would likely be short-term, as shown in research summarized by Hitchcock and Bell (2004), and are confined mainly to an area of a few hundred meters from the point of discharge (Newell *et al.,* 1998; Hitchcock and Bell, 2004 as reported in Todd *et al.,* 2015). Many marine mammals are accustomed to a turbid environment and utilize sophisticated sonar systems to sense the environment around them (Au *et al.,* 2000).

4.14.2.1.7. Spills and Contaminants

Petroleum products spilled into the marine environment may enter benthic or pelagic food chains. Magnitude, time of year, and duration of a spill determines the extent to which marine mammals are affected. Accidental release of hydrocarbons and contaminants in the spring, summer, and early fall all have the potential to effect migration and feeding in the proposed Project Area. Direct contact with oil adversely affects marine mammals by ingestion through feeding activities, inhalation or absorption (Ober, 2016). Contamination of the surrounding marine feeding areas would limit available habitat. A review of the oil and hazardous substance spills reported to ADEC (http://dec.alaska.gov/Applications/SPAR/PublicMVC/PERP/SpillSearch) indicated that only two spills greater than 10 gallons have occurred at West Dock in the past 21 years; however, both of these spills were recovered. More than 300 spills were reported for the City of Seward, Port of Seward, and Resurrection Bay in the past 21 years; 95 percent of these spills were non-crude oil and approximately half of these were diesel fuel.

Fuel and other contaminants may be spilled on the tundra in Steller's eider, spectacled eider, and polar bear habitat during the construction or operations phase of the proposed Project. These contaminants could enter the food chain or soil feeding grounds, denning habitat, or nesting habitats.

Proposed Project construction, operation, and maintenance activities could affect important habitat of threatened, endangered, and candidate species by accidentally introducing contaminants, oils, or fuels. The magnitude of a spill's impact would depend on the spill's contaminant, size, location, and seasonality. If a spill were to occur in the winter on ice or snowpack, the spill would be easier to contain and clean up and the impact would be short-term and minor. If the spill were to occur in the summer and penetrate soils or spread in the marine environment, the impact would be long-term and moderate. If a spill of significant size were to occur in either season, the impact could be major and long-term. The minor impacts from small spills and discharges could be partially mitigated through the establishment and implementation of a SPCC Plan, as required by 40 CFR 112.

4.14.2.2. Impact Criteria

Table 4.14-2 summarizes the criteria used to determine the level of impact based on the magnitude, extent, duration and likelihood of occurrence. Table 4.14-3 defines the types of effects the proposed Project and alternatives may have on the biological resources that are assessed in this SEIS. Applicant-proposed design features, mitigation measures and BMPs that may reduce impact to threatened, endangered, and candidate species resources are listed in Section 4.14.3, Applicant-Proposed Design Features, Mitigation Measures, Best Management Practices, and Project Management Plans. These design elements and mitigation measures to reduce impacts, such as the potential interaction between proposed Project personnel or equipment with threatened, endangered, or

candidate species, have been taken into account to determine a final integrated impact result of negligible, minor, moderate, or major.

Table 4.14-2 Impact Criteria for Threatened and Endangered Species

Impact Component	Impact Level			
	Major	**Moderate**	**Minor**	**Negligible**
Magnitude or Intensity	The impact is sufficient to cause population level changes to productivity, growth rate, survival rate, and range.	The impact is sufficient to cause sub-population level changes to productivity, growth rate, survival rate, and range.	The proposed Project would impact a few individuals in a population, but not affect population productivity, growth rate, survival rate, and range.	There are no perceivable impacts or the mechanism for effects on population status (*i.e.*, productivity, growth rate, survival rate and range) are indistinguishable from baseline.
Geographic Extent	Impacts are statewide, or over the entire range of the species or identified population.	Impacts are at a regional or community level, on a limited portion of the study area.	Impacts are site specific or occur within a few isolated locations.	No measurable effects.
Duration or Frequency	The effect would cause chronic and long-term changes that are likely to be permanent.	The effect would cause periodic, temporary, or short-term changes that are reversed after 1 to 3 reproductive seasons (3 years).	The effect would cause periodic, temporary, or short-term changes that are reversed over one reproductive season (1 year).	No measurable effects.
Likelihood	Most likely (Impacts that have greater than 75% chance of arising from the action)	Likely (Impacts that have a 50% to 75% chance of arising from the action)	Somewhat likely (Impacts that have a 10% to 50% chance of arising from the action)	Unlikely (Impacts that have less than 10% chance of arising from the action)

Table 4.14-3 Types of Effects and Impacts on Threatened and Endangered Species

Type of Effect	Proposed Action Causing Potential Impact	
	Construction	Operations and Maintenance
Mortality • **Direct:** Mortality • **Indirect:** Disturbance, contaminants, invasive species, and increased predation.	• Destruction of dens or nests and mortality due to vehicle or vessel. • Increased predator populations attracted to area as a result of food waste from camps. • Introduction of contaminants or invasive species.	• Destruction of dens or nests and mortality due to vehicle strike. • Increased predator populations attracted to area as a result of food waste from camps. • Stresses from presence of vehicles, and aircraft disturbs animal. • Introduction of contaminants or invasive species.
Reproductive Effects/ Function/Health/ Resilience: • Displacement of wildlife from noise and human activity during construction. • Introduction of non-native species and predation. • Changes to predator populations may affect prey abundance, distribution, and demography. • Disturbance and, stress from noise and presence of vessels, aerial and equipment activity during construction. o Exposure to toxic substances (*i.e.,* oil or hazardous materials spills). o Diminished juvenile recruitment.	• Vessel traffic. • Vegetation removal and worker activities. • Disturbance from presence of vehicles, vessels, and aircraft.	• Activities resulting in disturbance by noise (vehicles, surface noise, aerial noise), human presence avoidance, etc.

4.14.3. Applicant-Proposed Design Features, Mitigation Measures, Best Management Practices, and Project Management Plans

The following design features, mitigation measures and BMPs are proposed by AGDC, and have been taken into consideration when evaluating potential impacts on threatened, endangered, and candidate species resources under Alternatives 1 and 2 during the construction and operations phases. A complete list of mitigation measures and BMPs are also provided in Appendix M.

Proposed mitigation measures would include:

1. Construction gravel infrastructure on the ACP and at West Dock would take place during the winter, and therefore, would not occur during bird nesting season (*e.g.*, Steller's eider [*Somateria fischeri*] or spectacled eider [*Polysticta stelleri]*). Migratory birds would not be present during the construction on the ACP or at West Dock, as work would occur during the winter. Additionally, migrating whales are not in the

area during the winter, reducing potential conflicts with whaling activities. Winter sea ice also mitigates the potential of an excavation turbidity plume.

2. Prior to any winter route clearing or maintenance clear the area for polar bear dens:
    - Make efforts to locate occupied polar bear dens within and near proposed areas of operation, utilizing appropriate tools, such as, forward looking infrared (FLIR) imagery and/or polar bear scent-trained dogs to report polar bear dens to USFWS prior to the initiation of activities.
    - Observe a 1-mile operational exclusion zone around all known polar bear dens during the denning season (November-April) or until the female and cubs naturally leave the areas.
    - Cease work in the immediate area of previously unknown occupied polar bear dens and contact USFWS for guidance.
    - Restrict the timing of activity to limit disturbance around polar bear dens.
3. The proposed Project would include implementation of the following measures to reduce and eliminate interaction with proposed Project personnel and polar bears:
    - Proposed Project activities would not approach polar bears on ice or land closer than 805 m (0.5 mile).
    - Implement 24-hour monitoring to record and observe polar bears in the area to minimize polar bear and human interactions, thereby reducing the potential for take.
    - Reduce/eliminate polar bear attractants.
    - Ensure polar bear has escape route(s) prior to conducting harassment activity.
    - Choose the harassment method that would have the least effect on the polar bear and increase the intensity of the method or use additional methods of harassment only, if necessary.
    - Shout at the polar bear as a method of harassment before using a projectile.
    - Monitor polar bear movement after harassment.
    - Train operation and construction crews regarding polar bear awareness.
    - Report all observations of polar bears during any industry operation.
4. During the final design stages of the proposed Project, AGDC would coordinate with USFWS in regards to birds and lighting, while taking into account the lighting safety requirements for operators.
5. Pile-driving would not be conducted when visible observation of all waters within and surrounding the exclusion zone is not possible. If crews must be working during periods of darkness or bad weather, an additional PSO would be placed farther up the causeway (*e.g.*, at DH3 or STP) to ensure coverage of the entire zone and to

provide a greater extent of visibility. In addition, during activities conducted at night, artificial lights directly around the observer would be kept absent or low, so that natural light reflecting off the ice or the surface of the water would allow for identification of the presence or absence of cetaceans or pinnipeds within the exclusion zone. Additional details on the observer protocols is provided in Appendix N, Part II (Biological Assessment).

6. AGDC would have an approved SPCC Plan before construction. The SPCC Plan would be developed in accordance with all pertinent regulations and would follow BMPs. The SPCC Plan would identify material handling procedures and storage requirements and outline the actions to reduce spill potential.
7. AGDC would consult with NMFS and USFWS regarding the need for an authorization for incidental harassment (*i.e.*, either an Incidental Harassment Authorization [IHA] or LOA under the Marine Mammal Protection Act [MMPA], depending on the duration and type of activities covered). An IHA or LOA would include additional mitigation measures to reduce the potential for impacts to marine mammals due to incidental or intentional harassment, as defined under the MMPA.
8. Consult with potentially affected communities (PACs) and appropriate subsistence user organizations to discuss potential conflicts with subsistence marine mammal hunting caused by the location, timing, and methods of proposed operations and support activities.
9. AGDC would dispose of hazardous wastes at approved facilities.

4.14.4. Alternative 1 – Proposed Action

Alternative 1 is designated the proposed Action (proposed ASAP Project). This alternative is described in Chapter 2 in detail. The 36-inch, 733-mile-long pipeline and 12-inch, 30-mile lateral pipeline to Fairbanks would cross various habitats and ecoregions from the North Slope to the existing ENSTAR pipeline system in the Mat-Su Borough. This section discusses the analysis of impacts to threatened, endangered, and candidate species along the route.

The proposed construction spread (*i.e.*, schedule) for the pipeline is presented in Chapter 2, Table 2.2-7 (Alternative 1: ASAP Construction Spread Plan). The construction schedule provides important context for understanding how marine mammals may interact with proposed Project activities. The following sections describe potential impacts associated with the proposed Project activities based on the anticipated timeline described below for marine-related activities. On land, the proposed Project ROW would cross ranges and habitats used by Steller's eider, spectacled eider, and polar bear, while other activities in the marine environment near Prudhoe Bay and Seward could affect listed whales, bearded seal, Steller sea lions, or Steller's eider. Complete descriptions of threatened, endangered, and candidate species are provided in Chapter 3. Impacts to species and their habitats that potentially occur at Prudhoe Bay or

Resurrection Bay are shown in Table 4.14-4. Impacts by species are summarized in Table 4.14-5.

Table 4.14-4 Evaluation of Impacts to Species and Habitat that Potentially Occur at Prudhoe Bay / West Dock or at Resurrection Bay / Port of Seward

Species	Potential Impacts
Prudhoe Bay / West Dock Port	
Bearded seal (*Erignathus barbatus*)	Disturbance that leads to avoidance of area. Contribution of pollutants and contaminants into the species' habitats.
Bowhead whale *(Balaena mysticetus)*	Acoustic habitat alteration. Disturbance that leads to avoidance of traditional feeding areas. Disruption of migratory pathways resulting from disturbance. Increased mortality resulting from vessel traffic. Increased mortality from acoustic masking of predators (killer whales). Contribution of pollutants and contaminants into the species' habitats.
Polar bear *(Ursus maritimus)*	Direct mortality resulting from destruction of dens and lairs during winter and spring. Disturbance that leads to the abandonment of preferred denning or lair habitat. Contribution of pollutants and contaminants into the species' habitats.
Ringed seal (*Phoca hispida*)[a]	Disturbance that leads to avoidance of area. Contribution of pollutants and contaminants into the species' habitats.
Spectacled eider *(Somateria fischeri)*	Disturbance to nest sites, foraging or staging habitats, reduced habitat suitability due to altered water quality. Habitat alteration resulting from introduction of invasive species. Increased mortality resulting from changes to predator distributions. Collision related mortality with stationary object in low visibility conditions. Contribution of pollutants and contaminants into the species' habitats.
Steller's eider *(Polysticta stelleri)*	
Resurrection Bay / Port of Seward	
Fin whale *(Balaenoptera physalus)*	Acoustic habitat alteration. Disturbance that leads to avoidance of traditional feeding areas. Disruption of migratory pathways resulting from disturbance. Increased mortality resulting from vessel traffic. Increased mortality from acoustic masking of predators (killer whales). Contribution of pollutants and contaminants into the species' habitats.
Humpback whale *(Megaptera novaeangliae)*	
Steller sea lion *(Umatopias jubatus)* (Western DPS)	
Steller's eider *(Polysticta stelleri)*	Collision-related mortality with stationary object in low visibility conditions. Contribution of pollutants and contaminants into the species' habitats.

a The ringed seal is discussed in greater detail in Section 4.12, Marine Mammals.

4.14.4.1. Construction

From north to south, construction activities for Alternative 1 (proposed Action) would occur at Prudhoe Bay, along the 733-mile pipeline ROW, along the 30-mile Fairbanks Lateral line, and proposed Project-related shipping traffic would occur at the Port of Seward.

4.14.4.1.1. Gas Conditioning Facility

Construction of the GCF would result in the permanent conversion of tundra habitat: 90.6 acres for the GCF itself, 57.1 acres for GCF access roads, and 20.2 acres for GCF

camps. The loss of possible nesting habitat to eiders would be permanent. Construction of the facilities would result in the disturbance of some eiders and possibly polar bear, which would likely cause them to avoid the area. If polar bear dens are not identified in advance of ice road construction, direct mortality could occur if dens collapse from equipment passing over, or if disturbance leads to abandonment of den and cubs. Temporary displacement of wildlife is expected where construction activities occur. With the implementation of the seasonal and spatial restrictions during breeding and denning periods, impacts related to disturbance would be minor because they are temporary and would not result in population-level effects.

The GCF would be an additional aboveground feature on the North Slope and could impact adult Steller's and spectacled eiders through direct mortality or injury from collisions during low visibility conditions. Lighting on the GCF would be designed in coordination with USFWS in regards to birds, while taking into account the lighting safety requirements of operators. If injury or mortality due to collision occurred, the effects would be direct; however, impacts would occur at the individual level and not at the population level. GCF lighting in particular is not anticipated to create a significant attractant to eiders, and therefore, would not create an appreciable collision hazard to Steller's and spectacled eiders.

Habitat degradation, direct mortality, or injury could also occur to threatened, endangered, or candidate species if there were a spill. The magnitude of a spill's impact would depend on the spill's contaminant, size, location, and seasonality.

Construction-related disturbance at the GCF would be short-term and would be unlikely to result in population-level effects on any threatened, endangered, or candidate species under consideration (*i.e.*, polar bear, Steller's eider, or spectacled eider). Some construction activities, such as barge offloading and setup of equipment such as cranes, would occur during critical time periods, including nesting and denning (Mitigation Measure No. 1 listed in Section 4.14.3). These considerations, notwithstanding the geographic extent of noise disturbance activities, would be localized. If injury or mortality due to construction activities at the GCF occurred to threatened, endangered, or candidate species, the impacts would be moderate.

4.14.4.1.2. Pipeline ROW

The entire 733-mile pipeline (except at fault zones, elevated bridge stream crossings, pigging facilities, and block valve locations) is proposed to be buried underground.

The loss of potential nesting habitat to Steller's and spectacled eider would be permanent. Within the first 25 miles of pipeline construction for the ROW, 64.7 acres of tundra habitat would be permanently lost and an additional 426.0 acres would be temporarily used for construction. Also within the first 25 miles, access roads would convert 87.6 acres permanently and ice access roads would convert 33.0 acres temporarily; material source sites would convert 212.0 acres permanently; PSYs would convert 2.8 acres permanently; and bridges and stream crossings would use 0.7 acres

temporarily. Construction of the Mainline would result in the disturbance of some Steller's and spectacled eider and possibly polar bear, which is likely to result in animals avoiding the proposed Project Area. As stated above, while mortality of an animal that is undetected (*i.e.*, undetected polar bear den) is possible due to equipment collapsing a den, the likelihood of this occurring given the mitigation measures proposed is very low. Temporary displacement of wildlife is expected where construction activities are proposed.

Habitat degradation, direct mortality, or injury could also occur to threatened, endangered, or candidate species if there were a spill. The magnitude of a spill's impact would depend on the spill's contaminant, size, location, and seasonality.

Habitat loss and alteration on the ACP was not identified as a significant factor resulting in the decline of spectacled eiders (USFWS, 1993) and remains a non-significant threat to eider populations (USFWS, 2010a).

Construction-related disturbances along the pipeline ROW would be short-term, and would be unlikely to cause population-level effects on any species under consideration. Some construction activities would occur critical time periods including nesting (Mitigation Measure No. 1); however, the geographic extent of noise disturbance activities would be localized to the individual pipeline construction spread. Construction plans would be coordinated with both state and federal agencies to mitigate for disturbance. The effects to ESA-listed or candidate species from construction of the pipeline Mainline would be minor, as displacement and disturbance would be short-term, localized, and would not cause population-level effects. If injury or mortality due to construction activities along the ROW occurred to threatened, endangered, or candidate species, the impacts would be moderate.

4.14.4.1.3. West Dock Head 3 and Causeway Upgrades

The West Dock causeway would require widening and infrastructure modifications as described in Chapter 2 and in the ASAP Dredge and Disposal Plan. Activities would occur up to 1 year in advance of the sealift to prepare DH3 and the West Dock causeway to allow for module movement, as well as pile-driving and infrastructure improvements.

Dredging is necessary for the proposed activity; it would occur in a single winter at West Dock DH3. Improvements to West Dock would begin during winter before the sealift arrival and would consist of dredging the navigation channel and turning basin. Barges would require a minimum water depth of 8.5 feet; therefore, under Alternative 1, there would be a maximum winter dredge depth of -9 feet and screeding may also be necessary because of the potential for the channel to be infilled by late summer (Niedoroda *et al.,* 1980). The proposed dredging and screeding are intended to maintain adequate depth for safe barge movement and to avoid the need for summer maintenance dredging.

Disturbance of the bottom sediments due to activities proposed under Alternative 1 around West Dock would increase turbidity in the area if summer screeding were to occur. Sediment plumes resulting from screeding would likely be short-term as shown in research summarized by Hitchcock and Bell (2004), and are confined mainly to an area of a few hundred meters from the point of discharge (Newell *et al.*, 1998; Hitchcock and Bell, 2004 as reported in Todd *et al.,* 2015). Many marine mammals are accustomed to a turbid environment and utilize sophisticated sonar systems to sense the environment around them (Au *et al.,* 2000). Increased turbidity would be localized to the West Dock work areas and would only occur during the potential one summer of screeding.

Construction activities could affect important habitat of threatened, endangered, and candidate species by accidentally introducing minor amounts of contaminants, oils, or fuels. The magnitude of a spill's impact would depend on the spill's contaminant, size, location, and seasonality. The impacts from small spills and discharges could be partially mitigated through the establishment and implementation of a SPCC Plan that meets the regulatory requirements (40 CFR 112) to control the discharge of stormwater and oil.

Section 4.14.2.1.5, Introduced and Invasive Species, discusses the potential vessel-related introduction of such species to marine mammal habitat in Prudhoe Bay and other waters, as well as their overall effects on threatened, endangered, and candidate species. The effects of invasive species on threatened, endangered, and candidate species would be negligible, given the low likelihood of an invasive species (with the potential to harm threatened, endangered, and candidate species) infesting and surviving in the area.

Given that winter dredging and summer vessel activities would effectively be accomplished in two seasons, the duration of activities that could introduce invasive species is considered low. The effects of invasive species on marine mammals would be negligible given the low likelihood of an invasive species infesting and surviving in the area.

When considering potential impacts to threatened, endangered, and candidate species, winter dredging, pile driving, and the associated vessel traffic could disturb polar bears. The bearded seal overwinters in the Bering Sea, far from Prudhoe Bay (USFWS, 2016); therefore, they are not likely to be in the proposed Project Area during winter construction activities. Bowhead whales would not be found near Prudhoe Bay during winter months, as they would have migrated further south during this time of year (Mitigation Measure No. 4). Therefore, the potential impacts of dredging activities around West Dock are focused on assessing affects to polar bears.

As stated above, dredging and pile driving activity under Alternative 1 could adversely affect polar bears by exposing them to elevated noise levels in the vicinity of the proposed Project Area. Disturbance, including from increased noise or presence of vessels or vehicles, may affect bears differently depending on their reproductive status (*e.g.,* denning versus non-denning bears). Available scientific information indicates

female polar bears entering dens, or females in dens with cubs, are more sensitive than males and non-denning females, which can more readily avoid or move away from disturbance (USFWS, 2016).

Behavioral responses to these disturbances could include, but are not limited to, avoidance or attraction. The biological significance of these behavioral changes is difficult to predict and assess. Considering the dredging and pile driving activities would be temporary, if polar bears in the area were exposed to elevated underwater noise, the effects are not likely to result in long-term changes to habitat or bear behavior such that it would result in population-level affects. The above-seafloor portions of pilings would be removed at the end of the season. To remove pilings, a diver would use a suction hose to remove sediment around the piling. Next, an underwater oxygen lance would cut piles below the surface and a crane stationed on top of a barge would remove the top portion of the piling. These activities would be brief and are not likely to propagate high levels of noise. Additional detailed discussion on the potential effects of pile driving on marine mammals is included in Section 4.12, Marine Mammals.

No impulse noise would be produced by the proposed Project. Although there may be behavioral changes associated with presence of vehicles and vessels, they would not likely cause mortality or have long-term effects on reproduction. Changes to food availability for polar bears could occur because ringed seals may avoid the area due to higher levels of human activity. The schedule for ice road construction on the North Slope is expected to be approximately November through April, subject to approval by ADNR. Pre-construction ice roads would be constructed for Prudhoe Bay dredging and during the first and second winters of Mainline pipeline construction (pipe laying). Ice roads may also be needed on occasion for scheduled winter maintenance during ASAP operations. While the effects of ice roads would not be considered permanent, they could create moderate changes in prey availability due to disturbance from ice roads over the 2-year period.

Overall, the effects of winter dredging and pile driving that may occur during open water season on polar bears is considered minor because it would be short-term (a few months), over a small geographic area and would not likely result in mortality or population-level effects associated with disturbance during reproduction. Because ice road construction is proposed over two winters, the potential effects on polar bears would likely be moderate due to potential disturbance over the longer period and potential changes to prey availability if ringed seals avoid the area.

Summer activities in and out of Prudhoe Bay include vessel traffic and screeding (if needed), which could affect bowhead whales. On August 17, 2016, the Aerial Surveys of Arctic Marine Mammals Project (http://www.afsc.noaa.gov/NMML/cetacean/bwasp) recorded a total of 39 bowhead whale sightings (including five calves) in Block 1 (Prudhoe Bay area). During one summer season, six shallow-draft tugs ranging in size from 70 to 92 feet would be used to transport barges from the open water marshalling area 3 to 5 miles offshore into DH3. The tugs would be expected to operate at relatively

low speeds (*i.e.*, below 10 knots) which has been shown to reduce the likelihood of whale strikes. A review of whale-ship strikes by Jensen and Silber (2003) reported that whale strikes occurred predominantly with vessel speeds between 13 and 24 knots. While the potential of a vessel-marine mammal strike is expected to be low due to lower vessel speed, the frequency of the barges (*i.e.*, 23 barges in one season) may increase the chance of a strike. Most collisions in Alaska involve small recreational vessels or whale watch boats with no apparent long-term consequences for the whale. NMFS is actively working with sectors of the maritime industry on vessel strike avoidance and awareness programs (81 FR 62259). For these reasons, the likelihood of mortality associated with vessel traffic is considered minor.

Vessel activity would increase between the marine marshalling area and DH3, which would also increase underwater noise in the area. Vessel traffic and increased noise levels may result in changes to marine mammal behavior such as the duration of surfacing or dives, reduced/increased vocal activities, changes in socializing or feeding, startle response, or avoidance as described above. As noted by NMFS (2013), slow-moving vessels within several hundred meters may be tolerated by some marine mammal species, especially when the vessel is not directed toward the animal and when there are no sudden changes in direction or engine speed (Wartzok *et al.,* 1989; Richardson *et al.,* 1995). Given that existing vessel traffic in and out of West Dock during summer months is high, it is anticipated that while they could be disturbed due to human activity, animals would not likely be affected to the point where disturbance results in a population-level effect.

4.14.4.1.4. Port of Seward

Construction activities slated for the Port of Seward would be land-based at a marshalling yard, except for vessel shipment of materials and pipe pieces. The threatened and endangered species that occur near the Port of Seward include the Steller sea lion, humpback whale, fin whale, and Steller's eider.

Anticipated impacts to these threatened and endangered marine mammals from increased vessel traffic would consist of disturbance due to vessel presence and underwater noise and strike hazards. The Port of Seward would be used for two summers, where an estimated 35 shipments would be needed to deliver pipeline pieces and other materials. Vessel traffic during the summer would be short-term, and with the incorporation of mitigations for vessel speed and activities, described in Section 4.14.3, impacts to ESA-listed species from proposed Project activities would be minor. Similar to West Dock activities, underwater noise would increase with vessel traffic, but is not expected to result in mortality. Noise may cause short-term behavioral changes in threatened and endangered mammals, but these effects would not result in a reduction in reproduction or changes to the population. While the activities would contribute to increased disturbance in the area, disturbance from increased traffic or underwater noise would be minor, because vessels would use existing shipping lanes that currently have high vessel activity.

Section 4.14.2.1.5, Introduced and Invasive Species, discusses the potential vessel-related introduction of such species to habitat in the Port of Seward and other waters, as well as their overall effects on threatened and endangered species. The effects of invasive species on threatened and endangered species would be negligible, given the low likelihood of an invasive species (with the potential to harm threatened and endangered species) infesting and surviving in the area.

Vessel spills of diesel fuel or other substances could occur during transport in the Port of Seward. While the potential for a spill from the vessel exists, the likelihood is low. The magnitude of a spill's impact would depend on the spill's contaminant, size, location, and seasonality. The impacts from small spills and discharges could be partially mitigated through adhering to the regulatory requirements to prevent discharge to waters of the U.S. addressed using BMPs described in the SPCC Plan.

4.14.4.2. Operations and Maintenance

All operation activates for Alternative 1 (proposed Action) would be land-based, year-round, and may affect Steller's eider, spectacled eider, and polar bear in the Prudhoe Bay area extending south along the Mainline where habitat is present. The impacts of operations would be similar to those of construction in that disturbance to eiders during the breeding season (spring/summer) and disturbance and possible direct mortality to polar bears during the denning period (winter).

As an additional aboveground feature on the North Slope, the GCF could impact adult Steller's and spectacled eiders through direct mortality or injury from collisions during low visibility conditions. When visibility is impaired during inclement weather or darkness, birds are particularly at risk of collision with objects in their path (Weir, 1976). The risk of bird collision is largely determined by the timing and location of construction activities in relation to the presence of spectacled and Steller's eiders in the Beaufort Sea. If injury or mortality due to collision occurred, the effects would be direct; however, impacts would occur at the individual level and not at the population level.

Nesting eiders are subjected to predation pressure from Arctic and red foxes, grizzly bears, gulls, jaegers, common ravens (*Corvus corax*), and snowy owls (*Nyctea scandiaca*) (Day, 1998). Some predators, such as ravens, gulls, Arctic foxes, and bears, may be attracted to areas of human activity where they find anthropogenic sources of food and denning or nesting sites (Eberhardt *et al.,* 1982; Day, 1998; Burgess, 2000; Powell and Bakensto, 2009). The availability of anthropogenic food sources associated with villages or North Slope development, particularly during the winter, may increase winter survival of Arctic foxes and contribute to increases in the Arctic fox population. Anthropogenic sources of food at dumpsters and refuse sites may also help to increase populations of gulls and ravens above natural levels. Increased levels of predation due to elevated numbers of predators could affect nesting and brood-rearing eiders. Similarly, marine mammal threatened, endangered, and candidate prey species such as

Northern sea otter, bearded seal, and juvenile whales may experience changes in predation due to the increased presence of vessels.

The impacts to eiders and polar bear are considered minor as proposed Project-related operations would cause periodic, temporary, or short-term disturbances. As a requirement of USFWS Letter of Authorization (LOA) for polar bear, operations activities within polar bear habitat would occur outside of the critical time periods, including polar bear denning; operations would also occur outside of the Steller's and spectacled eider breeding period (Mitigation Measure No. 1). Operations related disturbance would be unlikely to have population-level effects on any threatened, endangered, or candidate species under consideration because activities would be outside the species' critical time periods. If injury or mortality due to operations activities occurred to threatened, endangered, or candidate species, the impacts would be moderate.

4.14.5. Alternative 2 – Denali NPP Route Variation

Alternative 2 of the proposed Project is referred to as the Denali NPP Route Variation and is described in detail in Chapter 2, Alternatives. The 36-inch, 733-mile-long pipeline and 12-inch, 30-mile lateral pipeline would cross various habitats from Prudhoe Bay to the existing ENSTAR pipeline system in the Mat-Su Borough. On-land modifications would also be made to a marshalling yard at the Port of Seward. This route would traverse 7 miles of Denali NPP, would have ocean disposal of dredge material, and would have an aerial crossing of the Yukon River. This section discusses the analysis of impacts to threatened, endangered, or candidate species along the route.

The following sections discuss activities that are proposed to occur during the construction, operations, and maintenance phases of the proposed Project with associated potential impacts.

4.14.5.1. Construction

Construction of Alternative 2 would be similar to Alternative 1 except at DH2, the oceanic dredge disposal location, the aerial Yukon River crossing, the first 62 miles aboveground on VSMs, and traverse of 7 miles of Denali NPP. The differences in impacts are described below.

4.14.5.1.1. Gas Conditioning Facility

Construction impacts for Alternative 2 on threatened and endangered species at the GCF would be the same as those discussed for Alternative 1. The placement of gravel fill would result in the permanent conversion of wetland tundra habitat: 90.6 acres for the GCF itself, 57.1 acres for GCF access roads, and 20.2 acres for GCF camps. Disturbance to polar bear, Steller's eider, and spectacled eider during construction would be temporary. Polar bear dens would be identified with mitigation techniques before construction to avoid disturbances and den collapse (Mitigation Measure No. 2). The risk of injury or mortality to eiders due to collision with the GCF would also be possible.

4.14.5.1.2. Pipeline ROW

Construction impacts for Alternative 2 on threatened and endangered species along the pipeline ROW would be the same as those discussed for Alternative 1. However, the first 62 miles of the proposed pipeline would be aboveground on VSMs. Habitat for Steller's eider, spectacled eider, and polar bear in the northern portion of the pipeline ROW would be disturbed during winter construction activities (*e.g.*, noise disturbance and drilling/trenching for VSM installation).

The installation of VSMs for the first 62 miles of pipeline would create additional elevated structures within threatened and endangered species habitat. Eiders are prone to collisions with man-made structures, particularly with those features low to the ground. If injury or mortality due to collision occurred, the effects would be direct; however, impacts would occur at the individual level and not at the population level. Additionally, the shipping and trucking of the aboveground pipeline's VSM materials would involve more vehicle and vessel traffic than in Alternative 1. Increased traffic could lead to more collisions with threatened or endangered species such as Steller's or spectacled eider.

Alternative 2's pipeline ROW differs from Alternative 1 in that it traverses 7 miles of Denali NPP; however, there are no threatened, endangered, or candidate species in Denali NPP, so no additional impacts would occur.

The effects of displacement or disturbance to threatened, endangered, or candidate species from construction activities along the ROW would be minor, as displacement and disturbance would be short-term, localized, and would not cause population-level effects. If injury or mortality due to construction activities along the ROW occurred to threatened, endangered, or candidate species, the impacts would be moderate.

4.14.5.1.3. West Dock Head 2 and Causeway Upgrades

DH2 is located in shallower waters and could not accommodate the weight and offloading of the modules without complete retrofitting, including the addition of a third berth. Under Alternative 2, the existing channel from DH2 would need to be widened and deepened to the 10-foot depth contour to accommodate large vessels delivering the modules. Bathymetric data suggest the depth at DH2 could require more than 750,000 CYs of dredging to allow for the barges. The required dredge depths at DH2 would require installing new sheet piling. The proven maximum cargo offload completed at DH2 has only been 2,500 s/tons. In addition, the rate of infill at DH2 is conceivably faster than at DH3 due to its location, introducing the likelihood of summer maintenance dredging following winter dredging. If summer dredging is necessary, some amount of dredge materials would need to be disposed, which would require vessels to transport material to the disposal site.

Under this alternative, dredge material would be disposed of in the ocean at the location depicted on Figure 2.2-5. Currently, no offshore disposal sites have been designated by EPA near the proposed Project Area. In coordination with EPA, a disposal site would be

identified and designated, as specified in the conditions under Section 103 of an individual Marine Protection, Research and Sanctuaries Act permit. USACE and EPA authorization is required for the transporting and disposal of dredged material at the designated offshore disposal site.

Dredging in waters deeper than the 5-foot contour line may impact polar bears. Effects include both direct mortality resulting from lair collapse, and disturbance that leads to abandonment of lair and cubs.

Similar to Alternative 1, disturbance of the bottom sediments due to potential one-summer screeding activities proposed under Alternative 2 around West Dock would increase turbidity in the area. Sediment plumes resulting from dredging would likely be short-term as shown in research summarized by Hitchcock and Bell (2004), and are confined mainly to an area of a few hundred meters from the point of discharge (Newell *et al.*, 1998; Hitchcock and Bell, 2004 as reported in Todd *et al.*, 2015). Many marine mammals are accustomed to a turbid environment and utilize sophisticated sonar systems to sense the environment around them (Au *et al.*, 2000). The level of noise from dredging would not result in mortality of marine mammals; however, behavioral responses to increased noise from dredging could be similar to what could occur under Alternative 1, including changing direction, changing durations of surfacing or dives, reduced/increased vocal activities, changes in socializing or feeding, startle, or avoidance.

Construction activities could affect important habitat of threatened, endangered, and candidate species by accidentally introducing minor amounts of contaminants, oils, or fuels. The magnitude of a spill's impact would depend on the spill's contaminant, size, location, and seasonality. The impacts from small spills and discharges could be partially mitigated through adhering to the regulatory requirements to prevent discharge to waters of the U.S. addressed using BMPs described in the SPCC Plan. Impacts from all upgrades and proposed activities to the DH2 and causeway could consist of direct mortality and disturbance from construction and dredging activities vessel traffic, pile driving, increased turbidity, and risk of spills and contaminants. Dredging and pile driving activities are scheduled to occur during year 1 and may occur during open water conditions. If construction is not completed during year 1, additional pile driving may be needed to complete work during open water of year 2 as described in more detail in Section 4.12, Marine Mammals (see Figure 4.12-1). Dredging activities are scheduled during the winter months on the ice, but may also be needed during the following summer due to the higher rate of infill at DH2. Barge traffic and summer dredging activities would be short-term but could cause temporary behavioral changes that are not expected to be biologically significant (such as resulting in changes to reproduction, long-term effects on foraging or long-term stress). The low sound levels related to these activities are not expected to affect polar bear significantly, and assuming standard mitigations for vessel speed and activities are in place, impacts to polar bear from proposed Project activities would be minor. The activities would contribute to increased disturbance in the area.

4.14.5.1.4. Port of Seward

Construction impacts for Alternative 2 on threatened and endangered species at the Port of Seward would be the same as those discussed for Alternative 1. The additional shipping traffic for two summers could disturb the species present, but would be minor because vessel traffic is currently high in the summer. Potential invasive species introduction would also be a minor impact. The magnitude of a spill's impact would depend on the spill's contaminant, size, location, and seasonality.

4.14.5.2. Operations and Maintenance

All operations activities for Alternative 2 would be land-based, year-round, and may likely affect Steller's eider, spectacled eider, and polar bears in the Prudhoe Bay area extending south along the Mainline where habitat is present. The impacts of operations are similar to those of Alternative 1 with disturbance to eiders during the breeding season (spring/summer) and disturbance and possible direct mortality to polar bear during the denning period (winter).

Alternative 2 would include using VSMs for the first 62 miles of the proposed pipeline route as well as at fault zones, elevated bridge stream crossings, pigging facilities, and block valve locations. As additional aboveground features on the North Slope, in the same vicinity of TAPS and the Dalton Highway, the GCF, pipeline, and VSMs, could potentially impact adult Steller's and spectacled eiders through direct mortality or injury from collisions during low visibility conditions. If injury or mortality due to collision occurred, the effects would be direct; however, impacts would occur at the individual level and not at the population level.

The impacts to polar bear are considered minor as proposed Project-related operation would, in general, cause periodic, temporary, or short-term disturbances. Compared to Alternative 1, the 0 to 62-mile elevated portion of the pipeline proposed in Alternative 2 could result in a greater likelihood of habitat fragmentation and obstruction, than an underground construction. As a requirement of the USFWS LOA for polar bear, operations activities within polar bear habitat would occur outside of the critical time periods, including polar bear denning; operations would also occur outside of the Steller's and spectacled eider breeding period (Mitigation Measure No. 1). Operations related disturbance would be unlikely to have population-level effects on polar bear because activities would be outside the species' critical denning time period.

Operations equipment would cause periodic, temporary, or short-term disturbance to Steller's and spectacled eider. Operations activities would occur outside of the critical breeding time period for the eider species. Disturbances resulting in temporary displacement would be minor. Additionally, mortality by collision with operations equipment is possible for the eider species. If mortality occurs, the impacts would be moderate.

4.14.6. Alternative 3 – No Action

Under Alternative 3 (No Action), the proposed Project would not be developed, and there would be no direct or indirect impacts to threatened, endangered, and candidate species.

4.14.7. Conclusions and Comparison of Alternatives

Alternatives 1 and 2 are similar in terms of the types and magnitude of effects expected for threatened, endangered, and candidate species. These effects consist of direct mortality during construction and operation, habitat loss and alteration, biological and behavioral responses due to disturbance, distribution changes due to anthropogenic practices, introduction of invasive species, turbidity, and contaminants.

There is low likelihood that any marine mammal threatened, endangered, and candidate species mortality would occur under either Alternative during construction or operations. Mitigation Measure No. 2 and 3 referenced in Section 4.14.3 intend to minimize interactions with polar bears and other listed marine mammals. These measures represent industry best practice for construction and operation activities on Alaska's North Slope, where these species may occur and have been successful in reducing animal-human interactions.

Steller's or spectacled eider could be injured or die from collisions with the GCF, or with equipment. When visibility is impaired during inclement weather or darkness, birds are particularly at risk of collision with objects in their path (Weir, 1976). The risk of bird collision is largely determined by the timing and location of construction activities in relation to the presence of spectacled and Steller's eiders in the Beaufort Sea. Dredging and DH2 improvements necessary under Alternative 2 would result in a greater level of impact than Alternative 1 but these are still expected to be minor. Summer vessel traffic under both Alternatives 1 and 2 would increase the chance of a strike given the number of barges expected (23) in one summer to Prudhoe Bay and 35 ships over two summers to Seward. However, as stated previously, a slower transit speed has been shown to decrease the likelihood of a strike as well as mortality due to a strike (NMFS, 2013). Vessels would use existing shipping lanes under both alternatives. Both Alternatives 1 and 2 would result in direct, but minor impacts due to injury or mortality for threatened, endangered, and candidate species. If eiders were injured or died from collisions with proposed Project facilities or equipment, impacts would be moderate.

Land-based habitat loss and alteration would occur for Steller's eider, spectacled eider, and polar bear near Prudhoe Bay at the GCF and pipeline ROW in both alternatives. Alternative 2 would result in slightly more habitat loss due to the aboveground VSMs and pipeline that would be permanent landscape features. Both Alternatives 1 and 2 would result in minor, but direct, impacts due to habitat loss for threatened, endangered, and candidate species.

Biological and behavioral responses due to disturbance could occur for all of the threatened, endangered, and candidate species discussed in this section. Increased noise,

both marine and on land, could disturb species. Increased human presence, vehicles, and vessel traffic could also disturb species. Slightly more disturbance would occur in Alternative 2 in Prudhoe Bay because more work would be needed to modify DH2 than DH3, and the ocean disposal location of dredge material would be a further distance away from the proposed Project. Disturbances to threatened, endangered, and candidate species caused by the work in Seward and on the pipeline ROW would be similar for both Alternative 1 and 2. While Alternative 2 would result in greater impacts due to a greater level of activity (more pile driving and increased traffic to the ocean disposal site), both Alternatives 1 and 2 would result in minor impacts on threatened, endangered, and candidate species.

Predator distribution changes due to anthropogenic practices could impact prey species such as Steller's eider, spectacled eider, and juvenile whales similarly in both Alternative 1 and 2. General proposed Project activities in both construction and operation phases could change predator's distribution by either attracting them or displacing them and that may in turn effect how the predators prey upon the prey species. Both Alternatives 1 and 2 would result in minor impacts due to anthropogenically-caused distribution changes to threatened, endangered, and candidate species.

Invasive species could be introduced by proposed Project-related activities similarly in both Alternative 1 and 2. The risk of invasive species causing effects under any alternatives is negligible for both Alternatives 1 and 2.

Construction and upgrades at West Dock would cause turbidity if screeding and/or dredging were required during summer. Alternative 2 would likely cause more turbidity than Alternative 1 because with Alternative 2 more screeding and/or dredging work would be needed to upgrade DH2 than at DH3. Screeding a larger area would result in more turbidity for threatened, endangered, and candidate species to navigate through with Alternative 2.

Proposed Project activities, vessels in particular, could contribute pollutants and contaminants into the habitats of threatened, endangered, and candidate species. Spills of diesel fuel or other toxic substances could occur from vessels in either Prudhoe Bay or in Seward. The magnitude of a spill's impact would depend on the spill's contaminant, size, location, and seasonality in both Alternative 1 and 2. The impacts from small spills and discharges could be partially mitigated through adhering to the regulatory requirements to prevent discharge to waters of the U.S. addressed using BMPs described in the SPCC Plan.

Alternative 3 (No Action) would not result in any impacts on threatened, endangered, or candidate species.

Table 4.14-5 provides a summary of potential impacts on threatened, endangered, and candidate species associated with the alternatives.

Figure 4.14-1 illustrates some of the key findings from the impact analysis. The figure intends to provide context for the description of potential impacts of alternatives as

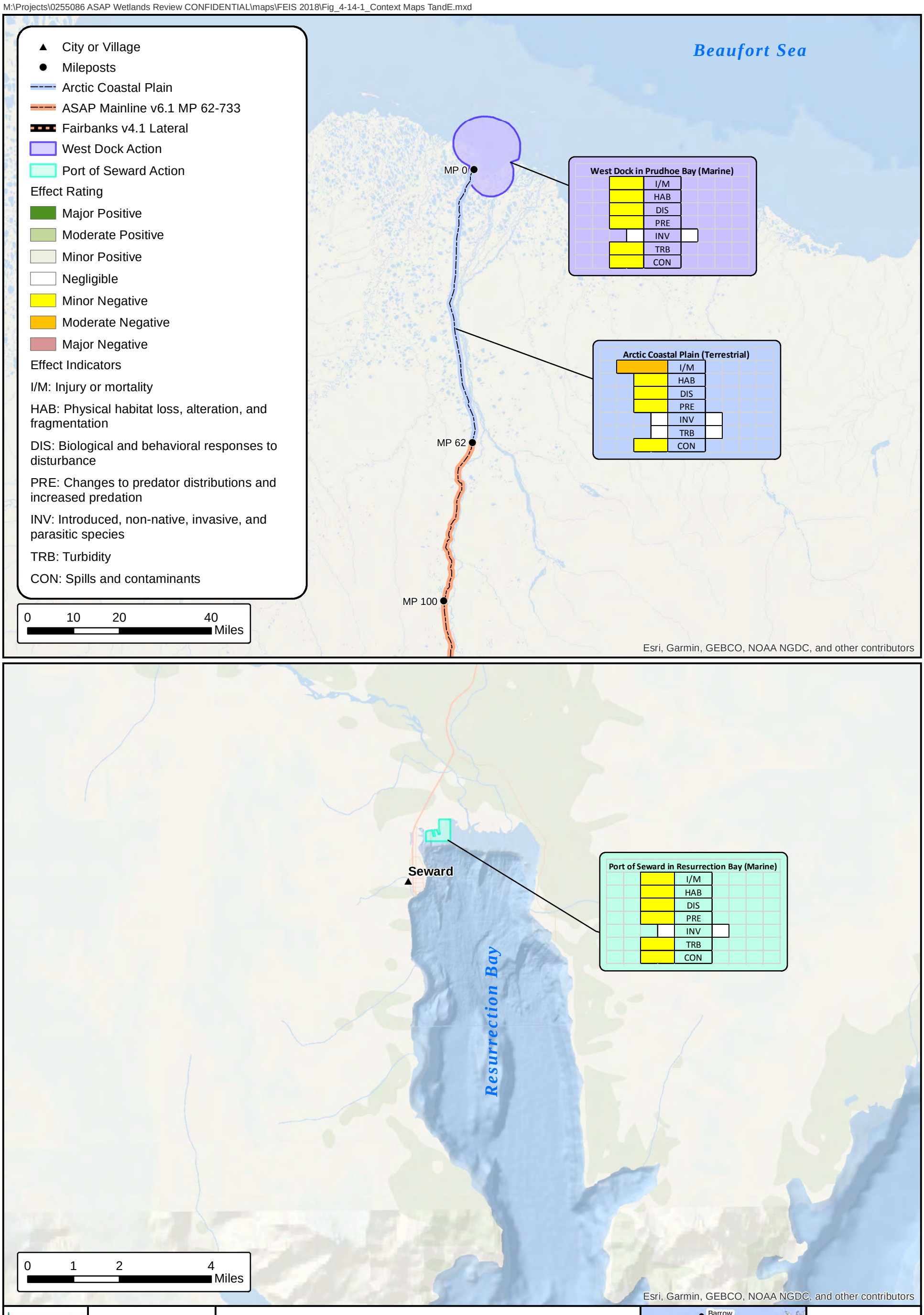
described in detail in this section. By illustrating the potential impacts of the proposed Project on a map using a consistent color scheme consistent with Table 4.14-5, we could begin to draw a few conclusions. Examples are provided below:

- The results indicate the above listed impacts are relatively equally perceived in Prudhoe Bay, the ACP, and in Resurrection Bay.
- The most significant impacts to threatened and endangered species would be those associated with injury or mortality.

Table 4.14-5 Comparison of Alternatives for Impacts to Threatened and Endangered Species (Direct and Indirect)

Biological Resource Effect	Potential Impact Description	Alternative 1		Alternative 2		Alternative 3
		Construction	Operations	Construction	Operations	Construction/ Operations
		Impact Rating		Impact Rating		Impact Rating
Injury or Mortality	Flight collisions with GCF, VSMs, pipeline, or equipment, den collapse, disturbance or displacement	*Moderate if injury or mortality, Minor if disturbance*	*Moderate if injury or mortality, Minor if disturbance*	*Moderate if injury or mortality, Minor if disturbance*	*Moderate if injury or mortality, Minor if disturbance*	*Negligible*
Physical habitat loss, alteration, and fragmentation	Addition of gravel fill, and installation of VSMs and the pipeline	*Minor*	*Minor*	*Minor*	*Minor*	*Negligible*
Biological and behavioral responses to disturbance, including changes to distributions	Responses resulting from construction and operational activities that include vessel traffic, low-level helicopter or airplane over flights	*Minor*	*Minor*	*Minor*	*Minor*	*Negligible*
Changes to predator distributions and increased predation	Changes to predator distributions due to anthropogenic practices (*i.e.*, food waste from construction camps)	*Minor*	*Minor*	*Minor*	*Minor*	*Negligible*
Introduced non-native, invasive and parasitic species	Proposed Project equipment and/or personnel transporting exotic species to the proposed Project Area	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*
Turbidity	Water cloudiness and reduced visibility due to proposed Project activities in Prudhoe Bay	*Minor*	*Minor*	*Minor*	*Minor*	*Negligible*
Spills and Contaminants	Risk of proposed Project activities contributing pollutants and contaminants into habitats of threatened, endangered, and candidate species	*Minor*	*Minor*	*Minor*	*Minor*	*Negligible*

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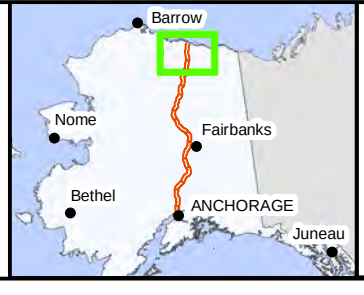


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DATE: MAR 2018
CHKD: K.A.
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PROJ. No.: 0416166

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Figure 4.14-1: THREATENED AND ENDANGERED SPECIES IMPACTS CONTEXT MAP ALASKA STAND ALONE PIPELINE



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4.15. Land Use

4.15.1. Introduction

This section describes potential impacts to land use resources associated with the construction and operation of the proposed Project and connected actions. The information, data, and methods used in this analysis is based on information provided in the 2012 FEIS as well as relevant new information that has become available since the publication of the 2012 FEIS (USACE, 2012a), including the new proposed route, Revision 6.1. Specifically, the following items have been substantially updated from the 2012 FEIS related to impacts to land use resources:

- The section has been reorganized with regard to the three alternatives, each with sub-sections for construction and operations and maintenance;
- A new section (Section 4.15.2, Methods) was added to explain the approach to assessing impacts on land use associated with the proposed Project;
- Mitigation measures were carried over from the 2012 FEIS and expanded to include new proposed Project information and recommendations from federal and state agencies (Section 4.15.3, Applicant-Proposed Design Features, Mitigation Measures, Best Management Practices, and Project Management Plans); and
- Land use acreage impacts differ from those presented in the 2012 FEIS due to route alterations and modified land use evaluation methods.

4.15.1.1. Incomplete and Unavailable Information

In compliance with CEQ guidance (see Section 4.3), this section addresses incomplete or unavailable information pertinent to analyzing impacts of the alternatives on land use. When site-specific information on land use could not be obtained, a more generalized assessment was undertaken. For example, in many cases, information on private land uses was not publicly available; therefore, a more qualitative assessment of the likely effects of the proposed Project and alternatives on land use is presented.

4.15.2. Methods

The potential land use impacts for the proposed Project presented below are based on the evaluation of the land use resources along the proposed Project corridor, review of available proposed Project descriptions and reports, and public comments received after the publication of the 2012 FEIS. Land use data and descriptions were obtained from a combination of sources including the 2012 FEIS, NLCD (MRLC Consortium, 2016), and several other publications specific to Alaskan land use, all of which are cited and included in Chapter 7, Literature Cited, of this SEIS.

Potential impacts for this SEIS were analyzed by assessing the magnitude, extent, duration, and likelihood of occurrence as presented in Table 4.15-1, Impact Criteria for Land Use. Effects assessed include:

- Affects to land use planning;
- Affects to existing transportation and utilities, easements/ROW rights; and
- Affects to forestlands, agriculture, farmlands, or developed areas.

4.15.2.1. Description of Effects

4.15.2.1.1. Compatibility with Existing Land Use Plans

An evaluation of whether the Alternative 1 (proposed Action) is compatible with existing land use plans helps determine if any proposed Project activities would result in acreage not being available for other land uses such as farmland, solid waste facilities, recreation lands, transportation corridors, or other municipal, state or federal uses. Note, no prime farmland, as defined by the Farmland Protection Policy Act (FPPA) of 1981, has been designated in the state of Alaska. If Alternative 1 or any alternatives were determined to be incompatible, existing plans and planning efforts may require modification.

4.15.2.1.2. Changes to Existing Transportation, Utilities, and Easements/ ROW Rights

Changes to existing transportation and utility corridors and easement or ROW rights could result from construction and operation of a permanent ROW, which could alter existing transportation infrastructure or place stress on existing utilities infrastructure.

4.15.2.1.3. Changes to Forestlands, Agriculture, Developed Areas

The proposed Project Area does not contain prime farmland, prime forestland, or prime rangeland. In addition, no unique farmlands or farmlands of statewide importance have been designated in Alaska. Important farmland, prime forestland, and prime rangeland receive protection from FPPA and U.S. Department of Agriculture (USDA) Departmental Regulation No. 9500-3, Land Use Policy. The USDA regulation, 7 CFR 658, implements the FPPA. However, the construction and operations ROWs for the proposed Project would affect soils designated as farmlands of local importance by the Fairbanks Soil and Water Conservation District and the Mat-Su Borough. Approximately 24 acres of land within the proposed Project ROW was described as either "cultivated crop" or "pasture/hay" on the National Land Cover Database. Additionally, the proposed Project ROW approaches or intersects the Tanana Valley State Forest (one of three designated state forests in Alaska) between MP 407 and MP 452. The construction and permanent ROWs would affect soils designated as Farmlands of Local Importance.

Clearing of forestlands or clearing land that could otherwise be used for agriculture, farmland, or development could result from construction and/or operation of a pipeline. These activities could result in secondary effects on lands available for recreation, hunting, subsistence, or other uses.

4.15.2.2. Impact Criteria

Table 4.15-1, Impact Criteria for Land Use, summarizes the criteria used to determine the level of impact based on the magnitude, extent, duration, and likelihood of occurrence. Table 4.15-2 defines the types of effects the proposed Project or alternatives may have on the land use resources within the proposed Project Area. The potential effects listed in these tables do not consider the implementation of the mitigation measures described in Appendix M of this SEIS. Potential impacts that remain after mitigation measures have been implemented are described for each alternative in the following sections. Where additional resource-specific information may provide further insight into the rationale behind impact criteria, these details are presented following each table.

Table 4.15-1 Impact Criteria for Land Use

Impact Component	Impact Level			
	Major	Moderate	Minor	Negligible
Magnitude or Intensity	Permanently changes transportation and land use on a statewide scale	Changes transportation and land use on a regional scale but does not permanently disrupt uses	Impacts to land use and transportation are temporary and localized	No or minimal perceptible effect
Geographic Extent	The effect would occur on a statewide basis, or throughout the study area	The effect would occur at a borough or community level, or on a limited portion of the study area	The effect would be site-specific or would occur in a few isolated locations	No measurable effects
Duration or Frequency	The effect would be permanent and would not be reversed during operations	The effect would cause intermittent disruption of current uses for up to 10 years. Changes could be reversed during the operation phase	The effect would occur intermittently or for less than 1-year duration. Periodic, temporary, or short-term changes that are reversed	No measurable effects
Likelihood	Most likely (Effects are those that have greater than 75% chance of arising from reasonable or demonstrated mechanisms due to the action)	Likely (Effects are those that have a 50% to 75% chance of arising from reasonable or demonstrated mechanisms due to the actions)	Somewhat likely (Effects are those that have a 10% to 50% chance of arising from reasonable or demonstrated mechanisms due to the action)	Unlikely (Effects are those that have less than 10% chance of arising from reasonable or demonstrated mechanisms due to the action)

Table 4.15-2 Types of Effects and Impacts on Land Use

Type of Effect	Proposed Action Causing Potential Impact	
	Construction	Operations and Maintenance
Effects to Land Use Planning and Conservation • Acreage is not available for other land use planning efforts	• Temporary impacts to existing land use during construction • Compatibility with Section 6(f) of the Land and Water Conservation Fund	• Long-term compatibility with existing land use plans • Compatibility with Section 6(f) of the Land and Water Conservation Fund
Effects to Existing Transportation and Utilities; Easements/ ROW Rights: • Acres included in permanent ROW would not be available for other uses during the construction phase of the proposed Project • Degradation of existing transportation infrastructure • Stress on existing utilities infrastructure	• Usage of acres included in permanent ROW during the construction phase • Increase usage of existing transportation infrastructure during the construction phase • Increase usage of existing utilities infrastructure during the construction phase	• Usage of acres included in permanent ROW during the operations phase • Increase usage of existing transportation infrastructure during the operations phase • Increase usage of existing utilities infrastructure during the operations phase
Effects to Land Cover: Forestlands, Agriculture, Farmlands, Developed Areas • Impacts to farmland acreage of local importance • Clearing of various forest types available for recreation, hunting, subsistence or other uses	• Farmland acreage of local importance during construction would be temporarily impacted • Clearing of various forest types during construction phase	• Farmland acreage of local importance permanently lost during operations • Clearing of various forest types during operations phase
Waste Generation	• Stress on existing solid waste infrastructure in terms of capacity and competition with existing municipality use as a result of construction efforts	• Stress on existing solid waste infrastructure in terms of capacity and competition with existing municipality use as a result of long-term operation of permanent facilities
Property Ownership and Zoning	• Changes in land ownership as a result of proximity to pipeline • Impacts to property values • Compatibility with zoning requirements	• Changes in land ownership as a result of proximity to pipeline • Impacts to property values • Compatibility with zoning requirements

4.15.3. Proposed Design Features, Mitigation Measures, Best Management Practices, and Project Management Plans

4.15.3.1. Applicant-Proposed Design Features, Mitigation Measures, Best Management Practices, and Project Management Plans

The following design features, mitigation measures, BMPs are proposed by AGDC and have been taken into consideration when evaluating potential impacts on visual resources under Alternatives 1 and 2 during the construction and operations phases. This list includes certain State of Alaska ROW Lease stipulations, as provided in Attachment 3 of the July 2016 ASAP EED (AGDC, 2016b). As such, some of the measures below reference the "leasehold," which refers to the lease area for the proposed Project. A complete list of mitigation measures and BMPs are also provided in Appendix M.

Proposed mitigation measures would include:

1. Prior to construction, AGDC would enter into a comprehensive agreement with ADOT&PF for the use of highways and other facilities under the jurisdiction of ADOT&PF.
2. For land use, specific plans for traffic control; camps; timber clearing salvage and utilization; methods for pipeline and access road construction; disposal of trench spoils and excess material; and restoration and revegetation of disturbed areas would be required. These plans are required as part of the State of Alaska ROW lease. They are mentioned here, but have not been analyzed as part of this impact analysis as they have not yet been developed.
3. Where requested by the landowner, limit public access to ROW for recreation or hunting by blocking entry areas with large boulders, berms, or fencing.
4. Provide and maintain access roads and airstrips, the number and location of which shall be approved by SPCS or BLM, to ensure that the AGDC's maintenance crews and state representatives shall have continued access. This applies to areas where a lease is required from the SPCS or federal grant of ROW is required from BLM.
5. Regulate or temporarily prohibit public access and vehicular traffic on roads on state and BLM lands, which are not managed or owned by ADOT&PF, as required for activities in the immediate vicinity of the pipeline and related facilities. Provide appropriate warnings, flagging, barricades, and other safety measures when AGDC is regulating public access. Develop and Implement Traffic Control Plans to Minimize Negative Impacts to Local Businesses by Blocking Access during Construction.
6. Pipeline activities shall not interfere with the public's free and unrestricted access to and upon the Leasehold, except that, with the SPCS' approval, regulate or prohibit access, including vehicular traffic, to and upon the Leasehold to the extent necessary to facilitate pipeline activities, maintain pipeline integrity, or to protect the public and wildlife from hazards associated with pipeline activities.

7. Where a lease is required from the SPCS or a federal grant of ROW is required form BLM, the creation of any permanent obstruction to the passage of small craft in streams is prohibited, unless otherwise approved by the SPCS/BLM.
8. Make provisions for suitable permanent crossings for the public where the Leasehold or access roads cross existing roads, foot trails, winter trails, easements or other ROWs, unless otherwise authorized by the SPCS.
9. Operation of mobile ground equipment off the Leasehold, access roads, state highways, or authorized areas must be approved in areas where a lease is required from the SPCS or a federal grant of ROW is required from BLM, from either entity.
10. Agents, employees, contractors, and the employees of each of them would be prohibited from hunting, fishing, trapping, shooting, and camping within the Leasehold. Agents, employees, contractors, and the employees of each of them shall not use proposed Project equipment, including transportation to and from the job site, for the purpose of hunting, fishing, shooting, and trapping.
11. After construction is complete, with the concurrence of AGDC, the SPCS/BLM may designate areas of the Leasehold to which the public shall have free and unrestricted access.
12. For road crossings where the proposed pipeline cannot be installed by HDD, a trench would be excavated. In such cases, a temporary bypass or bridge would be built to minimize the effects to traffic flow.
13. The proposed Project would entail segregating the surface layer and replacing it as the last layer of backfill in the trench within designated agricultural lands and in select continuous and discontinuous permafrost areas and non-permafrost areas (as discussed in the AGDC planning document, *Segregation of the Surface Layer* [AGDC, 2017g], and in the Revegetation Plan [Appendix E, Part I]).
14. In areas where a lease is required from the SPCS or federal grant of ROW from BLM, all waste generated in construction, operation, maintenance, and termination of the proposed pipeline would be removed or otherwise disposed of according to all local, state, and federal laws, and in a manner reasonably acceptable to SPCS/BLM.
15. AGDC has committed to avoiding the known contaminated site areas described in Chapter 3, and any newly discovered contamination would be reported to the ADEC in accordance with their reporting requirements and handled in a manner to avoid transport of contaminated materials.
16. In areas where a lease is required from the SPCS or a federal grant of ROW is required from BLM, AGDC would protect existing telephone and other transmission lines, roads, trails, fences, ditches, and like improvements during construction, operation, maintenance, and termination of the proposed Pipeline. Any damages caused by AGDC to public utilities and/or improvements would be promptly repaired by AGDC to a condition that is reasonably satisfactory to SPCS/BLM.

17. In areas where a lease is required from the SPCS or a federal grant of ROW is required from BLM, a surveillance and monitoring program for the proposed pipeline would be approved by SPCS/BLM prior to start-up of the proposed pipeline. The program shall be designed, at a minimum, to protect public and private property.

4.15.3.2. Agency-Recommended Mitigation Measures

A variety of mitigation measures and best practices have been recommended by the cooperating agencies (Appendix M). Many of these recommendations have been incorporated in the proposed Project and are included in Table 4.15-3 below. The impacts discussed in this chapter are based upon the Applicant-proposed measures. These additional agency recommended measures are not included in the impact analysis.

Table 4.15-3 Land Use Resources Agency-Recommended Mitigation Measures

Additional Measure Consideration	Agency Proposing Mitigation Measure	Agency Jurisdiction	Authority (*i.e.*, CWA, RHA, ESA)	Affected Resources	Comment Code
When new access roads/airstrips are created on public land, consult with ADF&G when considering whether to allow for possible public access for hunting, particularly in areas with underutilized wildlife populations.	ADF&G	ADF&G, BLM, ADNR	Alaska Hunting Regulations (AHR); Federal Land Policy and Management Act	Recreation, Land Use, Subsistence	WLD_22
Alternative access should be provided around temporarily blocked public access routes and at locations and periods when free and unrestricted access upon public land is temporarily restricted, particularly along RS2477 easements, section-line easements, and 17(b) easements. There should also be a clear and defined public process that addresses long-term public access beyond the pipeline construction period (*i.e.*, temporarily prohibited access).	ADF&G	BLM, ADNR	Federal Land Policy and Management Act	Recreation, Land Use	ACC_34
In addition to temporary alternate access for 17(b) easements, alternate access should be provided at locations and periods when public use of RS2477 easements and section-line easements is temporarily restricted.	ADF&G	BLM	Federal Land Policy and Management Act	Recreation, Land Use	ACC_34
A large number of Applicant-proposed design features, mitigation measures, BMPs, and project management plans listed in the Draft SEIS contain the language, "In areas where a lease is required from the State Pipeline Coordinator's Section" or "a federal grant of ROW is required from BLM ..." These measures generally represent a best management approach that we recommend using to the maximum extent possible along the entire pipeline route, while acknowledging the outstanding need to complete coordination with private landowners.	EPA	--	--	Numerous	MIT_35

AAC = Alaska Administrative Code
ADF&G = Alaska Department of Fish and Game
ADEC = Alaska Department of Environmental Conservation
ADNR = Alaska Department of Natural Resources
AGDC = Alaska Gasline Development Corporation
APDES = Alaska Pollution Discharge Elimination System
BLM = Bureau of Land Management
BMP = Best Management Practice
CAA = Clean Air Act
CWA = Clean Water Act
DHSS = Alaska Department of Health and Social Services
EPA = U.S. Environmental Protection Agency
MBTA = Migratory Bird Treaty Act
NMFS = National Marine Fisheries Service
RHA = Rivers and Harbors Act of 1899
SEIS = Supplemental Environmental Impact Statement
USACE = U.S. Army Corps of Engineers
USFWS = U.S. Fish and Wildlife Service

4.15.4. Alternative 1 – Proposed Action

Alternative 1 is designated the proposed Action (proposed ASAP Project). This alternative is described in Chapter 2 in detail. The 36-inch, 733-mile-long pipeline and 12-inch, 30-mile lateral pipeline would cross various land use areas from the North Slope to the existing ENSTAR distribution system in the Mat-Su Borough. This section discusses the analysis of impacts to land use along the route.

The proposed Project would intersect land use areas and land cover types in a wide variety of regions in Alaska, described in Chapter 3. Construction and operations activities of the proposed Project and impacts by land cover type are summarized in Table 4.15-4.

The following sections discuss activities that are proposed to occur during the construction, operations, and maintenance phases of the proposed Project with associated potential impacts.

4.15.4.1. Construction

The proposed construction spread (*i.e.,* schedule) for the pipeline is presented in Chapter 2, Table 2.2-7, Alternative 1: ASAP Construction Spread Plan (Schedule). The construction schedule provides important context for understanding how land use may be affected by construction during specific periods.

4.15.4.1.1. Land Use Planning and Conservation

The proposed Project would intersect lands that are managed by land use plans as well as lands that are managed by conservation plans. The expected impacts to these lands are described below.

4.15.4.1.1.1. Compatibility with Existing Land Use Plans

As described above, the proposed Project would intersect lands managed according to numerous federal, state, borough, and local management plans. Table 4.15-4 provides a brief assessment of the compatibility of the proposed Project with existing land use and management plans. Proposed mitigation measures and BMPs listed in Section 4.15.3 generally intend to minimize effects on existing land use within the proposed Project Area. The majority of lands with applicable management plans (or similar) have provisions for utility crossings compatible with the proposed Project. Exceptions include the Denali State Park Management Plan, the Iditarod National Historic Trail Comprehensive Management Plan, the Susitna Community Council Comprehensive Plan, and the Willow Area Community Comprehensive Plan, all of which do not include provisions for utility crossings.-

Table 4.15-4 Summary of Relevant Land Use Plans and Documents and Their Relationship to Alternative 1 (Proposed Action)

Author/Agency	Land Use Plan/Document	Relationship with the Proposed Action
BLM	Utility Corridor Resource Management Plan (RMP)/EIS Record of Decision (1991)	The proposed RMP/FEIS identifies the inner and outer portions of the utility corridor within its planning area. The proposed Project would be located within the utility corridor. The primary management direction and use of BLM-administered lands in the utility corridor is for energy transportation. In addition to the management practices and allowable uses for the Galbraith Lake ACEC and Toolik Lake Research Natural Area, the protection measures and stipulations detailed in Appendices K and L of the proposed RMP/FEIS would apply in the event that BLM granted the ROW authorization for the proposed Project.
	RMP and Record of Decision for the Central Yukon Planning Area (1986)	The following policies would apply for access to or across BLM lands managed under the RMP: Access to or across public lands would be considered on a case-by-case basis. Under this RMP, the use of vehicles of greater than 1,500 pounds gross vehicle weight would be allowed by authorization only. Vehicle use may be authorized under a mining plan of operations (43 CFR 3809), with a permit (43 CFR 2800 or 43 CFR 2920), or by other appropriate means. Approval would be subject to conditions that minimize the impact to other land uses and/or prevent unnecessary damage to the environment.
	East Alaska RMP (2006)	The required operating procedures and oil and gas leasing stipulations described in Appendix C of the RMP/FEIS would apply in the event that BLM granted the ROW authorization for the proposed Project.
	Iditarod National Historic Trail Comprehensive Management Plan (1986)	The plan does not provide guidance related to utility corridors.
	Dalton Highway Recreation Area Management Plan (DHRMA) (1991)	The plan states: *The primary function of the lands within the DHRMA is the transportation of energy resources; therefore, actions or activities potentially adverse to existing and future energy transportation systems would be avoided. Mineral material extraction is allowed within the DHRMA for maintenance and construction of transportation systems. This planning decision may be in conflict with recreation management objectives in some areas.*
ADNR	Tanana Valley State Forest Management Plan 2001 Update	The plan contains the following policies relevant to the proposed Project: Other land management proposals may be initiated by other agencies or private individuals and may include requests for ROW, commercial leases, timber or material sales, or permits for mineral activity, trapping, cabins, or grazing. The following process would be used to review these permit or conveyance requests. Applications for use of State Forestland, including mining or prospecting, would be forwarded to the Northern Regional Office of the Division of Mining, Land and Water. The Division of Mining, Land and Water would distribute the applications for review by agencies, including the Northern Regional Office of the Division of Forestry. The Division of Forestry would review applications for consistency with this plan and other existing laws and policies. The Division of Forestry would then return applications to the Division of Mining, Land and Water with stipulations for processing. The Division of Forestry may also require additional review of applications after interagency or public comment. Although preliminary decisions or final findings would continue to be made by the Division of Mining, Land and Water, applications must be consistent with the stipulations given by the Division of Forestry.

Author/Agency	Land Use Plan/Document	Relationship with the Proposed Action
		No permits, leases, disposals, or ROWs would be authorized for use of state forestland that are not consistent with stipulations from the Division of Forestry. **Timber Management** **II. Management Guidelines** **H. Timber Salvage From Rights-of-Way** All timber that has value for commercial or personal use should be salvaged on ROWs to be cleared for construction. See AS 41.17.083 regarding salvage and salvage value. **Trails** **G. Trail Crossings** **II. Management Guidelines** When it is necessary for powerlines, pipelines, or roads to cross trail corridors, crossings should be at 90-degree angles, when feasible, except when a trail corridor is deliberately combined with a public utility or transportation corridor. Where feasible, vegetative screening should be preserved when a utility crosses a trail corridor. **Public Access** **I. Goals** Maintain, enhance, or provide adequate access to publicly owned land and resources. **II. Management Guidelines** **J. Pipeline Crossings** ADNR should work with APSC to identify options to develop new pipeline crossings. Future pipelines (such as the Trans-Alaska Gas Line) should provide more places for public crossings to state land for hunting, fishing, recreation, timber harvest, settlement, and other uses or provide a mechanism to improve or develop future public crossings as the need arises.
	North Slope Management Plan	The plan is under development.
	Susitna Matanuska Area Plan (SMAP) (February 2010 Public Review Draft)	The SMAP specifies land management policies for each of the 11 regions within the plan boundaries. Mainline segment MP 555 to End would intersect the North Parks Highway, Petersville Road, and Susitna Lowlands regions. Prior to making an authorization decision, ADNR takes into account the management guidelines and statement of intent specific to each unit within a region. The SMAP emphasizes minimizing land use conflicts through plan guidelines and intent rather than through prohibitions, although prohibitions are sometimes identified. Other uses are initially presumed compatible with the primary use. However, if ADNR determines that a use conflict exists and that the proposed use is incompatible with the primary use, the proposed use shall not be authorized or it shall be modified so that the incompatibility no longer exists (11 AAC 55.040 (c)). The Area-wide Land Management Policies include management guidelines relevant to pipeline development: **Shorelands and Stream Corridors**

Author/Agency	Land Use Plan/Document	Relationship with the Proposed Action
		C. Public Access Adjacent to Waterbodies. Pursuant to AS 38.05.127, legal public access would be reserved to protect the public's right to travel to and along the ordinary high water of a waterbody without encouraging trespass. Permits, leases, and plans of operation for commercial and industrial uses, transportation facilities, pipelines and other water dependent uses may be authorized on state uplands adjacent to waterbodies if their activities are consistent with the management intent for the area, and if they maintain tideland and stream bank access, and protect important fish and wildlife habitat, public water supplies, and public recreation. Trails and other forms of non-motorized public access are generally considered appropriate within these areas, if they meet the conditions listed in 11 AAC 96.025. **H. Buffer, Easement, and Building Setback Widths**. d) Public access easements, including 'to and along' easements required under AS 38.05.127, or utility easements adjacent to tidelands, lakes, and streams: 50 feet. Other types of utility easements may be less than this width, depending on the purposes of the easement. **Public Access** **F. Alignment with Crossings**. When it is necessary for power lines, pipelines or roads to cross trails, crossings should be at a 90-degree angle. Vegetative screening should be preserved at trail crossings.
	Southeast Susitna Area Plan (2008)	The Area-wide Land Management Policies include management guidelines relevant to pipeline development. These guidelines are identical to those found in the SMAP (see above).
	Susitna Area Plan (1985, as amended)	The Area-wide Land Management Policies listed in the plan include management guidelines relevant to pipeline development: **Forestry** **II. Management Guidelines** **B. Timber Salvage**. Timber with commercial or personal use value should be salvaged from lands that are to be cleared for other uses, such as farms and transportation or utility corridors. **Trail Management** **G. Trail Crossings**. When it is necessary for powerlines, pipelines, or roads to cross trail corridors, crossings should be at 90-degree angles when feasible, except when a trail corridor is deliberately combined with a public utility or transportation corridor. Where feasible, vegetative screening should be preserved when a utility crosses a trail corridor.
	Susitna Basin Recreation Rivers Management Plan (1991)	The plan includes goals and management practices for recreation, fish and wildlife habitat, and public access, among others. There is no specific mention of management guidelines relevant to pipeline development.

Author/Agency	Land Use Plan/Document	Relationship with the Proposed Action
	Tanana Basin Area Plan (1986)	The Area Wide Land Management Policies listed in the plan include management guidelines relevant to pipeline development: **Trail Management** **G. Trail Crossings**. When it is necessary for powerlines, pipelines, or roads to cross trail corridors, crossings should be at 90-degree angles when feasible, except when a trail corridor is deliberately combined with a public utility or transportation corridor. Where feasible, vegetative screening should be preserved when a utility crosses or co-locates within a trail corridor. In addition, the Transportation Goals specified in Chapter 2 apply to forms of utility or resource transportation corridors. The following transportation corridors were identified in the plan: • Alaska Natural Gas Pipeline • Alaska Railroad Extension • PWS - Upper Tanana Railroad Corridor • Western Access Railroad Corridor • Twin Mountain Access Route • Parks Highway - Kantishna – McGrath Highway Corridor • Upper Wood River (Bonnifield Mining District) Access • Nenana - Totchaket Area Access • TAPS Oil Spill Contingency Plan Access Routes • Existing transportation routes identified by the plan include the RS 2477 trails and existing highways maintained and operated by ADOT&PF. • Utility corridors are prohibited within the following units: • Management Unit 2H: Minto • Management Unit 3B: South Shore Lake Minchumina • Management Unit 3E: Middle Cosna-Zitziana Watersheds
	Willow Creek State Recreation Area Master Plan (1990)	The highest level of development permitted within the park includes, but is not limited to, roads, trails, and public transportation routes or access. Exceptions to the provisions of the master plan may be made without modification to the plan. Special exceptions could occur only when complying with the plan is excessively difficult or impractical and a practical alternative procedure could be implemented, which adheres to the purposes and spirit of the plan.
	Denali State Park Management Plan (2006)	The plan designates land use within park boundaries. Land use designations adjacent to the Parks Highway consist of Natural Area and Recreation Development. Areas designated Natural Area are intended to be relatively undeveloped and provide users opportunities for a high value, natural experience. Figure 11 within the plan provides guidelines for activities and facilities within the various land-use designations in the park. For both the Natural Area and Recreation Development designations, utilities, transmission lines, and pipelines are allowable by permit only when no viable alternative exists. Tower heights are limited to 85 feet. Best practices must be employed to minimize impacts to viewsheds, especially within those with high public use.

Author/Agency	Land Use Plan/Document	Relationship with the Proposed Action
	Dalton Highway Master Plan (1998)	The plan specifies development nodes along the Dalton Highway Corridor at the following locations: Yukon River Crossing, Coldfoot, Chandalar Shelf, Happy Valley and Deadhorse. Each node is a distinct and compact cluster of development. Oil and gas development activities, transportation, and incidental or minor governmental activities are allowed to locate outside of nodes if the needs of the activity are demonstrably better met outside the nodes.
	Scenic Resources Along the Parks Highway – Inventory and Management Recommendations (1981)	See Section 4.17, Visual, of this SEIS for a discussion of this plan's applicability to the proposed Project.
ADF&G	Minto Flats State Game Refuge Management Plan (1992)	The Minto Flats State Game Refuge Management Plan contains policies related to transportation/utility corridors through the refuge: Transportation and utility corridors, including railroads, roads, powerlines, and pipelines may be sited on refuge lands if they are determined to be compatible with the purposes for which the refuge was established. Proposals would be evaluated for compatibility with the refuge purposes listed in legislation and reflected in the goals of this plan: 1) protection and enhancement of habitat resources; 2) conservation of fish and wildlife populations; and 3) the continuation of fishing, hunting, trapping, and other public uses compatible with habitat protection and enhancement and fish and wildlife conservation. Additionally, corridor proposals must demonstrate that there is a significant public need for the corridor that cannot be reasonably met off-refuge, that the use of refuge lands and impacts to refuge resources are avoided or minimized to the maximum extent feasible, that public access to the refuge is maintained, and that impacts to refuge resources are fully mitigated. Given the distribution of habitats and public uses within the refuge, the potential for incompatibility between corridor development and resource values appears to be greater within the portion of the refuge north of the Tanana River. Therefore, the highest priority should be given to avoiding the future siting of transportation and utility corridors in the most valuable refuge habitats north of the Tanana River.
	Palmer Hay Flats State Game Refuge Revised Management Plan (2002)	The plan does not provide guidance specific to the development of material sites. A Special Area Permit is required for any construction work, including any habitat altering activity on state land or water, in a designated State Game Refuge (5 AAC 95.420). ADF&G Habitat Division reviews all proposed activities for consistency with the management plan and with regulation 5 AAC 95.505. Activities would be approved, conditioned, or denied based on the direction provided in the management plan.

Author/Agency	Land Use Plan/Document	Relationship with the Proposed Action
NSB	NSB Comprehensive Plan (2005)	The NSB Comprehensive Plan contains policies related to the development of oil and gas resources: **Issue #32:** Drill pads and pipelines encroach upon subsistence zones. • **Goal:** Minimize impacts to subsistence from development, sport hunting, and other outside influences. o *Objective/Policy:* Coordinate with village residents to reduce the footprint of development and encourage common use of facilities. o *Objective/Policy:* Mitigate impacts to subsistence from development. o *Objective/Policy:* Develop a program to compensate village residents for impacts to subsistence. **Issue # 81:** Development activities could impact fish and wildlife populations, habitat, and their capacity to continue to support subsistence activities. • **Goal:** Minimize habitat fragmentation from construction of resource development infrastructure that impacts migratory patterns of fish and wildlife. • **Goal:** Encourage development to use best available technology to reduce adverse impacts of fish and wildlife. o *Objective/Policy:* Coordinate with the NSB and local residents when preparing resource development plans to avoid or reduce impacts to fish and wildlife. o *Objective/Policy:* Monitor fish and wildlife populations and habitat before, during, and after development activities to document impacts. o *Objective/Policy:* Incorporate measures, such as buried pipelines, common ROWs way, and directional drilling, to minimize adverse effects on fish and wildlife migration and habitat. **Issue #90**: A small percentage of local residents are presently employed by outside companies • **Goal:** Increase local hire in outside companies, such as the oil and gas industry. **Issue #118:** Resource development changes the character of the landscape and alters the way local people use the land. • **Goal**: Minimize visual and other impacts on community character. o *Objective/Policy:* Locate and design oil and gas facilities to minimize visual and other impacts on community character. **Issue #156:** Oil field infrastructure, including roads, pads, and pipelines, cause physical changes in the environment. • **Goal:** Minimize physical changes in the environment from oil field infrastructure. o *Objective/Policy:* Work with industry in the permitting process to incorporate mitigation measures that reduce impacts. o *Objective/Policy:* Develop incentives for industry to develop alternative designs to minimize development footprint and consolidate facilities. **Issue #160:** There is a lack of regulations for oil and gas pipelines.

Author/Agency	Land Use Plan/Document	Relationship with the Proposed Action
		• **Goal:** Develop and implement state regulations for oil and gas pipeline installation, operation, and maintenance. o *Objective/Policy:* Develop agreements with the state for minimum criteria and inspections. o *Objective/Policy:* Bring public attention to the issue to encourage development of state regulations for pipelines. **Issue #162:** Communities are concerned about the potential impacts of demobilizing oil and gas facilities in the future. • **Goal:** Require industry to rehabilitate oil and gas facility sites as resources are depleted. • **Goal:** Ensure adequate funds and resources for demobilization and restoration activities are established. o *Objective/Policy:* Encourage public participation in demobilization planning. o *Objective/Policy:* Enforce existing permit requirements for demobilization. o *Objective/Policy:* Monitor demobilization efforts. o *Objective/Policy:* Work with federal and state agencies to ensure that adequate funds and resources for demobilization and restoration activities are being reserved. **Issue #42:** The resource industry does not adequately coordinate with local subsistence users prior to development or dismantlement of oil and gas facilities. • **Goal:** Improve coordination with local subsistence users prior to development and dismantlement activities. o *Objective/Policy:* Use the Kuukpik Subsistence Oversight Panel as a model for improving coordination and local participation in planning for and monitoring resource exploration and development activities. o *Objective/Policy:* Investigate other models for coordinating subsistence and resource development, including Canadian hunting and trapping associations. **Issue #57:** State and federal government entities and the oil and gas industry do not fully understand the importance of traditional and contemporary local knowledge to NSB residents. • **Goal**: Recognize the importance of cultural values and traditional and contemporary local knowledge to NSB residents. o *Objective/Policy:* Educate state, federal, and local government entities and the oil and gas industry about the importance of traditional and contemporary local knowledge to NSB residents. o *Objective/Policy:* Develop a handbook for government entities and the oil and gas industry that relays the importance and utilization of traditional and contemporary local knowledge. o *Objective/Policy:* Seek out and incorporate aspects of traditional and contemporary local knowledge during proposed Project design, permitting, and environmental impact assessments. **Issue #97:** NSB communities are not energy self-sufficient. • **Goal**: Develop energy strategies for the villages to achieve greater self-sufficiency.

Author/Agency	Land Use Plan/Document	Relationship with the Proposed Action
		o *Objective/Policy*: Develop alternative energy sources for NSB communities, such as coal, natural gas, and wind power. o *Objective/Policy*: Look for ways that oil and gas development could provide natural gas to village communities. **Issue #165:** Some communities close to natural gas resources do not have supply facilities. **Issue #166:** It is expensive to develop natural gas facilities for supply and distribution to small communities. • **Goal:** Develop gas supply facilities in communities within close proximity to natural gas. • **Goal:** Obtain grants and other funding sources to develop supply and distribution facilities. o *Objective/Policy*: Identify communities for potential gas supply development. o *Objective/Policy*: Develop business relationships with funding partners and the resource development industry. o *Objective/Policy*: Define roles and responsibilities for operations and maintenance. o *Objective/Policy*: Identify and apply for funding for proposed Project development, implementation, and maintenance.
FNSB	FNSB Regional Comprehensive Plan (2005)	The FNSB Zoning Map and Zoning Code are extensions of the Comprehensive Plan land use categories, and are the administrative tools for implementing land use policies and regulations. Pursuant to the zoning code, the installation and maintenance of utility lines are permitted uses in the zoning districts.
Denali Borough	Denali Borough Comprehensive Plan (2009)	Land in the Denali Borough is zoned unrestricted unless otherwise provided for by ordinance. There are no prohibitions on land zoned unrestricted. [Ord. 96-04 § 2.]
Mat-Su Borough	Mat-Su Borough Wide Comprehensive Plan (2005 update)	The plan states that "[i]n order for the borough to keep pace with new technologies and globalization of the economy, recommendations should be considered for other modes of transportation such as electrical, communications, and pipelines" (p. 8). The plan includes the following policy for orderly development of multi-modal transportation, including pipelines: **Policy T1-4**: Develop an effective multi-modal transportation plan that provides recommendations for modes of transportation including surface, air, waterborne, rail, public transit and trails, pipeline, electrical, and communications. Such a plan should strive to better connect the borough's various communities and neighborhoods.
	Trapper Creek Community Council Comprehensive Plan	Plan is under development.
	Susitna Community Council Comprehensive Plan (2005)	The plan does not provide guidance related to utility corridors.
	Willow Area Community Comprehensive Plan (draft September 2009)	The draft plan does not mention utility corridors.

Author/Agency	Land Use Plan/Document	Relationship with the Proposed Action
	Big Lake Community Council Area Comprehensive Plan Update (August 2009)	Strategy 4 of the plan recommends that utilities be placed underground for future development in the Big Lake Community.
	Point MacKenzie Community Council Comprehensive Plan (Draft December 2010)	The plan contains language relevant to pipeline development through the area, including expressing a need for "expanded utility infrastructure" (p.22) and encouraging "development of efficient energy sources in the community" (p.12). Furthermore, Goal 5 intends to encourage the routing of major "linear" infrastructure projects to locate away from existing or planned commercial or residential areas unless doing so would clearly result in unreasonable land use outcomes or conflicts. Limited available public land for development in the Point MacKenzie community would result in a majority of the development occurring along Point MacKenzie Road. Every effort should be made to retain the open nature and natural beauty of this corridor. **Objective 1:** New "linear" projects should locate along existing easements and ROWs.

4.15.4.1.1.2. Section 6(f) of the Land and Water Conservation Fund

The proposed Project would cross Denali State Park, and the Nancy Lake State Recreation Area (SRA), which are Section 6(f) parklands. Section 6(f) of the Land and Water Conservation Act (LWCA) requires that the conversion of lands or facilities acquired with LWCA funds be coordinated with the U.S. Department of Interior, National Parks Service (NPS). Both Alternative 1 and Alternative 2 would cross Nancy Lake SRA between MP 714.7 and MP 716.7. An approximately 1-mile long access road is also proposed in the Nancy Lake SRA at MP 714. Alternative 2 would cross Denali State Park between MP 606.7 and MP 644.5. Additionally, several small access roads are proposed (all less than 1 mile in length) as well as a material site near MP 610 within the Denali State Park under Alternative 2. Portions of the pipeline within Denali State Park would be sited in the ADOT&PF ROW for the Parks Highway, but the area outside of the ADOT&PF ROW and the Nancy Lake SRA area would trigger a 6(f) conversion, requiring approval from NPS for conversion of the land. A ROW lease would also be required from ADNR Division of Parks and Outdoor Recreation. Approximately 227 acres of Denali State Park land and 17 acres of Nancy Lake SRA land would be converted to non-recreational use for the permanent operations ROW of the proposed Project.

NPS would consider conversion of public outdoor recreation areas to another use if the following conditions are met:

- Practicable alternatives to the conversion have been evaluated and rejected on a sound basis;
- The property proposed for substitution is of at least fair market value as that of the property to be converted; and
- The property proposed for replacement is of reasonably equivalent usefulness and location for recreational purposes as that being converted.

All conditions listed above would be met prior to mitigation measures described in Section 4.15.3. Mitigation Measure Nos. 5, 6, 8, 9, 10, and 11 help to address impacts associated with Section 6(f) lands.

4.15.4.1.1.3. Impact Summary

The impacts to land use planning and conservation as a result of construction of the proposed Project are expected to be minor, for the following reasons:

- Magnitude and Intensity: The direct impacts to the current land use may disrupt the current land use in areas where permanent access roads would be constructed. A 6(f) conversion for some areas within Denali State Park and the Nancy Lake SRA would require approval from NPS for conversion of the land. Additionally, a ROW lease would be required from ADNR Division of Parks and Outdoor Recreation. Indirect impacts to recreation on these lands would be controlled by Mitigation Measure No. 10, and existing land use planning documents, and as such, are expected to be minor.

- Geographic Extent: The proposed Project would intersect lands managed according to numerous federal, state, borough, and local management plans resulting in impacts throughout the study area. A 6(f) conversion for some areas within Denali State Park and the Nancy Lake SRA would require approval from NPS for conversion of the land. The direct impacts would be limited to lands that are subject to a land use plan and are not expected to disrupt the current land use.
- Duration or Frequency: The affects to the current land use from proposed Project construction would be temporary and localized to the portion of the route under construction. Construction is not expected to disrupt the current land use. A small portion of the Denali State Park and Nancy Lake SRA Section 6(f) lands would require permanent conversion from public outdoor recreation to another use to complete Alternative 2. Only Nancy Lake SRA land would require conversion under Alternative 1.
- Likelihood: It is most likely that these affects to land use would occur.

4.15.4.1.2. Existing Transportation, Utilities, Easements, and ROWs

The proposed Project would impact existing transportation, utilities, easements, and ROWs. The expected impacts to these features are described below.

4.15.4.1.2.1. Transportation and Utilities

As described in Chapter 3, Section 3.11.6, Transportation and Utilities Crossed by the Proposed Project, the proposed Project ROW would cross railroads, utilities (including TAPS), trails, driveways, and local and arterial roads. Potential effects during the construction phase would include disruption to traffic flow and utility service. However, design features of the proposed Project would minimize these effects. For major road crossings, AGDC proposes to use HDD methods that would not affect the road surface or impede traffic flow. Arterial roads would be crossed using trenchless methods. For road crossings where the pipeline cannot be installed by HDD, a trench would be excavated. In such cases, a temporary bypass or bridge would be built to minimize the effects to traffic flow.

All railroad crossings would be installed using HDD; therefore, there would not be disruptions to railroad service. TAPS crossings and critical access road crossings would be installed by HDD. Effects from crossing existing foreign pipelines and utility lines would be minimized by boring below the existing pipeline or utility. Ice road construction planned for the first and second winters of the construction schedule would be coordinated with ADOT&PF and ADNR (see Mitigation No. 1 in Section 4.15.3); therefore, it is assumed that impacts to existing and planned uses for North Slope areas and routes would be minimized.

As described in Section 4.15.3, Mitigation Measure Nos. 4 and 5 would specifically address vehicular traffic and transportation access to help minimize potential impacts. Considering the relatively short duration of construction in each location and the

proposed mitigation, effects to transportation and utilities due to construction of the proposed pipeline are expected to be minor and temporary.

4.15.4.1.2.2. RS 2477 Trails, 17(b) Easements, and Section-Line Easements

As described in Chapter 3, Section 3.11.5, the proposed Project would intersect 20 RS 2477 ROW and 11 17(b) easements. In addition, the proposed Project would intersect section-line easements (some section-line easements are also RS 2477 ROW). The proposed Project would not infringe on the existing rights attributable to the RS 2477 ROW, 17(b) easements, and section-line easements that it would cross.

As described in the ROW Lease granted to AGDC by the state for the original alignment, the proposed Project may not obstruct a public access easement or otherwise render it incapable of reasonable use for the purposes for which it was reserved. The proposed Project would, therefore, not interfere with the use of section-line easements, RS 2477, and 17(b) easements. The ROW Lease also specifies that before any particular activity requiring any federal, state, or municipal permits or authorizations occurs under the Lease, all required permits and other authorizations for that particular activity must be obtained by AGDC. AGDC would be required to obtain the necessary permits or authorizations prior to constructing any proposed Project features that would intersect with section-line easements, RS 2477, and 17(b) easements.

Temporary effects may result during construction, when a small portion of each intersected trail and easement may need to be disturbed during the process of burying the proposed pipeline. Temporary alternative access across Native-owned land may need to be negotiated with the Native landowner and the federal agency administering the easement. It may be necessary to acquire alternative legal access prior to blocking 17(b) easements across Native land. AGDC has proposed a mitigation measure (Mitigation Measure No. 6, described in Section 4.15.3) that would retain existing public access routes and uses (Appendix M).

Using criteria described in Table 4.15-1, the level of impact on RS 2477 Trails and 17(b) and section-line easements would be negligible. Construction impacts would be minimal and short-term. When construction activities require the intersection of these ROWs and easements, AGDC would work with the landowners to gain access to the property and mitigate affects to accessibility or usability of these features. Mitigation Measure Nos. 1, 4, 6, and 8, described in Section 4.15.3, are designed to comply with the ROW lease and to prevent deleterious impacts to accessibility.

4.15.4.1.2.3. Impact Summary

The impacts to existing transportation infrastructure, utilities, and easements as a result of construction of the proposed Project are expected to be minor, for the following reasons:

- Magnitude and Intensity: Proposed Project ROW would cross railroads, utilities (including TAPS), trails, driveways, and local and arterial roads, which could result

in disruption to traffic flow and utility service as well as RS 2477 Trails and 17(b) section line trails. Impacts would be temporary and localized.

- Geographic Extent and Duration: Impacts would be limited to the location that the pipeline construction intersects the utility or easement and would occur only for the time required to cross the feature.
- Likelihood: The likelihood of these impacts is most likely and have greater than a 75 percent chance of occurring.

4.15.4.1.3. Forestland

Approximately 19,063 acres of forested land would be affected by the proposed Project. These forested acres were calculated using the NLCD from 2011 (MRLC Consortium, 2016). Chapter 3, Section 3.11.4, Land Cover, describes the forested land that would be cleared for construction and operation of the proposed Project. After proposed Project construction, those forested areas outside of the proposed permanent Project facilities (*i.e.,* permanent and maintenance ROW, new access roads, and aboveground facility footprints) would be allowed to revert to pre-Project conditions. This is discussed in greater detail in Section 4.8, Vegetation. Forestland would not be restored within the permanent proposed Project footprint; therefore, there would be a long-term conversion of forestland use in these areas. The volume of commercial timber within areas that would be cleared for the proposed Project ROW has not been quantified by a timber survey.

The 2006 Alaska Forest Resources and Practices Act (FRPA) (AS 41.17) governs how timber harvesting, reforestation, and timber access occur on state, private, and municipal land. Forest management standards on federal land must also meet or exceed the standards for state land established by the FRPA (ADNR, 2011b). Section 41.17.083 of the FRPA provides guidance regarding the clearing of forestland for non-timber purposes (§10 Ch 34 SLA 1990):

> *A state agency, municipality, or public utility shall determine whether the timber to be removed has significant salvage value before approving or conducting clearing of forestland for purposes other than timber harvest. If the timber has significant salvage value, the agency or utility shall salvage the timber as part of the clearing process.*

The FRPA provisions for timber salvage within lands that would be cleared for the pipeline ROW would promote proper use of timber resources affected by the proposed Project. AGDC would conduct a desktop analysis, supplemented with surveys, of merchantable timber in the proposed Project Area. AGDC would determine the appropriate evaluation methods in coordination with regulatory agencies during the design and construction phase of the proposed Project.

Clearing of various forest types would be necessary for the proposed Project, and all ROWs would require continuous mowing as part of proposed Project operations and

maintenance. Moderate impacts to forestland would occur and continue within the pipeline ROW. All locations cleared for temporary access during planning and construction aspects of the proposed Project would be allowed to re-vegetate following the conclusion of construction activities. Successful completion of the proposed Project cannot be accomplished without some impact to forestlands. Mitigation Measure No. 1, however, is in place to prevent unnecessary clearing and potential, resulting cumulative impacts from the activities.

Forestland would not be restored within the permanent proposed Project footprint; therefore, there would be a long-term conversion of forestland use in these areas. This effect would be limited to the portion of the study area that intersects forested lands. For these reasons, the effect to forested lands is considered major and would impact the length of the study area.

The cleared forestland portions of the pipeline ROW may attract additional off-road vehicle users (*e.g.*, snow machines and ATVs) along the ROW. Because the proposed Project ROW generally follows existing or officially designated transportation and utility corridors including the Dalton Highway/TAPS corridor and Parks Highway, an increase in user access would not be expected in these areas. However, increased access in areas that do not follow existing transportation or utility corridors, particularly between the TAPS corridor and Parks Highway in the Minto Flats vicinity, could see increased use. Preventative access measures such as boulders, berms, or fencing near entry points would be put in place at the request of landowners to help limit access to the proposed Project ROW. These preventative measures would then help lessen the impact of increased use along the ROW, although they would not likely eliminate the impact.

4.15.4.1.4. Agriculture

Effects to agricultural land would be minimal, with only 24.1 total acres of the construction area affected by the proposed Project ROW consisting of agricultural land, as described in Chapter 3, Section 3.11.4.2, Agricultural Land and Prime and Important Farmlands. As allowable land uses generally permitted within the permanent ROW would include agriculture, including the use of farming equipment and the cultivation of row crops, and pastureland, impacts to these agricultural lands would generally be limited to the duration of proposed Project construction.

The State of Alaska does not contain prime farmland, prime forestland, or prime rangeland.

Impacts to agriculture would temporarily impact a geographic area of only approximately 24 acres. Construction within agricultural lands may prevent crops from being produced within the proposed Project ROW during the growing season that the construction takes place. To mitigate impacts to agricultural soils, the surface layer would be segregated in agricultural areas as described in Mitigation Measure No. 13.

Overall, the impacts to agricultural lands as a result of construction are expected to be localized and negligible.

4.15.4.1.5. Developed Areas

The proposed Project would affect several previously developed areas. Analysis has not been conducted to determine the location and number of structures, residential or otherwise, within close proximity to the ROW and aboveground facilities. However, the density of development in the proximity of the ROW is inferred by the visual class locations assigned to the various sections of the proposed pipeline (see Section 5.19, Reliability and Safety, of the 2012 FEIS).

The proposed Project has the potential to affect developed land by exposing residences or commercial/industrial buildings located near the proposed Project ROW and aboveground facilities to dust and noise primarily during proposed Project construction. Section 4.22, Air Quality, Climate Change, and Greenhouse Gas Emissions, and Section 4.23, Noise, discuss the effects related to dust and noise, respectively. Furthermore, in some areas the proposed Project would result in the removal of trees within the proposed ROW that currently provide a visual buffer between private properties and the Parks Highway. Visual effects are further discussed in Section 4.17, Visual.

Impacts to developed areas primarily include exposure to dust and noise and removal of visual buffers. Restrictions on private land use by property owners may also result as certain operations are restricted within proximity of pipeline ROW and support features. These impacts would be localized to developed areas and would be temporary in nature resulting in moderate to major impact at a local level but an overall minor affect at a regional level.

4.15.4.1.6. Waste Generation

Suitable disposal facilities would be used to dispose of waste, depending on location and source of generation. Non-hazardous waste disposal sites, including landfills or monofills, would be utilized for the proposed Project in accordance with ADEC solid waste regulation 18 AAC 60. Several existing permitted sites have been identified for proposed Project use:

- NSB Service Area 10 (Oxbow) Landfill, Deadhorse
- FNSB Landfill, Fairbanks
- Denali Borough Landfill, Anderson
- Galbraith Lake Monofill, MP 143
- Five Mile Monofill, MP 353
- Cantwell Monofill, MP 564
- Mat-Su Borough Central Landfill, Palmer
- Kenai Peninsula Borough Central Landfill, Seward

Existing disposal sites would be utilized for all proposed Project waste and additional land would not be required. Land use impacts due to waste generation during pipeline construction are expected to be negligible because no new waste facilities would be constructed by AGDC. However, the proposed Project could stress the capacity of existing solid waste infrastructure during the construction phase resulting in a potential impact on those facilities, as the proposed Project would generate tens of thousands of tons of solid and liquid wastes from construction camp setup and operations, pipeline and associated infrastructure construction, and fixed facility construction and operations. In particular, if camps tie into existing systems, they would increase the quantity of solid waste in the systems and compete with the existing municipal uses. Camps are planned as 'gathering points' for waste generation along the length of the proposed Project. Construction and operation waste would be collected, containerized, and securely stored in one of the 13 planned construction camps or work locations.

All construction and operations wastes would be collected, containerized, and stored securely at one of the 12 temporary pipeline construction camps or at the Project work location (as necessary). The camps are planned as the gathering points for wastes generated by the camps themselves and the associated construction sites to ensure secure storage and consolidation of wastes in order to reduce environmental and traffic impacts.

No solid wastes nor any new landfills or disposal cells would remain at the Project camps and facilities upon completion of the Project. In general, all burnable, non-hazardous refuse from camp, facility, and construction activities would be incinerated onsite using a mobile, semi-continuous, skid mounted incinerator system. It is anticipated that at least one incinerator system would be installed at each operating construction camp.

Waste construction steel such as pipe end cuts, defective pipe, and other scrap steel from pipeline and camp construction and operation would be collected, transported, and sold as recycled scrap to a scrap steel buyer in Anchorage, Alaska. It is assumed that waste steel from all ASAP construction and operations located between the camps at Franklin Bluffs and Cantwell would be transported by truck to the Fairbanks Logistical Support Facility for central collection. The waste steel collected in the Fairbanks area would be transported by rail to the recycler in Anchorage once an adequate volume of waste steel is gathered for transport. Waste steel generated from the camps at Swan Lake and Rustic Wilderness and from the Seward Logistics Support Facility would be trucked directly to the steel recycler in Anchorage.

The level of impact to waste management facilities resulting from proposed Project activities at this time is unknown; however, all solid and liquid wastes would be managed, treated, and disposed according to applicable federal, state, and local regulations by one or more waste management contractors. All solid and liquid wastes would be managed using accepted federal, state, and local BMPs. The proposed Project

intends to coordinate closely with the ADEC to permit any needed disposals or discharges on the ROW or at off-ROW facilities.

4.15.4.1.7. Land Ownership and Zoning

Land ownership could change once construction or operation of the pipeline begins if certain landowners did not want to be in close proximity to the construction activities or operation of the pipeline. While the likelihood of this occurring cannot be certain, it is expected to be low. Approximately 500 acres of land are currently held under private ownership. Also considering much of the land impacted by the proposed Project is state or federal land, an assumption could be made that state and federal agencies have and would be involved in reviewing proposed Project plans and permitting specific activities, and would therefore, not modify their land ownership as a result of the proposed Project. Mitigation Measure Nos. 3, 5 and 6 would help to minimize potential impacts to land ownership by ensuring coordination with landowners prior to any activities. ROW use would be negotiated with each landowner prior to construction of the pipeline and it is unknown that this would not prompt any changes. For these reasons, the potential effects on land ownership would likely be negligible.

The proposed Project route crosses through five Alaska boroughs or census designated area: NSB, YKCA, FNSB, Denali Borough, and the Mat-Su Borough. Land use and zoning regulations and requirements vary for each. All permits and approvals would be completed prior to construction of the pipeline, and there has not been any indication that pipeline construction would be expected to have effects on local zoning.

4.15.4.2. Operations and Maintenance

4.15.4.2.1. Land Use Planning and Conservation

During the operations phase of the proposed Project, effects would continue for land use planning, as the construction of permanent access roads would disrupt other land use in these areas. The proposed Project would be operated consistent with existing federal, state, borough, and local land use and management plans, as described in Table 4.15-4, with the exception of Section 6(f) lands. If a Section 6(f) conversion is approved by NPS for the proposed Project to cross the Denali State Park, and the Nancy Lake SRA (which would need to occur before construction began), there would be no additional impacts to Section 6(f) lands during operations of the proposed Project.

The construction of permanent access roads within Section 6(f) lands would permanently change the land use in these areas. These impacts would occur in a few isolated locations and are likely to occur. For these reasons, the impacts to land are planning and conservation, and are expected to be moderate.

4.15.4.2.2. Existing Transportation, Utilities, Easements, and ROWs

The proposed Project may result in effects to transportation and utility ROWs during operations phases. Temporary closures of roads, trails, or utilities may be necessary

depending on the size and duration of the operations or maintenance activities. Similar to the construction phase, potential effects include disruption of traffic flow and utility service. As described in Section 4.15.3, Mitigation Measure Nos. 4 and 5 would specifically address vehicular traffic and transportation access to help minimize potential impacts.

The current ROW lease granted to AGDC for the 2012 alignment of the proposed Project prohibits the obstruction of public access easements as well as the rendering of them incapable for the intended use, it is expected that a new ROW lease would contain the same prohibitions. Temporary closures of the immediate work areas may be necessary depending on the size and duration of the maintenance activities (*e.g.*, if part of the pipeline needs requires excavation and/or replacement). Maintenance impacts would be intermittent and infrequent. As the proposed Project pipeline would be buried, daily operations would not impact accessibility/use by users. Proposed Project operations would not be expected to affect the use and access through the RS 2477, ROW, 17(b), and section-line easements. Overall, maintenance and operational impacts are expected to be minor at the state level.

4.15.4.2.3. Land Cover

Operations and maintenance activities are not expected to result in additional impacts to forested land. Forestland beyond those described in Section 4.15.4.2 would not be restored within the permanent and maintained ROW of the proposed Project footprint, resulting in a long-term conversion of forestland use in these areas. This effect would be limited to the portion of the study area that intersects forested lands. For these reasons, the effect to forested lands is considered major.

Additional impacts during operations and maintenance activities are not expected to occur on agricultural lands. Construction within agricultural lands may prevent crops from being produced within the proposed Project ROW during the growing season the construction takes place. To mitigate impacts to agricultural soils, the surface layer would be segregated in agricultural areas as described in Mitigation Measure No. 13. Overall, the impacts to agricultural lands as a result of construction are expected to be minor.

To facilitate pipeline integrity management and safety inspection activities, some lands in developed areas would be designated for long-term utility use resulting in development restraints. It is likely that limits would be placed on construction of permanent structures such as dwellings within the permanent ROW (*i.e.,* 53 feet on federal lands ROW and 30 feet on state/private lands ROW) for the life of the pipeline. For these reasons, the impact to developed areas during operations and maintenance of the pipeline are considered moderate.

4.15.4.2.3.1. Waste Generation

The proposed Project could exert stress on existing solid waste infrastructure during the operations phase, but significantly less so than during the construction phase. Waste generation impacts would result mainly from operation of the camps. Although these effects would occur over the life of the pipeline, the magnitude of the impact is expected to be negligible, resulting in an overall minor effect.

4.15.4.2.4. Land Ownership and Zoning

Operation and maintenance of the proposed Project is not expected to impact land ownership or zoning. Presence of the pipeline is not expected to impact property values of the lands that are traversed or of adjacent properties. Affects to property values related to the presence of a natural gas pipeline are described in Section 4.18, Socioeconomics. Overall, impacts to land ownership and zoning during operations and maintenance are expected to be negligible.

4.15.5. Alternative 2 – Denali NPP Route Variation

Alternative 2 of the proposed Project is described in Chapter 2 in detail. The Denali NPP Route Variation would begin at MP 535.8 and enters the Denali NPP boundary approximately 0.2 miles after crossing the Nenana River on the pedestrian bridge to the west of the Parks Highway (also contained within Denali NPP). Just south of the pedestrian bridge, the Denali NPP Route Variation would cross the Parks Highway again (from west to east) and remains on the east side of the road. The route would parallel the highway until the second at-grade railroad crossing south of the Denali NPP entrance, at which point the route would diverge from it. At this point, the route would shift to the southeast, away from the Parks Highway, crossing the Nenana River downstream (east) of McKinley Village. The Denali NPP Route Variation would rejoin the proposed route at MP 543. The lengths of both routes are similar, only differing by about 0.3 miles.

Alternative 2 would intersect land use areas and land cover types in a wide variety of ecoregions in Alaska, described in Chapter 3. Construction and operations activities of Alternative 2 and impacts by land cover type are summarized in Table 4.15-2.

The following sections discuss activities that are proposed to occur during the construction, operations, and maintenance phases of the proposed Project with associated potential impacts. Effects to land use along the proposed Project during construction are the same as those discussed above in Alternative 1, except for the following aspects unique to Alternative 2:

- DH2 at West Dock;
- Ocean disposal of dredge material; and
- Aboveground pipeline mode (MP 0 – MP 62) and belowground (buried) pipeline mode MP 62 – MP 733.5 as well as the Fairbanks Lateral;

- Aerial crossing at Yukon River.
- An approximately 7-mile portion of the route traverses Denali NPP;

These differences are discussed in detail in the following sections.

4.15.5.1. Construction

4.15.5.1.1. Land Use Planning and Conservation

In addition to the existing land use plans listed in Table 4.15-4, the Denali NPP Route Variation would also intersect lands managed according to the Denali NPP Consolidated General Management Plan. As of December 2016, Congress was still considering the enactment of the Energy Policy Modernization Act of 2016. If passed, this Act would allow that a proposed gas transmission pipeline may be located in a non-wilderness area within the boundary of Denali NPP and shall not be subject to Title XI of the Alaska National Interest Lands Conservation Act (ANILCA). The Tanana Basin Area Plan and Denali Borough Comprehensive Plan also apply to the Denali NPP Route Variation (Table 4.15-5). The addition of these two land use plans is not expected to result in any significant changes to the impact analysis provided in Alternative 1. Table 4.15-5 describes the consistency of the proposed Project with existing land use.

Table 4.15-5 Land Use Plans Applicable to Denali NPP Route Variation

Author/Agency	Land Use Plan/Document	Relationship with the Proposed Action
NPS	Denali NPP Consolidated General Management Plan (2008)	The proposed Project would be inconsistent with the purposes for which the Denali NPP is to be managed, as established by Sections 101 and 202 of ANILCA. Transportation systems that are proposed to cross a CSU created or expanded by ANILCA require an act of Congress if such transportation system would cross any Congressionally designated wilderness area, or if there is no existing authority for granting a ROW for the particular type of transportation system proposed, such as a natural gas pipeline across NPS units in Alaska. The Denali NPP Natural Gas Pipeline Act has been approved, allowing ROW access of the pipeline through the park.
ADNR	Tanana Basin Area Plan (1986)	The Area Wide Land Management Policies listed in the plan include management guidelines relevant to pipeline development: **Trail Management** **G. Trail Crossings.** When it is necessary for powerlines, pipelines, or roads to cross trail corridors, crossings should be at 90-degree angles when feasible, except when a trail corridor is deliberately combined with a public utility or transportation corridor. Where feasible, vegetative screening should be preserved when a utility crosses or co-locates within a trail corridor. In addition, the transportation goals specified in Chapter 2 apply to forms of utility or resource transportation corridors. The following transportation corridors were identified in the plan: • Alaska Natural Gas Pipeline

Author/Agency	Land Use Plan/Document	Relationship with the Proposed Action
		• Alaska Railroad Extension • PWS - Upper Tanana Railroad Corridor • Western Access Railroad Corridor • Twin Mountain Access Route • Parks Highway - Kantishna – McGrath Highway Corridor • Upper Wood River (Bonnifield Mining District) Access • Nenana - Totchaket Area Access • TAPS Oil Spill Contingency Plan Access Routes • Existing transportation routes identified by the plan include the RS 2477 trails and existing highways maintained and operated by ADOT&PF. • Utility corridors are prohibited within the following units: • Management Unit 2H: Minto • Management Unit 3B: South Shore Lake Minchumina • Management Unit 3E: Middle Cosna-Zitziana Watersheds
Denali Borough	Denali Borough Comprehensive Plan (2009)	Land in the Denali Borough is zoned unrestricted unless otherwise provided for by ordinance. There are no prohibitions on land zoned unrestricted [Ord. 96-04 § 2].

Construction Work at DH2 Instead of DH3, the change in locations of ocean disposal of dredge material, construction of an aerial bridge at the Yukon River crossing, and an aboveground portion of the pipeline are not expected to result in impacts to land use planning.

4.15.5.1.2. Existing Transportation, Utilities, Easements, and ROWs

4.15.5.1.2.1. Transportation/Utilities

The 7-mile segment of Denali NPP Route Variation would intersect the ARRC ROW twice and would cross the Parks Highway twice. This segment would not cross trails/driveways, utilities, or TAPS. All railroad and road crossings would be installed by HDD; therefore, no disruption to railroad service or traffic would occur.

The aerial crossing via suspension bridge at the Yukon River instead of utilizing HDD methods as proposed in Alternative 1 would not result in impacts to existing transportation or utility corridors, as no crossings occur at this site. Impacts to navigational activities on the Yukon River may result during construction of the bridge. These impacts are described in Section 4.24, Navigation Resources, of this SEIS and are considered negligible.

As described in Section 4.24, additional vessel traffic at Prudhoe Bay would result with Alternative 2 because more work would be required to conduct modifications at DH2. Although the magnitude of the impact would be slightly larger, impacts to navigability would still be negligible given that any transit through Prudhoe Bay would use existing shipping lanes. No utility corridors would be impacted by the proposed work at DH2 or the ocean disposal of dredge material.

Aboveground construction of the first 62 miles of the Mainline is not expected to result in impacts to transportation, utilities, easements, and ROWs.

As no impacts are expected to occur to transportation or utility corridors as a result of the alternate proposed Project features considered under Alternative 2, the impacts are expected to be minor, as described in Alternative 1.

4.15.5.1.2.2. RS 2477 ROW, 17(b) Easements, and Section-Line Easements

The Denali NPP Route Variation would not intersect RS 2477, ROW, or 17(b) easements. Some section-line easements would be intersected by the Denali NPP Route Variation. Consistent with Alternative 1, the Denali N PP Route Variation would not interfere with the use of section-line easements, RS 2477, ROW, and 17(b) easements. Impacts to RS 2477 Trails and 17(b) and section-line easements under Alternative 2 are expected to be negligible for the reasons described in Section 4.15.4.1 for Alternative 1.

The aerial crossing via suspension bridge at the Yukon River instead of utilizing HDD methods as proposed in Alternative 1 would not result in impacts to RS 2477 ROWs, 17(b) easements, or section-line easements, as no crossings occur at this site.

Work at DH2 instead of DH3, the change in locations of ocean disposal of dredge material, and aboveground construction of the first 62 miles of the pipeline would not result in impacts to RS 2477 ROWs, 17(b) easements, or section-line easements.

The proposed Project features described under Alternative 2 are not expected to significantly impact existing transportation, utilities, easements, and ROWs. The degree of impact expected under Alternative 2 is expected to be minor for the same reasons described under Alternative 1.

4.15.5.1.3. Land Cover

4.15.5.1.3.1. Forestland

Approximately 91 acres of forestland would be cleared within the proposed Project ROW for the 7-mile segment of the Denali NPP Route Variation, as compared to 211 acres of forestland that would be cleared for the 7-mile route portion to the east of the Denali NPP as proposed in Alternative 1. The Denali NPP Route Variation is cited primarily within the ADOT&PF ROW, in previously developed/disturbed areas, resulting in fewer impacts to forests. The volume of commercial timber within areas that would be cleared for the proposed Project ROW has not been quantified by a timber survey.

The Denali NPP Route Variation would result in forestland being cleared from lands managed according to the Denali NPP Consolidated General Management Plan and the Tanana Basin Area Plan. It should be noted that forestland that would be cleared in the area managed by the Denali NPP Consolidated General Management Plan is located within the ADOT&PF ROW. For the proposed Project, the FRPA provisions for timber

salvage within lands that would be cleared for the Denali NPP Route Variation ROW would promote proper utilization of timber resources affected by the proposed Project.

The aerial crossing via suspension bridge at the Yukon River instead of utilizing HDD methods as proposed in Alternative 1 would not result in additional impacts to forestland, as both alternatives would be contained within the proposed ROWs and the same acreage of forestland would be cleared in either alternative.

The suspension of the proposed pipeline on VSMs for the first 62 miles would not impact forestland differently than the proposed buried alternative, because forestland does not exist for the forest 62 miles of the proposed pipeline route.

Work at DH2 instead of DH3 as proposed in Alternative 1, and the change in locations of ocean disposal of dredge material would not result in impacts to forestland, as it is entirely offshore.

The proposed Action under Alternative 2 would reduce the total acreage of forested land impacts by 120 acres, approximately 0.5 percent of the total acres affected. Under Alternative 2, the impacts to forested land would be largely the same as described in Section 4.15.4.1 for Alternative 1 and would be major.

4.15.5.1.3.2. Agricultural Lands

The Denali NPP Route Variation, the aerial crossing of the Yukon River, use of DH2, and aboveground construction of a portion of the pipeline would neither affect agricultural lands, nor farmlands of local importance.

Under Alternative 2, the impacts to agricultural land would be the same as described in Section 4.15.4.1 for Alternative 1 and would be minor.

4.15.5.1.3.3. Developed Areas

As described above, the Denali NPP Route Variation would affect developed areas. The same types of effects would occur as for the proposed Project.

The aerial crossing via suspension bridge over the Yukon River and the suspension of the pipeline on VSMs for the first 62 miles of the pipeline would increase the visual impacts of the proposed Project on developed areas.

Work at DH2 instead of DH3 as proposed in Alternative 1, and the change in locations of ocean disposal of dredge material would not result in additional impacts to developed areas, as it is entirely offshore.

Under Alternative 2, the impacts to developed land would be the same as described in Section 4.15.4.1 and would be minor.

4.15.5.1.4. Land Ownership

The Denali NPP Route Variation would intersect the boundary of the Denali NPP. Recent federal legislation has approved access for ROWs of natural gas pipelines

through Denali NPP, with the Denali National Park Improvement Act. The Improvement Act states that the Secretary of Interior may issue ROW leases for a high-pressure natural gas transmission pipeline in non-wilderness areas within the boundary of Denali NPP within, along, or near the approximately 7-mile segment of the Parks Highway that runs through the park. A ROW lease would only be issued if the lease is consistent with the laws generally applicable to utility ROWs within units of the National Park System. A ROW lease is in accordance with Section 1106(a) of ANILCA if an appropriate NEPA analysis is conducted and determines that the ROW route through the park has the least adverse environmental effects on the park.

The aerial crossing via suspension bridge at the Yukon River and work proposed at West Dock are far outside of Denali NPP and would not be impacted by this segment of construction work.

Under Alternative 2, the impacts to land ownership and zoning are expected to remain negligible, as described in Section 4.15.4.1.

4.15.5.2. Operations and Maintenance

Effects to land use along the proposed Project during operations are the same as those discussed above in Alternative 1, except where the Alternative 2 ROW differs from the Alternative 1 ROW: the Denali NPP Route Variation, the Yukon River aerial crossing via suspension bridge, and DH2 instead of DH3.

Similar to the Mainline pipeline, operation of the pipeline within the Denali N PP Route variation would not result in adverse effects on land use, as it would be located primarily underground and would not restrict access or compromise the land use in the surrounding area. DH2, instead of DH3, would only be used for the proposed ASAP Project during construction phases, so no operational phase impacts would occur.

4.15.6. Alternative 3 – No Action

Under Alternative 3 (No Action), the proposed Project would not be developed and there would be, therefore, no impacts to land use for construction or operational phases.

4.15.7. Conclusions and Comparisons of Alternatives

Alternatives 1 and 2 would result in similar impacts to land use resources during both construction and operations phases of the proposed Project. Construction and operations activities would be the same for both Alternatives 1 and 2 (*e.g.,* vegetation clearing, dust deposition, soil compaction, potential noxious plant species introduction, etc.). Mitigation measures listed in Section 4.15.3 are likely to help minimize impacts on land use. A summary of the primary differences Alternative 1 and 2 effects to land use is as follows:

- Alternative 2 would result in impacts within Denali NPP, resulting in consideration of two additional land use plans, and a slightly lesser (0.5 percent) impact to forested lands.

- Under Alternative 2, transportation along the Yukon River may be affected during construction of the Yukon River bridge.
- Use of DH2 and ocean disposal of dredged material would result in a slightly greater need for shipping transportation in Prudhoe Bay as additional construction materials would be required.
- Aboveground construction of the first 62 miles of the proposed pipeline route is not expected to have an impact on land use.

Figure 4.15-1 illustrates some of the key findings from the impact analysis. This figure intends to provide context for the description of potential impacts of the alternatives, as described in detail in this section. By illustrating the potential impacts of the proposed Project on a map using a consistent color scheme consistent with the impact summary table (Table 4.15-6), we could begin to draw a few conclusions. Examples are provided below:

- The proposed ROW is separated into three sections based on MPs on Figure 4.15-1, MP 0 to MP 250, MP 250 to MP 500, and MP 500 to MP 733 (End). The figure depicts how potential impact ratings vary across the three stretches of the proposed Project ROW and are color coded to identify each stretch.
- As depicted on Figure 4.15-1, potential land use impacts increase as the proposed Project approaches the more populated areas of the state. As the proposed Project approaches established communities, potential impacts could arise because of conflict with existing land use plans, degradation and stress to existing utilities and resources, and potential limitations to future land use as a result of the proposed Project.
- The impact to forestland would be major for both construction and operation activities. Forestlands were identified using the NLCD, and are depicted on either side of the proposed Project ROW where potential impacts could occur. Forestlands were not identified north of MP 200, and the associated impact ratings for that stretch of the alignment are considered negligible. Agricultural areas are depicted on the figure and are located at the terminus of the proposed ROW, and are identified in pink. Very few acres of agricultural land are impacted by the proposed Project, and are considered negligible.
- Land use planning documents not depicted on the effect rating scale here as a positive effect; however, were considered as a mitigating factor in evaluating land use planning and conservation. These plans provide details for management of resources for wilderness areas, refuges, NPPs, local communities, boroughs, and municipalities. As such, where land use planning documents exist, and would result in mitigating otherwise negative impacts, the negative effect ratings on the figure have been downgraded.

Under Alternative 3 (No Action), the proposed Project would not be developed and there would be, therefore, no impacts to land use during construction or operations and maintenance phases.

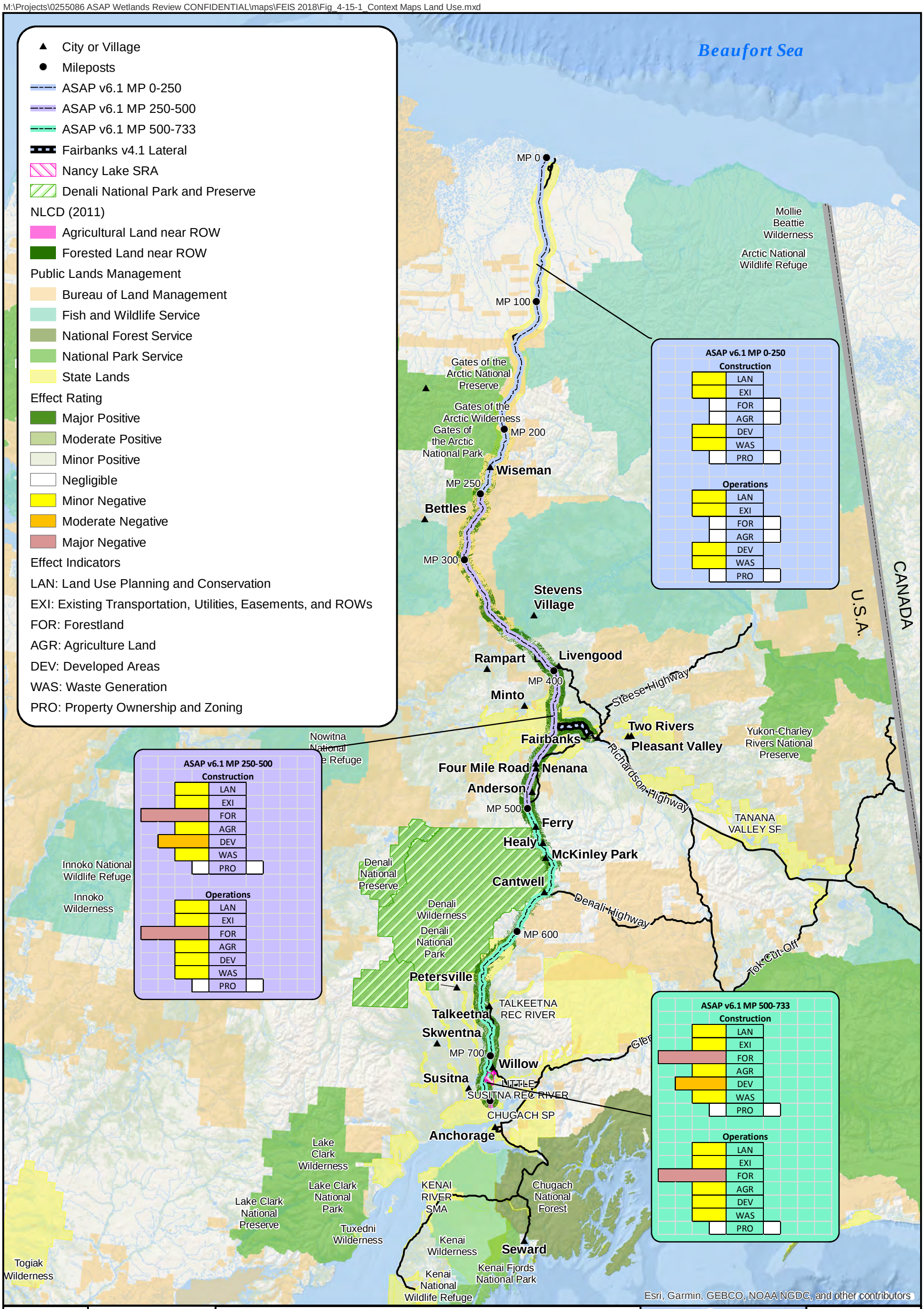
Table 4.15-6 shows the potential effects that proposed Project activities would have on the land use in the proposed Project Area.

Table 4.15-6 Comparison of Alternatives Summary for Impacts to Land Use

Biological Resource Effect	Potential Impact Description	Alternative 1		Alternative 2		Alternative 3
		Construction	Operations	Construction	Operations	Construction/ Operation
		Impact Rating		Impact Rating		Impact Rating
Effects to Land Use Planning and Conservation	• Compatibility with existing land use plans • Section 6(f) of the Land and Water Conservation Fund	*Minor*	*Minor*	*Minor*	*Minor*	*Negligible*
Effects to Existing Transportation and Utilities; Easements/ROW Rights	• Acres included in permanent ROW would not be available for other uses during the construction phase of the proposed Project • Degradation of existing transportation infrastructure • Stress on existing utilities infrastructure.	*Minor*	*Minor*	*Minor*	*Minor*	*Negligible*
Effects to Forestlands; Agriculture; Important Farmlands; Developed Areas	• Loss of Farmland acreage of local importance • Clearing of forested areas • Limits to future development within the proposed Project ROW in developed areas	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*Negligible*
Waste Generation	Stress on existing solid waste infrastructure in terms of capacity and competition with existing municipality use	*Minor*	*Minor*	*Minor*	*Minor*	*Negligible*
Land Ownership and Zoning	• Changes in land ownership as a result of proximity to pipeline • Impacts to property values • Compatibility with zoning requirements	*Minor*	*Minor*	*Minor*	*Minor*	*Negligible*

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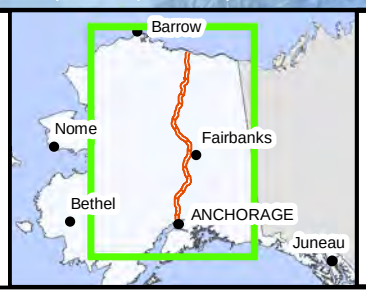


DATE: MAR 2018
CHKD: K.A.
DRWN: A.V.K.
PROJ. No.: 0416166

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Figure 4.15-1: LAND USE IMPACTS CONTEXT MAP
ALASKA STAND ALONE PIPELINE

0 30 60 120 180 Miles



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4.16. Recreation

4.16.1. Introduction

This section describes the potential direct and indirect effects of the alternatives described in Chapter 2 on recreational sites in the area. The section outlines the proposed Project Area, defines frequently used terms, identifies incomplete or unavailable information and how the lack thereof influenced the analysis, describes the methods for determining the level of impact to recreation sites, and presents the results of the assessment. Also described are some of the mitigation measures that would aid in avoiding or minimizing the potential impacts. Additional information on proposed mitigation and monitoring is provided in Section 4.16.3, Applicant-Proposed Design Features, Mitigation Measures, Best Management Practices, and Project Management Plans, and in Appendix M. The information used in this section builds on the 2012 FEIS (USACE, 2012a) and incorporates new data and information relevant to environmental concerns associated with the alternatives that have become available since the original 2012 FEIS document. While this assessment tiers from the 2012 FEIS, important proposed changes in route and design described for Alternative 1 are emphasized. In some instances, information from the 2012 FEIS is replicated with relatively minor changes and updates, while other material is entirely new or substantially altered. For this SEIS, the following elements have been added to the assessment of impacts to recreation.

This section addresses the impacts on recreation attributed to the construction and operation of the proposed Project (Alternative 1) and alternatives, including a No Action alternative (Alternative 3). Potential impacts are related primarily to effects on recreational access and quality of the recreational experience, and would vary in duration and magnitude. From a duration perspective, impacts are characterized as temporary or short term (primarily due to construction activities) and permanent or long-term (associated with proposed Project operations).

4.16.2. Methods

The evaluation of impacts on recreation from the proposed Project are based on the available resources, review of available proposed Project descriptions and reports, public comments received after the publication of the 2012 FEIS and during the public scoping period for the SEIS held in 2014, and review of public comments received on the Draft SEIS during the July/August 2017 public comment period. Information on recreation was obtained from a combination of sources, including the 2012 FEIS and the 2016 EED, all of which are provided in Chapter 7, Literature Cited, of this SEIS. Effects on visual resources are discussed in Section 4.17.

Potential impacts for this SEIS were analyzed by assessing the magnitude, extent, duration and likelihood of occurrence as presented in Table 4.16-1, Impact Criteria for Recreation. As described in Table 4.16-2, effects that were assessed include changes to recreation quality, and changes to recreation access.

4.16.2.1. Description of Effects

4.16.2.1.1. Changes in Recreation Quality or Access

Impacts on recreation from proposed construction and operation activities could occur as a result of increased vehicular or vessel traffic, airborne or underwater noise, dust, trash, hazardous materials or oil spills, or introduction of non-native species (vegetation or wildlife) that could alter the native landscape or ecosystem. Restrictions on access could also reduce recreation opportunities within the proposed Project Area.

4.16.2.2. Impact Criteria

Table 4.16-1 summarizes the criteria used to determine the level of impact based on the magnitude, extent, duration and likelihood of occurrence. Table 4.16-2 defines the types of effects the proposed Project and activities may have on recreation assessed in this SEIS. Mitigation measures are described in Appendix M of this SEIS. Potential impacts that remain after mitigation measures have been implemented are described for each alternative in the following sections.

Table 4.16-1 Impact Criteria for Recreation Resources

Impact Component	Impact Level			
	Major	Moderate	Minor	Negligible
Magnitude or Intensity	The effect would alter a recreation resource in terms of its value, quantity, quality, and uses such that it would no longer be used, or conversely would increase the intrinsic value such that it is recognized on a statewide national scale.	The effect would indisputably alter a recreation resource in terms of its value, quantity, quality, and uses, but could continue to be used.	The effect would visibly or measurably alter a recreation resource, but not in a manner that affects use.	There are no or minimal perceivable effects.
Geographic Extent	The effect would be recognized on a statewide or national basis.	The effect would be recognized at a borough or community level, or on a limited portion of the study area.	The effect would be site specific or occur within a few isolated locations.	The effect would be limited to a specific, contained location.
Duration or Frequency	The effect would occur consistently for greater than a 10-year duration or become permanent.	The effect would occur intermittently or for 1 to 10 years' duration. Periodic, temporary, or short-term changes could be reversed during the operation phase.	The effect would occur intermittently or less than 1-year duration. Periodic, temporary, or short-term changes are reversed.	The effect, if perceived, would be limited to less than 1-month duration.

Impact Component	Impact Level			
	Major	Moderate	Minor	Negligible
Likelihood	Most likely (Effects are those that have greater than 75% chance of arising from reasonable or demonstrated mechanisms due to the action)	Likely (Effects are those that have greater than 50% to 75% chance of arising from reasonable or demonstrated mechanisms due to the action)	Somewhat likely (Effects are those that have a 10% to 50% chance of arising from reasonable or demonstrated mechanisms due to the action)	Unlikely (Effects are those that have less than 10% chance of arising from reasonable or demonstrated mechanisms due to the action)

Table 4.16-2 Types of Effects and Impact on Recreation

Type of Effect	Proposed Action Causing Potential Impact	
	Construction	Operations and Maintenance
Changes to Recreational Quality • Possible impact on recreational experience of cruise vessel passengers • Traffic congestion may diminish the recreational experience • Noise generation, change in soundscape, and visual impacts detracts that detract from wilderness experience and character • Changes in water quality that result in diminished recreational use of waterbodies including fishing, boating, and hunting	• Use of marine vessels to transport pipe, equipment and supplies • Use of public roads to transport pipe, heavy equipment, and personnel • Construction activity near isolated recreation areas, such as designated wilderness areas • Construction activities along highways and roads • Construction activities near water bodies and stream crossings	• Visual site of portion of above ground pipeline changing recreational experience, including occasional noise, lights, and movement associated with maintenance activities
Changes to Recreational Access • Traffic congestion may disrupt access along roads as well as alternative mode access, such as bicycle access to the park; short-term impact • Restricted access to water bodies used by recreational users • Competition for recreational facilities between the temporary construction work force and traditional recreation users (*e.g.*, campgrounds, day use areas, and access to fishing and hunting areas); short-term impact • Temporary restrictions and delays accessing nearby recreation sites	• Use of public roads to transport pipe, heavy equipment, and personnel • Construction activities near water bodies and stream crossings • Construction activities near recreational waysides, facilities, campgrounds, and other known sites of recreation interest and use • Influx of construction workers • Construction of above ground facilities, construction camps, pipeline yards, and material sites	• ROW use during operations phase • Long-term operations and maintenance assimilated into industrial character of the region

4.16.3. Proposed Design Features, Mitigation Measures, Best Management Practices, and Project Management Plans

4.16.3.1. Applicant-Proposed Design Features, Mitigation Measures, Best Management Practices, and Project Management Plans

The following design features, mitigation measures and BMPs are proposed by AGDC, and have been taken into consideration when evaluating potential impacts on recreation resources under Alternatives 1 and 2 during the construction and operations phases. A complete list of mitigation measures and BMPs is also provided in Appendix M.

Many of the proposed measures associated with recreational resources are similar to (or the same as) those related to fisheries and wildlife (*i.e.*, fish and game species), socioeconomics, visual resources, and land use. The SPCS lease stipulations are applicable to locations where the proposed Project Area crosses state-owned land. AGDC would use these stipulations as the basis for operations processes and procedures, which would be used throughout the proposed Project Area.

Proposed mitigation measures associated with recreational resources would include:

1. Implement mitigation measures to minimize construction impacts on recreation and tourism. These measures include:
    - Retain existing public access routes and uses.
    - Where requested by the landowner, restrict public access to ROW for recreation or hunting by blocking entry areas with large boulders, berms, or fencing.
    - Avoid or minimize activities in areas with tourist-related facilities during high-use periods to the extent practical.
    - Avoid or minimize activities in areas with public recreation facilities during high-use periods to the extent practical.
    - Minimize creating new public vehicular access to remote areas.
    - Minimize impacts to the existing natural landscape to the extent practicable.
    - Schedule preconstruction work to minimize activity during peak periods of tourism and recreation (*e.g.*, wildlife viewing, hunting, fishing, snow machining, and dogsledding); specifically, schedule pipeline construction within the Denali NPP Route Variation during the winter when there is little commercial and recreational activity.
    - Conduct early and continuing consultation with the public, tourism, and recreation businesses.
    - Collocate with existing and planned transportation and utility system, where practicable.
    - Explore potential for enhanced recreation opportunities such as trails with local communities and landowners.

2. Minimize the construction of new permanent access roads, and reduce the impact of necessary crossings by using snow-ice roads during construction
3. Cross the Yukon River via HDD, and evaluate crossing the Putuligayuk River, Susitna River, Montana Creek, and the Nenana River via existing or new bridge structures
4. Where requested by the landowner, limit public access to ROW for recreation or hunting by blocking entry areas with large boulders, berms, or fencing
5. Prohibit agents, employees, contractors, and the employees of each of them from hunting, fishing, trapping, shooting, and camping within the leasehold

4.16.3.2. Agency-Recommended Mitigation Measures

A variety of mitigation measures and best practices have been recommended by the cooperating agencies (Appendix M). Many of these recommendations have been incorporated in the proposed Project and are included in Table 4.16-3 below. The impacts discussed in this chapter are based upon the Applicant-proposed measures. These additional agency recommended measures are not included in the impact analysis.

Table 4.16-3 Recreation Resources Agency-Recommended Mitigation Measures

Additional Measure Consideration	Agency Proposing Mitigation Measure	Agency Jurisdiction	Authority (*i.e.*, CWA, RHA, ESA)	Affected Resources	Comment Code
When new access roads/airstrips are created on public land, consult with ADF&G when considering whether to allow for possible public access for hunting, particularly in areas with underutilized wildlife populations.	ADF&G	ADF&G, BLM, ADNR	Alaska Hunting Regulations (AHR); Federal Land Policy and Management Act	Recreation, Land Use, Subsistence	WLD_22
Alternative access should be provided around temporarily blocked public access routes and at locations and periods when free and unrestricted access upon public land is temporarily restricted, particularly along RS2477 easements, section-line easements, and 17(b) easements. There should also be a clear and defined public process that addresses long-term public access beyond the pipeline construction period (*i.e.*, temporarily prohibited access).	ADF&G	BLM, ADNR	Federal Land Policy and Management Act	Recreation, Land Use	ACC_34
In addition to temporary alternate access for 17(b) easements, alternate access should be provided at locations and periods when public use of RS2477 easements and section-line easements is temporarily restricted.	ADF&G	BLM	Federal Land Policy and Management Act	Recreation, Land Use	ACC_34
We recommend that the Final SEIS list specific fugitive dust control measures, such as speed limits and frequency of watering during non-winter months, that would be used to achieve this level of control.	EPA	EPA, ADEC	CAA	Air, Wetlands, Vegetation, Human Health, Recreation	AIR_22
NPS wishes to maintain year-round public access to NPS lands to the extent safely possible during the construction phase. Backpackers, mushers, and skiers enter the eastern portion of the park from the Dalton Hwy in all seasons from a variety of locations, including the following four primary access points:	NPS			Recreation, Land Use	--

Additional Measure Consideration	Agency Proposing Mitigation Measure	Agency Jurisdiction	Authority (*i.e.*, CWA, RHA, ESA)	Affected Resources	Comment Code
Kuyuktuuvuk Creek, Trembley Creek, Nolan Road near Wiseman (MP 188), and Galbraith Lake (MP 274). NPS proposes the following mitigations to maintain safe public access during the construction phase: • Plan construction activities to ensure at least some of the above primary access points from the Haul Road remain open at any one time. • Development of a good calendar, posted on a well-maintained website hosted by the Project proponent, detailing where work is occurring and which access points are open/closed. • Project should be planned to assure that there would be no long-term change in access to any of the above four primary points once the line is buried.					

AAC = Alaska Administrative Code
ADF&G = Alaska Department of Fish and Game
ADEC = Alaska Department of Environmental Conservation
ADNR = Alaska Department of Natural Resources
AGDC = Alaska Gasline Development Corporation
APDES = Alaska Pollution Discharge Elimination System
BLM = Bureau of Land Management
BMP = Best Management Practice
CAA = Clean Air Act
CWA = Clean Water Act
DHSS = Alaska Department of Health and Social Services
EPA = U.S. Environmental Protection Agency
MBTA = Migratory Bird Treaty Act
NMFS = National Marine Fisheries Service
RHA = Rivers and Harbors Act of 1899
SEIS = Supplemental Environmental Impact Statement
USACE = U.S. Army Corps of Engineers
USFWS = U.S. Fish and Wildlife Service

4.16.4. Alternative 1 – Proposed Action

Alternative 1 is designated the proposed Action (proposed ASAP Project). This alternative is described in Chapter 2 in detail. The 36-inch, 733-mile-long pipeline and 12-inch, 30-mile lateral pipeline would cross various habitats and ecoregions from the North Slope to the existing ENSTAR pipeline system in the Mat-Su Borough. This section discusses the analysis of impacts to recreation sites areas along the route.

4.16.4.1. Construction

4.16.4.1.1. Mainline

The Mainline portion of the pipeline is located primarily in transportation corridors, namely the Dalton and Parks highways. These roadways facilitate access across Alaska, serving both residents and non-resident visitors, and are used extensively by recreationists to access their destination, including recreational areas in close proximity to the proposed Project. Generally, no recreation activity occurs directly in the roadways, with the exception of sightseeing from vehicles and stopping at interpretive sites managed by BLM along the Dalton Highway. Recreation activities that occur adjacent to roadways include berry-picking, photography, hiking, fishing, camping, and picnicking. The proposed pipeline route also requires multiple waterbody crossings, many of which support recreation activities.

Although the proposed pipeline alignment was designed to avoid recreational areas to the greatest extent practicable, the Mainline pipeline would either cross, or be located within 1 mile of a number of key recreation features in Alaska, including:

- Prudhoe Bay
- Arctic National Wildlife Refuge (ANWR)
- Chandalar Shelf
- Snowdon Mountain
- Sukapak Mountain
- Grayling Lake
- Arctic Circle Wayside
- Gobblers Knob
- Marion Creek Campground
- Arctic Interagency Visitor Center
- Five Mile Campground
- Minto Flats State Game Refuge
- Tanana Valley State Forest
- East Fork Chulitna River Campground

- Denali State Park
- Yukon Crossing
- Montana Creek SRA
- Willow Creek SRA
- Nancy Lake SRA
- Little Susitna Recreation River
- Susitna Flats State Game Refuge

Multiple interpretative sites would be located within 0.1 mile of the Mainline pipeline, with one interpretive site (Farthest North Spruce Tree) located less than 0.02 miles from the proposed Mainline pipeline corridor. The Mainline pipeline would cross the Atigun Pass, where drivers cross the Continental Divide and watch for Dall sheep. Additionally, both public and private land along the Mainline route, outside designated recreation areas, is commonly subject to dispersed recreation activities.

Proposed Project construction could temporarily disrupt recreation activities and restrict recreational access along the proposed pipeline route. Potential recreation impacts are attributed to shipment of construction materials, construction activity within the temporary ROW (*e.g.,* use of heavy equipment and machinery), and influx of construction labor to the proposed Project Area, all of which are discussed in more detail below. Construction is expected to occur over a 2.5-year period (*i.e.,* 30 months); however, localized construction activity would be shorter in duration, limited to construction requirements across the various construction spreads and sections.

It is anticipated that the Port of Seward, south of Anchorage, would serve as the point of entry for many of the construction materials. The Port of Seward is also utilized by cruise ships embarking and disembarking from Alaska. The entry of construction materials to the port is consistent with the industrial nature of the facility, but may adversely affect the recreational experience of cruise line passengers due to scheduling or other land use conflicts depending on the proximity and timing of utilization of dock facilities at the port. Under Alternative 1, port activity would be taken into account when scheduling docking in Seward. The shipment of construction materials from the Port of Seward would be accomplished by water (barge), rail, and air, as well as along local roadways. Shipments using barge, rail, or air would not likely affect recreation uses as the transportation options that would be utilized by the proposed Project already serve industrial uses and are not characterized by substantial recreation activity. Therefore, there would be no conflicts between these types of transportation modes and recreation users. However, the use of public roads to transport pipe, heavy equipment, other construction materials, and personnel when other options are not available could result in potential impacts on recreation-related travel due to temporary increases in traffic congestion along affected roadways, primarily in the Fairbanks, Palmer, Wasilla,

and Anchorage areas. Such traffic may cause delays accessing recreation destinations along the pipeline route and elsewhere in Alaska.

Actual construction activity could also impair the recreational experience at areas along the proposed pipeline route. Pipeline construction would require a standard 120-foot temporary ROW (up to 230 feet in some locations), including storage of the surface layer. The presence of construction materials and activity would detract from the visual quality of the area, would result in noise generation (*e.g.,* overhead flights from helicopters and fixed wing aircraft associated with environmental and engineering fieldwork and use of heavy construction machinery), and could generate dust, thereby reducing recreation quality of land- and water-based activities. There are particular concerns with construction reaches near isolated recreation areas, such as designated wilderness areas (*e.g.,* Gates of the Arctic NPP) and fishing and hunting locales that are dependent on undisturbed environments. In addition, there could be direct effects from proposed Project construction that may affect recreation, such as OC of roads and streams that could result in temporary disturbance to some roads and trails (including section-line easements, RS 2477 trails, and Section 17(b) easements); restricted access to recreation areas, including navigable rivers, interpretive sites and waysides along the Dalton Highway, and designated trails; or potential adverse effects on fish and wildlife resources that provide the basis for much of the recreation in Alaska.

In the context of water-dependent recreation, proposed Project construction would involve the pipeline ROW crossing approximately 359 waterways and drainages, of which 27 are major streams and 71 have been confirmed as anadromous streams (*i.e.*, 57 along the Mainline and 13 along access roads). Crossing of waterbodies would be accomplished by one of four methods: (1) OC method; (2) IOC method; (3) HDD; or (4) bridge crossings. Proposed Project construction in and near waterbodies could result in water quality impacts, generate noise and visual impacts, and restrict access, all of which could diminish the quality of water-based recreation activities, such as floating, boating, and fishing.

The presence of a large construction workforce may also result in recreation impacts in some areas. The temporary influx of new people to the region (construction work force) could result in competition for recreation facilities like campgrounds. Depending on the location and type of recreational facility, such an influx of people could also result in overcrowding, which could detract from the recreational experience. A temporary increase in the population base from construction workers serving the proposed Project may also result in competing demands for local public services in some locales, including competition with tourists and recreational users during high-use periods, which could detract from the recreational experience and adversely affect local tourism.

Revisions to the Alternative 1 alignment since 2012 included rerouting the Mainline pipe to avoid the Montana Creek SRA at MP 675. In addition, several adjustments to the alignment were made to avoid important areas along creeks or rivers where recreation may occur. Finally, between MP 698 and 707, the Mainline alignment was rerouted to

avoid impacts to the Willow Creek SRA. In this location, a construction camp was also moved approximately 9 miles north to a forested area on State of Alaska land.

Overall, the proposed Project could result in short-term adverse effects on recreation, primarily attributed to a general decline in recreation quality, competition for local public services, and restricted access in proximity to the pipeline route during construction. These impacts would be of particular concern during the peak recreation seasons, including salmon fishing in the spring and early summer, and big game and waterfowl hunting in the fall. However, such impacts would be localized along the pipeline route and would last for the duration of construction in any one area. In addition, standard procedures have been incorporated into the proposed Project that would minimize potential impacts on recreation, which address many of the issues outlined above, including measures related to restricting access, avoiding high-use periods and areas, and coordination between the public and the recreation industry, as described in Mitigation Measure No. 1 provided in Section 4.16.3. Although construction impacts would alter the recreational experience, impacts such as noise, water quality, and congestion of transportation routes, the effects would be temporary and localized for the duration of construction in any one area, resulting in an impact rating of moderate.

4.16.4.1.2. Yukon River Crossing

The proposed Project includes an HDD crossing at the Yukon River. Chapter 2, Figure 2.2-20 provides a schematic of the proposed HDD crossing. HDD is a steerable trenchless method of installing underground pipe, conduit, or cable in a shallow arc along a prescribed bore path by using a surface-launched drilling rig, with minimal impact on the surrounding area. HDDs would be scheduled to occur during both winter and summer construction seasons with construction-related activities occurring around the HDD site for 24 hours per day until pipe placement is complete.

Construction of the proposed pipeline across the Yukon River would have similar impacts on recreation as those generally described above for the pipeline route, including potential short-term effects on the quality of recreation opportunities near construction activities. The Yukon River Camp, rest area, and boat launch located immediately northwest of the existing highway bridge and the BLM visitor contact station located immediately northeast of the bridge are not in proximity to and would not be directly affected by the pipeline crossing of the river. Recreation activities in the river itself, such as fishing and some water sports, would not be adversely affected during construction. The magnitude of potential recreation impacts is expected to be comparable under all three crossing options and would likely be minor due to the temporary and localized nature of the impact.

4.16.4.1.3. Fairbanks Lateral

Construction of the Fairbanks Lateral would be similar to the Mainline portion of the pipeline route, including the construction methods and measures to minimize impacts

on recreation resources described in Section 4.16.3. Accordingly, the recreation-related impacts for the Fairbanks Lateral would be similar to those described above for the pipeline Mainline, including potential short-term adverse effects on recreation in proximity to the pipeline route during construction.

4.16.4.1.4. Gas Conditioning Facility

The GCF would be located near Prudhoe Bay. This area receives limited visitation, although tours of the oil fields and bay are available to visitors to the region. Recreation activity in the area is negligible.

Construction of the GCF would not restrict access to any recreation features and is not expected to alter visitation patterns of people coming to the area. For this reason, no impact on recreational resources is anticipated during construction.

4.16.4.2. Operations and Maintenance

The proposed pipeline ROW and associated facilities would directly affect a number of recreational areas, including Atigun Pass, Denali State Park, Little Susitna Recreation River, Minto Flats State Game Refuge, Tanana Valley State Forest, and Willow Creek SRA. However, as stated above, refinements to the alignment since the 2012 FEIS are intended to minimize the impacts to these areas such as Willow Creek SRA. Proposed Project facilities would also transect a number of recreation trails, including the Iditarod Trail and other local trail systems. While the pipeline would be located underground and existing public access points would be retained, there would be restrictions on access in some areas along the proposed ROW through the use of large boulders, berms, and/or fencing. This would detract from the natural environment characterizing many of these recreation areas and trail systems, thereby affecting the recreational experience of visitors.

In addition, introducing a new ROW in these areas could also result in the establishment of unattended trails, which could affect public trail planning processes and trail designs. In terms of proposed Project operations, ongoing activities would include mowing and maintenance of vegetation resources along the ROW, which would not likely affect recreation activity or the quality of recreation opportunities in proximity to the proposed pipeline route. Further, no new public vehicular access routes would be required for Alternative 1 operations, although there may be opportunities to include multi-use paths in the proposed Project design to address issues raised during public scoping; this would be a benefit to recreation in the region. The primarily self-contained underground facility would generate very little externalities (*e.g.,* dust and noise) from pipeline operations that would compromise the recreational quality of the region. Infrastructure that could result in the generation of minor externalities would include pig launchers and receivers, metering stations, and operation and maintenance response bases. Minor disruptions to recreation activity during spill events or while conducting maintenance activities. Overall, there would be minor long-term adverse effects on recreation once construction is completed.

The cleared forestland portions of the pipeline ROW may attract additional recreationists and/or off-road vehicle users (*e.g.*, snow machines and ATVs) along the ROW. Because the proposed Project ROW generally follows existing or officially designated transportation and utility corridors including the Dalton Highway/TAPS corridor and Parks Highway, an increase in user access would not be expected in these areas. However, increased access in areas that do not follow existing transportation or utility corridors, particularly between the TAPS corridor and Parks Highway in the Minto Flats vicinity, could see increased use. Preventative access measures such as boulders, berms, or fencing near entry points would be put in place at the request of landowners to help limit access to the proposed Project ROW. These preventative measures would then help lessen the impact of increased use along the ROW, although they would not likely eliminate the impact.

From a regulatory perspective, long-term operation of the proposed Project under Alternative 1 would require various permits, including permits in areas that have a recreation focus. For example, permits from ADNR would be required for pipeline development in state park units and special area permits would be required from ADF&G for lands under its jurisdiction. It is expected that permit conditions would include measures to minimize impacts on recreational activities occurring on these public lands. For this analysis, it is assumed that proponents of the proposed Project would secure and comply with all applicable permits over the life of the proposed Project. In addition, proposed Project operations would not result in the long-term conversion of the pipeline corridor to non-recreation uses; therefore, there would be no conveyances of Section 6(f) properties under the Land and Water Conservation Fund (LWCF), specifically Denali State Park, since the pipeline would be buried (C. LeClair, Pers. Comm. 2011).

Operation of the Fairbanks Lateral would be similar to the Mainline portion of the pipeline route, including operating parameters, permit compliance, and measures to minimize impacts on recreation resources. As a result, the recreation-related impacts associated with operation and maintenance of the Fairbanks Lateral would be similar to those described above for the pipeline Mainline; minor impacts on recreation are anticipated during proposed Project operations.

Long-term operations and maintenance of the GCF would be assimilated into the industrial character of the region. Although the facility would be permanent, it would not adversely affect any recreation resources or activities, nor would it restrict access to Prudhoe Bay. Furthermore, the small size of the operations workforce would not result in a substantial increase for recreation resources in the region and the development of new recreation facilities would not be warranted. Negligible impacts to recreation resources are expected during proposed Project operations under Alternative 1.

4.16.5. Alternative 2 – Denali NPP Route Variation

4.16.5.1. Construction

Construction of the Denali NPP Route Variation (Alternative 2) would result in similar types of recreation impacts as those described above for the Mainline pipeline. These impacts include short-term adverse effects on recreation attributed to restricted access to localized areas of the Denali NPP and the Yanert Valley during construction. Recreation activities within the park potentially impacted by construction activities include hiking, backpacking, mountaineering, cycling, wildlife viewing, photography, sightseeing, fishing, camping, and whitewater rafting. Recreational areas and additional activities are discussed in detail in Chapter 3, Section 3.12.4.3. Further, construction-related externalities, such as noise and traffic, may result in a short-term degradation in recreational quality in the immediate area, including effects on game species and related hunting opportunities. Construction may also require subsistence users, as well as returning park visitors, to find alternate access routes to the park in the long-term. Furthermore, the Denali NPP Route Variation would be constructed in an area of the Denali NPP in which a low level of recreational use currently occurs. Land fragmentation because of Alternative 2 construction could result in additional development in the area. This may occur due to the area now being more accessible and because the pristine quality of the landscape has already been diminished. Finally, the construction procedures described in Section 4.16.3 would be incorporated into the proposed Project, and would help to minimize potential impacts on recreation.

4.16.5.2. Operations and Maintenance

Similar to Alternative 1, operation of the pipeline within the Denali NPP would result in only minor adverse effects on recreation, as the pipe would be located primarily underground and would not restrict access or permanently compromise the recreational experience in the surrounding area. An aboveground pipeline would generally follow the belowground route, but would be longer, adding approximately 200 feet of distance every 1,500 feet through the use of Z-loops to accommodate expansion. The aboveground portion from MP 0 to MP 62, however, could result in long-term impacts to recreational snowmachining and hunting, should these recreational activities occur in association within the proposed ROW.

4.16.6. Alternative 3 – No Action

Under Alternative 3 (No Action), the proposed Project would not be constructed. As a result, there would be no direct impact on existing recreational resources or temporary interruption in recreational activities in the proposed Project Area. Therefore, current recreation use and trends would continue.

4.16.7. Conclusions and Comparison of Alternatives

Alternative 1 (proposed Action) and Alternative 2 (Denali NPP Route Variation) would result in similar impacts to recreation during both construction and operations phases of the proposed Project. However, Alternative 2 would pass through Denali NPP, a significant recreation location for both Alaska residents and visiting tourists. Construction and operations activities would be the same for both Alternatives 1 and 2 (*e.g.,* restriction to recreation areas, construction noise, etc.):

- The Mainline pipeline would either cross, or be located within 1 mile of a number of key recreation features in Alaska.
- The Mainline pipeline would cross Atigun Pass, where drivers cross the Continental Divide and watch for Dall sheep.
- In addition, both public and private land along the Mainline route, outside designated recreation areas, is commonly subject to dispersed recreation activities.
- Potential recreation impacts are attributed to shipment of construction materials, construction activity within the temporary ROW (*e.g.,* use of heavy equipment and machinery), and influx of construction labor to the proposed Project Area.

Figure 4.16-1 illustrates some of the key findings from the impact analysis. This figure intends to provide context for the description of potential impacts of the alternatives, as described in detail in this section. By illustrating the potential impacts of the proposed Project on a map using a consistent color scheme consistent with the impact summary table (Table 4.16-4), we could begin to draw a few conclusions. Examples are provided below:

- As described in Chapter 3, Section 3.12, Recreation, numerous recreation features are located along the proposed Project ROW. These recreation features have been visualized in relation to the proposed Project on Figure 4.16-1. In addition to the recreation features, the communities near the proposed Project are documented on the figure. As the proposed Project progresses south from the GCF facilities on the North Slope, the number of potentially impacted communities and recreation features increases. Based on Figure 4.16-1, the highest concentration of recreational opportunities appears to be located south of Livengood, between the proposed Project terminus and Denali NPP.
- Major roads and highways are also depicted on Figure 4.16-1. Impacts to recreational quality and access may occur where recreation users and construction activities interact. As depicted on Figure 4.16-1, access options for both recreational users and construction workers are limited along the proposed ROW. Impacts from traffic congestion and temporary restrictions and delays could change the quality of the experience for the user.
- Lastly, the communities along the proposed Project ROW, which support recreation users, are limited. The influx of workers during construction activities may

temporarily benefit these communities economically; however, competition with construction workers could result in a diminished experience for both the regular recreation users and tourists visiting the state.

In the No Action alternative (Alternative 3), a pipeline would not be built and there would be no impacts to recreation for construction or operational phases.

Table 4.16-4 presents a summary of impact ratings for effects of the proposed Project and alternatives on recreation.

Overall, the proposed Project could result in short-term adverse effects on recreation, primarily attributed to a general decline in recreation quality, competition for local public services, and restricted access in proximity to the pipeline route during construction. These impacts are of particular concern during the peak recreation seasons, including salmon fishing in the spring and early summer and big game and waterfowl hunting in the fall. However, such impacts would be localized along the proposed pipeline route and would last for the duration of construction in any one area. Long-term impacts to established recreational user relationships with the landscape could occur as a result of proposed pipeline and ROW operation and maintenance activities and access restrictions. Additionally, standard procedures have been incorporated into the proposed Project that would minimize potential impacts on recreation, which address many of the issues outlined above, including measures related to restricting access, avoiding high-use periods and areas, and coordination between the public and the recreation industry.

Table 4.16-4 Comparison of Alternatives Summary for Impacts to Recreation (Direct & Indirect)

Effect	Potential Impact Description	Alternative 1		Alternative 2		Alternative 3
		Construction	Operations	Construction	Operations	Construction/Operations
		Impact Rating		Impact Rating		Impact Rating
• Changes to Recreational Quality: • Possible impact on recreational experience of cruise vessel passengers • Traffic congestion may disrupt recreational activities and access along roads • Change in soundscape and visual impacts detracts from wilderness experience • Changes in water quality that result in diminished recreational use of water bodies	• Use of marine vessels to transport pipe, equipment and supplies • Use of public roads to transport pipe, heavy equipment, and personnel • Construction activity near isolated recreation areas, such as designated wilderness areas • Construction activities near water bodies and stream crossings	*Moderate*	*Minor*	*Moderate*	*Minor*	*Negligible*
• Changes to Recreational Access: • Traffic congestion may disrupt access along roads • Restricted access to water bodies used by recreational users • Competition for recreational facilities (*e.g.*, campgrounds, access to fishing or hunting areas) • Temporary restrictions and delays accessing nearby recreation sites	• Use of public roads to transport pipe, heavy equipment, and personnel • Construction activities near water bodies and stream crossings • Influx of construction workers • Construction of above ground facilities, construction camps, pipeline yards, and material sites • ROW use during operations phase • Long-term operations and maintenance assimilated into industrial character of the region	*Moderate*	*Minor*	*Moderate*	*Minor*	*Negligible*

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City or Village
Mileposts
Recreation Features
Iditarod Trail
ASAP v6.1 Mainline
Yukon Crossing and Denali Alternative Reroute
Fairbanks v4.1 Lateral

Public Lands Management
Bureau of Land Management
Fish and Wildlife Service
National Forest Service
National Park Service
State Lands

Effect Rating
Major Positive
Moderate Positive
Minor Positive
Negligible
Minor Negative
Moderate Negative
Major Negative

Effect Indicators
CRQ: Changes to Recreation Quality
CRA: Changes to Recreation Access

Beaufort Sea
MP 0
Prudhoe Bay
MP 62
MP 100
Mollie
Mainline and Fairbanks Lateral
Construction
CRQ
CRA
Operations
CRQ
CRA
Anaktuvuk Pass
Gates of the Arctic National Park
Atigun Pass
MP 200
Wiseman
Coldfoot
Marion Creek Campground
Arctic Interagency Visitor Center
Bettles
Alatna
New Allakaket
Allakaket
MP 300
Kanuti National Wildlife Refuge
Yukon Flats National Wildlife Refuge
Five Mile Camp
Stevens Village
Koyukuk Wilderness
Koyukuk National Wildlife Refuge
Rampart
Livengood
MP 400
Minto
Steese Highway
Yukon-Charley Rivers National Preserve
TANANA VALLEY SF
Two Rivers
Pleasant Valley
Fairbanks
Four Mile Road
Nenana
Richardson Highway
Anderson
MP 500
TANANA VALLEY SF
Ferry
Healy
Yukon River Crossing and Denali Alternative
Construction
CRQ
CRA
Operations
CRQ
CRA
Innoko National Wildlife Refuge
Innoko Wilderness
McKinley Park
Denali National Preserve
Denali National Park
Cantwell
Denali Wilderness
MP 600
East Fork Chulitna River Campground
Denali Highway
Petersville
TALKEETNA REC RIVER
Talkeetna
NELCHINA PUBLIC USE AREA
Glenn Highway
Wrangell-Saint Elias National Preserve
Skwentna
Montana Creek SRA
MP 700
Willow
Susitna
NANCY LAKE SRA
LITTLE SUSITNA REC RIVER
MP 733
Anchorage
Wrangell-Saint Elias Wilderness
CHUGACH SP
Wrangell-Saint Elias National Park
Lake Clark Wilderness
Lake Clark National Park
KENAI RIVER SMA
Lake Clark National Preserve
Tuxedni Wilderness
Kenai National Wildlife Refuge
Chugach National Forest
Kenai Wilderness
KACHEMAK BAY SP
Kenai Fjords National Park
KACHEMAK BAY OIL & GAS CL
Togiak Wilderness

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PROJ. No.: 0416166

Figure 4.16-1: RECREATION IMPACTS CONTEXT MAP ALASKA STAND ALONE PIPELINE

0 30 60 120 180 Miles

Barrow
Nome
Fairbanks
Bethel
ANCHORAGE
Juneau

N

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4.17. Visual

4.17.1. Introduction

As defined in Chapter 3, Section 3.13, Visual, visual resources are landscape characteristics that have an aesthetic value to local residents and visitors based on their perspective from sensitive viewpoints, such as residences, recreation areas, rivers, or highways. Section 3.13 also describes the existing visual resources along the proposed Project route (Alternative 1) and Alternative 2 (Denali NPP Route Variation) and their proximity to potentially sensitive viewpoints and user groups, and identifies special management and regulatory considerations for visual resources in the proposed Project Area.

This section assesses potential changes to the visual environment resulting from proposed Project construction and operations, in proximity to (defined generally as within 5 miles of) the pipeline route. The three alternatives evaluated are described in detail in Chapter 2; the components and characteristics relevant to visual resources are summarized below.

- Alternative 1: Proposed Action (proposed ASAP Project), including:
  - Use of DH3 at West Dock, nearshore disposal of dredge material;
  - HDD at the Yukon River; and
  - Buried pipeline for the extent of the route, except at elevated bridge crossings, fault crossings, pigging facilities, and valves.
- Alternative 2: Denali NPP Route Variation, including:
  - Use of DH2 at West Dock, ocean disposal of dredge material;
  - Aboveground pipeline mode from MP 0 to MP 62; and
  - Aerial crossing at the Yukon River.
- Alternative 3: No Action.

The ROW (indicating vegetation clearing and potential visual contrast) for Alternatives 1 and 2 would be as follows:

- Mainline ROW:
  - Construction: variable width, 120-foot-wide minimum temporary ROW, plus additional lands out to 350 feet to construct.
  - Operations and Maintenance: A 53-foot-wide minimum permanent ROW, plus additional lands out to 350 feet to maintain land.
- Fairbanks Lateral ROW:
  - Construction: variable width, 100-foot-wide minimum temporary ROW, plus additional lands out to 350 feet to construct.

- Operation and Maintenance: 30-foot-wide minimum permanent ROW, plus additional lands out to 350 feet to maintain land.

The primary differences (relevant to visual resources) between Alternatives 1 and 2 are as follows: 1) between MP 0 and 62 the proposed pipeline would be placed below ground in Alternative 1, but above ground in Alternative 2; and, 2) the Yukon River crossing would be constructed using HDD for Alternative 1, versus an aerial crossing under Alternative 2. These differences are discussed in greater detail in Section 4.17.4. Additional changes to the proposed Project design since the publication of the 2012 FEIS (USACE, 2012a) are summarized in Chapter 1.

4.17.1.1. Incomplete or Unavailable Information

In compliance with CEQ guidance (see Section 4.3), this section addresses incomplete or unavailable information pertinent to analyzing impacts of the alternatives on visual resources. When site-specific information on visual resources could not be obtained, general regional or statewide information was incorporated for the assessment. For example, few lands within the proposed Project Area have an established Visual Resource Management (VRM) system class rating. In some cases, photosimulations have been prepared to depict how the proposed Project could affect visual resources. For the segments of the proposed Project where simulations were not prepared, this SEIS includes a more qualitative assessment of the likely effects on visual resources.

4.17.2. Methods

Visual impacts are analyzed by studying how the proposed Project would contrast with the scenic quality of the existing landscape, in the context of associated viewer sensitivity. Impacts from the proposed Project construction, and operations and maintenance facilities would be greatest in areas of high scenic quality, high viewer sensitivity (as indicated by type and level of use and scenic or special area designations), and high visual contrast (as indicated by changes in line, form, color, or texture) due to pipeline construction and/or operations. While the general approach to visual impact assessment includes elements from BLM's VRM system, developed to manage visual resources on BLM lands, few lands within the proposed Project Area have an established VRM Class rating (see Section 4.17.2.3, BLM Visual Resource Management Criteria).

4.17.2.1. Project Activities Causing Potential Impacts

Table 4.17-1 presents the types of effects the proposed Project activities may have on visual resources during the construction, and operations and maintenance periods. The sections below describe the proposed Project design features of each alternative, and evaluate the impacts of these features on visual resources.

To capture the variable scenic quality and viewer sensitivity across the proposed Project Area, impacts are analyzed separately for seven distinct pipeline segments (Mainline Segments 1 through 4, the Denali NPP Route Variation, and the Fairbanks Lateral) as

presented in Table 4.17-1, and described in terms of the types of effects that could occur. Some of these segments correspond to those presented in Chapter 3, Table 3.13-1; however, these seven segments are delineated exclusively for the purpose of assessing potential impacts to visual resources, and their denotation (*e.g.*, Mainline Segment 1) applies only to this visual resources section. The segmentation for visual resources specifically allows comparison between the aboveground and buried ROWs in Alternatives 1 and 2 between MP 0 and MP 62, and accounts for the presence of TAPS in the viewshed between MP 0 and MP 400. Existing scenic quality and viewer sensitivity along the proposed Project route is described in detail in Chapter 3, Section 3.13.3, Potentially Affected Communities.

Table 4.17-1 Types of Effects and Impacts on Visual Resources

Type of Effect	Proposed Action Causing Potential Impact	
	Construction	Operations and Maintenance
Increase in visual contrast with existing landscape and reduction in scenic quality (through changes in color, form, line and texture), for the following pipeline segments: **Mainline:** • Mainline Segment 1a: MP 0 to 62 (GCF to near TAPS Pump Station 2 [PS2]) • Mainline Segment 1b: MP 62 to Livengood/TAPS divergence near MP 400 • Mainline Segment 2: MP 400 to 535 (Denali NPP) • Mainline Segment 3: MP 535 to 634 (Denali NPP to approximately Byers Lake in Denali State Park) • Mainline Segment 4: MP 634 to End • Denali NPP Route Variation (Alternative 2) **Fairbanks Lateral**	**Both Alternatives:** • Grading, clearing, excavating, trenching, pipe laying, backfilling, reclaiming • Construction of water crossings (pipelines and bridges) • Construction of facilities, including nighttime construction • Presence of construction workers and equipment • Presence of temporary construction camps to house workers • Solid waste storage and disposal	**Both Alternatives:** • Pipeline ROW visible in several areas - visual contrast greatest in areas requiring hill cutting and new bridge crossings • Permanent cleared vegetation in ROW • Facility operations - permanent presence of operational aboveground facilities, personnel, and equipment at facilities • Temporary recurring presence of maintenance workers, equipment, and activities **Alternative 2 Only:** • Permanent presence of aboveground pipeline from MP 0 to 62

4.17.2.2. Impact Criteria

The criteria used to analyze impacts to visual resources are presented in Table 4.17-2. For each pipeline segment presented in Table 4.17-1, impact levels (as defined in Table 4.17-2) were assigned for each impact component (*i.e.*, magnitude/intensity, geographic extent, duration/frequency, and likelihood). These impact levels were evaluated in the context of existing scenic quality and viewer sensitivity for each pipeline segment. Applicant-proposed design features, mitigation measures, and BMPs that may reduce impacts to visual resources are listed in Section 4.17.3. These design elements and

mitigation measures to reduce visual impacts (*e.g.*, such as revegetation and vegetation screening measures, and limiting vegetation clearing, ground disturbance, and development of new access roads), have been taken into account to determine a final integrated impact result of negligible, minor, moderate, or major.

Table 4.17-2 Impact Criteria for Visual Resources

Impact Component	Impact Level			
	Major	**Moderate**	**Minor**	**Negligible**
[Magnitude or] Intensity	The effect would alter a visual resource in terms of its value, quantity, quality, and uses to the point it could not be used, or would degrade, remove, or destroy value of the resource.	The effect would indisputably alter a visual resource in terms of its value, quantity, quality, and uses, but would allow the resource to be used without removing, degrading, destroying its value.	The effect would noticeably or measurably alter a visual resource in terms of its value, quantity, quality, and uses without removing, degrading, or destroying its value.	No or minimal perceptible effect
Geographic Extent	The effect would occur on a statewide basis, or throughout the study area.	The effect would occur at a borough or community level, or on a limited portion of the study area.	The effect would be site-specific or would occur in a few isolated locations.	The effect would be limited to a specific, contained location.
Duration or Frequency	The effect would be permanent, or would occur consistently for greater than 10 years duration, and would not be reversed during operations.	The effect would occur intermittently for 1 year up to 10 years. Periodic, temporary, or short-term changes that could be reversed during the operation phase.	The effect would occur intermittently and/or for less than 1 year duration. Periodic, temporary, or short-term changes that are reversed.	The effect, if perceived, would be limited to less than a 1-month duration.
Likelihood	Most likely (Effects are those that have greater than 75% chance of arising from reasonable or demonstrated mechanisms due to the action)	Likely (Effects are those that have a 50% to 75% chance of arising from reasonable or demonstrated mechanisms due to the actions)	Somewhat likely (Effects are those that have a 10% to 50% chance of arising from reasonable or demonstrated mechanisms due to the action)	Unlikely (Effects are those that have less than 10% chance of arising from reasonable or demonstrated mechanisms due to the action)

4.17.2.3. BLM Visual Resource Management Criteria

As described above, elements of BLM's VRM system have informed the evaluation of visual impacts. The VRM system consists of an inventory of visual conditions and visual management objectives.

BLM's Visual Resources Inventory describes existing visual conditions on BLM lands in terms of landform, water, vegetation, color, adjacent scenery, scarcity of the scenery being viewed, and the degree of modification of the view (BLM, 1986e), as well as

distance between an observer and elements of the landscape. Under the VRM, the combined effect of these visual components is expressed in terms of "Scenic Quality" ratings. The VRM system also identifies a level of viewer sensitivity, reflecting the "public concern for visual quality" at a given location. Scenic quality and viewer sensitivity ratings are listed in Table 4.17-3.

Table 4.17-3 Visual Component Rating

Visual Components	Rating Highest to Lowest (Left to Right)		
Scenic Quality	A	B	C
Viewer Sensitivity	High	Medium	Low

This SEIS identifies scenic quality as either high, medium, or low. For example, high-quality landscapes include BLM lands with an "A" rating for scenic quality, as well as non-BLM lands that would likely be assigned an "A" rating based on BLM's Visual Resources Inventory methodology (BLM, 1986e). Similarly, viewer sensitivity in this SEIS reflects either established ratings on BLM lands, or likely ratings on non-BLM lands.

4.17.3. Applicant-Proposed Design Features, Mitigation Measures, Best Management Practices, and Project Management Plans

The following design features, mitigation measures, and BMPs are proposed by AGDC, and have been taken into consideration when evaluating potential impacts on visual resources under Alternatives 1 and 2 during the construction and operations phases. A complete list of mitigation measures and BMPs are also provided in Appendix M.

AGDC proposes to avoid or minimize significant adverse effects on visual resources created by construction and operation of the proposed Project by incorporating proven mitigation measures into the design and location of the proposed Project. Specifically, AGDC proposes to implement the following measures to mitigate effects on visual resources:

1. Minimize the construction of new permanent access roads by using snow-ice roads during construction.
2. Restore the construction zone in a manner that facilitates reestablishment of the adjacent natural vegetation.
3. Use root balls, salvaged native plant materials, and the surface layer removed from the construction footprint for redistribution on disturbed areas, where feasible.
4. Maintain an undisturbed screen of existing natural vegetation when the pipeline is offset from a highway, as well as an undisturbed vegetative screen of at least 500 feet between material sites and highways.

5. Use existing disturbed areas to the maximum extent practicable for temporary construction activities, such as construction camps, material stockpiling, pipe jointing, and pipe bending.
6. Minimize locating pipeline facilities, new material sites, and construction material stockpiling in places with special visual resource values that would be visible to the public.
7. Blend the pipeline system into the natural setting when crossing places with high visual resource value.
8. Use revegetation species that are appropriate for the general area.
9. Re-grade construction disturbances to a condition that blends with the surrounding terrain and surface drainage patterns.
10. Monitor reclaimed, disturbed construction areas for the life of the proposed Project, and take remedial action where expected revegetation success is not achieved.
11. Provide minimum offsets, and possibly fencing of significant environmental resources.
12. Limit or minimize the permanent ROW, but allow adequate size to accommodate operations, maintenance, and future expansion.
13. Use trenchless construction methods in certain areas, including (but not limited to) waterbody crossings, as described in Chapter 2.
14. For temporary and permanent facilities, use the minimum lighting intensity necessary for a safety, use localized task lighting, and incorporate measures (such as diffusers, lenses, and shielding) to reduce nighttime glare, light radiation, and backscatter into the sky.
15. For permanent aboveground facilities, select paint colors that blend into the background, including different shades of green, brown, or grey.
16. Temporary facilities, such as structures required for construction and camps, would be removed after construction.

4.17.4. Alternative 1 – Proposed Action

This section evaluates potential impacts to visual resources from Alternative 1. Results of the impact assessment are summarized in Table 4.17-4, and described in the sections below.

4.17.4.1. Alternative 1 - General Visual Impacts

Several aspects of construction and operations of the proposed Project would be present across all pipeline segments, and are summarized herein. Figures 2.2-1 and 2.2-2 in Chapter 2 (Alternatives) depict the Mainline and Fairbanks Lateral proposed routes, respectively. All proposed pipeline segments were considered to have high scenic

quality to some degree. Although some segments are a mix of developed and undeveloped land, the portions of the natural landscape within each segment have high scenic quality, with views of wildlife, mountains, tundra, forest, rivers, and lakes interspersed with commercial, industrial, public, and private development.

4.17.4.1.1. Construction

Construction of the proposed Project would increase visual contrast due to the clearing and removal of existing vegetation in the ROW—and the subsequent earthwork and exposure of bare soils—the presence of construction workers, vehicles, and equipment, storage of construction materials, the establishment of temporary construction camps along the route, and nighttime lighting associated with construction activities. Locations of the temporary construction camps and PSYs are depicted on Figure 2.2-18 in Chapter 2.

The visual impacts of construction activities for these camps include nighttime lighting and associated glare. During late spring, summer, and early fall, nighttime lighting conditions rarely include full darkness. As a result, while nighttime construction (and work camp) lighting may be visible, the contrast between this lighting and nighttime visual conditions would be low to moderate. During the remainder of the year, nighttime construction lighting would contrast with dark night skies.

Visual contrast during construction would be the highest in undeveloped areas that are visible to the public, such as the Dalton and Parks highway corridors.

Mitigation Measure Nos. 1 through 5, 9, 11, and 13 through 15, listed in Section 4.17.3, would help minimize impacts during construction by minimizing the extent of the construction ROW and the visibility of construction activities and nighttime lighting.

4.17.4.1.2. Operations and Maintenance

A portion of the proposed Project pipeline is located primarily outside of transportation corridors, limiting visibility of the ROW. Where the proposed Mainline pipeline passes through populated areas, other linear features, such as roads and power lines, as well as dispersed residential and commercial structures, occur throughout, reducing the visual contrast of the Mainline ROW.

Visual contrast during the operations phase would occur where the permanent ROW and aboveground facilities are visible and differ from the surrounding landscape. Visual contrast would be greatest in locations such as:

- ROW segments requiring hill cuts;
- New aerial crossings over rivers;
- Near permanent aboveground facilities, which would contrast with surrounding scenery and landscape in height, shape, and (if present) nighttime lighting;

- ROW segments across areas where the predominant vegetation is forest or woody shrub (*i.e.*, vegetation types that would not be allowed on the ROW); and,
- Undeveloped areas where viewers expect (and currently experience) minimal evidence of human activity, such as portions of the Dalton or Parks highway corridors, the ARRC corridor, or recreation areas.

Aboveground block valves would be installed at increments of no more than 20 miles along the ROW (specific locations are based on suitable terrain). Where visible, the block valves would create a permanent visual contrast—in terms of height, shape, and, if present, nighttime lighting—with the surrounding landscape.

Mitigation Measure Nos. 1, 6 through 8, 10, 11, 14, and 15, listed in Section 4.17.3, would help to minimize impacts during operations by maximizing use of existing roads, limiting construction of permanent roads, blending the pipeline into the existing natural landscape, and limiting nighttime glare. Operation of the proposed Project pipeline would involve limited maintenance activities. In general, the presence of maintenance workers, vehicles, and associated activities would be of negligible duration, and the visual impacts of these activities would be negligible.

4.17.4.2. Alternative 1 – Impacts by Pipeline Segment

4.17.4.2.1. Mainline Segment 1a - GCF to MP 62

Mainline Segment 1a extends from the GCF south to MP 62, near the existing TAPS PS2. The proposed GCF would be constructed approximately 5 miles south of West Dock in Prudhoe Bay (Figure 2.2-3 in Chapter 2, Alternatives). This pipeline segment would be mostly adjacent to the Dalton Highway, which extends south from Deadhorse.

Viewer sensitivity is moderate for this segment, with viewers consisting of recreational visitors, a limited number of residents, and commercial truck traffic. The existing landscape of Prudhoe Bay is characterized by substantial oil and gas infrastructure and related support service development and heavy truck traffic. Outside of Prudhoe Bay, the landscape is open tundra, with low vegetation, river and wetland areas, and no forest. The TAPS and associated aboveground facilities, including pump stations, are a substantial and constant visual presence.

4.17.4.2.1.1. Construction

Visual impacts during construction would be moderate. Construction of the GCF and pipeline, staging areas, worker camps, and increased traffic would most likely alter the visual landscape at a borough or community level for the duration of construction.

4.17.4.2.1.2. Operations and Maintenance

Once constructed, the visual impact of the GCF and the pipeline on this segment would be minor. The GCF and its associated activities would generally be consistent with existing visual character in and near Prudhoe Bay. Outside of Prudhoe Bay, the pipeline

ROW would be unlikely to be visible from the Dalton Highway, once vegetative restoration is complete. This restoration could take several years.

4.17.4.2.2. Mainline Segment 1b - MP 62 to 400

Mainline Segment 1b extends from MP 62 to MP 400 near Livengood, where the proposed route would diverge from the TAPS route (Figure 2.2-1 in Chapter 2, Alternatives). This pipeline segment would also be adjacent to the Dalton Highway.

Viewer sensitivity is moderate for this segment, with viewers consisting of recreational visitors, a limited number of residents, and commercial truck traffic. The landscape between MP 62 and approximately MP 140 (Galbraith Lake) is open tundra, as described above for Segment 1a. Between MP 140 and MP 180, the ROW passes through the Atigun River valley and the central Brooks Range, characterized by steep mountains above the treeline, and the glaciated Chandalar Shelf, with tundra-like vegetation. South of MP 180, the ROW crosses through river valleys and mountainous areas, generally covered by a mixture of low shrubs and boreal forest. TAPS and the associated aboveground facilities, including pump stations, are a substantial visual presence, and are visible nearly continuously.

4.17.4.2.2.1. Construction

Visual impacts during construction would be moderate. Pipeline construction, staging areas, worker camps, and increased traffic would most likely alter the visual landscape at a borough or community level for the duration of construction within the segment.

4.17.4.2.2.2. Operations and Maintenance

Once constructed, the visual impact of the pipeline would be expected to be minor, with the greatest contrast near permanent aboveground facilities and in areas where the ROW (which would be maintained in grasses or other low vegetation) would cross and contrast with forested areas, and particularly near inhabited locations such as Coldfoot or Livengood. Forested areas cleared for TWs could take years to decades to revegetate.

Particularly along the northern portion of the route, these aboveground facilities could occur in areas where park visitors expect relatively pristine conditions. The TAPS route, the Dalton Highway, and existing material sites contrast with this expectation, particularly for visitors whose intent is to seek out areas out of sight of these facilities. That contrast notwithstanding, many Alaskans likely consider TAPS and the Dalton Highway to be appropriate, if not desirable, parts of the landscape, rather than contrasting elements. As a result, the presence of the proposed Project amongst existing contrasting features would be an additional human-made element in the landscape, rather than a new element in an otherwise untouched landscape.

The Yukon River crossing would occur in this segment. Because this crossing would be constructed using HDD, visual impacts during operations and maintenance would be limited to the entry pad on the north side of the river. This pad would create some visual

contrast during construction and prior to the completion of revegetation; however, the visibility of the HDD entry pad would be limited by terrain and surrounding vegetation. Upon completion of revegetation, the entry pad would no longer create a visual contrast.

4.17.4.2.3. Mainline Segment 2 - MP 400 to 535

Mainline Segment 2 extends from MP 400 approximately at Livengood, south to MP 535, approximately the northern boundary of Denali NPP (Figure 2.2-1 in Chapter 2, Alternatives). Between MP 400 and 469, this segment crosses undeveloped areas and minor roads through the Minto Flats and Tanana Lowlands. It joins the Parks Highway at MP 469, and crosses the Tanana River at Nenana (MP 472) using HHD. The route then follows the west side of the Nenana River, and is not visible from the Parks Highway, until MP 498, where it crosses the Parks Highway. It then parallels the Parks Highway through more developed areas (*e.g.,* south of Clear, but avoiding Healy), south to MP 535.

Viewer sensitivity for this segment is moderate, with viewers consisting of recreational visitors, rail passengers, Parks Highway traffic, and local residents on minor roads. The vegetation is primarily boreal forest.

4.17.4.2.3.1. Construction

Visual impacts during construction would be moderate. Pipeline construction, staging areas, worker camps, and increased traffic would most likely alter the visual landscape at a borough or community level for the duration of construction within the segment.

4.17.4.2.3.2. Operations and Maintenance

Once constructed, the visual impact of the pipeline would be minor. Most of the route is boreal forest. The ROW (which would be maintained in grasses or other low vegetation) would contrast with the boreal forest landscape; however, the ROW on this segment would be visible only to a limited number of viewers, such as at the crossing of sparsely traveled rural roads, or occasional views from the Parks Highway. In some areas, where the proposed pipeline would parallel the Parks Highway, its ROW is often within the existing road ROW, limiting additional visual contrast. Such segments are generally adjacent to Denali NPP, in Denali State Park, and from MP 680 to 684.

4.17.4.2.4. Mainline Segment 3 - MP 535 to 634

Mainline Segment 3 extends from MP 535, adjacent to Denali NPP (Parks highway MP 238), south to MP 634, approximately 5 miles south of Byers Lake in Denali State Park (Figure 2.2-1 in Chapter 2, Alternatives). Viewer sensitivity on this segment would be high, due to high scenic quality and high recreation and tourist use (with consequent high visual sensitivity) of the area near Denali NPP and Denali State Park. The landscape is primarily boreal forest with mountains, alpine tundra, and numerous waterbodies.

4.17.4.2.4.1. Construction

Visual impacts during construction would be moderate. Pipeline construction, staging areas, worker camps, and increased traffic would most likely alter the visual landscape at a borough or community level for the duration of construction within the segment.

As described in Chapter 2, Section 2.2.11, Waterbody Crossings, construction of the proposed Project would potentially occur during daylight and nighttime, throughout the year. Denali NPP is open to the public from May 20 to mid-September (NPS, 2017). During this time of year, nighttime lighting conditions rarely include full darkness. As a result, while nighttime construction lighting may be visible, the contrast between these lighting and nighttime visual conditions would be low to moderate. During the remainder of the year (mid-September to mid-May), Denali NPP is closed to visitors; as a result, while nighttime construction lighting may create contrast with dark night skies, this contrast would typically only be visible for residents or travelers along the Parks Highway.

4.17.4.2.4.2. Operations and Maintenance

Visual impacts of the proposed pipeline in this segment during operations would be moderate due to high viewer sensitivity, the visibility of the proposed Project from the Parks Highway corridor, and in many areas of Denali NPP and Denali State Park, the permanent visual contrast of the cleared ROW through the shrub and forested sections, and hill cuts that would be required along steeper sections of this segment.

To further evaluate the visual impacts of the proposed Project on Denali NPP and Denali State Park, AGDC prepared a series of photosimulations of the proposed Project from Denali NPP. This visual assessment included separate simulations of both Alternative 1 (labeled as "Route Revision 'C'") and the Denali NPP Route Variation under Alternative 2.

Figure 4.17-1 shows Alternative 1 as viewed from Denali Park Road, between the Denali NPP visitor center and park headquarters (Key Observation Point [KOP] 1, as identified in Appendix K of the 2012 FEIS—see Chapter 3, Section 3.13.5.4.1, Key Observation Points). From this location, the hill cuts and aerial ravine crossings of Alternative 1 are clearly visible as a new linear element across the entire vista.

Similar views are available from other east-facing observation points in Denali NPP. As described in Chapter 3, Section 3.13.4.5, Denali National Park and Preserve, many of the simulated viewpoints are in areas of Denali NPP where evidence of human activity and development may be visible. As described in Chapter 3, Section 3.13.5.4.1, Key Observation Points, the KOPs identified in Appendix K of the 2012 FEIS were assigned (for purposes of the 2012 FEIS) to BLM VRM Class II or III. Per Chapter 3, Section 3.13.4.1, BLM Visual Resources Management, those classes describe places where management activities may be visible, but should not attract attention or dominate the view.

As shown on Figure 4.17-1, the presence of the proposed Project attracts attention and detracts from, but does not entirely degrade, the scenic nature of the simulated viewpoints.

Figure 4.17-1 View of Alternative 1 from Denali Park Road



4.17.4.2.5. Mainline Segment 4 - MP 634 to End

Mainline Segment 4 extends from MP 634, located approximately 5 miles south of Byers Lake in Denali State Park, to the end of the pipeline (Figure 2.2-1 in Chapter 2, Alternatives). This segment parallels the Parks Highway from MP 634 to MP 700, north of the community of Willow. South of MP 700, the route heads southwest through areas of year-round and seasonal residences and recreation areas, passing to the west of Nancy Lake SRA. This is the most populated and developed segment of the proposed route, and is considered to have moderate viewer sensitivity. Local resident and tourist traffic is high on the Parks Highway through this section, particularly during the summer months. Although developed, nearly the entire segment passes through a landscape of high scenic value, with views of mountains, glaciers, forests, and waterbodies.

4.17.4.2.5.1. Construction

Visual impacts during construction would be moderate. Pipeline construction, staging areas, worker camps, and increased traffic would alter the visual landscape in select areas for the duration of construction within the segment. Within the Parks Highway corridor (south of Denali State Park), the corridor is relatively developed with residences and businesses, minimizing the visual contrast of the cleared pipeline ROW.

4.17.4.2.5.2. Operations and Maintenance

Once constructed, the visual impact of the pipeline would be moderate. The ROW (which would be maintained in grasses or other low vegetation) would contrast with the boreal forest landscape; however, within the Parks Highway corridor (south of Denali State Park), the corridor is relatively developed with power line ROWs, residences, and businesses, minimizing the visual contrast of the cleared pipeline ROW. Visual impacts would be limited to undeveloped areas visible from the Parks Highway, where the pipeline is outside of the Parks Highway ROW. Such areas include:

1. Areas within Denali State Park where the pipeline ROW is visible;
2. Undeveloped areas visible from the Parks Highway; and
3. Areas outside of the Parks Highway ROW with high concentrations of recreational users and seasonal or year-round residences, including Trapper Creek (MP 662), Willow (MP 706), and the Nancy Lake area (MP 715).

4.17.4.2.6. Fairbanks Lateral

The Fairbanks Lateral segment extends from the Mainline at MP 440, east to Fairbanks along Murphy Dome and Old Murphy Dome Roads (Figure 2.2-2). The proposed route would follow the Old Murphy Dome Road and existing power lines, where possible; however, the majority of the proposed ROW would be outside of existing ROWs. This route was significantly revised from the 2012 FEIS, which followed the ARRC corridor for most of its length through the Goldstream watershed. The proposed Fairbanks Lateral route is no longer within the rail corridor, reducing visibility by rail passengers for much of this segment. MPs 24 to 33 of the Fairbanks Lateral are within a ½-mile of the railroad, and would likely remain at least partially visible.

The landscape in the vicinity of the Fairbanks Lateral is rolling hills covered by boreal forest. Although there is limited traffic along the Murphy Dome and other roads visible from the pipeline ROW, viewer sensitivity for the Fairbanks Lateral is moderate, due to the proximity of the route to Fairbanks. Viewers along the proposed route consist primarily of recreationists (*e.g.,* at Murphy Dome or Moose Mountain Ski Resort) and local residents.

4.17.4.2.6.1. Construction

Visual impacts during construction of the Fairbanks Lateral would be minor. Pipeline construction, staging areas, and increased traffic would alter the visual landscape only at specific site locations for the duration of construction within the segment. No construction work camps are proposed to be located along the Fairbanks Lateral.

4.17.4.2.6.2. Operations and Maintenance

Once constructed, the visual impact of the Fairbanks Lateral pipeline ROW would be minor. The ROW (which would be maintained in grasses or other low vegetation) would contrast with the boreal forest landscape; however, the ROW would be visible only to a

limited number of viewers, and much of the ROW would be routed through areas with existing visual contrast created by roads and residences. The proposed Project's visual impacts would be limited to undeveloped areas visible from the local roads or recreational areas.

4.17.5. Alternative 2 – Denali NPP Route Variation

This section evaluates the potential impact of Alternative 2 Denali NPP Route Variation (Figure 2.4-1) and associated proposed Project design measures on visual resources along the proposed Project corridor. Visual impacts resulting from Alternative 2 are summarized in Table 4.17-3.

Mainline Segments 2, 3, 4, and the Fairbanks Lateral segments would have the same proposed Project design and in turn, the same visual impacts in both Alternatives 1 and 2, and are therefore, not evaluated here. The placement of the pipeline on VSMs from MP 0 to 62 (Mainline Segment 1a), the aerial crossing of the Yukon River on a newly created suspension bridge (Mainline Segment 1b), and the Denali NPP Route Variation, would be the most substantial visual differences between Alternatives 1 and 2. Mitigation Measure Nos. 1 through 5, 9, 11, and 13 through 15, listed in Section 4.17.3, would help to minimize impacts during construction by minimizing the extent of the construction ROW and the visibility of construction activities and nighttime lighting. Mitigation Measure Nos. 1, 6 through 8, 10, 11, and 15 would help to minimize impacts during operations by maximizing use of existing roads, limiting construction of permanent roads, blending the pipeline into the existing natural landscape, and limiting nighttime glare.

4.17.5.1.1. Mainline Segment 1a - MP 0 and MP 62 (Aboveground)

Mainline Segment 1a, MP 0 to 62 of the pipeline (*i.e.,* GCF to TAPS PS2) (Figure 2.2-2 in Chapter 2, Alternatives) would be constructed above ground on VSMs. As described for Alternative 1, viewer sensitivity was considered moderate in this segment.

4.17.5.1.1.1. Construction

Construction of Alternative 2 would have moderate visual impacts, similar to those evaluated for Alternative 1.

4.17.5.1.1.2. Operations and Maintenance

The impact to visual resources under Alternative 2 for this segment would be moderate. While the TAPS route is already visible from the Dalton Highway, and creates visual contrast with the surrounding landscape, the proposed Project under Alternative 2 would add another aboveground linear feature, and would create more contrast than the below ground route in Alternative 1.

4.17.5.1.2. Mainline Segment 1b - MP 62 to MP 400, Including Yukon River Aerial Crossing

Mainline Segment 1b of Alternative 2 would be identical to Alternative 1, except that the pipeline crossing of the Yukon River would be via a newly constructed suspension bridge rather than using HDD (see Figure 2.4-3 in Chapter 2, Alternatives). As described above, viewer sensitivity is moderate in this segment, including at the Yukon River crossing, where viewers are primarily recreationists (on the Dalton Highway and on the Yukon River), residents, and commercial truck traffic.

4.17.5.1.2.1. Construction

Construction of Alternative 2 would have moderate visual impacts, similar to those that could result from Alternative 1. While construction of the aerial crossing at the Yukon River would require additional land area, compared to Alternative 1, this disturbance would still occur within a limited area, and for a limited time.

4.17.5.1.2.2. Operations and Maintenance

The visual impact of the proposed Project operations and maintenance would be moderate, due to the new visual contrast created by the aerial crossing of the Yukon River. This crossing would substantially alter views from the river and from the Dalton Highway, particularly from the Yukon River bridge.

4.17.5.1.3. Denali NPP Route Variation

The Denali NPP Route Variation would route the pipeline through a corner of Denali NPP (Figure 2.4-1 in Chapter 2 Alternatives), between Mainline (Alternative 1) MPs 535.8 and 543. The route would generally parallel the Parks Highway corridor into Denali NPP on flatter terrain, including through the developed commercial area just north of the northern park entrance. Both scenic quality and viewer sensitivity in Denali NPP and Denali State Park are generally high, based on high concentration of tourists during the summer season and Denali NPP's identity as a scenic resource. This characterization of viewer sensitivity is not necessarily true along Parks Highway itself. The Parks Highway is one of the state's major transportation routes, and runs adjacent to an active rail line. As described in Chapter 3, Section 3.13.4.5, Denali National Park and Preserve, the management areas crossed by the Denali NPP Route Variation generally incorporate some, if not a considerable amount of visible development and human activity. As a result, viewer sensitivity along the Parks Highway corridor and the Denali NPP Route Variation is moderate.

4.17.5.1.3.1. Construction

Visual impacts during construction of the Denali NPP Route Variation would be moderate. Although construction activities including pipeline construction, staging areas, and increased traffic would be expected to alter the visual landscape throughout the segment for the duration of construction, the segment is relatively short. While there

is a high concentration of viewers in the commercial area located north and south of the Denali NPP entrance, this area has extensive existing visual contrast (compared to undeveloped surrounding areas) that would limit the perception of visual contrast (and therefore impact) for tourists in these areas. No construction work camps are proposed to be located along the Denali NPP Route Variation.

As described in Section 4.17.4.2.4 for Alternative 1, nighttime construction would result in a low to moderate visual contrast with nighttime conditions during the tourist season for Denali NPP (mid-May to mid-September). During winter months, when dark nighttime skies are prevalent, only a limited number of residents and travelers would see nighttime construction lighting associated with the proposed Project.

4.17.5.1.3.2. Operations and Maintenance

Once constructed, the visual impact of the Denali NPP Route Variation pipeline ROW would be expected to be minor. The ROW would be clearly visible where the pipeline ROW would be collocated with or adjacent to the Parks Highway. In these areas, cleared ROW segments would contrast with surrounding forest. Views from Denali NPP itself would be limited, particularly from the visitor center and along Denali Park Road, where the highest sensitivity viewers would travel. The Denali NPP Route Variation (Alternative 2) would likely be less visible than Alternative 1 from these visitor-focused areas of Denali NPP.

As discussed in above for Alternative 1, AGDC provided photosimulations of the completed Denali NPP Route Variation (Alternative 2) from the Denali NPP. Figure 4.17-2 shows the view of the Denali NPP Route Variation from Parks Highway near the park's northern entrance, while Figure 4.17-3 shows the Denali NPP Route Variation along Parks Highway within Denali NPP prior to full vegetative regrowth. In both cases, the ROW is visible and noticeable, but is at least to some degree a visual extension of the existing road ROW. Because the ROW would follow the Parks Highway, the Denali NPP Route Variation would generally be less visible from viewpoints within Denali NPP (other than those on Parks Highway). For example, the Parks Highway is not visible on Figure 4.17-1 (AGDC did not provide an Alternative 2 simulation from that viewpoint).

As described in Chapter 3, Section 3.13.4.5, Denali National Park and Preserve, many of the simulated viewpoints are in areas of Denali NPP where evidence of human activity and development may be visible. As described in Section 3.13.4.4.1, Key Observation Points, the KOPs identified in Appendix K of the 2012 FEIS were assigned (for purposes of the 2012 FEIS) to BLM VRM Class II or III. Per Chapter 3, Section 3.13.4.1, BLM Visual Resources Management, those classes describe places where management activities may be visible, but should not attract attention or dominate the view.

Figure 4.17-2 View of Denali NPP Route Variation from Denali NPP Northern Entrance



Figure 4.17-3 View of Denali NPP Route Variation from the Parks Highway



4.17.6. Alternative 3 – No Action

Under Alternative 3 (No Action), the proposed Project would not be constructed, and therefore, there are no impacts presented in Table 4.17-3. As a result, there would be no impact on existing visual resources in the proposed Project Area.

4.17.7. Conclusions and Comparison of Alternatives

The impacts of Alternatives 1 and 2 are presented in Table 4.17-3. Alternative 1, with the pipeline buried below ground for the extent of the route, and the HDD crossing of the Yukon River, would have less impact to visual resources.

Figures 4.17-4 and 4.17-5 illustrate some of the key findings from the impact analysis for Alternatives 1 and 2, respectively. The figures provide context for the detailed description of the potential impacts of the alternatives, as provided in Section 4.17.4 (Alternative 1) and Section 4.17.5 (Alternative 2). The potential for visual impacts was generally evaluated within approximately 15 miles of the pipeline route, consistent with the farthest edge of the "background" distance zone, as defined in BLM's VRM system (BLM, 1986e). More detailed consideration was given to areas within 5 miles of the pipeline route, the foreground-middle ground, as defined in the VRM system (BLM, 1986e). These maps use the same color scheme as Table 4.17-4, and are intended to identify the overall findings related to visual impacts of the proposed Project. These findings include:

- Overall, visual impacts would be less than "major," as defined in Section 4.17.2.2.
- Visual impacts during construction are generally higher than during operations, due to the presence of construction activities, materials, equipment, OCs in the landscape, and work camps.
- The operations phase visual impacts of Alternative 2 would be slightly higher than for Alternative 1, due to the presence of VSMs between MP 0 and 62, as well as the aerial crossing of the Yukon River.

Table 4.17-4 Visual Impact, Comparison of Alternatives Summary (Direct & Indirect)

Segment	Description	Scenic Quality	Viewer Sensitivity	Alternative 1		Alternative 2		Alternative 3	
				Construction	Operations	Construction	Operations	Construction	Operations
				Impact Rating[a]		Impact Rating[a]		Impact Rating[a]	
Mainline Segment 1a	MP 0 to MP 62 (GCF to TAPS PS2)	*Major*	*Moderate*	*Moderate*	*Minor*	*Moderate*	*Moderate*	*Negligible*	*Negligible*
Mainline Segment 1b	MP 62 to MP 400 (TAPS PS2 to Livengood)	*Major*	*Moderate*	*Moderate*	*Minor*	*Moderate*	*Moderate*	*Negligible*	*Negligible*
Mainline Segment 2	MP 400 to MP 535 Livengood to Denali NPP	*Major*	*Moderate*	*Moderate*	*Minor*	*Moderate*	*Moderate*	*Negligible*	*Negligible*
Mainline Segment 3	MP 535 to MP 634 Denali NPP to Byers Lake in Denali State Park	*Major*	*Major*	*Moderate*	*Moderate*	*Moderate*[b]	*Moderate*[b]	*Negligible*	*Negligible*
Mainline Segment 4	MP 634 to End	*Major*	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*Moderate*	*Negligible*	*Negligible*
Fairbanks Lateral	Along Murphy Dome and Old Murphy Dome Roads	*Major*	*Moderate*	*Minor*	*Minor*	*Minor*	*Minor*	*Negligible*	*Negligible*
Denali NPP Route Variation	Mainline MP 536 to MP 543	*Major*	*Major*	*N/A*[c]	*N/A*[c]	*Moderate*	*Minor*	*N/A*[c]	*N/A*[c]

a Impact rating based on the integration of scenic quality, viewer sensitivity, and the impact components presented in Table 4.17-1: magnitude/intensity, geographic extent, duration/frequency, and likelihood.
b For Alternative 2, rating excludes the segment between MP 536 and 543 (*i.e.*, the segment replaced by the Denali NPP Route Variation.
c Not applicable—Alternatives 1 and 3 do not include the Denali NPP Route Variation.

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City or Village
ASAP v6.1 Mainline
FBX v4.1 Lateral (Belowground)
Areas Within 15 Miles (BLM foreground, middleground, and background) of the Proposed Mainline Pipeline Route with Potential Spur Pipeline Access (Excluding Fairbanks North Star Borough and Denali NPP)
Fairbanks North Star Borough
Denali National Park and Preserve

Effect Rating

Major Positive
Moderate Positive
Minor Positive
Negligible
Minor Negative
Moderate Negative
Major Negative

Effect Indicators

VIS: Increased visual contrast and reduced scenic quality

Beaufort Sea

MP 0
MP 100
MP 200
MP 300
MP 400
MP 500
MP 600
MP 700
MP 733

Anaktuvuk Pass (51.8 mi)
Wiseman (0.6 mi)
Bettles (28.8 mi)
Alatna (55.9 mi)
Allakaket (52.8 mi)
Stevens Village (18.0 mi)
Rampart (27.2 mi)
Livengood (4.5 mi)
Minto (18.7 mi)
Four Mile Road (0.3 mi)
Nenana (0.7 mi)
Two Rivers (24.6 mi)
Fairbanks (28.5 mi)
Pleasant Valley (29.1 mi)
Anderson (3.2 mi)
Healy (2.3 mi)
Ferry (5.9 mi)
McKinley Park (1.7 mi)
Cantwell (1.2 mi)
Petersville (15.8 mi)
Talkeetna (4.9 mi)
Skwentna (34.0 mi)
Willow (2.9 mi)
Susitna (9.7 mi)
Anchorage (17.2 mi)

U.S.A.
CANADA

Communities within 60 Miles
Construction: VIS
Operations: VIS

Fairbanks North Star Borough
Construction: VIS
Operations: VIS

Denali National Park and Preserve
Construction: VIS
Operations: VIS

Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

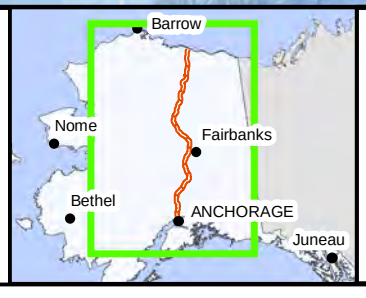
ERM

DATE: MAR 2018
CHKD: K.A.
DRWN: A.V.K.
PROJ. No.: 0416166

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Figure 4.17-4: VISUAL IMPACTS CONTEXT MAP, ALTERNATIVE 1
ALASKA STAND ALONE PIPELINE

0 30 60 120 180 Miles



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▲ City or Village

FBX v4.1 Lateral (Belowground)

Areas Within 15 Miles (BLM foreground, middleground, and background) of the Proposed Mainline Pipeline Route with Potential Spur Pipeline Access (Excluding Fairbanks North Star Borough and Denali NPP)

Fairbanks North Star Borough

Denali National Park and Preserve

Effect Rating

Major Positive

Moderate Positive

Minor Positive

Negligible

Minor Negative

Moderate Negative

Major Negative

Effect Indicators

VIS: Increased visual contrast and reduced scenic quality

Beaufort Sea

MP 0

MP 100

Anaktuvuk Pass (51.8 mi)

MP 200

Wiseman (0.6 mi)

Bettles (28.8 mi)

Alatna (55.9 mi)

Allakaket (52.8 mi)

MP 300

Stevens Village (18.0 mi)

Rampart (27.2 mi)

Livengood (4.5 mi)

MP 400

Minto (18.7 mi)

Four Mile Road (0.3 mi)

Nenana (0.7 mi)

Two Rivers (24.6 mi)

Fairbanks (28.5 mi)

Pleasant Valley (29.1 mi)

Anderson (3.2 mi)

MP 500

Ferry (5.9 mi)

Healy (2.3 mi)

McKinley Park (1.7 mi)

Cantwell (1.2 mi)

MP 600

Petersville (15.8 mi)

Talkeetna (4.9 mi)

Skwentna (34.0 mi)

MP 700

Willow (2.9 mi)

Susitna (9.7 mi)

MP 733

Anchorage (17.2 mi)

U.S.A.

CANADA

Communities within 60 Miles
Construction: VIS
Operations: VIS

Fairbanks North Star Borough
Construction: VIS
Operations: VIS

Denali National Park and Preserve
Construction: VIS
Operations: VIS

Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

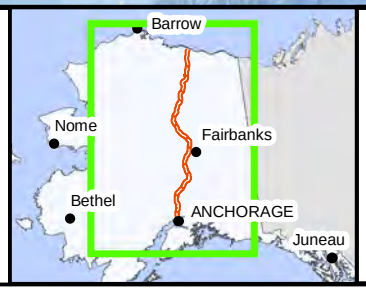
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CHKD: K.A.
DRWN: A.V.K.
PROJ. No.: 0416166

Figure 4.17-5: VISUAL IMPACTS CONTEXT MAP, ALTERNATIVE 2
ALASKA STAND ALONE PIPELINE

0 30 60 120 180 Miles



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4.18. Socioeconomics

4.18.1. Introduction

This section describes potential direct and indirect effects of the alternatives described in Chapter 2, Alternatives, on local and statewide socioeconomics. This section begins by outlining characteristics of the proposed Project that are frequently discussed in this section. This section then describes what information was incomplete or unavailable and how that has influenced this analysis, describes the methods for determining the level of impact to socioeconomics, and presents the results of the assessment. This section describes some of the mitigation measures that would aid in avoiding or minimizing the potential impacts. Additional information on proposed mitigation and monitoring is provided in Appendix M. The information used in this section builds on the 2012 FEIS (USACE, 2012a) and incorporates new data and information relevant to environmental concerns associated with the alternatives that have become available since the original 2012 FEIS document. While this assessment tiers from the 2012 FEIS, importantly, the proposed changes in route and design described for Alternative 1 are emphasized. In some instances, information from the 2012 FEIS is replicated with relatively minor changes and updates, while other material is entirely new or substantially altered. For this SEIS, the following elements have been added to the assessment of impacts to socioeconomics:

- A new section (Section 4.18.2, Methods) was added to explain the procedures used to evaluate the potential impacts associated with the proposed Project and alternatives;
- Mitigation measures were carried over from the 2012 FEIS and expanded upon to include new proposed Project information and recommendations from federal and state agencies; and
- Impact evaluations have been revised based on changes in the proposed Project description and alternatives.

4.18.1.1. Incomplete or Unavailable Information

In compliance with CEQ guidance (see Section 4.3), this section addresses incomplete or unavailable information pertinent to analyzing impacts of the alternatives on socioeconomics. Assessments for this SEIS are made based on the most updated and accessible documents. When specific information could not be obtained, more generalized information is incorporated and a statement of the relevance of this information, as well as any implications of the data with regard to analyzing the alternative, are described below.

- Where detailed community level information could not be obtained, borough-specific information is used for a more generalized assessment. The relevance of this information when evaluating socioeconomic factors is described throughout the text.

- The U.S. Census Bureau provides updated socioeconomic data every 10 years. In most cases, the most recent socioeconomic data available is the data gathered for the 2010 census.
- In some cases, more recent estimates are available. These estimates are likely more representative of the current socioeconomic situation than the 2010 U.S. Census Bureau information, as they account for estimated population growth; however, some accuracy is lost in making these predictions.

4.18.2. Methods

The potential socioeconomic impacts for the proposed Project presented below are based on the evaluation of the socioeconomic indicators along the Mainline and Fairbanks Lateral as presented in Chapter 3, Section 3.14, Socioeconomics, review of available proposed Project descriptions and reports, and public comments received after the publication of the 2012 FEIS.

This section describes the known changes to the affected environment for socioeconomic indicators since release of the 2012 FEIS, and describes the anticipated changes in impacts to socioeconomics based on the revised proposed Project description. Specific changes in the proposed Project description from the 2012 FEIS that affect socioeconomic indicators include:

- The total cost of the proposed Project has increased from $4 billion projected in the 2012 FEIS, to $9.9 billion as a result of changes to and refinements in the proposed Project description;
- Use of enriched gas rather than Natural Gas Liquids (NGLs) has resulted in an increase from 24-inch to 36-inch diameter pipeline and precludes the need for compressor stations or a NGL extraction facility;
- The number of employees required and housing provided for these employees during construction, operation and maintenance of the pipeline has been revised to reflect the changes in the proposed Project description; and
- Anticipated number of material sites has been revised from pre geological testing determination of 546 material sites (13.1 MCY gravel) to 89 material sites (25 MCY gravel)

The analysis has been revised to reflect the current socioeconomic conditions, provided in Chapter 3. Recent data was acquired from the U.S. Census Bureau, the Alaska Department of Labor and Workforce Development (ADOLWD), and various recent publications.

4.18.2.1. Project Activities Causing Potential Impacts

This section summarizes proposed Project activities that may result in potential impacts to socioeconomic resources. These impacts are summarized in Table 4.18-1, Types of

Effects and Impacts on Socioeconomic Resources. Impacts generally include changes to the following socioeconomic factors as a result of the proposed Project:

- Population trends, projections and demographics: The influx and outflow of non-permanent workers during the construction phase (temporary) and employees associated with operations and maintenance (permanent) of the pipeline and associated facilities would result in an increase in local population, respectively.
- Employment and employment income: The temporary and long-term employment requirements to construct and operate the proposed Project would affect the employment base, competition, services (increases and fluctuations), per capita income, and unemployment rates locally and statewide.
- Housing and property values: Pressure on existing housing availability by employees that do not reside in construction camps could impact availability during the operations phase of the proposed Project and the proximity of the proposed Project features to existing properties could affect property values.
- State and local government revenues and expenditures: Local revenue would be generated through local taxes and state revenues would increase as a result of state property tax revenues, corporate income tax, royalties for lease of mineral rights, and property tax on oil and gas infrastructure. Expenditures would include the cost to construct and maintain the pipeline as well as government funded infrastructure improvements in the form of new infrastructure needed to access natural gas supplied by the proposed Project or in the form of improvements to existing infrastructure as a result of degradation due to increased use.
- Infrastructure and services: Development of the proposed Project would place increased pressure on existing infrastructure and services resulting in impacts to the users of these services. The costs to residents for infrastructure upgrades necessary to access the natural gas supplied by the proposed Project are also discussed.
- Energy supply and demand: The increased energy supply would affect the cost of the natural gas energy supply resulting in impacts to the cost of living and may result in decreased demand for existing sources of home heating energy supply (*e.g.*, heating oil, wood, or electricity as described in Chapter 3, Section 3.14, Socioeconomics).

4.18.2.2. Environmental Justice

According to the 1997 CEQ guidelines, federal agencies must evaluate whether a proposed Action would have a disproportionately high adverse impact on low-income populations, minority populations or Indian tribes due to a proposed Action (CEQ, 1997). Analysis of potential impacts may rely on available demographic data from credible sources such as the U.S. Census. Section 4.18.5.3, below, identifies potentially affected census tracts that exhibit low-income populations or concentrations of minority populations, including Alaska Native or American Indian populations. The impact

criteria presented throughout Chapter 4 of this SEIS may be compared to the information presented in this section to determine if those impacts have a disproportionately higher adverse impact on low-income, minority, or Alaska Native or American Indian populations.

4.18.2.3. Direct and Indirect Effects

The direct socioeconomic impacts of the proposed Project are assessed in terms of changes in demographic, economic, and fiscal indicators caused by the proposed Project and occurring at the same time and place as the proposed Project. Effects to the 31 PACs within 60 miles of the Mainline pipeline described in Chapter 3, Section 3.14, Socioeconomics, are considered to be within the area directly affected by the proposed Project. These communities could potentially access natural gas directly by constructing their own spur-line to tie into the Mainline at an offtake point. The temporal scope considered in the SEIS for direct effects is 10 years.

Indirect effects are defined as those effects "caused by an action and are later in time or farther removed in distance but are still reasonably foreseeable." The indirect impacts of the proposed Project would include impacts to communities greater than 60 miles from the Mainline that could access gas indirectly through the existing infrastructure in the Fairbanks, Anchorage, and Kenai areas, or through truck transport. Indirect impacts also include changes in socioeconomic indicators (*i.e.,* population, employment, income, and government revenues and expenditures) resulting from indirect activities. As described in the 2012 FEIS, the NGL fractionation facility that was part of the original proposed Project design could produce fuel products for customers along the Alaska Highway system in the form of propane and butane. Under the current proposed ASAP Project design, the NGL fractionation facility would not be constructed; therefore, propane and butane would not be produced. However, the transportation of compressed natural gas (CNG) by truck to highway-accessible communities in the state is similar to the delivery of propane described in the 2012 FEIS and is considered a method of access in this analysis. CNG could also be distributed to rural Alaska communities via the Yukon and Tanana rivers or by marine barges from Cook Inlet. In-state spending that results from proposed Project revenues are considered indirect effects; these are the additional economic effects (*i.e.,* jobs and income) generated by the infusion of money into the local and state economy resulting from the proposed Project payments to local business, local workers and state and local government revenues.

Table 4.18-1 presents a summary of types of effects and impacts that the proposed Project would have on the social and economic environment. This analysis takes into account the economic and distributional effects of the alternatives and their associated elements. The impacts identified are translated into measures of overall expected changes in jobs, income, housing, state and municipality revenues, and public health.

The analysis of socioeconomic effects also discusses the distribution of effects of the proposed Project (*e.g.*, what human populations are likely to be affected and how, where

the effects would occur, and what businesses or industries would be advantaged or disadvantaged).

Table 4.18-1 Types of Effects and Impacts on Socioeconomic Resources

Type of Effect	Proposed Action Causing Potential Impact	
	Construction	Operations and Maintenance
Population Trends and Projections	Influx of non-permanent worker during construction phase	Population from employees associated with operations and maintenance of facilities
Employment • Effect on employment base • Effect on per capita income • Effect on employment income • Unemployment	Additional temporary workers for the duration of the construction phase of the proposed Project	Additional workers for the operations and maintenance period of the proposed Project
Housing and Property Values • Housing availability • Effect on property values	• Influx of non-resident construction workers during construction period • Pipeline construction and aboveground facilities effect on property values	• Operations and maintenance personnel would require housing for the duration of operations and maintenance • Pipeline construction and aboveground facilities effect on property values
Revenue and Expenditures • Local taxes: gravel tax, bed tax, sales tax, alcohol and tobacco tax, property tax • Local expenditures for pipeline tie-in, infrastructure improvements • State taxes: production tax, corporate tax, royalties, property tax • State expenditures for pipeline tie-in, infrastructure improvements	• Additional temporary workers for the duration of the construction phase of the proposed Project contribute to local bed tax, sales tax, alcohol and tobacco tax, property tax, increase in grocery store and general household good purchases • Project need for gravel would contribute to local revenues through gravel tax • Local expenditures for pipeline tie-in, infrastructure improvements	• Local expenditures for pipeline tie-in, infrastructure improvements • Additional local taxable proposed Project infrastructure/property • Natural gas and oil production taxes (based on net value of gas) • Royalties for lease of mineral rights (agreed value of gas, volume of gas removed and royalty rate) • Corporate income taxes based on total proposed Project values
Infrastructure and Services • Increased use of air and ground transportation • Pressure on government services • Cost of natural gas utility conversion to residents	• Construction material transport and influx of construction workers increase use of air and ground transportation • Increased activity and construction employees require public services • Access to natural gas requires utility conversions	Access to natural gas requires utility conversions

Type of Effect	Proposed Action Causing Potential Impact	
	Construction	Operations and Maintenance
Increased Energy Supply • Access via new and existing infrastructure • Indirect affects to other energy suppliers		• Access via Fairbanks Natural Gas, LLC and Interior Gas Utility Systems • Access via ENSTAR Distribution System • Access via truck or barge • Access via new infrastructure • Indirect affects to heating oil producers

4.18.2.4. Impact Criteria

Potential impacts for this SEIS were analyzed by assessing the magnitude, extent, duration and likelihood of occurrence as presented in Table 4.18-2, Impact Criteria for Socioeconomics. The potential impacts to each socioeconomic indicator (*e.g.*, population, employment, etc.) are rated individually in terms of the criteria provided below.

Table 4.18-2 Impact Criteria for Socioeconomic Resources

Impact Component	Impact Level			
	Major	Moderate	Minor	Negligible
Magnitude or Intensity	The effect would alter a socioeconomic resource in terms of its value, quantity, quality, and uses to the point that it could not be used, or would degrade, remove, destroy or increase the cultural, social, financial or public health importance of the resource.	The effect would indisputably alter a socioeconomic resource in terms of its value, quantity, quality, and uses, but would allow the resource to be used without removing, degrading, destroying its social, cultural, financial or public health value.	The effect would visibly or measurably alter a socioeconomic resource in terms of its value, quantity, quality, and uses without removing, degrading, destroying its social, cultural, financial or public health value.	No or minimal perceivable effect.
Geographic Extent	The effect would occur on a statewide or national basis, or throughout the study area.	The effect would occur at a borough or community level, or on a limited portion of the study area.	The effect would be site specific or occur within a few isolated locations.	The effect would be limited to a specific, contained location.
Duration or Frequency	The effect would occur for greater than 10 years' duration or through operations of the proposed Project. Chronic and long-term changes not likely to be reversed during operations.	The effect would occur intermittently and/or for 1 to 10 years' duration. Periodic, temporary, or short-term changes could be reversed during the operation phase.	The effect would occur intermittently and/or less than 1 year duration. Periodic, temporary, or short-term changes that are reversible.	The effect, if perceived, would be limited to less than 1 month duration.

Impact Component	Impact Level			
	Major	Moderate	Minor	Negligible
Likelihood	Most likely (Effects are those that have greater than 75% chance of arising from reasonable or demonstrated mechanisms due to the action)	Likely (Effects are those that have greater than 50% to 75% chance of arising from reasonable or demonstrated mechanisms due to the action)	Somewhat likely (Effects are those that have a 10% to 50% chance of arising from reasonable or demonstrated mechanisms due to the action)	Unlikely (Effects are those that have less than 10% chance of arising from reasonable or demonstrated mechanisms due to the action)

4.18.3. Applicant-Proposed Design Features, Mitigation Measures, Best Management Practices, and Project Management Plans

The following mitigation measures are proposed by AGDC, and have been taken into consideration when evaluating potential impacts on socioeconomic factors under Alternatives 1 and 2 during the construction and operations phases. A complete list of mitigation measures and BMPs are also provided in Appendix M.

AGDC proposes to implement the following measures to mitigate effects on socioeconomics (USACE, 2012a):

1. Time construction activities to minimize impacts to high-use tourist and local recreation seasons (*e.g.*, wildlife viewing, hunting, snow machining, and dogsledding).
2. Time construction activities to minimize impacts to local business (*i.e.*, avoid summer and fall construction in recreational and tourist areas).
3. Develop and implement traffic control plans to minimize negative impacts to local businesses resulting from blocking access during construction.
4. Identify and promote work opportunities for local residents.
5. Develop training programs for local residents so that they could be employed during construction and operations and maintenance.
6. A highway use agreement would be in place prior to construction, and would be an agreement between AGDC and ADOT&PF for how impacts to infrastructure caused by construction would be mitigated.
7. Avoid locating construction support facilities (*e.g.*, construction camps) in places with special visual resource values that would be observable to the general public, which would reduce the visual impact of these facilities and any associated impacts on private property value (UASCE, 2012a).

4.18.4. Alternative 1 – Proposed Action

The proposed Project includes a GCF capable of producing an annual average 500 MMscfd of utility-grade natural gas at peak capacity and a 733-mile long, 36-inch-

diameter natural gas transmission Mainline extending from the GCF near Prudhoe Bay, south to a connection with the existing ENSTAR pipeline system in the Mat-Su Borough. An approximately 30-mile-long, 12-inch-diameter lateral pipeline would connect the Mainline to Fairbanks. The Fairbanks Lateral would transport gas to the existing and planned distribution systems of both the Fairbanks Natural Gas, LLC (FNG) and the Interior Gas Utility (IGU), a municipally owned utility formed in 2012 by the FNSB, the City of Fairbanks, and the City of North Pole (MWH Americas, 2014).

The pipeline is expected to begin operating in 2026. While the design life and the amount of gas reserves available on the North Slope may extend beyond 30 years and the design life of the pipeline is a minimum of 30 years, the timeframe for the SEIS analysis is defined as 2018 through 2038, approximately 10 years into operation of the pipeline. The proposed construction spread (*i.e.*, schedule) for the pipeline is presented in Chapter 2, Table 2.2-7, Alternative 1: ASAP Construction Spread Plan. Pipeline construction is projected to last 2.5 years.

This section discusses and rates the potential impacts of construction and operation of proposed Project Alternative 1 on socioeconomics. Results of the impact ratings are presented in Table 4.18-23.

4.18.4.1. Construction

4.18.4.1.1. Population

Influx and outflow of non-permanent workers during the construction phase of the proposed pipeline could result in impacts to population trends. Non-resident construction workers would temporarily increase the population in the proposed Project Area by up to 5,962 total employees at any one time, as indicated by the employment totals provided in Table 4.18-3. In addition, approximately 130 employees would be required to construct the GCF.

Table 4.18-3 Pipeline Craft Labor by Season

Location	Mainline							Fairbanks Lateral	
	Pre-construction		Year 1		Year 2		Year 3	Year 2	Year 3
Season	Summer -0.5	Winter 0	Summer 0.5	Winter 1	Summer 1.5	Winter 2	Summer 2.5	Summer 1.5	Summer 2.5
Pipeline Employees	954	119	3,564	3,697	5,962	4,165	3,923	100	400

Source: AGDC, 2016h
Summer construction (May 1 through October 31)
Winter construction (November 1 through April 30)

Given the extreme remoteness of the areas traversed by the proposed Project, it is anticipated that most of the Mainline construction workers would reside in work camps and travel to and from these camps primarily using air or bus transportation to either Fairbanks or Anchorage. Population increase is expected to be concentrated in areas where construction camps are located as shown in Table 4.18-4.

Table 4.18-4 ASAP Camp Locations and Approximate Capacities

Camp Name	Camp Location[a] (Milepost)	Camp Capacity[a]	Estimated Maximum Population Increase (Summer, Year 2)[b]	Estimated Average Population Increase (Year 1-3)	Area	Borough Population (2010)[c]	Maximum Population Increase due to ASAP Project[d]	Average Population Increase due to ASAP Project[e]
GCF	0.0	800	450	136	NSB	9,430	17%	6%
Franklin Bluffs	43.6	600	337	102				
Happy Valley	85.2	1,000	562	170				
Galbraith Lake	142.6	1,000	562	170				
Dietrich	205.7	1,000	562	170	YKCA	5,590	32%	11%
Prospect	278.0	1,000	562	170				
Five Mile	351.9	1,000	562	170				
Livengood	400.0	1,000	562	170				
Dunbar	455.0	600	337	102				
Healy	527.7	1,000	562	170	Denali Borough	1,830	33%	19%
Cantwell	566.7	600	337	102				
Swan Lake	645.4	1,000	562	170	Mat-Su Borough	89,000	<1%	<1%
Rustic Wilderness	700.5	1,000	450	136				
Fairbanks	N/A	N/A	400	350	FNSB	97,580	<1%	<1%

a AGDC, 2016b
b This total is conservative in that it assumes camp capacities are met and assumes all employees are brought in from other locations.
c U.S. Census Bureau, 2010a.
d The estimated maximum population increase is based on the maximum employee requirement of 5,962 employees for the complete alignment (summer, year 3). The maximum population increase was estimated under the assumption that camps would be filled at an equal rate using the ratio of each individual camp capacity to the overall camp capacity of 10,600 throughout the proposed Project Area.
e The estimated average population increase is based on the average employee requirement of 3,198 employees (year 1-3). The average population increase was estimated under the assumption that camps would be filled at an equal rate using the ratio of each individual camp capacity to the overall camp capacity of 10,600.

The most significant potential population increase would be in the Denali Borough, where the average population increase would be an average of 19 percent and a maximum of 33 percent. Population impacts are also particularly noticeable in the YKCA, where the average population increase would be 11 percent with a maximum of 32 percent. These boroughs would be impacted by the increased population to a greater extent than the North Slope or Mat-Su boroughs because of their potentially smaller increase to existing populations.

Table 4.18-5 provides a summary of nearest communities to each camp within 60 miles of the proposed Project and their respective populations.

Table 4.18-5 Summary of Nearest Communities to Each Camp within 60 Miles of the Proposed Project[a]

Camp	Borough	Community	2013 Population
Galbraith Lake Camp	NSB	Anaktuvuk Pass	358
Franklin Bluffs Camp		Prudhoe Bay (includes Deadhorse)	2,527[b]
GCF			
Happy Valley Camp			
Prospect Camp	YKCA	Evansville	2
Dunbar		Four Mile Road	26
Five Mile Camp, Livengood Camp		Livengood	14
Dietrich Camp		Wiseman	15
Cantwell Camp	Denali Borough	Cantwell	196
Healy Camp		Healy	1,066
Swan Lake Camp	Mat-Su Borough	Trapper Creek	475
Rustic Wilderness Camp		Wouldow	2,118

a ADOLWD, 2014a
b Deadhorse is not listed as an incorporated city by the ADOLWD, so the population of the Prudhoe Bay Census Tract is provided.

The nearest community to Happy Valley Camp is Deadhorse, which is approximately 75 miles away. As Deadhorse is not listed by the ADOLWD as an incorporated city, the population of the Prudhoe Bay census area (Figure 3.14-2) is provided. Several thousand transient workers support the Prudhoe Bay oil field and utilize the airport, lodging, and general store, which are located at Deadhorse. The camps would provide adequate lodging and amenities for all Mainline pipeline employees so the population increase is not expected to significantly impact these nearby communities. Workers would reside in the camps and are expected to only occasionally utilize outside services, which includes one general store/post office, as well as government services. Communities with smaller populations, such as Evansville, Four Mile Road, Livengood, and Wiseman, would likely see a larger impact due to the increased population as their existing populations range from 2 to 26 people.

Employees working on the Fairbanks Lateral would not be provided with housing and would rely on available housing within the community. The expected increase in population in the Fairbanks North Star Borough is an average of 350 people over years 2 and 3 of construction, and a maximum of 400 people during year 3. This increase in population accounts for approximately 0.4 percent increase in population.

4.18.4.1.1.1. Impact Summary

Impacts of the proposed Project construction on population would result in an overall, moderate impact, as provided in Table 4.18-6.

Table 4.18-6 Impacts of the Proposed Project Construction on Population

Impact Component	Impact Level
	Moderate
Magnitude or Intensity	• Populations are expected to increase at a maximum of 1% to 33% and an average of less than 1% to 19%. Although populations would increase significantly the magnitude of the effect is expected to be minimal as camp accommodations would be provided for all employees. • Communities with smaller populations such as Evansville, Bettles, Four Mile Road, Livengood, and Wiseman would likely see a larger impact due to the increased population as their existing populations range from 2 to 26 people.
Geographic Extent	• The population increase would affect the NSB, YKCA, Denali Borough and Mat-Su Borough. This would be most notable in Denali Borough and the YKCAs, where the existing population is small. • Communities located within 60 miles of a proposed camp location with smaller populations, such as Evansville, Bettles, Four Mile Road, Livengood, and Wiseman, would likely see a larger impact due to the increased population as their existing populations range from 2-26 people. These larger geographic extent impacts would be localized to the communities listed.
Duration or Frequency	• Populations are expected to increase for 2.5 years, reaching a peak during summer of Year 3.
Likelihood	• This analysis assumes that the increase in population described in this section is most likely.

4.18.4.1.2. Employment

Employment estimates for pipeline construction are provided in Table 4.18-4. Based on the information provided in this table, it is expected that an average of 3,198 employees would be required to construct the Mainline over the 2.5-year construction period with maximum of 5,962 employees required to construct the Mainline during summer of Year 3. A total of approximately 500 employees would be required to construct the Fairbanks Lateral, and construction labor required for the GCF is estimated to be at approximately 130 personnel over the 2.5-year construction period (AGDC, 2016b). As provided in Table 4.18-7, below, it is anticipated that a maximum of 6,630 construction employees would be on-site at any given time.

Table 4.18-7 Total Maximum Construction Employment Estimates

Proposed Action	Total Employment
Mainline	6,000
Fairbanks Lateral	500
Gas Conditioning Facility	130
MVLs/Pig Launchers	Included in Mainline construction estimates
Operations and Maintenance Buildings	Unknown, potentially included in other facility estimates
Total	**6,630**

4.18.4.1.2.1. Effect on Employment Base

The 2010 Nonresidents Working in Alaska report (issued in January 2012) prepared an extensive table of the percentages of nonresident workers (by job type) for pipeline-related occupations (ADOLWD, 2012b). In 2010, approximately 30 percent of workers employed in Alaska, in oil and gas were nonresident (ADOLWD, 2012b). The percentage of state resident versus non-residents that would be employed by the proposed Project depends on several factors.

- Economic opportunities in Alaska compared to other states: Chapter 3, Figure 3.14-4 and Table 3.14-9 show historical unemployment data for Alaska and the Nation overall. Figure 3.14-4 presents the unemployment rate for the proposed Project Area, Alaska, and the U.S. Between 2004 and 2008, the U.S.' unemployment rate was consistently lower than Alaska and the proposed Project Area. Between 2009 and 2014, however, unemployment rates in Alaska, and the proposed Project Area specifically, are lower than the U.S. as a whole. According to recent data from the Bureau of Labor Statistics (BLS), the U.S. unemployment rate has dropped to 5.5 percent in May of 2015, making the national unemployment rate lower than Alaska's rate of 6.7 percent in April 2015. Additionally, the recent drop in oil prices could result in increased unemployment rates for the state, increasing the need for employment opportunities for residents.
- Local regulations and initiatives: The ADOLWD designs initiatives to increase opportunities for residents including employment training, education, and regulatory enforcement. Incentives or regulations regarding resident hire at the time of pipeline construction would affect the number of residents employed.
- The work rotation schedule: The work rotation schedule could impact how many workers are Alaska residents. Work cycles of 1-week on, followed by a period of leave, for example, tend to encourage local residency because the annual cost of air transportation out of Alaska would be relatively high. Alternatively, a 4-week cycle would reduce the potential annual trips substantially and potentially encourage workers to maintain out of state residency. The work rotation schedule for proposed ASAP Project has not yet been determined.

Alaska residents made up 79.2 percent of all workers in 2014 and earned 84.4 percent of wages. In 2014, nonresidents accounted for 35.0 percent of oil industry workers. If

nonresident employment for the proposed Project are assumed to reflect that of the oil and gas sector in 2014, then approximately 35 percent of the workers would be nonresidents (ADOLWD, 2016b). AGDC would identify and promote work opportunities for local residents and provide training programs for local residents (USACE, 2012a).

As shown in Table 3.14-4, the percent of employed Alaska residents currently employed by the mining industry (which includes the oil and gas industry) is 4.9 percent and according to Table 3.14-5, the total number of Alaska residents employed in 2013 was 307,987. This assumes 65 percent (4,310) of the maximum 6,630 workers employed by the proposed Project are Alaska residents. Hence, the total number of residents employed by the oil and gas industry would increase by 1.4 percent.

Workforce needs for the proposed Project include: Craft labor (*e.g.,* carpenters, electricians, and welders), equipment operators, material handling (*e.g.,* laborers, movers and order clerks), logistics (*e.g.,* drivers and dispatchers), administration, camps/catering, engineering, environmental, and safety. The need for personnel with specialized skillsets may result in impacts to other industries that require these same specialties.

4.18.4.1.2.2. Effect on Per Capita and Employment Income

Table 4.18-8 provides the average employment income for Alaska residents working in the mining industry (which includes the oil and gas industry).

Table 4.18-8 Employment Earnings by Industry, 2013

Area	Employee Earnings in the Mining Industry	Employee Earnings Average (All Industries)	Percent Increase for the Mining Industry
Denali Borough	(D)	$55,473	N/A
FNSB	$69,627	$63,131	10%
Mat-Su Borough	$9,671[a]	$46,954	Not assessed[a]
NSB	$148,355	$121,177	22%
YKCA	$43,348	$44,843	-3%
State of Alaska	$118,052	$64,937	82%
U.S.	$103,753	$55,768	86%

Source: Bureau of Economic Analysis (BEA), 2014
(D) = Not shown to avoid disclosure of confidential information
a The average employment earnings for the Mat-Su Borough are shown as reported by the BEA although the earnings are significantly less than the average across all industries for the borough indicating a potential error in the data.

The average employment income for Alaska residents working in the mining industry in 2013 was $118,052, which is significantly higher than the statewide employment earnings average employment income of $64,937. According to this data, the proposed Project would likely result in an increase in employment income for the approximately 4,310 Alaska residents that are currently employed in other industries. Out of state employees would likely experience an increase in employment income as well as both

the mining industry, and the industry-wide earnings in Alaska are higher than the nationwide earnings.

The average employment income for residents of the boroughs traversed by the proposed Project is $66,316, and $87,110 for those employed by the mining industry. Note that this average excludes the value reported for mining industry earnings for the Mat-Su Borough, as the average employment earnings for the Mat-Su Borough reported by the BEA are significantly less than the average across all industries for the borough indicating a potential error in the data. The proposed Project would likely result in a significant increase in employment earnings for those hired locally.

The additional income could have both positive and negative effects on communities. While increased income may lead to improved quality of life, income spent on drugs, alcohol, or gambling may result in negative effects to the community by adding to existing social problems.

4.18.4.1.2.3. Unemployment

Although Alaska's 2014 unemployment rate of 6.4 percent remained slightly lower than the national average of 7.4 percent at that time (BLS, 2015), the recent decrease in oil prices may drive the unemployment rate higher. The ADOLWD predicted in its October 2015 employment forecast that oil and gas extraction employment in the state would decrease from 4,201 jobs to 3,785 jobs by 2024, a decrease of 10 percent. With a need for several thousand employees across a variety of skillsets, the proposed Project could have a positive impact on employment in the state.

4.18.4.1.2.4. Local Businesses

Local business may benefit from the increased demands of pipeline employees as well as corporate demand for industry suppliers for pipeline construction goods. Direct materials expenditures related to construction would have an immediate impact on Alaska's economy as well as the local economies of the communities within the proposed Project Area. These increased demands may result in a decreased availability or increased cost of these goods and services for residents due to the increased demand.

The direct impacts on employment, income, and expenditures as a result of the proposed Project construction would contribute towards compounding income creation, spending, and re-spending.

4.18.4.1.2.5. Impact Summary

The impacts of the proposed Project construction on employment would result in an overall, major positive impact, as provided in Table 4.18-9.

Table 4.18-9 Impacts of the Proposed Project Construction on Employment

Impact Component	Impact Level
	Major Positive Impact
Magnitude or Intensity	Nonresident employment for the proposed Project is assumed to be approximately 35% based on the oil and gas sector in 2014. This would provide employment for an estimated 4,310 Alaska residents, an increase of approximately 1.4% of the total number of residents employed by the oil and gas industry in 2013. In addition, income for jobs in the mining sector are approximately 82% greater on average, than the average employment income in Alaska.
Geographic Extent	As employees with specialized skillsets would be required, employees would be hired locally as well as throughout Alaska and nationally.
Duration or Frequency	Benefits to employment for pipeline construction would be short-term over the 2.5-year construction period.
Likelihood	It is most likely that the proposed Project would result in employment as described in this section.

4.18.4.1.3. Housing and Property Values

4.18.4.1.3.1. Housing Availability

Lodging needs would be provided for Mainline construction employees by stationary construction camps (SCCs) for most work locations as shown in Table 4.18-4. The SCCs would be erected along the proposed Mainline and would house proposed Project personnel, including construction workers, management, agency staff, and support service personnel. This is a modification from the 2012 FEIS, which eliminates the need for workers to reside in local lodging in Wasilla. Mobile construction camps would be used during the construction preparation phase, or preconstruction. As construction worker housing needs would be met by AGDC (except in the Fairbanks area), there is no expected increased demand for local housing during pipeline construction, and therefore, no expected changes in housing market conditions.

It is anticipated that workers constructing the Fairbanks Lateral within the FNSB portion and the YKCA portion would reside in the Fairbanks area and find their own housing that meets health, safety, security and environmental requirements for personnel. A maximum of 400 workers would require accommodations at any one time, although a number of these workers could be existing FNSB residents. FNSB has a vacancy rate of 12.8 percent for a total of 5,530 vacant homes. In addition, there are numerous motels, RV parks, and other short-term lodging in FNSB. Thus, housing availability in FNSB would be expected to meet the needs of the employees of the proposed Project. Depending on the time of year of construction, this could decrease the availability of such lodging options for tourists, but would have little to no expected effect on the housing market. AGDC would avoid locating construction support facilities (such as construction camps) in places with special visual resource values that would be observable to the general public. This would reduce the visual impact of these facilities and any associated impacts on private property value (USACE, 2012a).

4.18.4.1.3.2. Affect to Property Values

Construction of the Mainline pipeline is not expected to affect property values as it is a temporary impact. Long-term impacts of the proposed pipeline on property values are discussed in Section 4.18.4.2.3, Housing and Property Values.

4.18.4.1.3.3. Impact Summary

The overall impact of the proposed Project construction on housing is expected to be moderate, as provided in Table 4.18-10.

Table 4.18-10 Impacts of the Proposed Project Construction on Housing

Impact Component	Impact Level
	Moderate
Magnitude or Intensity	Lodging needs in the FNSB could impact the availability of lodging options for recreationists and tourists, but would have little to no expected effect on the housing market during the construction period if they already reside in the Fairbanks area. Impacts in lodging options for visitors are expected to be minor.
Geographic Extent	The proposed Project is not expected to affect housing availability in any PACs. Housing could be impacted within the FNSB during construction of the Fairbanks Lateral.
Duration or Frequency	Effects on housing availability are expected to last 2 years throughout construction of the Fairbanks Lateral.
Likelihood	The housing impact on the FNSB described in this section is most likely.

4.18.4.1.4. Government Revenue and Expenditures

Government revenues during construction of the proposed Project include, local sales tax, and local gravel tax. Expenditures include the cost of pipeline construction and operation as well as increased expenditures that may be required to support police, fire, medical, and human services. Local taxes imposed by boroughs traversed by the pipeline and communities that are within 60 miles of proposed worker housing are provided below in Table 4.18-11. The only community that is within 60 miles of a proposed camp location that imposes local taxes is Anaktuvuk Pass, which has been included in the table for this reason. Fairbanks and North Pole have been included as pipeline employees would reside in local housing throughout the FNSB. YKCA does not impose any local taxes as it is not an organized borough.

Table 4.18-11 2015 Municipal Sales Taxes, Special Taxes, and Revenues

Borough or Community	Sales		Bed Tax		Alcohol Tax		Tobacco Tax (Wholesale Rate)	
	Tax	Revenue	Tax	Revenue	Tax	Revenue	Tax	Revenue
NSB	0%	$0	N/A	N/A	0%	0	0%	0
Anaktuvuk Pass	3%	$0	N/A	N/A	0%	0	3%	0
Denali Borough	7%	$3,318,321	N/A	N/A	0%	0	0%	0
Mat-Su Borough	0%	$0	N/A	N/A	0%	0	55%	$7,548,977
FNSB	0%	$0	8%	$1,746,676	5%	$998,195	8%	$1,470,899
Fairbanks	0%	$0	8%	$2,712,661	5%	$2,239,679	8%	$887,239
North Pole	4%	$2,675,696	8%	$82,374	5%	$211,997	8%	$132,228

Source: ADR, 2016b
Local municipality rates may be in addition to borough rates, or exclusive of; depending on the local municipality

4.18.4.1.4.1. Gravel Tax

Material sites would result in tax revenues for the Denali Borough as it levies a $0.09-per-cubic-yard gravel tax. According to Table 2.2-5 in Chapter 2, approximately 3.65 MCY of gravel would be required from material sites located within the Denali Borough, which would equate to a revenue of approximately $328,500 for the Denali Borough.

4.18.4.1.4.2. Local Bed Tax

The current proposed Project peak workforce for the Fairbanks Lateral is 500 employees, which would be housed in local lodging. According to the City of Fairbanks Ordinance No. 5857, the City of Fairbanks imposes an 8 percent bed tax on hotels and motels. This tax funds services for the tourist industry, economic development, and the public. Total bed tax revenues would depend on the number of construction workers employed during construction that do not reside in the FNSB.

4.18.4.1.4.3. Local Sales Tax

Denali Borough and the communities of North Pole and Anaktuvuk Pass implement a sales tax of 7 percent, 4 percent, and 3 percent, respectively. It is anticipated that sales tax revenue would increase in these communities due to additional construction workers purchasing goods and services in the community.

4.18.4.1.4.4. Alcohol and Tobacco Tax

Alcohol or tobacco taxes are implemented by the FNSB, including the communities of Fairbanks and North Pole, as well as in Mat-Su Borough. Alcohol and tobacco taxes are implemented in the FNSB communities at a rate of 5 percent and 8 percent, respectively. The Mat-Su Borough implements a tobacco tax on the wholesale product rate of 55 percent. It is anticipated that alcohol and tobacco tax revenue would increase in these

communities due to the increased population consisting of pipeline employees purchasing these goods in the communities.

4.18.4.1.4.5. Spur-line Expenditures

Spur-line expenditures are indirect effects, as the proposed Project would not include any local distribution infrastructure. At an estimated $9.9 billion, the cost to the state to construct the proposed Project is substantial. Over time, the state would recover this expense through the sale of natural gas as well as through state taxes, which are described in detail in Section 4.18.4.2.4, Government Revenue and Expenditures.

The capital cost of a transmission spur pipeline and distribution system, compared to the revenue to be generated, would determine economic feasibility of extending natural gas service to nearby communities. The capital costs of installing a transmission line would depend on several factors:

- The distance of the community from the Mainline;
- The size of the distribution system required to supply homes within the community depending on number and density of homes; and
- The terrain and soil conditions along the spur-line route.

Revenue is dependent on the number of customers reached, consumption, and price. Accessing natural gas from the proposed ASAP pipeline would require an offtake point on the Mainline, as well as a transmission spur pipeline to the community. Although transmission piping costs would depend on the size of pipe used, construction methodology, materials used and other factors, these costs can be on the order of $300,000 per mile (MWH Americas, 2014). Based on an assumed average distance of 20 miles from the Mainline, piping cost would be approximately $6 million per community. Costs would increase for road-inaccessible study area communities. Winter construction would require the additional costs of building ice roads and pads. In 2008, the cost to construct an ice road in the National Petroleum Reserve-Alaska region of the North Slope was estimated to be about $100,000 per mile, not including maintenance costs (Arctic Economics, 2008). The costs associated with converting a home heating system are discussed below in Section 4.18.4.1.5.3, Natural Gas Utility Conversion.

The NSB used bonds to fund construction of the main pipeline that transports gas from the oil field to Nuiqsut, while construction of the pipeline system within the community was funded by National Petroleum Reserve-Alaska impact aid grant funds. The borough also used grant funds to place gas burning boilers and furnaces in homes and other buildings (NSB, 2005c). The NSB is second only to the Municipality of Anchorage in terms of the amount of local tax revenues collected by an Alaska municipality and on a per capita basis; it is the wealthiest municipality in Alaska and among the wealthiest regional governments in the U.S. (Goldsmith, 2008). Anaktuvuk Pass is the only study area community located in the NSB. It is uncertain if other boroughs in the study area have the financial capability to help pay the capital cost of a gas distribution system. The

revenues collected by these other boroughs are substantially lower than those of the NSB.

Given the low household incomes in several study area communities, simply raising the local tax rate or levying a special assessment to cover the municipal portion of a system's capital costs may not be economically feasible. One possible solution involves a combination of issuing debentures, to be paid off by capturing incremental tax revenues from the gas system itself and a small tax increase (USACE, 2012a). If the spur-line, distribution system, or a combination are subject to property taxes, the municipalities in which these facilities are located would experience an increase in property tax revenues.

The State of Alaska could support construction of gas distribution systems that generate both environmental and economic benefits. Environmental benefits include reduced emissions of sulphur dioxide, CO_2, and Particulate Matter (PM) of 2.5 microns (µ) ($PM_{2.5}$) in diameter or smaller as a result of natural gas replacing fuel oil. The FNSB began investigating and developing its natural gas distribution system partly in response to the Fairbanks non-attainment status determination by the EPA, with severe air pollution at North Pole, primarily generated by wood burning during air inversions (Northern Economics, 2012). Failure to meet air quality standards could cost local governments significant penalties and potential lawsuits, including loss of federal grants.

Alaska's State government has supported gas service for rural areas in recent years. The state legislature included $18.15 million in fiscal year 2013 State Capitol Budget for construction of the gas pipeline from Anchor Point to Homer and Kachemak City (City of Homer, 2014). Aside from direct legislative appropriations to cover the capital cost of gas distribution systems, there are other ways the state could support the provision of natural gas. These include subsidizing gas tariffs, establishing a fund to cover operating deficits of LDCs in early years of operation, and helping obtain grants from the federal government and other sources to develop gas distribution facilities.

4.18.4.1.4.6. Government Infrastructure and Services

The temporary increase in population could lead to increased pressure on existing local infrastructure and services including police, fire, medical, and human services, resulting in additional local government expenditures. The potential for the proposed Project to affect existing social problems in communities could be increased by demanding work schedules that involve long periods away from home. This would result in an increased demand for local and regional health care, social services, and protective services. Although the increase in government services needs would be funded partially by the revenues described in this section, it is difficult to know if these additional revenues would adequately fund the increased need for the services.

4.18.4.1.4.7. Impact Summary

The overall impact of the proposed Project construction on government revenue and expenditures are expected to be major, as provided in Table 4.18-12.

Table 4.18-12 Impacts of the Proposed Project Construction on Government Revenue and Expenditures

Impact Component	Impact Level
	Major Negative
Magnitude or Intensity	Although the cost to the state to construct the pipeline is substantial, over time, the state would recover this expense. In addition, local government expenditures for infrastructure and services would increase with increasing population, and would be supported by the increase in local tax revenues. The impact of the investment cost in the proposed Project is considered major.
Geographic Extent	Government expenditures and revenues would take place statewide.
Duration or Frequency	The expenditures and revenues described in this section would occur over the pipeline construction period, approximately 2.5 years.
Likelihood	It is most likely that the expenditures and revenues described in this section would be realized during construction.

4.18.4.1.5. Infrastructure and Services

Impacts to infrastructure and services include the impacts of construction on current transportation systems, a potential increase in demand for government services, and the cost of conversion to a natural gas utility.

4.18.4.1.5.1. Air and Ground Transportation

Transportation to and from camp would be via air or bus transportation to either Fairbanks or Anchorage. As described in Chapter 2 of this SEIS, the proposed Project would use existing airports or runways for transport of personnel. The proposed Project does not include plans to build, improve, or expand any runways.

Pipeline employees would utilize existing roads and highways managed by ADOT&PF during pipeline construction. A highway use agreement would be in place prior to construction, and would be an agreement between AGDC and ADOT&PF for how impacts to infrastructure caused by construction would be mitigated. AGDC would develop and implement traffic control plans to minimize negative impacts to local businesses by blocking access during construction. AGDC would time construction activities to minimize impacts to high-use tourist and local recreation seasons such as wildlife viewing, hunting, snow machining, and dogsledding. Impacts to local business would be minimized by avoiding summer and fall construction in recreational and tourist areas.

A total of 298 new access roads totaling 174.4 miles would be constructed to provide access to the pipeline. Although some of these roads may be reclaimed, many may remain permanently, providing new access routes for local residents to recreation areas.

4.18.4.1.5.2. Government Services

The proposed Project may place more pressure on government services including health and social services, law enforcement, emergency medical, and education. Government

revenue gained through taxes on the proposed Project are intended to offset the additional costs to the local government to provide these services. Use of electricity and telephone may increase slightly during pipeline construction from residential and commercial users.

Improvements in transportation and local services required as a result of the influx of workers may be funded by the tax revenues described in Section 4.18.4.1.4, Government Revenue and Expenditures. Government revenue gained through taxes on the development are intended to offset the additional costs to the local government to provide these services. Local businesses may benefit from the increased use of privately owned services such as electricity and telephone services.

4.18.4.1.5.3. Natural Gas Utility Conversion

Effects associated with natural gas utility conversions are indirect effects as the proposed Project would not include any local distribution infrastructure. A recent analysis evaluated the cost of converting home heating systems for Homer households and illustrates the broad range of conversion costs for area residents. The cost of converting a home heating system to natural gas varies widely, ranging from approximately $851 to $8,547, depending on the size of the house and type of fuel and equipment currently used (Smith, 2012). Converting appliances that use electricity, fuel oil, or wood to natural gas tends to be more costly than changing propane-fired appliances. However, fuel oil/kerosene and wood are the dominant home heating fuels in most study area communities. In communities where incomes are especially low, such as Allakaket, Alatna, and Stevens Village, it is possible that conversion to gas service would be cost-prohibitive for most households. An opportunity to reduce the cost for residents include potential to defer capital costs of conversion to local governments and utility companies for a period of time. This is demonstrated by the City of Homer for the installation of constructing a local gas distribution system. Other possibilities to reduce costs to property owners include: loans offered by agencies, commercial banks, or utility companies; a turnkey utility connection and conversion, followed by monthly payments; or subsidies for low income households. A transmission spur pipeline could also potentially deliver natural gas transported by the proposed Project to public utilities for centralized electricity generation and heating. It is possible that public utilities could negotiate directly with natural gas producers and the Mainline pipeline owner to access pipeline gas via a spur-line.

4.18.4.1.5.4. Impact Summary

The direct and indirect impacts of the proposed Project construction on government expenditures and revenue are expected to be moderate, as provided in Table 4.18-13.

Table 4.18-13 Direct and Indirect Impacts of the Proposed Project Construction on Infrastructure and Services

Impact Component	Impact Level
	Moderate
Magnitude or Intensity	High cost to residents to upgrade infrastructure, offset by potential opportunities for assistance through loans and grants. Significant increase in use of transportation infrastructure would results in government funded improvements.
Geographic Extent	This effect would occur throughout the study area.
Duration or Frequency	Impacts to infrastructure would occur over a period of 4 years, but could take many more years to repair. Costs of natural gas utility conversions to access natural gas would take an estimated 1 to 10 years to pay off.
Likelihood	The impacts described above are likely to occur.

4.18.4.2. Operations and Maintenance

4.18.4.2.1. Population

Operations and maintenance efforts would consist of continued ground surveillance, corrective erosion control and vegetation maintenance within the pipeline ROW and along access roads. These efforts would be conducted at three operations and maintenance response bases (MRBs): GCF MRB, Fairbanks MRB, and the Big Lake MRB. Approximately 240 employees and contractors would be required to staff the proposed Project during its operations and maintenance as provided in the Table 4.18-14.

Table 4.18-14 Annual Operations and Maintenance Employment Estimates

Proposed Action	FTE Estimate
Mainline (Security and Surveillance)	30
GFC Maintenance and Response Base	57
Fairbanks Maintenance and Response Base	33
Big Lake Maintenance and Response Base	29
Clearing and Maintaining the ROW	3
Anchorage Headquarters	88
Total	**240**

Source: AGDC, 2016b

These positions would result in population increases at the MRBs at the GCF, in Fairbanks, in Big Lake, and in Anchorage. Maintenance and security personnel would be centered at the three MRBs and the Anchorage headquarters. It is likely that full-time employees could be current residents of the larger communities such as Anchorage and Fairbanks. If current residents of these communities are employed, the population increase due to MRBs in these communities would be negligible. GCF MRB staff would be housed on-site and would contribute to a worker population increase in the NSB. The U.S. census reported the population of Big Lake, Alaska as 2,436 people in 2010. At most, the population of Big Lake could increase by 30 people, or 1.2 percent, which is expected to have minimal impact on the community.

4.18.4.2.1.1. Impact Summary

The direct impact of the proposed Project operation on population is expected to be moderate, as provided in Table 4.18-15.

Table 4.18-15 Impacts of the Proposed Project Construction on Population

Impact Component	Impact Level
	Moderate
Magnitude or Intensity	Long-term population effects from the proposed Project would be expected to be minor based on relatively low number of operations and maintenance employees needed, combined with the expectation that many operations and maintenance employees could be existing residents.
Geographic Extent	The majority of this effect would occur in a few isolated communities along the pipeline route.
Duration or Frequency	The population increase is expected to occur throughout operations of the pipeline, a period of 10 or more years.
Likelihood	It is unlikely that Anchorage and Fairbanks would experience a population increase as these locations would likely be staffed with current residents of these communities. The population of Big Lake is significantly smaller than Anchorage or Fairbanks and is somewhat likely to experience a minor population increase to meet the staffing requirements of the Big Lake MRB. It is most likely that the NSB would experience a minor population increase to staff the GCF MRB.

4.18.4.2.2. Employment

4.18.4.2.2.1. Effect on Employment Base in Alaska

The GCF MRB would require approximately 10 full-time equivalent (FTE) management positions that would function in roles of administration, management, and technical services. These managers would oversee the activities of approximately 24 GCF MRB operational staff for the pipeline and 23 operational staff for the GCF. The 24 GCF MRB operational staff for the pipeline would perform tasks related to monitoring and maintenance of the pipeline and ROW, environmental monitoring, equipment operation and maintenance, logistics, and other services. The 23 GCF facility staff would perform tasks related to gas compressor operation, gas plant operation, plant and system operation, building maintenance, food service, housekeeping, and other services. For positions requiring 24 hours a day, 7 days a week (24/7) on-staff personnel, two 12-hour shifts would be utilized for 24-hour coverage. All GCF MRB staff would be housed on-site in 2-week on, 2-week off rotational shifts.

The Fairbanks MRB would require approximately 9 FTE management positions with roles in administration, management, technical services, scheduling, and outreach. These managers would oversee the activities of approximately 24 operational staff. Tasks performed would be related to pipe monitoring and maintenance, environmental monitoring and maintenance of the ROW, equipment operation and maintenance, logistics, building maintenance, and other services. For positions requiring 24/7 on-staff personnel, three 8-hour shifts would be utilized for 24-hour coverage. All Fairbanks MRB staff would be housed off site (in town).

The Big Lake MRB would require approximately five FTE management positions that would function in administrative, management, and technical services. These managers would oversee the activities of approximately 24 operational staff. Tasks performed would be related to pipe monitoring and maintenance, environmental monitoring and maintenance of the ROW, equipment operation and maintenance, logistics, building maintenance, and other services. For positions requiring 24/7 on-staff personnel, three 8-hour shifts would be utilized for 24-hour coverage. All Big Lake MRB staff would be housed off site (in town).

Approximately 30 security personnel would be required for the proposed Project. Security personnel would work two 12-hour shifts for 24-hour coverage. The personnel would be centered at the three MRBs and the Anchorage Headquarters.

A total of three staff dedicated solely to clearing and ROW monitoring and maintenance would be required. These personnel would work out of the three MRBs, as is required for meeting ROW maintenance needs.

The Anchorage headquarters would require 88 FTE management positions for operations and maintenance that would function in the following roles: executive; finance and accounting; commercial; operations; legal and land; government and external affairs; engineering; health, safety, security, environmental, and quality (HSSEQ); and information technology (IT). All Anchorage staff would be housed off site (in town). The Anchorage headquarters offices are currently proposed to be located at AGDC's present offices at 3201 C Street, Suite 200, Anchorage, AK 99503.

4.18.4.2.2.2. Effect on per Capita and Employment Income

As described in Section 4.18.4.1.2.2, Effect on Per Capita and Employment Income, the average employment income for Alaska residents working in the mining (including oil and gas) industry is significantly higher than the statewide employment earnings average employment income. Employment requirements of the proposed Project would likely result in an increase in employment income for 240 Alaska residents if they are currently employed in other industries.

4.18.4.2.2.3. Unemployment

Although Alaska's 2014 unemployment rate percent remained slightly lower than the national average at that time (BLS, 2015) the recent decrease in oil prices may drive the unemployment rate higher. The ADOLWD predicted in its October 2015 employment forecast that oil and gas extraction employment in the state would decrease 10 percent by 2024. With a need for several hundred employees across a variety of skillsets, the proposed Project could have a positive impact on employment in the state.

4.18.4.2.2.4. Local Businesses

Local business may benefit from the increased demands of pipeline employees as well as corporate demand for industry suppliers for pipeline maintenance materials. These

increased demands may result in a decreased availability or increased cost of these goods and services for residents due to the increased demand. The direct impacts on employment, income, and expenditures due to proposed Project maintenance and operation contributes towards indirect impacts of compounding income creation, spending, and re-spending.

4.18.4.2.2.5. Impact Summary

The impacts of operation and maintenance of the proposed Project on employment would result in an overall, moderate positive impact, as provided in Table 4.18-16.

Table 4.18-16 Impacts of the Proposed Project Operations and Maintenance on Employment

Impact Component	Impact Level
	Moderate
Magnitude or Intensity	The opportunities provided by the proposed Project would provide employment for an estimated 240 Alaska residents. In addition, jobs in the mining sector (which includes oil and gas) are significantly greater on average, than the average employment income in Alaska.
Geographic Extent	Employees would likely be hired from the communities of Anchorage, Fairbanks, and Big Lake.
Duration or Frequency	Benefits to employment for pipeline operations and maintenance would occur for more than 10 years.
Likelihood	It is most likely that the proposed Project would result in employment as described in this section.

4.18.4.2.3. Housing and Property Values

Personnel would require housing for the duration of operations and maintenance. A summary of the housing requirements for operation and maintenance of the proposed Project is provided below:

- All GCF MRB staff would be housed on-site in 2-week on, 2-week off rotational shifts
- All Fairbanks MRB staff would be housed off-site (in town)
- All Big Lake MRB staff would be housed off-site (in town)
- Security personnel would be centered at the three MRBs and the Anchorage Headquarters
- Maintenance personnel would work out of the three MRBs as is required for meeting ROW maintenance needs

4.18.4.2.3.1. Housing Availability

It is expected that the Fairbanks and Anchorage MRBs would be staffed mainly by current residents of these large cities, resulting in a minor impact on housing availability. Housing would be provided for GCF MRB staff. Big Lake, population 3,350 in 2010, may experience an increase in housing demand of up to 29 people. For Big Lake,

the rental vacancy rate was 8.5 percent (236 homes) and the homeowner vacancy rate was 3.6 percent (100 homes) in 2010. Accommodation of 29 people would result in a minor impact to housing availability (ADOLWD, 2016c).

4.18.4.2.3.2. Property Values

Private lands in the proposed Project Area are used for residential, agricultural, and commercial purposes. AGDC would be required to purchase private property and compensate private property owners for easements upon their property. Approximately 614 acres of land would be impacted by the proposed Project. Nine off-ROW features overlap a total of 15 private parcels. Operations and maintenance buildings would be co-located with other facilities. Impacts on private property values would be minimized by: 1) selecting compatible adjacent land uses, or 2) minimizing adjacent private lands. AGDC would avoid locating operation and maintenance facilities in places with special visual resource values that would be observable to the general public. This reduces the visual impact of these facilities and any associated impacts on private property value (USACE, 2012a).

Research conducted by the Interstate Natural Gas Association of America (INGAA) Foundation 2001, and PGP Valuation, Inc. 2008 indicate that there would be no discernible and significant impact on the value of properties located along natural gas pipelines (INGAA, 2001; Diskin *et al.,* 2011). INGAA conducted a natural gas pipeline impact study in four geographically diverse areas in the U.S. including rural, suburban, and commercial areas. Based on cumulative results of these four areas, the study determined that there is no significant impact on the sales price of properties located along natural gas pipelines in the areas of study. Nor did the size of the pipeline (diameter) or the product carried by the pipeline have any significant impact on sales prices. Additionally, the existence of a pipeline did not impede development of the surrounding properties in any location researched. A study conducted in 2011 focused on locations in the southwestern U.S. where eminent domain was used to acquire real estate rights for a natural gas pipeline easement. Approximately 1,000 parcels were studied and a systematic relationship between proximity to the pipeline and sale price or value was not identified. These studies are referenced to further support the conclusion that proximity to a natural gas pipeline does not necessarily decrease the value of a property. It is important to note that these conclusions are limited to the datasets studied.

4.18.4.2.3.3. Impact Summary

The impacts of operation and maintenance of the proposed Project on housing would result in an overall, moderate impact, as provided in Table 4.18-17.

Table 4.18-17 Impacts of the Proposed Project Operations and Maintenance on Housing

Impact Component	Impact Level
	Moderate
Magnitude or Intensity	Due to the availability of housing in the communities where MRBs would be located, pressure on existing housing stock is expected to be minor. Impacts to property values and availability during the operations phase of the proposed Project are expected to be minor, as AGDC would avoid locating operation and maintenance facilities adjacent to private property. Additionally, many studies have indicated that proximity to a pipeline does not result in negative impacts to property values.
Geographic Extent	Employees would likely reside in the communities of Anchorage, Fairbanks, and Big Lake.
Duration or Frequency	Housing needs for pipeline operations personnel would occur for more than 10 years.
Likelihood	It is most likely that the proposed Project would result in employment as described in this section.

4.18.4.2.4. Government Revenue and Expenditures

There are four types of taxes associated with oil and gas production within Alaska: oil and gas production taxes, corporate income tax, royalties for lease of mineral rights, and property tax on oil and gas infrastructure. This section describes methodology and estimated results of these taxes that would accrue to the State of Alaska and municipalities from the proposed Project assuming current tax rates.

AGDC is a subsidiary corporation of the Alaska Housing Finance Corporation, a public corporation and a government instrumentality within the Alaska Department of Revenue. AGDC was created to plan, construct, and finance the proposed Project. Once constructed, it is anticipated that the proposed Project would be operated by a private corporation, and would be, therefore, subject to all relevant gas taxes discussed in this section. Note that the estimates provided below have been rounded.

4.18.4.2.4.1. State Production Tax

Natural gas production taxes are based on net value of the gas, which is the value of gas at the point of production less all qualified lease expenditures. The production tax rate per unit of natural gas produced, therefore, varies based on market price and production costs. As defined by AS 43.55.900, the point of production for natural gas is the first point where the gas is accurately metered following the completion of mechanical separation. The point of production for this analysis is, thus, assumed to be the GCF and, therefore, part of the proposed Project.

Alaska natural gas and oil production volume and production taxes in 2015 were used to estimate expected proposed Project production taxes (U.S. Energy Information Administration [EIA], 2016a). The State of Alaska does not report natural gas production tax revenues separately from oil production taxes, so it is assumed that the portion of all production taxes from natural gas is equivalent to its proportion of all production. At 343,534 million standard cubic feet (MMscf) or approximately 61.3 million barrels of oil equivalents, natural gas production in Alaska accounted for approximately 26 percent of

total Alaska oil and gas production in 2015 (176.2 million barrels) (EIA, 2016b,c). In 2015, oil and gas production tax revenues were $389 million (Alaska Department of Revenue [ADR], 2016a). It was assumed that 26 percent of 2015 oil and gas production tax revenues, or $101.1 million, were due to natural gas production (ADR, 2016a).

A conservative estimate of natural gas production from the proposed Project was used for this analysis. Initially it is assumed that the proposed Project would produce 250 MMscfd or 91,250 MMscf per year. This would represent an increase of approximately 27 percent from 2015 natural gas production within Alaska. Therefore, assuming the net value per MMSCF of natural gas production remains fairly constant, it is estimated that the proposed Project would increase gas production tax revenue by approximately 27 percent. This is an additional $27.3 million in annual natural gas production tax revenue for the State of Alaska. As described by AGDC, it is anticipated that full capacity of the proposed Project would be 500 MMscfd. Once the proposed Project begins this level of production, then it could be expected that the estimated annual production taxes would increase from $27.3 million as described above to $54.6 million.

4.18.4.2.4.2. State Corporate Tax

Similar to production taxes, the State of Alaska does not separately report oil and gas corporate tax revenue. The same methodology as described for natural gas production tax revenue was used to estimate the proposed Project's corporate tax effects. In 2015, oil and gas corporate tax revenue was $94.8 million (ADR, 2016a). As natural gas accounted for 26 percent of total oil and gas production in 2015, $24.6 million is assumed to have accrued from natural gas production. Based on an estimated increase in natural gas production of 27 percent due to the proposed Project, corporate petroleum tax revenues from natural gas are expected to increase by 27 percent or approximately $6.6 million annually. As described by AGDC, it is anticipated that at full capacity, the proposed Project would be 500 MMscfd. Once the proposed Project begins this level of production, then it could be expected that these estimated corporate taxes would increase by a total of $13.2 million.

4.18.4.2.4.3. State Royalties

The State of Alaska receives royalty payments for oil and gas produced from state lands leased to oil and gas producers. Royalties are based on the agreed value of the oil or gas removed from the lease, the volume removed, and the royalty rate (State of Alaska, 2011). Royalties are due to the state once natural gas leaves the unit or enters a common carrier pipeline (J. Stouffer, Pers. Comm. 2011). Therefore, it is assumed that royalty payments would be associated with the GCF. Using the same approach as provided for production taxes and corporate taxes it assumed that natural gas accounts for nearly $278.7 million (approximately 26 percent) of the total $1.08 billion in royalties collected by the State of Alaska in 2015. Provided that natural gas production within Alaska would increase by 27 percent due to proposed Project construction, an additional

$75.3 million in royalties would be collected by the State of Alaska. At 500 MMscfd, it could be expected that these estimated royalty payments would increase by a total of $150.5 million.

4.18.4.2.4.4. State Property Tax

The State of Alaska collects oil and gas property taxes applicable to oil and gas exploration, production, and pipeline transportation property consisting of 20 mills each tax year. In 2015, petroleum property tax revenues were $125.2 million (ADR, 2016a). Using the same approach as above, natural gas would account for $32.3 million, approximately 26 percent of the total oil and gas property tax revenues. Natural gas production within Alaska would increase by 27 percent due to the proposed Project. This leads to an additional $8.7 million in royalties that would be collected by the State of Alaska and increases to $17.44 million at full capacity.

Table 4.18-18, summarizes estimated annual taxes to the State of Alaska during the first year of the proposed Project's operation, including gas production, corporate, and property taxes. These are estimated to total $358.6 million, with the majority ($154 million) from gas production taxes (USACE, 2012a).

Table 4.18-18 Estimated State Tax Revenue from Proposed Project (at 250 MMscf)

Tax Type	State of Alaska (Millions of Dollars)
Royalties	$99.7
Gas Production Taxes	$36.0
Corporate Taxes	$8.75
Property Taxes (Year 1)	$11.5
Total	**$156.0**

4.18.4.2.4.5. Local Property Tax

The Alaska Constitution permits delegation of the state's taxation power to local governments, but limits delegation of that power to only boroughs and incorporated cities. The proposed pipeline intersects three incorporated cities: Nenana, Anderson, and Fairbanks. All boroughs intersecting the purposed pipeline route are organized except the YKCA.

Table 4.18-19 summarizes the estimated property tax revenues for each municipality traversed by the proposed Project. These estimated property tax revenues are based on the class III total installed cost estimate prepared in 2014. This includes the total cost associated with the pipeline installation, the cost of the GCF, and contingency. To estimate the value of pipeline infrastructure within each municipality traversed by the pipeline, it was assumed that each mile of pipeline infrastructure has equal value. The average per mile construction value is $1.30 million ($9.9 billion construction cost divided by 764 miles of Mainline and lateral construction). This value was then allocated to municipalities based on the length of pipeline located within each municipality. The property tax values presented in Table 4.18-19 represent revenue estimates in the first

year that the proposed Project would be operational. Note that these numbers are approximate, as they have been rounded for simplicity. The total pipeline length includes the length of the Fairbanks Lateral for total length of 764 miles. As the proposed Project infrastructure depreciates, property taxes would decrease. This analysis estimates property tax revenues using current property tax rates; if these rates are modified, revenues would adjust accordingly.

The Denali Borough is the only organized borough traversed by the proposed Project that does not implement a property tax. Unorganized boroughs, the Yukon Flats and Yukon-Koyukuk Regional Educational Attendance Areas (REAAs) are not permitted to implement a property tax.

Table 4.18-19 Estimated Local Property Tax Revenue, Year 1

Municipality	Miles of Pipeline within Municipality	Total Estimated Value of ASAP ($ Millions)	Mill Rate[c]	Local Property Tax Revenue ($ Millions)
Denali Borough	87	114	0.000	0
FNSB	32	41	13.456	6
Mat-Su Borough	160	209	9.984	21
NSB[a]	182	238	18.500	44
Yukon Flats REAA	120	156	0.000	0
Yukon-Koyukuk REAA	183	239	0.000	0
Study Area Total[b]	764	997	N/A	70

a Estimated value includes GCF construction costs.
b Total equals 764 miles (733 mile Mainline and 30 mile Fairbanks Lateral) due to rounding
c Source: Alaska Department of Commerce, Community, and Economic Development (ADCCED), 2015

4.18.4.2.4.6. Other Local Tax

Other local taxes including local bed taxes, sales taxes, and alcohol and tobacco taxes as described in Section 4.18.4.1.4, Government Revenues and Expenditures, could be collected in the communities of Anchorage and Fairbanks. However the minimal number of employees needed for pipeline operation and maintenance would result in a minor impact to revenues in these communities.

4.18.4.2.4.7. Government Infrastructure and Services

The impacts on infrastructure and services are similar to those described in Section 4.18.4.1.4.6, Government Infrastructure and Services. However, the impacts on a much smaller scale as the employment requirement for operations and maintenance is approximately 4 percent of the number of employees required for construction.

Spur-line expenditures are indirect effects as the proposed Project would not include any local distribution infrastructure.

4.18.4.2.4.8. Impact Summary

The overall impact of the proposed Project operations and maintenance on government expenditures and revenue are expected to be major, as provided in Table 4.18-20.

Table 4.18-20 Impacts of the Proposed Project Operations and Maintenance on Government Expenditures and Revenue

Impact Component	Impact Level
	Major Positive
Magnitude or Intensity	During the operations and maintenance phase of the proposed Project, the state would recover the cost to construct the pipeline through state taxes and royalties, resulting in a positive socioeconomic impact. Local property tax would be collected by local governments, and the impact to infrastructure and services would be minimal due to the limited number of employees required for pipeline operation and maintenance.
Geographic Extent	Government revenues would result in a statewide effect.
Duration or Frequency	The expenditures and revenues described in this section would occur over a period of more than 10 years.
Likelihood	It is most likely that the expenditures and revenues described in this section would be realized.

4.18.4.2.5. Infrastructure and Services

4.18.4.2.5.1. Air and Ground Transportation

Transportation to and from the MRBs would be via air or bus transportation to either Fairbanks or Anchorage. As described in Chapter 2 of this SEIS, the proposed Project would use existing airports or runways for transport of personnel and does not include plans to build, improve, or expand any runways. The transportation required for 119 employees to access the MRBs would be significantly less than that transportation required during construction of the pipeline. Upgrades to infrastructure required as a result of the impacts of the construction phase may continue into the operations phase of the proposed Project resulting in additional government expenditures. This cost is intended to be offset by state and local government revenues that are a result of pipeline operation and maintenance.

4.18.4.2.5.2. Government Services

The proposed Project may place some pressure on government services including health and social services, law enforcement, emergency medical, and education. With only 240 employees required for operations and maintenance throughout the proposed Project MRBs, the impact on government services is expected to be minimal. Government revenue gained through taxes on the development are intended to offset the additional costs to the local government to provide these services.

4.18.4.2.5.3. Natural Gas Utility Conversion

Effects associated with natural gas utility conversions are indirect effects because the proposed Project would not include any local distribution infrastructure. It is likely that

conversion to natural gas utility infrastructure as described in Section 4.18.4.1.5.3, Natural Gas Utility Conversion, would continue into the operations and maintenance phase of pipeline construction.

4.18.4.2.5.4. Impact Summary

The overall impact of proposed Project operations and maintenance on infrastructure and services are expected to be major, as provided in Table 4.18-21.

Table 4.18-21 Impacts of Proposed Project Operations and Maintenance on Infrastructure and Services

Impact Component	Impact Level
	Major Negative
Magnitude or Intensity	High cost to residents to upgrade infrastructure, offset by potential opportunities for assistance through loans and grants. Significant increase in use of transportation infrastructure would result in government funded improvements.
Geographic Extent	This effect would occur throughout the study area.
Duration or Frequency	Upgrades to infrastructure as a result of the impacts of construction may continue into the operations phase of the proposed Project resulting in additional government expenditures. Costs of infrastructure to access natural gas would take an estimated 1 to 10 years to pay off.
Likelihood	The impacts described above are likely to occur.

4.18.4.2.6. Energy Supply

Natural gas would be a leaner composition than the enriched gas described in the 2012 FEIS in that it would not contain high concentrations of the heavier hydrocarbons or NGLs. The lean gas would be compatible with the ENSTAR distribution network and would be accessible to the public without additional processing facilities. This is in contrast to an enriched gas scenario with higher concentrations of hydrocarbons, requiring a much higher pressure for transport, and construction of additional processing facilities to make the gas available for use. The impacts associated with developing infrastructure to access ASAP natural gas are considered indirect effects and are described in Section 4.18.4.1.5, Infrastructure and Services.

Clean-burning natural gas would help to substantially improve Fairbanks air quality by providing a substitute to wood and oil-burning heating systems (for those that convert to gas heating units), helping the region meet federal EPA standards (Henry, 2015). Additional discussion of potential impacts to air quality as a result of the proposed Project are described in Section 4.22, Air Quality, Climate Change, and Greenhouse Gas Emissions. A new source of affordable and reliable natural gas may also provide relief to high-energy costs by increasing the energy supply.

4.18.4.2.6.1. Access via FNG and IGU Systems

According to Cardno ENTRIX (2014), currently, FNG provides service to approximately 1,100 natural gas customers within central Fairbanks and purchases gas from the Cook Inlet area of Alaska, which is transported by trucks to Fairbanks.

The Fairbanks Lateral pipeline would provide natural gas to FNG and IGU gas distribution systems at a lower price than truck haul and in greater quantity. In 2006, for example, FNG was unable to secure sufficient natural gas from Cook Inlet to allow expansion of its distribution system in Fairbanks. Attempts to establish an liquefied natural gas (LNG) plant on the North Slope have encountered delays due to difficulties in negotiating gas supply contracts and securing anchor tenants (Lidji, 2014).

In 2015, FNG purchased Cook Inlet gas from Hilcorp Alaska, LLC at a base price of $7.13 per million cubic feet (MCF) and a swing price of $8.19, per MCF. FNG's base cost including operational and transportation charges based on non-interruptible natural gas from FNG's plant at Port MacKenzie was $15.06 per MCF in 2014 (Lidji, 2014). According to IGU's 2014 Interior Gas Utility 6-Year Plan to complete the distribution system within the greater Fairbanks area, IGU proposed a delivered cost to the customer of $15 per MCF, including operational and transportation charges (MWH Americas, 2014).

Natural gas delivered by pipelines is generally less expensive than trucking. As an example, ENSTAR delivers gas to residential users for $8.77 per MCF as of July 1, 2014, excluding a customer charge of $13.50 per month per account and 0.295 percent of the total bill for regulatory cost charges (ENSTAR, 2014).

4.18.4.2.6.2. Access via ENSTAR Distribution System

The proposed Project would connect into ENSTAR's distribution system, Beluga Pipeline, southwest of Big Lake. ENSTAR serves much of the Southcentral region, including the Municipality of Anchorage and communities in the Mat-Su Borough and Kenai Peninsula Borough (Figure 3.14-6).

Connecting the Mainline to ENSTAR's distribution system at MP 39 of the Beluga Pipeline could generate significant cost savings for residences and businesses in the ENSTAR service area, depending on the actual delivered cost to the ENSTAR system. Cook Inlet producers sell natural gas for approximately $8.50 per MCF, not including the swing cost.[10] This is based on a Revenue Requirement Study and Cost of Service Study filed with the Regulatory Commission of Alaska (RCA) in 2014. The projected price for LNG in Fairbanks from an interruptible supply in Nikiski is $17.35/MCF (cost based on use of ConocoPhillips Alaska, Inc. (ConocoPhillips) plant at Nikiski that

[10] Swing Pricing: the process of adjusting the fund's net asset value per share (U.S. Securities and Exchange Commission – Investment Company Swing Pricing)
https://www.sec.gov/rules/final/2016/33-10234.pdf

provides gas when it is available). The difference between the cost of gas sold by producers and its delivered cost in Fairbanks is approximately $8.85/MCF, an amount that includes truck haul of loads averaging 9,212 gallons of LNG (RCA, 2014).

4.18.4.2.6.3. Access via Truck or Barge

The transportation of CNG by truck to highway-accessible communities in the state is similar to the delivery of propane described in the 2012 FEIS, and is considered a method of access in this analysis. CNG could be used by cars and trucks in Fairbanks; by communities along the Parks and Dalton highways, including tour buses in Denali NPP; and by Anchorage and other communities on the Kenai Peninsula. CNG by truck or barge could allow expansion of natural gas services to customers who are beyond the existing distribution pipeline reach or outside the current franchise area of the local distribution companies (Concentric Energy Advisors, 2013).

An analysis prepared by R.W. Beck (2011) evaluated the economic feasibility of shipping propane to off-road communities as an alternative energy source. The analysis selected Tanana as a representative river community and Seldovia as a representative marine community. The analysis concluded that in communities where propane delivery is accomplished by barge, propane would be more expensive that barge-delivered fuel oil due to substantially higher intermodal transportation, storage, and distribution costs.

CNG has 65 percent less energy, in the form of British thermal units (Btu) per gallon, than propane; consequently, CNG is even less likely than propane to be an economically feasible alternative energy sources for off-road communities. Further, whereas propane may be shipped by ISO-certified tanks capable of holding 6,400 gallons per unit, there are no equivalent standard containers for waterborne delivery of CNG. While integrated tug and barge systems for CNG shipment are being developed, the costs of these systems are still very high (USACE, 2012a).

4.18.4.2.6.4. Access via New Infrastructure

The government expenditures associated with the cost of constructing a spur-line for community access to natural gas are considered indirect effects and are discussed in Section 4.18.4.1.4, Government Revenue and Expenditures, as the costs may be expended during both pipeline construction and operations and maintenance phases.

The costs associated with conversion of a home heating system to natural gas are described in Section 4.18.4.1.5.3, Natural Gas Utility Conversion, as the costs may be expended during both the pipeline construction and operations and maintenance phases.

4.18.4.2.6.5. Indirect Effects to Heating Oil Producers

Current industrial users at North Pole, such as the Petro Star refinery, could also benefit from natural gas delivered by the Fairbanks Lateral pipeline. It is also important to recognize that operation of the Fairbanks Lateral (and the spur-lines previously

discussed) could potentially have a negative economic effect on the Petro Star refinery and regional heating oil distribution companies due to the decrease in heating oil demand. The effect to Petro Star would be less significant than the effect to regional heating oil distribution companies as Petro Star also produces diesel and jet fuel.

4.18.4.2.6.6. Impact Summary

The overall impact of proposed Project operations and maintenance on access to natural gas via existing infrastructure are expected to be major and positive, as provided in Table 4.18-22.

Table 4.18-22 Impacts of the Proposed Project Operations and Maintenance on Access to Natural Gas via Existing Infrastructure

Impact Component	Impact Level
	Major Positive
Magnitude or Intensity	Improved access to natural gas would help meet the statewide demand for improved access to an energy source that is cleaner and more reliable. Potentially, it could reduce the cost of home heating as a result of increased energy supply in the community. The operation of the proposed Project could lower the local public utility costs for residents that are currently connected to a natural gas distribution due to increased supply. As a result, the proposed Project would provide improved access to natural gas to many residents of Alaska.
Geographic Extent	Existing infrastructure would provide access to natural gas beyond the proposed Project Area.
Duration or Frequency	The access described in this section would occur following pipeline construction for a duration of greater than 10 years.
Likelihood	Access to ASAP natural gas via existing infrastructure is somewhat likely to occur throughout the proposed Project Area depending on the affordability of the infrastructure.

4.18.4.3. Environmental Justice

This section identifies potentially affected census tracts that have low-income populations or concentrations of minority populations including Alaska Native or American Indian populations. Environmental justice analysis is performed at the Census Tract (CT) level for CTs traversed by the proposed Project, with borough/census area and statewide totals used for comparison. Figure 3.14-5 presents CTs traversed by the proposed Project.

Two CTs that would be traversed by the proposed Action have minority populations in excess of the statewide racial minority population of 33 percent. The YKCA has the highest percentage of racial minorities out of all borough census areas in this analysis, with 78 percent of the total population belonging to a minority group, followed by the NSB with 67 percent of the population being a minority.

Of the 10 CTs that would be traversed by the proposed Project, six have higher poverty rates than the statewide average. Poverty rates are presented in Table 3.14-14 (Chapter 3). Poverty rates in the YKCA (23.8 percent) are the highest at approximately double the statewide rate (9.4 percent). While higher than the statewide average, poverty rates for

the CT that would be traversed by the proposed Project within the YKCA (18.7 percent in CT 200) are significantly less than the overall poverty rate within the YKCA. Four CTs traversed by the proposed Project do have higher poverty rates than their respective boroughs. Three of the four CTs traversed in the Mat-Su Borough have higher poverty rates (13.1 to 15.3 percent) than the borough overall (10.1 percent), and CT 1300 located within the FNSB has a higher poverty rate (11.3 percent) than the borough rate (7.6 percent).

Multiple opportunities for public involvement have been provided for the communities of concern. Scoping meeting advertisements and instructions for obtaining additional Project information was sent by USACE to affected parties and community leaders. As a result of public input during the scoping and review phases, mitigation measures have been proposed by AGDC for local residents. This includes the development of an Economic Opportunity Plan, coordination with local training centers, and the use of local businesses to support the proposed Project.

Potential adverse effects to these CTs compared to the effects to the overall proposed Project Area are described below in terms of the potential for increase in population, decrease in housing availability, government expenditures, and infrastructure improvement costs. Although housing demands may be higher in CT 1300 due to its location in the FNSB, housing availability in the FNSB overall is expected to be sufficient to accommodate the number of employees required to construct the Fairbanks Lateral. The increased housing demand could even result in a positive effect on the housing market and existing home values. Government expenditures are expected to be offset in part by local tax revenues. The YKCA is not an organized borough, and as such, would not be capable of collecting local taxes to offset these costs. It would likely rely on state funds to support any government expenditures. Although the proposed pipeline route does traverse the YKCA, it crosses CT 200, which has an average poverty rate of less than that of the borough overall. Infrastructure costs to access natural gas are a function of the length of the line required (among other factors) so infrastructure costs may be lower for those communities that are in close proximity to the pipeline.

In general, it is expected that minority and low-income communities could be positively affected by the proposed Project through the creation of both temporary and permanent jobs, as well as income- and tax-effects. While the proposed Project would increase employment during construction, leading to increased discretionary income for some area residents, this effect would be temporary and would cease after the construction period. However, during the operations phase, area residents could be employed for the life of the proposed Project (a minimum of 30 years). The proposed Project would provide an opportunity for improved access to cleaner and more reliable home heating fuels in these communities.

4.18.5. Alternative 2 – Denali NPP Route Variation

This section discusses and rates the potential impacts of Alternative 2 (Denali NPP Route Variation) for construction and operation on socioeconomics. Results of the impact ratings are presented in Table 4.18-23. Alternative 2 is described in detail in Chapter 2; however, the components relevant to socioeconomics are summarized below.

- Denali NPP Route Variation;
- Aboveground pipeline mode (MP 0 – MP 62) and belowground (buried) pipeline mode MP 62 – MP 733.5 as well as the Fairbanks Lateral;
- Use of DH2 at West Dock at Prudhoe Bay and ocean disposal of dredged material; and
- Aerial crossing at Yukon River.

4.18.5.1. Denali NPP Route Alternative

The Denali NPP alternative route would begin at MP 535.8 and enters the Denali NPP boundary approximately 0.2 miles after crossing the Nenana River on the pedestrian bridge to the west of the Parks Highway (also contained within Denali NPP). It would rejoin the proposed route at MP 543, after crossing the Nenana River downstream (east) of McKinley Village. The Denali NPP Route Variation is shown on Figure 2.4-1.

4.18.5.1.1. Construction

It is anticipated that construction workers would either reside in the Healy (MP 527.7) or Cantwell (MP 566.7) work camp regardless of the route in this area. The route alternative is not likely to affect the 7 percent sales tax revenue collected by the Denali Borough.

The Denali NPP Route Variation would be located within the Denali Borough. As previously described, there is only one CT within the Denali Borough; therefore, no discrepancy exists between the CT level and borough level for race or poverty characteristics. However, when compared to Alaska statewide, there are no higher concentrations of any minority group or impoverished populations within the Denali CT 100. The Denali Borough has less racial diversity than Alaska statewide, with approximately 10.4 percent of the population belonging to a minority group. It is not believed that construction of the Denali NPP Route Variation would place an inequitable burden upon minority or low-income communities. The impacts to socioeconomics resulting from the development of the Denali NPP Route Variation would be similar to those of the related segment of the proposed pipeline.

4.18.5.1.2. Operations and Maintenance

Given that the Denali NPP Route Variation is within 0.3 miles in length of the route analyzed under Alternative 1, it is assumed that the total number of operations and maintenance employees would remain the same. As a result, the local population,

housing, and employment estimates would remain as described in Section 4.18.4.2, Operations and Maintenance. Sovereign immunity prevents a state or local government from asserting its taxing authority over the federal government. As a result, state and local property taxes would not be collection for this 7-mile portion of the route (about 1 percent of the route) (Garden, 2017). The route alternative would not affect the production tax revenues or royalties described in Section 4.18.4.2.4, Government Revenue and Expenditures. The impacts to socioeconomics resulting from the operations and maintenance of the Denali NPP Route Variation would be similar to those for the related segment of the proposed pipeline.

4.18.5.2. Partially Elevated Pipeline

Alternative 2 proposes to elevate the pipeline on VSMs through the extent of the ACP (Beaufort) from MP 0 to approximately MP 62 as shown on Figure 2.4-2.

4.18.5.2.1. Construction

Construction of an elevated pipeline is not anticipated to significantly affect the population, employment, and housing required to construct the first 62 miles of the pipeline, as there are no permanent residents in this area. AGDC's cost estimate for aboveground and belowground pipeline construction assumes that the cost to construct the pipeline is equal per mile of the pipeline. Based on this the cost to construct, aboveground construction from MP 0 to MP 62 would increase the total pipeline construction cost by approximately 6.8 percent. Construction of an aboveground pipeline is expected to impact infrastructure as described for Alternative 1. As the government expenditures required for construction of an aboveground section of the pipeline route would be 6.8 percent greater than the cost of Alternative 1, the overall impact on government expenditures during construction would remain major.

4.18.5.2.2. Operations and Maintenance

Construction of an elevated pipeline from MP 0 to MP 62 is not anticipated to significantly affect the population, employment, and housing required to operate and maintain the pipeline because the GCF would have workers, on a 2-week on and 2-week off schedule, staying in a camp constructed near the GCF. Government revenues based on the value of the property would increase slightly as the value of the overall proposed Project would increase slightly, and impact the proposed Project's ability to be commercially competitive. The overall impact of this change on operations and maintenance of the pipeline is expected to remain the same as for Alternative 1.

4.18.5.3. Aerial Bridge at Yukon River, DH2, and Ocean Disposal

Other components of Alternative 2, including an aerial bridge crossing at the Yukon River, the use of DH3 in place of DH2, and ocean disposal rather than nearshore disposal, are not expected to significantly affect the impact rating for socioeconomics during construction or operations of Alternative 2.

4.18.6. Alternative 3 – No Action

Under Alternative 3 (No Action), the proposed Project would not be constructed, and there would be no impacts to population, employment, housing, government expenditures and revenues, infrastructure, and economy.

4.18.7. Conclusions and Comparison of Alternatives

Impacts to socioeconomics resulting from the development of the Denali NPP Route Variation (Alternative 2) would be similar to those of the proposed Action (Alternative 1). Table 4.18-23 provides a summary comparison of all three alternatives for impacts to socioeconomics.

Figure 4.18-1 illustrates some of the key findings from the impact analysis. The figure provides geographic context for the description of potential impacts of both Alternatives 1 and 2, as described in detail in this section. The figure uses a consistent color scheme with the impact summary table (Table 4.18-23) for ease of comparison. The most notable conclusions illustrated by this figure are summarized below.

- Housing impacts during both construction and operations are expected to be slightly greater in the FNSB than in other boroughs intersected by the proposed pipeline, as employees working on the Fairbanks Lateral would not be provided with housing and would rely on available housing within the community.
- Impacts to local government revenues and expenditures are expected to be slightly less in the FNSB during the construction phase, as the FNSB may experience increased revenues bed tax (8 percent), alcohol tax (5 percent), and tobacco tax, while other boroughs do not implement these taxes. Other boroughs do implement a 0 to 7 percent sales tax.

Although several communities may indirectly access natural gas via the proposed Project via existing infrastructure, truck or rail, the negative and positive impacts to population, employment, revenues and expenditures, and natural gas supply in these areas would be less significant than communities that could potentially access natural gas via a spur tie in.

Table 4.18-23 Comparison of Alternatives Summary for Impacts to Socioeconomics

Resource Effect	Potential Impact Description	Alternative 1		Alternative 2		Alternative 3
		Construction	Operations	Construction	Operations	Construction / Operations
		Impact Rating		Impact Rating		Impact Rating
Population Trends and Projections	• Influx of non-permanent workers during construction and operations phase	*Moderate (-)*	*Moderate (-)*	*Moderate (-)*	*Moderate (-)*	*Negligible*
Employment	• Effect on employment base • Effect on per capita income • Effect on employment income • Unemployment	*Major (+)*	*Moderate (+)*	*Major (+)*	*Moderate (+)*	*Negligible*
Housing and Property Values	• Housing availability due to employee influx • Effect on property values adjacent to proposed Project components	*Moderate (-)*	*Moderate (-)*	*Moderate (-)*	*Moderate (-)*	*Negligible*
Government Revenue and Expenditures	• Increase in local tax revenue • Increase in state tax revenue • Local and state expenditures for pipeline tie in infrastructure and existing infrastructure improvements	*Major (-)*	*Major (+)*	*Major (-)*	*Moderate (+)*	*Negligible*
Infrastructure and Services	• Increased use of air and ground transportation • Pressure on government services • Cost of natural gas utility conversion to resident	*Moderate (-)*	*Major (-)*	*Moderate (-)*	*Major (-)*	*Negligible*
Increased Energy Supply	• Access via new and existing infrastructure • Effects to cost of energy • Indirect effects to other energy suppliers	*Negligible*	*Major (+)*	*Negligible*	*Major (+)*	*Negligible*

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- City or Village
- ASAP v6.1 Mainline
- FBX v4.1 Lateral (Belowground)
- Communities Within 60 Miles of the Proposed Mainline Pipeline Route with Potential Spur Pipeline Access (Excluding Fairbanks North Star Borough)
- Fairbanks North Star Borough
- Communties That May Access Natural Gas Indirectly (Through Truck, or Existing Infrastructure)

Effect Rating

- Major Positive
- Moderate Positive
- Minor Positive
- Negligible
- Minor Negative
- Moderate Negative
- Major Negative

Effect Indicators

POP: Population Trends and Projections
EMP: Employment
HOU: Housing and Property Values
REV/EXP: Government Revenue and Expenditures
INF: Infrastructure and Services
SUP: Increased Energy Supply

Communities within 60 miles
Construction: POP, EMP, HOU, REV/EXP, INF, SUP
Operations: POP, EMP, HOU, REV/EXP, INF, SUP

Communities with Indirect Access
Construction: POP, EMP, HOU, REV/EXP, INF, SUP
Operations: POP, EMP, HOU, REV/EXP, INF, SUP

Fairbanks Northstar Borough
Construction: POP, EMP, HOU, REV/EXP, INF, SUP
Operations: POP, EMP, HOU, REV/EXP, INF, SUP

Beaufort Sea
MP 0
MP 100
Anaktuvuk Pass (51.8 mi)
MP 200
Wiseman (0.6 mi)
Bettles (28.8 mi)
Alatna (55.9 mi)
Allakaket (52.8 mi)
MP 300
Stevens Village (18.0 mi)
Rampart (27.2 mi)
Minto (18.7 mi)
Livengood (4.5 mi)
MP 400
Four Mile Road (0.3 mi)
Nenana (0.7 mi)
Anderson (3.2 mi)
MP 500
Healy (2.3 mi)
Ferry (5.9 mi)
McKinley Park (1.7 mi)
Cantwell (1.2 mi)
MP 600
Petersville (15.8 mi)
Talkeetna (4.9 mi)
Skwentna (34.0 mi)
MP 700
Willow (2.9 mi)
Susitna (9.7 mi)
MP 733
Anchorage (17.2 mi)
Pleasant Valley (29.1 mi)
Two Rivers (24.6 mi)
Circle
Central
Circle Hot Springs
Big Delta
Delta Junction
Paxson
Glennallen
Nelchina
Mendeltna
U.S.A.
CANADA
Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

DATE: MAR 2018
CHKD: K.A.
DRWN: A.V.K.
PROJ. No.: 0416166

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Figure 4.18-1: COMMUNITY IMPACTS ALONG THE PROPOSED PIPELINE ROUTE ALASKA STAND ALONE PIPELINE

0 30 60 120 180 Miles

Barrow
Nome
Fairbanks
Bethel
ANCHORAGE
Juneau

N

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4.19. Cultural Resources

4.19.1. Introduction

This section describes potential impacts to cultural resources associated with the construction and operation of the proposed Project and discusses AGDC's proposed mitigation strategies that are being developed as part of the Section 106 PA to avoid, minimize, and mitigate potential impacts. The information, data, methods, and/or analyses used in this discussion are based on information provided in the 2012 FEIS (USACE, 2012a), as well as new circumstances or information relevant to environmental concerns that have become available since the publication of the FEIS, including the proposed changes in route and design described in the alternatives. The information provided here builds on the information provided in the 2012 FEIS; in some instances, the information is replicated with relatively minor changes and updates, while other material is entirely new or substantially altered. Specifically, the following items have been substantially updated from the 2012 document related to impacts to cultural resources:

- A new section (Section 4.19.2, Methods) was added to explain the procedures used to evaluate the potential impacts associated with the proposed Project and alternatives;
- Impacts are updated based on new alternatives and new information (*e.g.*, place names, Nuiqsut Cultural Landscape, types of sites); and
- A site-by-site impact analysis is included for sites in the direct impact area.

The Section 106 process, which is ongoing and being conducted concurrently with the SEIS, involves the establishment of the Area of Potential Effect (APE), as well as the development of a Programmatic Agreement (PA) between the State Historic Preservation Officer (SHPO), the Lead Federal Agency (USACE for this proposed Project), cooperating agencies that have chosen to participate (BLM), Indian Tribes and Native corporations that have chosen to participate in consultation (Knik Tribal Council, Chickaloon Traditional Village Council, Kenaitze Indian Tribe, Ahtna, Incorporated, Arctic Slope Regional Corporation, and Cook Inlet Region, Incorporated for this proposed Project), and AGDC. NPS may become a cooperator if the Denali NPP Route is selected. NPS has participated as a consulting party with interest in the Gallagher Flint Station NHL. USACE has invited the following groups to participate in various roles of the Section 106 process: 29 tribes, 28 villages, four regional corporations, seven federal agencies, five state departments, four cities and boroughs (Fairbanks North Star Borough, Denali, Mat-Su, and Fairbanks), as well as eight non-governmental organizations. A PA may be used for several reasons, including when effects on historic properties cannot be fully determined prior to approval of an undertaking and where other circumstances warrant a departure from the normal Section 106 processes. These circumstances are commonly encountered when planning large scale projects such as ASAP.

The PA will outline the process for remaining cultural resources surveys and identification efforts of previously unknown cultural resources; the potential discovery of previously unidentified cultural resources, including human remains, during construction; and the process for resolution of all adverse effects, both those already determined and those that may not yet be determined. It would also include collection and curation policies, consulting party coordination details, reporting and dispute resolution, and other requirements necessary to comply with Section 106 of the National Historic Preservation Act (NHPA) and its implementing regulations at 36 CFR 800. The PA would identify steps to address consultation of both unknown and unevaluated sites within the APE. The PA would include measures to avoid, minimize, and mitigate adverse effects to National Register of Historic Places (NRHP)-eligible sites within the direct APE (Permit Area). AGDC's Cultural Resources Management Plan (CRMP) (Appendix K) also includes information that delineates the process for phased historic property identification, findings of effect, and avoidance, minimization, and mitigation measures. The PA would be signed before the Record of Decision is signed. Lastly, ADNR and BLM are working on common stipulations, including cultural resource stipulations, to ensure consistent operations along the entire ROW.

4.19.1.1. Incomplete or Unavailable Information

In compliance with CEQ guidance (see Section 4.3), this section addresses incomplete or unavailable information pertinent to analyzing impacts of the alternatives on cultural resources. Various information sources have been used to assess impacts to the cultural resources potentially affected by the proposed Project. Assessments for this SEIS are based on the most updated and accessible documents. In regard to incomplete information, not all areas of the proposed Project corridor or ancillary components have been covered by cultural resource surveys. A summary of previous cultural resource survey coverages is presented under Chapter 3, Section 3.15.5 for each of the three study regions (North Slope, Table 3.15-3; Interior, Table 3.15-10; Southcentral, Table 3.15-15). The process for completing surveys in any remaining areas or areas requiring survey due to changes in proposed Project design would be addressed in the PA. Lastly, the spatial reliability of cultural resources in the Alaska Heritage Resource Survey (AHRS) and Traditional Land Use Inventory (TLUI), particularly those found prior to Global Positioning System (GPS) units, represent an incomplete component of cultural resource information. TLUI and AHRS databases may also describe the same resource but have them marked in different locations. Other recently discovered cultural resources may not have the most current information uploaded into the AHRS.

A total of 62 of 202 identified cultural resources in the direct impact area were unevaluated to the NRHP prior to proposed ASAP Project planning efforts. AGDC's cultural resource specialist (meeting the Secretary of the Interior Standards) have provided recommendations of eligibility for 25 of the 62 sites that have been incorporated into this SEIS with the remaining 37 sites incorporated based on the most recent and available information. The process for evaluating the eligibility of these

37 sites and for any other newly documented sites that may be identified between the time of this SEIS and construction is outlined in the PA. Specifically, USACE would require that procedures be implemented to identify all historic properties located within the APE for the proposed Project, including properties to which Indian Tribes attach religious and/or cultural significance, before the permittee or its contractors initiate construction activities. Furthermore, as part of the Section 106 consultation process, AGDC is working to determine which cultural resources would be avoided and to incorporate this information into the PA. The PA would also delineate the processes for the minimization and mitigation of adverse effects. Because development of the PA is in progress and these processes are not yet fully identified, the magnitude of impacts to cultural resources in this analysis is likely higher than the actual magnitude of effects once determinations of eligibility have been completed and the methods of avoidance, minimization, and mitigation have been finalized in the PA.

4.19.2. Methods for Determining Effects

Direct effects include any impact to a cultural resource that is caused by an action and occurs at the time of activity in the vicinity of the proposed Project. Indirect effects to cultural resources include those impacts that are reasonably foreseeable, result from the action, and/or are later in time or further removed from the resource by distance (40 CFR 1508.8). Visual and noise impacts could be direct or indirect effects, and could be temporary or cause lasting effects to a resource.

For the analysis of effects on cultural resources, a direct (ROW and project footprints with associated buffers) and indirect (1 mile buffer of ROW and 0.5 mile buffer of new and improved access roads) are defined for the proposed Project as provided in Section 3.15.1.The impact areas within this SEIS differ from the proposed APEs within the PA, which include more refined direct and indirect APEs that are under ongoing development as part of the Section 106 process. Examples of direct effects to cultural resources from ongoing or proposed activities could include physical destruction of, or damage to, all or part of the resource, removal of the cultural resource from its original location, or change in access to traditional use sites by traditional users. Examples of ground disturbing activities that could cause direct effects during the proposed Project include excavation; construction and maintenance of gravel roads, bridges, and culverts; construction of VSMs for power lines and pipelines; and any other disturbance of the ground surface in the proximity of proposed Project components. Other activities and events that could cause direct effects to cultural resources include damage caused by equipment during the construction and operation phases of the proposed Project, and unanticipated accidents such as spills or fires and subsequent cleanup activities.

Indirect alterations could be caused by the introduction of vibration, noise, or atmospheric elements, change of the character of the resource's use or of physical features within the resource's setting that contribute to its historic significance, neglect of a cultural resource that causes its deterioration, vulnerability to erosion, increased access to and proximity of proposed Project components to culturally sensitive areas, or

loss of cultural identity with a resource (*i.e.*, loss of connection with community's traditional history; loss of ancestral connection; no longer experiencing the therapeutic qualities, remembrances, and sense of place associated with the resource; no longer associating the area as a connection to the past). Increased access could result in a greater vulnerability of cultural resources to intentional and inadvertent damage caused by the general public or by proposed Project personnel and equipment during construction and operation. Changes to stream banks, flow patterns, and erosion characteristics at stream crossings could cause erosion damage to cultural resources in the vicinity of the stream and floodplain. Examples of visual impacts to cultural resources may include interrupted views such as direct views of proposed Project components from cultural resources; disruption of the natural landscape due to mining of gravel for proposed Project components; atmospheric pollution (*e.g.,* dust) visible from cultural resources; and loss or degradation of viewshed features such as large caribou herds, clean snow, and clear lakes, streams, and ponds that could add meaning and importance to cultural resources. Noise impacts on cultural resources could include changes in ambient sounds near culturally sensitive areas during construction and operation phases.

4.19.2.1. Impact Criteria

Impact criteria (*e.g.*, magnitude, duration, extent) for cultural resources are not typically used in NEPA impact assessments. Instead, the assessment of impacts is based simply on the proposed Project action and the proposed alternatives that could cause a potential impact and the type of effect that could result. Table 4.19-1 summarizes the types of effects that could result from the various construction and operational activities, operational infrastructure, and the general proposed Project. However, the effect categories are not mutually exclusive, and certain effects (*e.g.,* introduction of vibration, noise, or atmospheric elements) could occur from construction activities, operational activities, and/or proposed Project infrastructure. This cultural resource section is organized by a discussion of the types of direct and indirect effects for construction and operation phases of each alternative, with examples of how these effects could affect different types of cultural resources (*e.g.,* prehistoric sites, built environment, linear transportation features, landscapes). This is followed by an overview of the specific number, type, and list of known cultural resources that could experience the direct and indirect effects from construction and operation of the alternatives.

Table 4.19-1 Types of Effects and Impacts on Cultural Resources

Type of Effect	Proposed Action Causing Potential Impact
• Physical destruction or damage • Removal of the cultural resource from its original location • Vulnerability to erosion	Construction activities (*e.g.*, construction ground disturbance, traffic, human presence, barging, water use requirements)
• Change to character and setting • Change in use and/or access to traditional sites • Proximity of proposed Project components to culturally sensitive areas	Proposed Project operational infrastructure (*e.g.*, roads, material sites, ROW)
• Introduction of vibration, noise, or atmospheric (*e.g.*, visual, dust, olfactory) elements • Increased access to culturally sensitive areas	Operation activities (*e.g.*, traffic, maintenance and security activities, proposed Project policies)
• Loss of cultural identity with a resource • Neglect of a cultural resource that causes its deterioration	General proposed Project
• Alterations of environment resulting in change of eligibility status	General proposed Project

Approximately 800 cultural resources (see Chapter 3, Section 3.15) could be impacted by the proposed Project. To facilitate the analysis, the specific impact discussion is organized around 11 site types developed for this SEIS:

8. Prehistoric – cultural resources that show evidence of prehistoric/ancestral activity, which may include surface and subsurface features.
9. Historic Artifact/Activity Areas – cultural resources that show evidence of historic activity and are generally lacking identifiable/intact built structures.
10. Built Environment – cultural resources that represent historic structures, have been designed and constructed for habitation or commercial uses, have adequate preservation so that their function could be ascertained, and are the main focal point of the site.
11. Linear Transportation Feature – cultural resources that include trails, railways, roads, or any other travel route with prehistoric or historic uses.
12. Isolate – Prehistoric/Historic – a single prehistoric or historic object without any other associated cultural materials.
13. Cultural Modified Trees (CMTs) – a tree that has been modified for cultural purposes such as trail marking, subsistence, or spiritual reasons. Generally, ADNR, OHA does not give individual CMTs an AHRS number and these sites are preferably larger groves associated with other resources, over 50 years old, and well documented.
14. District/Landscapes – a concentration of individual sites or components that when taken together express a historic or prehistoric commonality.

15. Cemetery/Graves/Human Remains – cultural resources that can range from designed cemeteries, to an isolated grave, to a single instance of a recovered human bone with no other associated human remains.
16. Multicomponent – cultural resources that include a combination of prehistoric and historic components, or a combination of human remains with any other prehistoric or historic resource.
17. Paleontological –environmental resources (often fossilized) that can yield information regarding animals and plants.
18. Other – cultural resources with insufficient data to assess the nature of the cultural resource or a modern resource. In rare cases, other represents cultural resources that do not fit in the confines of any other resource type (*e.g.*, National Park and pet cemetery).

A site-by-site impact analysis is presented for eligible sites within the direct impact area while impacts to sites within the indirect impact areas of the proposed Project are discussed at the site type level. The site-by-site impact analysis takes into consideration the criteria of the NRHP for which the site is considered eligible (*e.g.,* A, B, C, D, and criteria considerations), the integrity aspects of the site that convey its significance, and other variables such as presence of surface/subsurface components, proximity to footprint of proposed Project components, and reliability and specificity of site boundaries. In some instances, the literature did not describe integrity aspects for a particular site, in which case, the cultural resource subject matter experts for this SEIS conducted an integrity analysis based on the available information. The site-by-site impact analysis concludes with a final ranking of the potential impacts to the site as major, moderate, minor, or negligible. These final impact rankings are based on the application of proposed mitigation in the CRMP and the resulting effect of proposed Project impacts on the integrity of the site and its ability to convey its significance under the NRHP criteria:

- Major
    - Site is within footprint of proposed Project components and no mitigation measures are proposed/identified for construction or operation.
- Moderate
    - Site is within footprint of proposed Project components and site-specific mitigation measures are proposed, or
    - Site is not within footprint of proposed Project components but has surface features within the direct impact area and site-specific mitigation measures are not currently proposed/identified for construction or operation.

- Minor
  - Site is not within footprint of proposed Project components but has surface features within the direct impact area and mitigation measures are proposed, or
  - Site is not within footprint of proposed Project components and is subsurface only and mitigation measures are not currently proposed/identified for construction or operation.
- Negligible
  - Site is not within footprint of proposed Project components and is subsurface only and mitigation measures are proposed, or
  - No mitigation measures are proposed but proposed Project impacts would not result in adverse effects.

For operational effects, if the site is in the footprint of proposed Project components the effects stay the same as construction, if the site is outside the footprint the effects may be reduced due to lower activity levels and continued mitigation.

The comparison of alternatives is discussed in the Section 4.19.7, Conclusions.

4.19.3. Applicant-Proposed Design Features, Mitigation Measures and Best Management Practices

As described above, USACE is currently in the process of developing a PA to address requirements of the Section 106 process. The PA identifies ways to avoid, minimize, and mitigate adverse effects to historic properties. Types of mitigation strategies that AGDC (2018) has proposed for the proposed Project include:

19. Avoidance of the cultural resource – would address standard and site-specific avoidance, minimization, and mitigation measures for the entire proposed Project, thereby eliminating the need for site-by-site Section 106 consultation each time new cultural resources are discovered or new effects are anticipated.
20. Data recovery through archaeological excavation, analysis, and documentation of all or part of the cultural resource – would identify the process in which excavation of cultural resources may be an appropriate mitigation measure when avoidance is not practicable.
21. Developing a procedure for unanticipated discoveries – would develop the procedures whereby unanticipated discoveries are addressed should they occur during construction of the proposed Project. A draft of this plan is provided in the draft CRMP (Appendix K) and includes procedures for stopping work, notifying officials, and evaluation and consultation on discoveries. This plan also includes separate protocols for inadvertent discoveries of human remains.
22. Performing Historic American Building Survey/Historic American Engineering Record/Historic American Landscape Survey (HABS/HAER/HALS)

documentation – these types of documentation may be appropriate – in some cases – for significant (NRHP-eligible) resources that may be directly/indirectly affected by the proposed Project. The specific structures/buildings/landscapes that would undergo this form of documentation would be identified in the PA.

23. Archaeological monitoring plan – an archaeological monitoring plan would be developed. It would specify the proposed Project components that would be monitored and include detail about how and where monitoring would be accomplished, by whom, and the process for reporting and consulting on discoveries. A draft of this plan is provided in the draft CRMP (Appendix K) and includes regional project component monitoring plans; pre-construction meetings; professional qualification requirements for archaeological monitors; contractor training provisions; stop work, notification, consultation and evaluation procedures; and record keeping and reporting guidelines.
24. Interpretation for and involvement of public – examples include brochures, signage, or partnering with local schools, museums, and/or heritage preservation groups. Interpretation products as mitigation would be detailed in the PA.

In addition, AGDC (2017b) provides more details regarding mitigation strategies that may be employed by the proposed Project, depending on the types of effects, including proposed mitigation for many of the eligible or treated eligible sites in the direct APE. These strategies include further details regarding avoidance, data recovery, inadvertent discovery plan, operation monitoring, vegetation screening, built environment documentation, and contractor awareness training. It is important to note that AGDC plans to avoid sites to the extent possible with a 500-foot buffer and drop-in monitoring program; however, the feasibility of avoidance for each site has yet to be determined with pipeline engineers. Therefore, the application of mitigation and resulting impact rankings do not factor in avoidance, and once avoidance has been finalized, impacts to a number of sites would be reduced. AGDC would also implement a long-term monitoring program to monitor the effects of nearby construction, operation, and maintenance activities to the sites. This monitoring program is factored into the impact rankings, particularly when assessing effects of increased access to surface sites. The following alternative analysis sections include the application of these proposed AGDC mitigation strategies.

4.19.4. Alternative 1 – Proposed Action

Alternative 1 is designated the proposed Action (proposed ASAP Project). This alternative is described in Chapter 2 in detail. The 36-inch, 733-mile-long pipeline and the 12-inch, 30-mile Fairbanks Lateral pipeline would cross several regions from the North Slope to Southcentral Alaska.

4.19.4.1. Construction

4.19.4.1.1. Pipeline Right-of-Way – Mainline

The Mainline construction ROW would range from a 120-foot easement at its narrowest point to a 350-foot easement at its widest point, which includes some temporary workspaces and other lands needed for constructing the pipeline. The Fairbanks Lateral construction ROW would range from a 100-foot easement at its narrowest point, to a 350-foot easement at its widest point. Hillsides along the ROW would be built up with gravel for work pads and ROW preparation, while others would be graded out of the slopes they cross and in some cases would have wider ROW widths than those on flatter ground. Temporary Workspaces and HDD False ROWs used during construction would need up to an 800-foot-wide easement. The pipeline itself would be buried 6 to 8 feet below grade with the spoils from the ditch stored on the opposite side from the work pads, then replaced over the pipeline.

4.19.4.1.1.1. Direct Effects

As discussed in the 2012 FEIS, the construction phase would be the most likely to disturb reported and undiscovered cultural resource sites in the proposed Project ROW. It should be noted, that the extent of reported cultural resource sites is sometimes poorly defined, as cultural resource sites discovered before GPS units were available may be imprecisely located (BLM, 2002). Unanticipated site discovery may occur as pipeline excavation penetrates surface sediments more deeply than archaeological testing typically could achieve. Undocumented buried cultural resource sites and surface cultural resource sites with small artifacts (*e.g.,* lithic scatters) would be most susceptible to impacts from the construction activities; whereas any larger undocumented surface cultural resource sites, such as built structures, would be more easily avoided should they be encountered. Table 4.19-2 presents a summary of environmental characteristics and their associated levels of potential for containing archaeological resources and where unanticipated site discoveries may be more likely.

Table 4.19-2 Environmental Characteristics and Archaeological Potential

Known Site Location	High Potential	Moderate Potential	Low Potential
• Includes a small area around previously identified sites, features, or artifact finds	• Proximity to the confluences of existing and relict rivers and streams • Well-drained terraces adjacent to rivers and streams • High ground near an important resource • Proximity to travel ways (trails/streams) • High prominences above surrounding terrain usable as lookouts for game • Rock shelters and caves • Shorelines • Inlets and outlets of lakes • Perennial snow and ice patches • Areas where remains have been reported but have not been confirmed	• Includes areas with some prospect of finding cultural resources but less than high potential • Along high riverbanks • Dry land with no topographic prominence relative to the surrounding terrain • Topographic prominences away from the rivers • High dry banks along the shores of lakes	• Wetland areas • Very recent geological features such as active river floodplain or islands • Areas with steep inclines • Areas where previous ground surface and subsurface has been destroyed or heavily disturbed and/or culture bearing sediments have been removed • Dry lake or stream beds • Areas determined not suitable for occupation • Where there is a low potential for site preservation

Placement of gravel for work pads and spoil and subsequent demobilization of gravel pads and replacement of spoil could disturb or dislocate buried artifacts, features, and possibly human remains. Operation of heavy equipment over wet tundra, water saturated soils or incompletely frozen wet tundra, even with tundra mats, could cause displacement of buried archaeological deposits. Historic-period built environment resources and artifacts are generally more easily identified and less likely to be damaged or disturbed during construction activities. CMTs and elements of cultural landscapes associated with subsistence, trapping, and travel across the landscape in prehistoric and historic time periods may be damaged or removed. Historic linear transportation features and RS 2477 trails may be obstructed or rerouted around construction activity, adversely impacting their integrity. Cultural resource sites in close proximity to the proposed Project that are from the historic-period primarily include trails/transportation routes and historic-period activity areas primarily associated with mining and road construction.

Cultural activities (*e.g.,* subsistence, culture camps) in culturally valued places (*e.g.,* traditional hunting grounds, cultural landscapes) may also be impacted if they occur in areas along the proposed Project during construction activities and/or there is a change in access to or use of traditional sites. These activities promote social cohesion, social

institutions, lifeways, religious practices, and/or other cultural institutions for various cultural groups located along the proposed Project from the North Slope to Southcentral Alaska. Construction activities in any one area along the proposed Project are anticipated to be completed in one season so the duration of these effects would be short. The likelihood of direct effects to cultural resources would be greater for those situated within the footprint of a proposed Project component versus those located outside the proposed Project footprint but still within the direct impact area.

Similar to impacts discussed above, impacts to cultural landscapes, in general, could include:

- Physical alterations, destruction, or damage to the landscape through ground disturbing activity;
- Restricted access to multi-generational camps, hunting areas, and travel routes used by residents due to physical barriers and user avoidance of industrial areas; and
- The destruction or degradation of any (including unknown or unrecorded) cultural resources or areas through construction or accidents associated with proposed Project activities.

4.19.4.1.1.2. Indirect Effects

Increased human presence and activity on the ROW during the construction phase would likely result in reported and previously undocumented cultural resource sites being encountered in and along the ROW, which could result in a greater vulnerability of cultural resource sites to damage or looting. The likelihood for damage or looting would be greater for surface sites that are more easily identifiable on the landscape than for buried/subsurface sites. Open cut crossings on streams may cause changes in stream banks, resulting in bank cutting or channel infill, potentially exposing, eroding, or flooding cultural resource sites.

Impacts to important locations identified by the presence of place names could also occur beginning during construction and carry on through operation which could affect cultural identity. As discussed in Chapter 3, Section 3.15, place names can signify a number of things including recording locations of natural history, human activities, mythological/sacred events, people, religion, or non-traditional names. Place names may have different levels of significance and may be impacted differently according to the level of importance placed on those locations by the cultural groups that identify with them and by the nature of the proposed Project activities. Some place names may simply be geographic landmarks used in navigation or signal a place where a particular resource may be gathered; others may have different importance and represent significant human or mythological/sacred events that are deeply tied to a group's cultural identity.

For cultural landscapes, the proposed Project could also indirectly alter the way subsistence hunters access traditional hunting and fishing areas away from the

community; alter routes used to access hunting areas and to travel between villages, cabins, and camps; cause decreased use of the landscape in the vicinity of proposed Project components due to decreased availability of subsistence resources, and accompanying loss of cultural association with those areas; and gradually shift cultural activities away from areas within the cultural landscape due to avoidance of proposed Project components. Visual and noise impacts to a cultural landscape include disruptions to ambient noise levels caused by construction, operation, and reclamation of proposed Project components; changes to the viewshed due to proposed Project components; and the introduction of new landmarks associated with industrial infrastructure in culturally sensitive areas.

4.19.4.1.2. Aboveground Facilities and Associated Project Components

Aboveground facilities and components include the GCF, pig launcher and receiver stations, operations and maintenance buildings, construction camps and pipeline yards, material sites, and access roads.

4.19.4.1.2.1. Direct Effects

Construction could affect undocumented cultural resource sites in the various proposed Project component footprints similar to the direct effects described above in Section 4.19.4.1.1.1.

4.19.4.1.2.2. Indirect Effects

An increased number of people would be active on the landscape at the time of construction, increasing the likelihood that nearby cultural resource sites would be visited, discovered, or damaged. Specific to access roads, runoff, erosion, and redeposition of sediment due to road construction activities could expose, disturb, or bury cultural resource sites. Access to areas previously unsurveyed for cultural resources would be increased as personnel build the access roads, increasing the likelihood of inadvertent discovery and potential damage or looting.

4.19.4.2. Operations

4.19.4.2.1. Pipeline Right-of-Way – Mainline

4.19.4.2.1.1. Direct Effects

Maintenance and operation of the proposed pipeline ROW would result in a pathway covered with low, shallow rooted vegetation. This vegetation may be maintained with a variety of methods including herbicides, manual vegetation management, and selective re-vegetation using native species selected for their low-level growth and shallow root systems.

RS 2477 trails and other historic-period trails may be obstructed or rerouted by surface infrastructure, such as access control points and fences, causing the trail to lose aspects of its integrity, although these effects are likely minimal and easily mitigated due to the

small footprint of aboveground facilities in the area. Additional traffic and use of these trails may also result, as AGDC would clear the pipeline ROW of vegetation and would create additional access to a well-used recreational trail system with historic-period trail elements. Product spills, modifications, or changes to the pipeline and possible future upgrades to the pipeline system could result in direct effects through displacement of reported or undocumented cultural resources.

4.19.4.2.1.2. Indirect Effects

Indirect effects would likely include increased access by the public to the ROW and adjacent lands, which could result in a greater vulnerability of cultural resources to damage or looting. AGDC would designate access roads as private and not for public use, and limit public access to the ROW, at the request of the landowner, by blocking entry areas with large boulders, berms, or fencing. However, these measures would not completely prevent increased access as some landowners may not want to restrict established access patterns (thereby increasing potential for access to culturally sensitive areas). Preventing unauthorized use would be less feasible in remote, rural areas of Alaska. This effect would be more likely in areas such as Minto Flats and the area south of Willow that do not parallel existing transportation corridors. Visual impacts to the landscape would include the linear feature of the cleared ROW, with periodic indications of the presence of the pipeline where it surfaces, which may be intrusive to a cultural landscape or individual cultural resource sites in which the setting and location contributes to its historical importance. For cultural resource sites where character and setting are important elements, the cleared vegetation above the buried pipeline could affect the visual integrity. In general, built environment resources, large historic districts (*e.g.,* the Denali Park Road and associated Park Road Historic District), and cultural landscapes, as opposed to buried archaeological sites, are more likely to experience visual impacts that degrade the cultural and aesthetic values of these cultural resources. Impacts to important locations signified by indigenous place names that began with construction may also continue into operations.

4.19.4.2.2. Aboveground Facilities and Associated Project Components

4.19.4.2.2.1. Direct Effects

No direct effects would be expected from operation and maintenance of aboveground facilities such as the GCF, Mainline Block Valves, and pig launcher/receivers. Other proposed Project components, such as camps, pipeline yards, and material sites, would not be used during operations and maintenance; therefore, no direct effects would be anticipated.

4.19.4.2.2.2. Indirect Effects

The appearance of aboveground components could be an incompatible visual and architectural element on the landscape. The range of this impact would be reduced in forested areas of the ROW and greatest on tundra landscapes; it would also be

heightened in areas of no development such as the Minto Flats. Collocation of aboveground facilities should reduce the overall effects, as contrasted to placing them separately. For example, the GCF would represent a small, incremental addition to the existing array of facilities of similar appearance and purpose in the Prudhoe Bay area and thus would not be an incompatible visual and architectural element on the landscape. For temporary construction facilities, such as the construction camps and pipeline yards, no indirect effects would be anticipated as these components would not be used during operations and maintenance.

Access roads, coupled with a cleared and maintained ROW, would create new networks of trails for summer and winter users. Access pattern changes could redistribute the use of existing trail networks such that cultural resource sites not previously accessible could be affected. Similar to visual impacts, effects resulting from increased access are more likely to impact historic built structures or surface archaeological sites as they are more apparent on the landscape, whereas buried archaeological sites are less likely to be disturbed as they are less readily identifiable.

4.19.4.3. Alternative 1 Site Impact Analysis

The following tables provide a comparison of the number of previously reported cultural resource sites that may experience direct and indirect effects described below during the construction and operation of the proposed Project Mainline and associated components (*e.g.,* access roads, material sites, camps). The tables include an analysis for the following five segments:

- GCF to MP 536 – This segment covers the portion of the proposed Project from the GCF in Prudhoe Bay to MP 536, which is the approximate location of the start of the Denali NPP Route Variation. This segment is the same for both Alternative 1 and 2.
- Fairbanks Lateral – This segment addresses the 30-mile lateral spur to Fairbanks.
- MP 536 to MP 543 – This segment is the proposed portion of the proposed Project (Alternative 1) that is the variant to the Denali NPP Route Variation.
- Denali NPP Route Variation – This segment represents the primary physical change in footprint between Alternative 1 and Alternative 2 (see discussion under Section 4.19.4.1)
- MP 543 to End – This segment covers the portion of the proposed Project from where the Denali NPP Route Variation and Alternative 1 rejoin to the end of the proposed Project (ENSTAR tie-in).

Tables 4.19-3 through 4.19-5 provide the number of AHRS sites/RS 2477 trails/place names located within the proposed Project ROW and associated components (direct impact area) and up to 1 mile of the ROW and associated components (indirect impact area). As mentioned in Chapter 3, Section 3.15, Cultural Resources, place names are frequently identified on maps as points, even though the place name may represent creeks, rivers, lakes, ancestral and modern villages, resource locations, mountain range,

or other large natural or geographic features that extend for some distance. To capture locations with indigenous place names within the direct and indirect impact areas, a 5-mile (8-km) area was used to identify geographic features and other locations that may intersect the impact areas whose identifying points were outside of the direct and indirect impact areas.

Table 4.19-3 AHRS Sites within the Direct and Indirect Impact Areas of Five Proposed Project Segments

Project Segment	Site Type – Direct Impact Area	AHRS Site Number within Direct Impact Area[a]	AHRS Sites within Indirect Impact Area
GCF to MP 536	**Prehistoric**	**DOE-S (43)** BET-00055, BET-00074, BET-00081, BET-00202, BET-00206, BET-00213, BET-00250, CHN-00077, CHN-00124, HEA-00595, LIV-00047, LIV-00055, LIV-00104, LIV-00106, LIV-00402, LIV-00553, LIV-00726, LIV-00748, LIV-00749, LIV-00776, LIV-00778, PSM-00049, PSM-00050, PSM-00075, PSM-00076, PSM-00192, PSM-00197, PSM-00498, PSM-00501, PSM-00572, PSM-00573, PSM-00578, PSM-00588, PSM-00596, PSM-00601, PSM- 0604, PSM-00605, PSM-00607, SAG-00109, WIS-00288, WIS-00413, WIS-00436, WIS-00437 **DOE-P-S (8):** BET-00083, PSM-00059, PSM-00172, PSM-00199, PSM-00499, PSM-00500, PSM-00597, PSM-00606 **NDE (8):** BET- 00018, BET- 00082, BET- 00121, BET- 00122, BET- 00208, LIV-00552, PSM-00582, WIS- 00005	401
	Built Environment	**DOE-S (1)**: CHN-00018	
	District/Landscape	**DOE-S (1):** LIV-00284 **NDE (1):** Nuiqsut Cultural Landscape[b]	
	Historic Artifact/ Activity Areas	**DOE-S (4):** CHN-00025, CHN-00125, FAI-02386, FAI-02389 **NDE (3):** HEA-00619, PSM-00186, SAG-00076	
	Isolate	**DOE-P-S (1):** BET-00253 **NDE (3):** BET-00183, HEA-00657, LIV-00779	
	Linear Transportation Feature	**DOE-S (11):** BET-00200, CHN-00070, FAI-02102, FAI-02177, FAI-02366, LIV-00501, LIV-00556, PSM-00570, SAG-00097, TAN-00118, WIS-00408 **DOE-P-S (1)**: LIV-00392 **NDE (2)**: SAG-00098, WIS-00434	
	Multicomponent	**DOE-S (1):** HEA-00062	
Fairbanks Lateral	**Historic Artifact/ Activity Areas**	**NDE (1):** FAI-02298	45
	Linear Transportation Feature	**DOE-S (1):** FAI-02119	
MP 536 to MP 543 (Alternative 1)	**Prehistoric**	**DOE-S (2):** HEA-00662, HEA-00658	9

Project Segment	Site Type – Direct Impact Area	AHRS Site Number within Direct Impact Area[a]	AHRS Sites within Indirect Impact Area
Denali NPP Route Variation (Alternative 2)[c]			15
MP 543 to MP 733 End	**Prehistoric**	**DOE-S (1):** TLM-00327 **DOE-P-S (1):** TAL-00188 **NDE (9):** HEA- 00597, HEA- 00680, TAL- 00189, HEA- 00601, TYO- 00178, TYO- 00204, TYO- 00179, TYO- 00208, TYO- 00315	138
	Built Environment	**DOE-S (2):** HEA-00066, TAL-00181 **NDE (1):** HEA-00188	
	Historic Artifact/ Activity Areas	**DOE-S (1)**: TAL-00180 **NDE (1):** TYO-00205	
	Isolate	**NDE (3):** HEA-00600, HEA-00604, HEA-00607	
	Linear Transportation Feature	**DOE-S (4):** HEA-00450, TYO-00084, TYO-00224, TYO-00228 **NDE (6):** TYO- 00164, TYO- 00170, TYO- 00184, TYO- 00225, TYO- 00226, TYO- 00201	

a For AHRS site descriptions in direct impact area refer to Chapter 3, Tables 3.15-4, 3.15-11, and 3.15-16. This column does not include sites that have been determined not eligible
b Not in AHRS
c The number of AHRS sites within the Direct and Indirect Impact Areas may increase following cultural resource surveys should this route be selected for project construction.
DOE-S – Eligible; DOE-P-S – pending consultation; NDE – no determination of eligibility
AHRS Data used in this analysis acquired on February 14, 2017

Table 4.19-4 RS 2477 Trails within the Direct Impact Areas of Five Proposed Project Segments

Project Segment	RS 2477 Crossed by Direct Impact Area	ID / Name[1]
GCF to MP 536	16	RST 9 Coldfoot-Chandalar Lake Trail – Crossed 3x RST 709 Healy-Diamond Coal Mine Dirt Road RST 66 Dunbar-Brooks Terminal – Crossed 2x RST 591 Coldfoot-Junction Trail 49 (east route) – Crossed 2x RST 491 Rex-Roosevelt RST 468 Hunter Creek-Livengood RST 450 Hickel Highway – Crossed 2x RST 412 Slate Creek – Crossed 3x RST 346 Nenana-Kantishna RST 345 Kobi-McGrath (via Nikolai & Big River) RST 344 Lignite-Kantishna RST 343 Kobi-Kantishna RST 340 Lignite-Stampede RST 262 Caro-Coldfoot – Crossed 2x RST 254 Wiseman-Chandalar – Crossed 2x RST 1595 Dunbar-Minto-Tolovana
Fairbanks Lateral	0	
MP 536 to MP 543 (Alternative 1)	0	
Denali NPP Route Variation (Alternative 2)	0	
MP 543 to MP 733 End	4	RST 625 Cantwell Small Tracts Road (Lovers Lane) RST 1506 Goose Creek Road RST 149 Nancy Lake-Susitna RST 118 Knik-Susitna

Table 4.19-5 Place Names within the Direct and Indirect Impact Areas of Five Proposed Project Segments

Project Segment	Place Names within Direct Impact Area	Place Name Number within Direct Impact Area[a]	Place Names within Indirect Impact Area (5 Miles)
GCF to MP 536	2	NS002, I154	302
Fairbanks Lateral	0	-	79
MP 536 to MP 543 (Alternative 1)	0	-	13
Denali NPP Route Variation (Alternative 2)	0	-	3
MP 543 to MP 733 End	0	-	148

a For place name in the indirect impact area refer to Appendix K, Part I, Tables T-2, T-4, and T-6

4.19.4.3.1. Gas Conditioning Facility to MP 536

This section of the proposed Project would extend from the Prudhoe Bay GCF to MP 536, and roughly follows the TAPS route. For the GCF to MP 536 segment, there would be a total of 146 cultural resource sites that could potentially experience direct effects from the proposed Project construction and 401 cultural resource sites that fall within the area for potential indirect effects (Table 4.19-3). Included within the 401 cultural resource sites is the Gallagher Flint Station National Historic Landmark, which would require special consideration from the National Park Service and consultation under Section 110(f) to assess and mitigate effects. Of the 146 cultural resource sites within the direct impact area, 83 are prehistoric, 19 are linear transportation features, 16 are isolates, and 18 are historic artifact/activity areas; the remaining categories of built environment, CMTs, districts/landscapes, multicomponent, paleontological, and other cultural resources comprise fewer than three for any one category. There are no reported cemetery/grave/human remains within the direct impact area for this segment. A total of 61 cultural resource sites within the direct impact area are eligible, 58 are not eligible, and the remaining 27 have no determination of eligibility. Of the eligible ones, the majority (43) are prehistoric (Table 4.19-6).

Table 4.19-6 Eligibility Status of AHRS Sites within the Direct and Indirect Impact Areas of GCF to MP 536 Segment

Resource Type	Direct			Indirect			Total
	Eligible[a]	Not Eligible	No Determination[b]	Eligible[a]	Not Eligible	No Determination[b]	
Prehistoric	43	24	16	13	13	204	**313**
Built Environment	1			3	2	27	**33**
Cemetery/Graves/Human Remains						1	**1**
CMTs		2					**2**
Districts / Landscapes[c]	1		1	2	1	2	**7**
Historic Artifact/Activity Areas	4	11	3	1		22	**41**
Isolate - Prehistoric/Historic		12	4		3	36	**55**
Linear Transportation Feature	11	5	3	8	6	18	**51**
Multicomponent	1			2	3		**6**
Other		1			1	18	**20**
Paleontological		3				15	**18**
Total	**61**	**58**	**27**	**29**	**29**	**343**	**547**

a Includes National Historic Landmarks, treated as eligible under PA, determined to be eligible as a contributing element to an eligible district (DXS), and determined eligible through keeper (DOE-K)
b No determination includes those pending consultation (DOE-P-S)
c Districts/Landscapes includes the Nuiqsut Cultural Landscape not listed in the AHRS

Sixteen RS 2477 trails (many of which have corresponding AHRS numbers) would be crossed by the proposed Project within this segment; several are crossed multiple times (Table 4.19-4). Three TLUI sites would also be located within 1 mile of the proposed Project along this segment. Lastly, there are two place names within the direct impact area with an additional 302 within the indirect place name impact area (Table 4.19-5). NS002 is an Iñupiat place name grouping that represents the Atigun area including related camps, creeks, river, pass, and gorge. I154 is a Lower Tanana place name that means "Swallows Creek." As discussed above, other place name locations on the map may not have had their point located in the direct impact area but still represent features that extend into the direct impact area. This is especially true for linear features such as rivers and creeks (*e.g.,* Yukon River [I006], Susitna [SC053]) or mountains and passes (*e.g.,* Panorama Mountain [SC002], Broad Pass [SC001]).

This segment includes the construction activities associated with West Dock. There are no known cultural resources within the footprint of these activities. Therefore, there would be no impacts to known cultural resources associated with the proposed Project activities at West Dock. This segment also includes the HDD for the Yukon River crossing in Alternative 1 (compared to new suspension bridge aerial crossing in Alternative 2). Other than the Dalton Highway, no known cultural resource sites are located with the direct impact area of the staging area for HDD. Because the pipeline would be buried beneath the Yukon River, there would be no chance for visual effects to nearby cultural resources versus the heightened potential for visual impacts from the aerial crossing in Alternative 2. Also within the GCF to MP 536 segment is the Nuiqsut Cultural Landscape. As shown on Figure 3.15-2, the proposed Project passes through the eastern boundary of the Nuiqsut Cultural Landscape and crosses over several traditional trails and travel/trade routes in addition to passing by several cultural resources.

4.19.4.3.1.1. Direct Effects

The following presents the site-by-site impact analysis, which is organized by level of impact (major to negligible) for eligible sites (including those pending consultation) and unevaluated sites within the direct impact area, with sites being grouped by common impact rankings (Tables 4.19-3 and 4.19-6). The mitigations applied in this section are based on the mitigation strategies that AGDC has proposed for the proposed Project (see Section 4.19.3) including specific site mitigation measures for sites within the direct APE that have been identified in AGDC's CRMP. Mitigation measures would be finalized in the PA. Other potential minimization and mitigation strategies may be identified during consultation and development of the PA that could help reduce effects.

4.19.4.3.1.1.1. Sites with Major Impact Rankings

Historic Artifact/Activity Areas – PSM-00186, SAG-00076: PSM-00186 is a historic artifact assemblage with a collapsed structure consisting of surface materials, and SAG-00076 is also a historic artifact assemblage consisting of surface materials. Both sites have no determinations of eligibility and are assumed eligible for the NRHP for this analysis.

The sites are located within the footprint of proposed construction, and associated ground disturbing activities would impact the sites through physical destruction or damage to the sites and the features that allow them to convey their significance to the NRHP. Furthermore, surface features at some of the sites could be at risk due to increased access. Because the sites have no determinations of eligibility, AGDC has not yet proposed site-specific mitigation measures until the eligibility process is completed. Therefore, at present, impacts to these sites would be **major** in construction due to the definite destruction and/or damage to the sites and lack of site-specific mitigation. Because the sites are within the footprint of proposed Project components, construction effects to the integrity of the sites would remain **major** in operation and beyond the life of the proposed Project.

Isolate – LIV-00779: LIV-00779 is a subsurface isolate site that has no determination of eligibility and is assumed eligible for the NRHP for this analysis. The site is located within the footprint of proposed construction, and although the site is currently reported as an isolate, the lack of delineation indicates additional resources are likely to be present, and associated ground disturbing activities would impact the site through physical destruction or damage to the site and the features that allow it to convey its significance to the NRHP. Because the site has no determination of eligibility, AGDC has not yet proposed site-specific mitigation measures until the eligibility process is completed. Therefore, at present, impacts to this site would be **major** in construction due to the definite destruction and/or damage to the site and lack of site-specific mitigation. Because the site is within the footprint of proposed Project components, construction effects to the integrity of the site would remain **major** in operation and beyond the life of the proposed Project.

Linear Transportation Feature – WIS-00434: WIS-00434 represents the Coldfoot-Chandalar Lake Trail and has no determination of eligibility and is assumed eligible for the NRHP for this analysis. One of the proposed Project access roads fully encompasses the trail. Because the proposed Project fully overlaps with the historic trail, the proposed Project would impact the trail through physical destruction or damage to the trail and the features that allow it to convey its significance to the NRHP. Because the site has no determination of eligibility, AGDC has not yet proposed site-specific mitigation measures for the trail until the eligibility process is completed. Therefore, impacts to the trail would be **major** in construction due to the definite destruction and/or damage to the trail and lack of site-specific mitigation. Because the trail is within the footprint of proposed Project components, construction effects to the integrity of the trail would remain **major** in operation and beyond the life of the proposed Project.

Prehistoric – BET-00082, BET-00018, LIV-00552, PSM-00059, PSM-00172, PSM-00500, PSM-00597, PSM-00606, WIS-00005: These nine sites are prehistoric archaeological sites with surface and/or subsurface cultural materials. These sites have no determinations of eligibility and/or are pending consultation and are assumed eligible for the NRHP for this analysis. The sites are located within the footprint of proposed construction, and associated ground disturbing activities would impact the sites through physical

destruction or damage to the sites and the features that allow them to convey their significance to the NRHP. Furthermore, surface features at some of the sites could be at risk due to increased access. Because the sites are pending consultation or have no determinations of eligibility, AGDC has not yet proposed site-specific mitigation measures until the eligibility process is completed. Therefore, at present, impacts to these sites would be **major** in construction due to the definite destruction and/or damage to the sites and lack of site-specific mitigation. Because the sites are within the footprint of proposed Project components, construction effects to the integrity of the sites would remain **major** in operation and beyond the life of the proposed Project.

4.19.4.3.1.1.2. Sites with Moderate Impact Rankings

District/Landscape – LIV-00284: LIV-00284 is the Rosebud Knob Archaeological District eligible under criterion D consisting of surface and subsurface cultural materials. Analysis conducted for this SEIS indicates the district retains integrity of location, material, design, and association through the presence of numerous archaeological sites that have yielded lithics and datable material. The district boundaries are reliably defined, and ground disturbing activities associated with the proposed Project would impact the district through physical destruction or damage to contributing sites of the district and the features that allow it to convey its significance and ability to yield information important to prehistory under criterion D. Furthermore, because many of the sites are surface or shallow buried sites, they are more susceptible to looting or damage from increased access. Because the district is eligible and could be impacted, AGDC has proposed specific mitigation measures including data recovery, spatial analysis of sites within the district, and analysis of collected material from sites within the district. Therefore, although the district is in the footprint of proposed Project components, impacts would be reduced to **moderate** due to AGDC's proposed mitigation or minimization measures. However, because the site is within the footprint of proposed Project components, construction effects to the integrity of the district would remain **moderate** in operation and beyond the life of the proposed Project.

Historic Artifact/Activity Areas – CHN-00025, CHN-00125, FAI-02390: These three sites are historic artifact assemblage with surface and/or subsurface cultural materials. All these sites have been evaluated to the NRHP and found eligible under criterion D with CHN-00025 and CHN-00125 also eligible under criterion A. These sites are located within the footprint of proposed construction, and associated ground disturbing activities would impact the sites through physical destruction or damage to the sites and the features that allow them to convey their significance to the NRHP under criterion D and/or A. Furthermore, surface features at these sites could be at risk due to increased access. Because the sites are eligible and could be impacted, AGDC has proposed site-specific mitigation measures including data recovery and archival research. Therefore, although the sites are in the footprint of proposed Project components, impacts would be reduced to **moderate** due to AGDC's proposed mitigation or minimization measures. However, because the sites are within the footprint of proposed Project components,

construction effects to the integrity of the sites would remain **moderate** in operation and beyond the life of the proposed Project.

Historic Artifact/Activity Area – HEA-00619: HEA-00619 is a historic artifact/activity area consisting of surface cultural materials from a campsite. The site has no determination of eligibility and is assumed eligible for the NRHP for this analysis. The site is located within the direct impact area but outside the footprint of nearby proposed Project components. Furthermore, surface features at the site could be at risk due to increased access. Because the site has no determination of eligibility, AGDC has not yet proposed site-specific mitigation measures until the eligibility process is completed. Therefore, at present, impacts to the site would be **moderate** in construction due to the higher likelihood for surface features to be disturbed and lack of site-specific mitigation; without mitigation, construction effects to the integrity of the site would remain **moderate** in operation and beyond the life of the proposed Project.

Isolate – BET-00183: BET-00183 is a surface isolate and has no determination of eligibility and is assumed eligible for the NRHP for this analysis. The site is located within the direct impact area but outside the footprint of nearby proposed Project components. Furthermore, surface features could be at risk due to increased access. Because the site has no determination of eligibility, AGDC has not yet proposed site-specific mitigation measures until the eligibility process is completed. Therefore, at present, impacts to the site would be **moderate** during construction due to the higher likelihood for surface features to be disturbed and lack of site-specific mitigation; without mitigation, construction effects to the integrity of the site would remain **moderate** in operation and beyond the life of the proposed Project.

Multicomponent – HEA-00062: HEA-00062 is both a surface historic site and a subsurface prehistoric site. The historic component of this site has not been evaluated for eligibility; however, the prehistoric subsurface component of the site is eligible under criterion D. The site is located within the footprint of proposed construction, and associated ground disturbing activities would impact the site through physical destruction or damage to the site and the features that allow it to convey its significance and ability to yield information important to prehistory under criterion D. Furthermore, surface features at some of the sites could be at risk due to increased access. Because the site is eligible and could be impacted, AGDC has proposed site-specific mitigation measures including field visits to inform data recovery methods. Therefore, although the site is within the footprint of proposed Project components, impacts would be reduced to **moderate** due to AGDC's proposed mitigation or minimization measures. However, because the site is within the footprint of proposed Project components, construction effects to the integrity of the site would remain **moderate** in operation and beyond the life of the proposed Project.

Prehistoric – BET-00206, CHN-00124, HEA-00595, LIV-00055, LIV-00553, LIV-00748, LIV-00749, LIV-00776, PSM-00075, PSM-00192, PSM-00197, PSM-00498, PSM-00573, PSM-00578, PSM-00601, SAG-00109, WIS-00288, WIS-00436: These 18 sites are

prehistoric archaeological sites with surface and/or subsurface cultural materials including a combination of debitage, tools, bone, datable material, and/or intact stratigraphic components. All these sites have been evaluated to the NRHP and found eligible under criterion D (PSM-00075 also criterion A). These sites are located within the footprint of proposed construction, and associated ground disturbing activities would impact the sites through physical destruction or damage to the sites and the features that allow them to convey their significance and ability to yield information important to prehistory under criterion D (or A). Furthermore, surface features at some of the sites could be at risk due to increased access. Because the sites are eligible and could be impacted, AGDC has proposed site-specific mitigation measures for these sites including data recovery, spatial analysis, analysis of collected material, and larger plans to address the Galbraith Lake and Gallagher Flint Station areas. Therefore, although the sites are in the footprint of proposed Project components, impacts would be reduced to **moderate** due to AGDC's proposed mitigation or minimization measures. However, because the sites are within the footprint of proposed Project components, construction effects to the integrity of the sites would remain **moderate** in operation and beyond the life of the proposed Project.

Prehistoric – BET-00074, BET-00083, BET-00121, BET-00208, PSM-00199: These five sites are prehistoric archaeological sites with surface and/or subsurface cultural materials. Except for BET-00074 (eligible), these sites have no determinations of eligibility and/or are pending consultation and are assumed eligible for the NRHP for this analysis. These sites are located within the direct impact area but outside the footprint of nearby proposed Project components. Furthermore, surface features at these sites could be at risk due to increased access. Because the sites are pending consultation (on eligibility/mitigation) or determinations of eligibility, AGDC has not yet proposed site-specific mitigation measures until the eligibility process is completed. Therefore, at present, impacts to the sites would be **moderate** in construction due to the higher likelihood for surface features to be disturbed and lack of site-specific mitigation; without mitigation, construction effects to the integrity of the sites would remain **moderate** in operation and beyond the life of the proposed Project.

4.19.4.3.1.1.3. Sites with Minor Impact Rankings

Built Environment – CHN-00018: CHN-00018 is a historic shelter and associated artifact assemblage eligible under criterion D. The features of the site include a small A-frame shelter and historic artifacts dating to the mid-twentieth century. The site is located within the direct impact area but outside the footprint of nearby proposed Project components, and therefore, the proposed Project would not affect the site's potential to convey significance and ability to yield information important to history under criterion D. However, surface features at the site could be at risk due to increased access. Because the site is eligible and could be impacted, AGDC has proposed data recovery measures. Therefore, although the presence of surface features could be susceptible to increased access, impacts to the site would be reduced to **minor** in construction due to AGDC's

proposed mitigation or minimization measures. The potential for effects due to increased access would further reduce to **negligible** during operations because of reductions in overall activity levels near the site.

District/Landscape – Nuiqsut Cultural Landscape: The presence of the proposed Project within the Nuiqsut Cultural Landscape could cause effects, particularly related to character and setting and change in use or access to traditional sites. However, the proposed Project is on the eastern periphery of the cultural landscape and generally follows the Dalton and TAPS corridor, which already has an elevated pipeline present. Because the landscape has not had a determination of eligibility, AGDC has not yet proposed site-specific mitigation measures for the landscape. Therefore, at present, impacts to the Nuiqsut Cultural Landscape would be **minor** during construction and operation due to continued presence of the proposed Project in the eastern periphery of the landscape.

Isolate – BET-00253, HEA-00657: These two sites are subsurface isolates that are unevaluated (HEA-00657) or pending consultation (BET-00253) and assumed eligible for the NRHP for this analysis. The sites are located within the direct impact area but outside the footprint of nearby proposed Project components. The sites are also subsurface sites and would be unlikely to experience indirect effects due to increased access. Because the sites have not had determinations of eligibility or are pending consultation, AGDC has not yet proposed site-specific mitigation measures for the sites. Therefore, although the sites lack surface features that would be more susceptible to increased access and are outside the footprint of proposed Project components, impacts to these sites would be **minor** in construction due to the lack of site-specific mitigation to address the range of potential effects; without mitigation, construction effects to the integrity of the sites would remain **minor** in operation and beyond the life of the proposed Project.

Linear Transportation Feature – FAI-02102, LIV-00392, LIV-00556, FAI-02177, FAI-02366, SAG-00098: FAI-02102 and LIV-00556 represent the Dunbar-Brooks Terminal Trail (historic trail), an unimproved two-track trail cut through undeveloped terrain that still represents the era of historic use in the Minto Flats area, and eligible under criterion A. The proposed Project crosses the trail in six discrete locations and in other areas parallels the trail for longer distances. Multiple crossings and the presence of a cleared ROW could reduce the scenic quality and impact the setting and feeling of this historic transportation feature. Increases in noise beyond natural ambient levels could also introduce adverse effects to these features. Furthermore, several access roads and the cleared ROW of the Fairbanks Lateral could draw in more users to the area who then access the historic trail possibly leading to damage through increased use and increased vulnerability to erosion. FAI-02177 is the Dunbar-Minto-Tolovana historic trail, an unimproved trail cut through undeveloped terrain that still represents the era of historic use, and eligible under criterion A. The proposed Project crosses three different sections of the trail near the trail's terminus at the Alaska Railroad; the remainder of the trail continues north away from the proposed Project. FAI-02366 is the Nenana Kantishna

historic trail, an unimproved trail cut through undeveloped terrain that still represents the era of historic use, and eligible under criterion A. The proposed Project has one perpendicular crossing of the trail, and no other proposed Project infrastructure is located near the crossing.

SAG-00098 (Hickel Highway) and LIV-00392 (Livengood Tram Road) have no determinations of eligibility and/or are pending consultation and are assumed eligible for the NRHP for this analysis. The proposed Project has one perpendicular crossing of the Hickel Highway and two crossings (Mainline and access road) of the Livengood Tram Road.

Because the trails are eligible and could be impacted, AGDC has proposed to minimize effects through vegetation and existing trail condition maintenance and scheduling construction activities during period of low use (assume mitigation would be applied to SAG-00098 and LIV-00392, as well). Therefore, with mitigation and because of the relatively few crossing locations along these trails, the proposed Project would have **minor** impacts on the trails during construction; these impacts would remain **minor** during operation and beyond the life of the proposed Project.

Prehistoric – BET-00081, BET-00202, BET-00213, BET-00250, LIV-00047, LIV-00104, LIV-00106, LIV-00402, PSM-00049, PSM-00076, PSM-00572, PSM-00588, PSM-00604, PSM-00607: These 14 sites are prehistoric archaeological sites with surface and subsurface cultural materials. All these sites have been evaluated to the NRHP and found eligible under criterion D (PSM-00049 and PSM-00076 also criterion A) through the presence of a combination of debitage, tools, bone, datable material, and/or intact stratigraphic components. These sites are located within the direct impact area but outside the footprint of nearby proposed Project components, and therefore, the proposed Project would not affect the sites' potential to convey significance and ability to yield information important to history under criterion D. However, surface features at these sites could be at risk due to increased access. Because the sites are eligible and could be impacted, AGDC has proposed site-specific mitigation measures for these sites including data recovery, spatial analysis, analysis of collected material, and larger plans to address the Galbraith Lake and Gallagher Flint Station areas. Therefore, although the presence of surface features could be susceptible to increased access, impacts to the sites would be reduced to **minor** in construction due to AGDC's proposed mitigation or minimization measures. The potential for effects due to increased access would further reduce to **negligible** during operations because of reductions in overall activity levels near the sites.

Prehistoric – BET-00122, PSM-00499, PSM-00582: These three sites are prehistoric archaeological sites with subsurface cultural materials. These sites have no determinations of eligibility and/or are pending consultation and are assumed eligible for the NRHP for this analysis. These sites are located within the direct impact area but outside the footprint of nearby proposed Project components. These sites are also subsurface sites and would be unlikely to experience indirect effects due to increased

access. Because the sites are pending consultation or have no determinations of eligibility, AGDC has not yet proposed site-specific mitigation measures until the eligibility process is completed. Therefore, although the sites lack surface features that would be more susceptible to increased access and are outside the footprint of proposed Project components, impacts to these sites would be **minor** in construction due to the lack of site-specific mitigation to address the range of potential effects; without mitigation, construction effects to the integrity of the sites would remain **minor** in operation and beyond the life of the proposed Project.

4.19.4.3.1.1.4. Sites with Negligible Impact Rankings

Historic Artifact/Activity Area – FAI-02386: FAI-02386 is a historic activity area eligible under criterion D consisting of subsurface cultural materials. The site is located within the direct impact area but outside the footprint of nearby proposed Project components. The site is also a subsurface site and would be unlikely to experience indirect effects due to increased access. Because the site is eligible and could be impacted, AGDC has proposed data recovery measures. Therefore, with mitigation and due to the lack of surface features that could be susceptible to increased access, construction and operational impacts to the site would be **negligible**.

Linear Transportation Feature – BET-00200, CHN-00070, LIV-00501, PSM-00570, SAG-00097, TAN-00118, WIS-00408: These AHRS numbers represent segments of the Dalton Highway, which is treated as eligible under criterion G through significance under criterion A for association with transportation and industry, and criterion C for association with significant engineering. Although the highway is treated as eligible under the terms of a PA executed between the Federal Highway Administration, the Advisory Council on Historic Preservation, Alaska SHPO, and ADOT&PF, an analysis of the highway's integrity is pending. In consideration of those areas of significance, proposed Project components would have a **negligible** construction and operational impact on the Dalton Highway and its ability to convey association with transportation, industry and significant engineering due to the temporary nature of construction activities, disruptions in discrete locations, and the nature of the proposed Project itself reflects the industry (oil and gas development) contributing to significance.

Prehistoric – BET-00055, CHN-00077, LIV-00726, LIV-00778, PSM-00050, PSM-00501, PSM-00596, PSM-00605, WIS-00437: These nine sites are prehistoric archaeological sites with subsurface cultural materials. All these sites have been evaluated to the NRHP and found eligible under criterion D through the presence of a combination of debitage, tools, bone, datable material, and/or intact stratigraphic components. Except for LIV-00778 (which AGDC indicates could be avoided), these sites are located within the direct impact area but outside the footprint of nearby proposed Project components, and therefore, the proposed Project would not affect the sites' potential to convey significance and ability to yield information important to history under criterion D. These sites are also subsurface sites and would be unlikely to experience indirect effects due to increased access. Because the sites are eligible and could be impacted, AGDC has

proposed site-specific mitigation measures for these sites including data recovery, spatial analysis, analysis of collected material, and larger plans to address the Galbraith Lake and Gallagher Flint Station areas. Therefore, with mitigation and due to the lack of surface features that could be susceptible to increased access, construction and operational impacts to the sites would be **negligible**.

Prehistoric – WIS-00413: WIS-00413 is a prehistoric archaeological site eligible under criterion D consisting of subsurface materials. While the site is located within the area of proposed construction, and associated ground disturbing activities would impact the site through physical destruction or damage to the site, AGDC's CRMP indicates the site has been extensively tested and only produced a single flake, which was collected. Therefore, due to the lack of remaining cultural materials at the site, impacts would be **negligible** during construction and operations.

4.19.4.3.1.2. Indirect Effects

4.19.4.3.1.2.1. Prehistoric Sites

For the indirect impact area, 230 prehistoric sites could potentially experience indirect effects. Thirteen of the sites are not eligible and would not experience adverse effects. The remaining eligible (13) and those with no determination (204) could experience adverse indirect effects. Effects resulting from increased access are more likely to impact surface sites as they are more apparent on the landscape, whereas buried sites are less likely to be disturbed as they are less readily identifiable. In general, prehistoric sites are important for their information potential, so effects related to character and setting or introduction of vibration, noise, or atmospheric elements would be relatively limited. The proximity of long-term operational and maintenance staff, activities, and infrastructure could introduce long term indirect effects near culturally sensitive areas particularly for the Gallagher Flint Station and Galbraith Lake archaeological sites (North Slope) and Kanuti River ancestral villages and archaeological sites and Bonanza Creek archaeological sites (Interior). This effect would likely not be able to be completely mitigated without large-scale revisions to the proposed Project.

4.19.4.3.1.2.2. Built Environment

For the indirect impact area, 32 built environment areas could potentially experience indirect effects. Two of the sites are not eligible and would not experience adverse effects. The remaining eligible (3) and those with no determination (27) could experience adverse indirect effects. Built environment resources, as opposed to buried archaeological sites, are more likely to experience visual, auditory, and other sensory impacts that degrade the cultural and aesthetic values of these cultural resources. Built environment sites are also more likely to experience indirect effects resulting from increased access as they are more apparent on the landscape.

4.19.4.3.1.2.3. Cemetery/Graves/Human Remains

For the indirect impact area, one cemetery/grave/human remain location could potentially experience indirect effects; the site has no determination of eligibility. Avoidance of cemeteries, graves, and human remains is the primary concern and because none are located in the direct impact area, and they are less likely to be looted or damaged as an indirect effect, there would be minimal impacts to these cultural resources from the proposed Project.

4.19.4.3.1.2.4. Districts/Landscapes

For the indirect impact area, five district/landscapes could potentially experience indirect effects. One of the districts is not eligible and would not experience adverse effects. The remaining eligible (2) and those with no determination (2) could experience adverse indirect effects. Within the indirect impact area, eligible (or those with no determination) districts include the Atigun Archaeological District, Rosebud Knob Archaeological District, Nuiqsut Cultural Landscape, and Wiseman Historic District. Impacts to the Rosebud Knob Archaeological District and Nuiqsut Cultural Landscape have been discussed above as these cultural resources lie in both the direct and indirect impact areas. The Atigun Archaeological District has been subject to vandalism and damage from construction of the TAPS and Dalton Highway and could experience additional indirect effects in the form of looting or damage, particularly during construction activities. The Wiseman Historic District is significant for its historic structures and important data it can provide on historic mining activities, neither of which would be affected by the presence of a cleared ROW. However, its proximity to the proposed Project could make it vulnerable to increased access during construction and potential damage or looting.

4.19.4.3.1.2.5. Historic Artifact/Activity Areas

For the indirect impact area, 23 historic artifact/activity areas could potentially experience indirect effects. One site is eligible and the others have no determinations of eligibility (22) and could experience adverse indirect effects. Similar to built environment resources, as opposed to buried archaeological sites, historic artifact/activity areas are more likely to experience visual, auditory, and other sensory impacts that degrade the cultural and aesthetic values of these cultural resources. Historic artifact/activity areas are also more likely to experience indirect effects resulting from increased access as they often contain surface features that are more apparent on the landscape.

4.19.4.3.1.2.6. Isolate – Prehistoric/Historic

For the indirect impact area, 39 isolates could potentially experience indirect effects. Three of the sites are not eligible and would not experience adverse effects. The remaining with no determination (36) could experience adverse indirect effects. Given their singular nature, the magnitude of effects to isolates would be lower than that to

larger archaeological or historic activity area cultural resources. It should be noted that some isolate sites could expand into larger sites when further survey research identifies additional associated artifacts in the vicinity of the isolate. Those within the indirect area would be less likely to be affected as they are less visible than larger cultural resources and if determined to be eligible the significance of isolates is usually not related to typical indirect effects such as introduction of noise, vibration or other changes to character and setting.

4.19.4.3.1.2.7. Linear Transportation Feature

For the indirect impact area, 32 linear transportation features could potentially experience indirect effects. Six of the sites are not eligible and would not experience adverse effects. The remaining eligible (8) and those with no determination (18) could experience adverse indirect effects. Primary indirect effects would be related to changes in regard to character and setting. Where linear transportation features are oriented east to west and do not parallel the proposed corridor (which runs north to south) there would be limited potential for impact to character and setting as there would be minimal exposure to viewers. Conversely, where historic linear transportation features parallel the proposed Project there would be increased potential for impacts to character and setting due to greater exposure. Furthermore, where aboveground infrastructure are present, the impact would be increased.

4.19.4.3.1.2.8. Multicomponent

For the indirect impact area, five multicomponent sites could potentially experience indirect effects. Three of the sites are not eligible and would not experience adverse effects. The remaining eligible (2) could experience adverse indirect effects. Indirect effects to these resources would be similar to those described above for prehistoric and historic artifact/activity areas.

4.19.4.3.1.2.9. Other

For the indirect impact area, 19 other sites could potentially experience indirect effects. One of the other sites is not eligible and would not experience adverse effects. The remaining with no determinations of eligibility (18) could experience adverse indirect effects. Further work is necessary to ascertain the nature and eligibility of the cultural resources with insufficient data in order to assess the potential for effects. Those listed as modern would not be affected by the proposed Project except for the rare instance that a cultural resource is found eligible under Criteria Consideration G.

4.19.4.3.1.2.10. Paleontological

For the indirect impact area, 15 paleontological sites could potentially experience indirect effects. All have no determinations of eligibility and could experience adverse indirect effects. Depending on their surface visibility and size, paleontological sites

within the indirect impact area could be susceptible to looting and damage, particularly during the construction phase.

4.19.4.3.2. Fairbanks Lateral

The Fairbanks Lateral alignment traverses east from the Mainline at MP 440 along the higher elevation of Murphy Dome, following the Old Murphy Dome Road and existing power lines. For the Fairbanks Lateral, four cultural resource sites including one built environment site, one historic activity area, and two linear transportation features could potentially experience direct effects from the proposed Project construction, and 45 cultural resource sites fall within the area for potential indirect effects (Table 4.19-3). One of the four cultural resource sites within the direct impact area have had determinations of eligibility (Table 4.19-7). No RS 2477 trails would be crossed by the proposed Project within this segment (Table 4.19-4). There are no place names within the direct impact area and 79 place names within the indirect impact area (Table 4.19-5).

4.19.4.3.2.1. Direct Effects

The following presents the site-by-site impact analysis by level of impact (major to negligible) for eligible sites (including those pending consultation) and unevaluated sites within the direct impact area (Tables 4.19-3 and 4.19-7). AGDC has not yet proposed mitigation measures for the one eligible site within the direct impact area, and the other site is unevaluated. Potential minimization and mitigation strategies that could help reduce effects would be identified during consultation and development of the PA.

Table 4.19-7 Eligibility Status of AHRS Sites within the Direct and Indirect Impact Areas of Fairbanks Lateral Segment

Resource Type	Direct			Indirect			Total
	Eligible	Not Eligible	No Determination	Eligible[a]	Not Eligible	No Determination	
Built Environment		1		7	6	20	**34**
Districts / Landscapes				1			**1**
Historic Artifact/Activity Areas			1		1	2	**4**
Linear Transportation Feature	1	1		1		7	**10**
Total	**1**	**2**	**1**	**9**	**7**	**29**	**49**

a Includes determined eligible through keeper (DOE-K)

4.19.4.3.2.1.1. Sites with Moderate Impact Rankings

Historic Artifact/Activity Area – FAI-02298: FAI-02298 is a historic artifact/activity area consisting of surface cultural materials from past mining operations. The site has no determination of eligibility and is assumed eligible for the NRHP for this analysis. The site is located within the direct impact area but outside the footprint of nearby proposed Project components. Furthermore, surface features at the site could be at risk due to increased access. Because the site has no determination of eligibility, AGDC has not yet proposed site-specific mitigation measures until the eligibility process is completed. Therefore, at present, impacts to the site would be **moderate** in construction due to the higher likelihood for surface features to be disturbed and lack of site-specific mitigation; without mitigation, construction effects to the integrity of the site would remain **moderate** in operation and beyond the life of the proposed Project.

4.19.4.3.2.1.2. Sites with Minor Impact Rankings

Linear Transportation Feature – FAI-02119: FAI-02119 is a portion of the Alaska Railroad Telephone and Telegraph Line, which consists of a pole and line system with unique spacing due to environmental conditions, and is eligible for the NRHP under criteria A and C. The proposed Project has two perpendicular crossings of the line; however, the impact is anticipated to be minor in construction and operation due to the mitigation measures already in place along other sections of the line through the preparation of a report documenting the significance and history of the Alaska Railroad Telephone and Telegraph Line.

4.19.4.3.2.2. Indirect Effects

4.19.4.3.2.2.1. Built Environment

For the indirect impact area, 33 built environment areas could potentially experience indirect effects. Six of the sites are not eligible and would not experience adverse effects. The remaining eligible (7) and those with no determination (20) could experience adverse indirect effects. Indirect effects to built environment resources along the Fairbanks Lateral would be similar to those described for the GCF to MP 536 segment (Section 4.19.4.3.1.2.2).

4.19.4.3.2.2.2. Districts/Landscapes

For the indirect impact area, one district/landscapes could potentially experience indirect effects. The Illinois Street Historic District is an eligible historic district in Fairbanks that is listed on the NRHP. This district would likely not be affected as it is already in a populated area with easy access and the areas of significance (*e.g.*, architecture) would not be lessened by an underground pipeline in the vicinity.

4.19.4.3.2.2.3. Historic Artifact/Activity Areas

For the indirect impact area, three historic artifact/activity areas could potentially experience indirect effects. One of the sites is not eligible and would not experience adverse effects. The others have no determinations of eligibility (2) and could experience adverse indirect effects. Indirect effects to historic artifact/activity areas along the Fairbanks Lateral would be similar to those described for the GCF to MP 536 segment (Section 4.19.4.3.1.2.5).

4.19.4.3.2.2.4. Linear Transportation Feature

For the indirect impact area, eight linear transportation features could potentially experience indirect effects. These include one eligible and seven with no determination that could experience adverse indirect effects. Primary indirect effects would be related to changes in regard to character and setting. Indirect effects to linear transportation features along the Fairbanks Lateral would be similar to those described for the GCF to MP 536 segment (Section 4.19.4.3.1.2.7).

4.19.4.3.3. MP 536 to MP 543

The Alternative 1 proposed alignment begins to parallel Denali NPP at MP 531 at the Moody Bridge (Nenana River) crossing, traversing behind the Denali Village area. At MP 535.8, Alternative 1 and Alternative 2 diverge from one another. The proposed Alternative 1 alignment would bypass the park to the east, climbing the ridge line at a higher elevation. There are no RS 2477 trails, but six prehistoric and isolate cultural resource sites that could potentially experience direct effects from the proposed Project construction are located along this pipeline segment (Tables 4.19-3 and 4.19-4). A total of nine previously reported cultural resource sites fall within the area for potential indirect effects. Two of the six cultural resource sites within the direct impact area are eligible (Table 4.19-8). Thirteen place names are within the indirect impact area; none are located within the direct impact area (Table 4.19-5).

4.19.4.3.3.1. Direct Effects

The following presents the site-by-site impact analysis by level of impact (major to negligible) for eligible sites (including those pending consultation) and unevaluated sites within the direct impact area (Tables 4.19-3 and 4.19-8). Application of AGDC's proposed mitigation strategies is provided; other potential minimization and mitigation strategies may be identified during consultation and development of the PA that could help reduce effects.

4.19.4.3.3.1.1. Sites with Moderate Impact Rankings

Prehistoric – HEA-00658: HEA-00658 is a prehistoric archaeological site eligible under criterion D consisting of subsurface cultural materials including debitage and bone. The site is located within the footprint of proposed construction, and associated ground disturbing activities would impact the site through physical destruction or damage to

the site and the features that allow it to convey its significance and ability to yield information important to prehistory under criterion D. Because the site is eligible and could be impacted, AGDC has proposed data recovery, spatial analysis, and analysis of collected material. Therefore, although the site is within the footprint of proposed Project components, impacts would be reduced to **moderate** due to AGDC's proposed mitigation or minimization measures. However, because the site is within the footprint of proposed Project components, construction effects to the integrity of the site would remain **moderate** in operation and beyond the life of the proposed Project.

Table 4.19-8 Eligibility Status of AHRS Sites within the Direct and Indirect Impact Areas of MP 536 to 543 Segment (Alternative 1) and Denali NPP Route Variation (Alternative 2)

Resource Type	Direct			Indirect			Total
	Eligible	Not Eligible	No Determination	Eligible	Not Eligible	No Determination	
Prehistoric	2 (0)	2 (0)		1 (0)			**5 (0)**
Built Environment					0 (1)	2 (6)	**2 (7)**
Districts / Landscapes				1 (1)			**1 (1)**
Historic Artifact/Activity Areas						0 (3)	**0 (3)**
Isolate - Prehistoric/Historic		2 (0)				3 (2)	**5 (2)**
Linear Transportation Feature				1 (1)			**1 (1)**
Other						1 (1)	**1 (1)**
Total	**2 (0)**	**4 (0)**		**3 (2)**	**0 (1)**	**6 (12)**	**15 (15)**

(Numbers in parentheses represent Alternative 2 counts)

4.19.4.3.3.1.2. Sites with Minor Impact Rankings

Prehistoric – HEA-00662: HEA-00662 is a prehistoric lithic assemblage eligible under criterion D consisting of surface and subsurface cultural materials including debitage and tools. The site is located within the direct impact area but outside the footprint of nearby proposed Project components, and therefore, the proposed Project would not affect the site's potential to convey significance and ability to yield information important to history under criterion D. However, surface features could be at risk due to increased access. Because the site is eligible and could be impacted, AGDC has proposed data recovery measures. Therefore, although the presence of surface features could be susceptible to increased access, impacts to the site would be reduced to **minor** in construction due to AGDC's proposed mitigation or minimization measures. The potential for effects due to increased access would further reduce to **negligible** during operations because of reductions in overall activity levels near the site.

4.19.4.3.3.2. Indirect Effects

4.19.4.3.3.2.1. Prehistoric Sites

For the indirect impact area, one prehistoric site could potentially experience indirect effects. This site is eligible and could experience adverse indirect effects. Indirect effects to prehistoric sites along the MP 536 to MP 543 segment would be similar to those described for the GCF to MP 536 segment (Section 4.19.4.3.1.2.1).

4.19.4.3.3.2.2. Built Environment

For the indirect impact area, two built environment areas could potentially experience indirect effects. Both of these sites have no determinations of eligibility and could experience adverse indirect effects. Indirect effects to built environment resources along the MP 536 to MP 543 segment would be similar to those described for the GCF to MP 536 segment (Section 4.19.4.3.1.2.2).

4.19.4.3.3.2.3. Districts/Landscapes

For the indirect impact area, one district/landscapes could potentially experience indirect effects. The Denali Park Road (and associated Park Road District) is eligible and could experience visual impacts from the proposed Project (particularly Alternative 1) due to the emphasis on viewsheds and natural scene as part of the historic design intent and character of the road.

4.19.4.3.3.2.4. Isolate – Prehistoric/Historic

For the indirect impact area, three isolates could potentially experience indirect effects. All three of the sites have no determinations of eligibility and could experience adverse indirect effects. Indirect effects to isolates along the MP 536 to MP 543 segment would be similar to those described for the GCF to MP 536 segment (Section 4.19.4.3.1.2.6).

4.19.4.3.3.2.5. Linear Transportation Feature

For the indirect impact area, one linear transportation features could potentially experience indirect effects. This feature is the Denali Park Road associated with the Park Road District and impacts would be similar to those discussed directly above.

4.19.4.3.3.2.6. Other

For the indirect impact area, one other site could potentially experience indirect effects. The site has no determination of eligibility and could experience adverse indirect effects. Indirect effects to other cultural resources along the MP 536 to MP 543 segment would be similar to those described for the GCF to MP 536 segment (Section 4.19.4.3.1.2.9).

4.19.4.3.4. MP 543 to MP 733 End

This section roughly parallels the George Parks Highway until the Willow area, where it skirts west of the Nancy Lake State Recreation Area before terminating at MP 733. For the MP 543 to MP 733 end segment, there are a total of 46 previously reported cultural resource sites that could potentially experience direct effects from the proposed Project construction, and 138 cultural resource sites that fall within the area for potential indirect effects (Table 4.19-3). These 46 cultural resource sites include 14 linear transportation features and 13 prehistoric sites; the remaining categories of historic artifact/activity areas, built environment, isolate, CMT, and other cultural resources comprise between one and seven cultural resources. Eight cultural resource sites within the direct impact area are eligible, 17 are not eligible, and the remaining 21 have no determinations of eligibility.

Eligible cultural resource sites include a prehistoric site, two built environment structures, a historic artifact/activity area, and four linear transportation features. (Table 4.19-9). Four RS 2477 trails would be crossed by the proposed Project within this segment (Table 4.19-4). Several historic-period components related to the Iditarod and dog sledding are also located in this region. These historic-period components consist of winter dog sledding trails and other sites related to the history of dog mushing in the area. Consultation with BLM's Anchorage Field Office, which serves as the Iditarod Historic Trail Administrator for potential effects to the INHT, associated historic trails, and other related cultural resources would be necessary to properly assess and mitigate effects. No place names are located within the direct impact area, but 148 are located within the indirect impact area and could be affected (Table 4.19-5).

Table 4.19-9 Eligibility Status of AHRS Sites within the Direct and Indirect Impact Areas of MP 543 to 733 Segment

Resource Type	Direct			Indirect			Total
	Eligible	Not Eligible	No Determination[a]	Eligible	Not Eligible	No Determination[a]	
Prehistoric	1	2	10	2	2	45	**62**
Built Environment	2	2	1	2	4	23	**34**
Cemetery/Graves/Human Remains						8	**8**
CMTs		1				4	**5**
Historic Artifact/Activity Areas	1	5	1	1	3	8	**19**
Isolate - Prehistoric/Historic		2	3		1	1	**7**
Linear Transportation Feature	4	4	6	4	3	20	**41**
Multicomponent				2		3	**5**
Other		1				2	**3**
Total	**8**	**17**	**21**	**11**	**13**	**114**	**184**

a No determination includes those pending consultation (DOE-P-S)

or example, scoping comments by the Knik Tribal Council have identified that much of the area crossed by the proposed Project in the Southcentral Region contains Dena'ina places of significance, especially around the Montana Creek and Fish Creek drainages.

4.19.4.3.4.1. Direct Effects

The following presents the site-by-site impact analysis by level of impact (major to negligible) for eligible sites (including those pending consultation) and unevaluated sites within the direct impact area (Tables 4.19-3 and 4.19-9). Application of AGDC's proposed mitigation strategies is provided; other potential minimization and mitigation strategies may be identified during consultation and development of the PA that could help reduce effects.

4.19.4.3.4.1.1. Sites with Major Impact Rankings

Historic Artifact/Activity Area – TYO-00205: TYO-00205 is a historic activity area consisting of surface cultural materials. The site has no determination of eligibility and is assumed eligible for the NRHP for this analysis. The site is located within the footprint of proposed construction, and associated ground disturbing activities would impact the site through physical destruction or damage to the site and the features that allow it to convey its significance to the NRHP. Furthermore, surface features could be at risk due to increased access. Because the site has no determination of eligibility, AGDC has not yet proposed site-specific mitigation measures until the eligibility process is completed. Therefore, at present, impacts to the site would be **major** in construction due to the definite destruction and/or damage to the site and lack of site-specific mitigation. Because the site is within the footprint of proposed Project components, construction

effects to the integrity of the site would remain **major** in operation and beyond the life of the proposed Project.

Isolate – HEA-00600: HEA-00600 is a subsurface isolate site that has no determination of eligibility for the NRHP and is assumed eligible for this analysis. The site is located within the footprint of proposed construction, and although the site is currently reported as an isolate, the lack of delineation indicates additional resources are likely to be present, and associated ground disturbing activities would impact the site through physical destruction or damage to the site and the features that allow it to convey its significance to the NRHP. Because the site has no determination of eligibility, AGDC has not yet proposed site-specific mitigation measures until the eligibility process is completed. Therefore, at present, impacts to the site would be **major** in construction due to the definite destruction and/or damage to the site and lack of site-specific mitigation. Because the site is within the footprint of proposed Project components, construction effects to the integrity of the site would remain **major** in operation and beyond the life of the proposed Project.

Prehistoric – HEA-00601, HEA-00680, TYO-00178, TYO-00204 – Major Impact: These four sites are prehistoric lithic assemblage sites with surface and subsurface components (TYO-00204 surface only). All sites have no determinations of eligibility and are assumed eligible for the NRHP for this analysis. The sites are located within the footprint of proposed construction, and associated ground disturbing activities would impact the sites through physical destruction or damage to the sites and the features that allow them to convey their significance to the NRHP. Furthermore, surface features at some of the sites could be at risk due to increased access. Because the sites have no determinations of eligibility, AGDC has not yet proposed site-specific mitigation measures until the eligibility process is completed. Therefore, at present, impacts to the sites would be **major** in construction due to the definite destruction and/or damage to the sites and lack of site-specific mitigation. Because the sites are within the footprint of proposed Project components, construction effects to the integrity of the sites would remain **major** in operation and beyond the life of the proposed Project.

4.19.4.3.4.1.2. Sites with Moderate Impact Rankings

Built Environment – TAL-00181: TAL-00181 is a historic shelter with associated artifacts eligible under criteria A, B, and D. The site is located within the footprint of proposed construction, and associated ground disturbing activities would impact the site through physical destruction or damage to the site and the features that allow it to convey its significance to the NRHP under criteria A, B, and D. Furthermore, surface features could be at risk due to increased access. Because the site is eligible and could be impacted, AGDC has proposed site-specific mitigation measures including HABS level documentation and data recovery. Therefore, although the site is within the footprint of proposed Project components, impacts would be reduced to **moderate** due to AGDC's proposed mitigation or minimization measures. However, because the site is within the

footprint of proposed Project components, construction effects to the integrity of the site would remain **moderate** in operation and beyond the life of the proposed Project.

Built Environment – HEA-00188: HEA-00188 is a concentration of log cabin and other building ruins along with associated historic debris. The site has no determination of eligibility and is assumed eligible for the NRHP for this analysis. The site is located within the direct impact area but outside the footprint of nearby proposed Project components. However, surface features at the site could be at risk due to increased access. Because the site has no determination of eligibility, AGDC has not yet proposed site-specific mitigation measures until the eligibility process is completed. Therefore, at present, impacts to the site would be **moderate** during construction due to the higher likelihood for surface features to be disturbed and lack of site-specific mitigation; without mitigation, construction effects to the integrity of the site would remain **moderate** in operation and beyond the life of the proposed Project.

Prehistoric – TLM-00327: TLM-00327 is a prehistoric lithic assemblage eligible under criterion D consisting of subsurface cultural materials. The site is located within the footprint of proposed construction, and associated ground disturbing activities would impact the site through physical destruction or damage to the site and the features that allow it to convey its significance and ability to yield information important to prehistory under criterion D. Because the site is eligible and could be impacted, AGDC has proposed data recovery. Therefore, although the site is within the footprint of proposed Project components, impacts would be reduced to **moderate** due to AGDC's proposed mitigation or minimization measures. However, because the site is within the footprint of proposed Project components, construction effects to the integrity of the site would remain **moderate** in operation and beyond the life of the proposed Project.

Prehistoric – HEA-00597, TAL-00188, TAL-00189, TYO-00208, TYO-00315: HEA-00597 is a prehistoric lithic assemblage with surface and subsurface components and the other four are prehistoric surface sites. These sites have no determinations of eligibility and/or are pending consultation and are assumed eligible for the NRHP for this analysis. These sites are located within the direct impact area but outside the footprint of nearby proposed Project components. However, surface features at these sites could be at risk due to increased access. Because the sites are pending consultation or have no determinations of eligibility, AGDC has not yet proposed site-specific mitigation measures until the eligibility process is completed. Therefore, at present, impacts to the sites would be **moderate** during construction due to the higher likelihood for surface features to be disturbed and lack of site-specific mitigation; without mitigation, construction effects to the integrity of the sites would remain **moderate** in operation and beyond the life of the proposed Project.

4.19.4.3.4.1.3. Sites with Minor Impact Rankings

Built Environment – HEA-00066: HEA-00066 is a historic railroad site eligible under criterion A. Reports indicate the site is heavily disturbed/destroyed (Yarborough, 2005;

Neely, 2007) and may no longer retain integrity; however, the site is still reported as eligible in the AHRS system. The site is located within the direct impact area but outside the footprint of nearby proposed Project components. Because the site is eligible and could be impacted, AGDC has proposed data recovery measures. Therefore, although the presence of surface features could be susceptible to increased access, impacts to the site would be reduced to **minor** in construction due to AGDC's proposed mitigation or minimization measures. The potential for effects due to increased access would further reduce to **negligible** during operations because of reductions in overall activity levels near the site.

Historic Artifact/Activity Area – TAL-00180: TAL-00180 is a historic activity area eligible under criterion D. The site is located within the direct impact area but outside the footprint of nearby proposed Project components, and therefore, the proposed Project would not affect the site's potential to convey significance and ability to yield information important to history under criterion D. However, surface features could be at risk due to increased access. Because the site is eligible and could be impacted, AGDC has proposed data recovery. Therefore, although the presence of surface features could be susceptible to increased access, impacts to the site would be reduced to **minor** in construction due to AGDC's proposed mitigation or minimization measures. The potential for effects due to increased access would further reduce to **negligible** during operations because of reductions in overall activity levels near the site.

Isolate – HEA-00604, HEA-00607: These two sites are subsurface isolates. Both sites are unevaluated and are assumed eligible for the NRHP for this analysis. These sites are located within the direct impact area but outside the footprint of nearby proposed Project components. These sites are subsurface sites and would be unlikely to experience indirect effects due to increased access. Because the sites have no determinations of eligibility, AGDC has not yet proposed site-specific mitigation measures until the eligibility process is completed. Therefore, although the sites lack surface features that would be more susceptible to increased access and are outside the footprint of proposed Project components, impacts to these sites would be **minor** in construction due to the lack of site-specific mitigation to address the range of potential effects; without mitigation, construction effects to the integrity of the sites would remain **minor** in operation and beyond the life of the proposed Project.

Linear Transportation Feature – TYO-00084, TYO-00224, TYO-00228: TYO-00084 is the Knik-Rainy Pass historic trail segment of the Iditarod National Historic Trail eligible under criterion A. TYO-00224 is the Iditarod Sled Dog Race Trail eligible under criterion A and criterion consideration G. TYO-00228 is a historic USGS Base Map Winter trail eligible under criterion A. The INHT, associated historic trails, and other cultural resources linked to the trail and dog sledding have been identified by agencies as items of special concern. For the TYO-00084 crossing of the INHT in particular, the proposed Project perpendicularly crosses at one location near areas of other cleared ROW and section lines thereby limiting the extent of impacts to the feature. The other trails have one (TYO-00224) and two perpendicular crossings (TYO-00228). Because the trails are

eligible and could be impacted, AGDC has proposed to minimize effects through vegetation and existing trail condition maintenance and scheduling construction activities during period of low use. Therefore, with mitigation and because of the relatively few crossing locations along these trails, the proposed Project would have **minor** impacts on the trails during construction; these impacts would remain **minor** during operation and beyond the life of the proposed Project.

Linear Transportation Feature – TYO-00164, TYO-00170, TYO-00184, TYO-00201, TYO-00225, TYO-00226: These trails represent a series of trails in the Susitna Valley primarily associated with historic dog sledding in addition to a historic runway feature (TYO-00201) all of which are unevaluated for the NRHP and are assumed eligible for this analysis. Depending on the feature, the proposed Project perpendicularly crosses between one to five locations. Because the sites have no determinations of eligibility, AGDC has not yet proposed site-specific mitigation measures until the eligibility process is completed. However, AGDC has proposed to minimize effects through vegetation and existing trail condition maintenance and scheduling construction activities during period of low use for other eligible trails crossed by the proposed Project. Therefore, assuming the same mitigation would be applied to these features, and because of the relatively few crossing locations along these trails, the proposed Project would have **minor** impacts on the trails during construction; these impacts would remain **minor** during operation and beyond the life of the proposed Project.

Prehistoric – TYO-00179: TYO-00179 is a prehistoric archaeological site. The site has no determination of eligibility and is assumed eligible for the NRHP for this analysis. The site is located within the direct impact area but outside the footprint of nearby proposed Project components. The site is a subsurface site and would be unlikely to experience indirect effects due to increased access. Because the site has no determination of eligibility, AGDC has not yet proposed site-specific mitigation measures until the eligibility process is completed. Therefore, although the site lacks surface features that would be more susceptible to increased access and is outside the footprint of proposed Project components, impacts to the site would be **minor** in construction due to the lack of site-specific mitigation to address the range of potential effects; without mitigation, construction effects to the integrity of the site would remain **minor** in operation and beyond the life of the proposed Project.

4.19.4.3.4.1.4. Sites with Negligible Impact Rankings

Linear Transportation Feature – HEA-00450: HEA-00450 is the Denali Highway and treated as eligible under criterion A for its association with transportation, entertainment/recreation, and conservation. Although the highway is treated as eligible under the terms of a PA executed between the Federal Highway Administration, the Advisory Council on Historic Preservation, Alaska SHPO, and ADOT&PF, an analysis of the highway's integrity is pending. The proposed Project crosses the road in one discrete location near its western end near Cantwell. Because the proposed Project crosses in one location in an already developed area near Cantwell, the proposed Project

would have a **negligible** construction and operation impact on the Denali Highway and its ability to convey significance through association with transportation, entertainment/recreation, and conservation.

4.19.4.3.4.2. Indirect Effects

4.19.4.3.4.2.1. Prehistoric Sites

For the indirect impact area, 49 prehistoric sites could potentially experience indirect effects. Two of the sites are not eligible and would not experience adverse effects. The remaining eligible (2) and those with no determination (45) could experience adverse indirect effects. The proximity of long-term operational and maintenance staff, activities, and infrastructure could introduce long term indirect effects near culturally sensitive areas such as Montana and Fish creeks ancestral villages (Southcentral). This effect would likely not be able to be completely mitigated without large-scale revisions to the proposed Project, although minor revisions have been made in certain areas, such as near Montana Creek, to avoid Native allotments and in response to consultation concerns regarding cultural resources. Other indirect effects to prehistoric sites along the MP 543 to MP 733 segment would be similar to those described for the GCF to MP 536 segment (Section 4.19.4.3.1.2.1).

4.19.4.3.4.2.2. Built Environment

For the indirect impact area, 29 built environment areas could potentially experience indirect effects. Four of the sites are not eligible and would not experience adverse effects. The remaining eligible (2) and those with no determination (23) could experience adverse indirect effects. Indirect effects to built environment resources along the MP 543 to MP 733 segment would be similar to those described for the GCF to MP 536 segment (Section 4.19.4.3.1.2.2).

4.19.4.3.4.2.3. Cemetery/Graves/Human Remains

For the indirect impact area, eight cemetery/grave/human remain locations could potentially experience indirect effects; the sites have no determination of eligibility. Indirect effects to cemetery/grave/human remain locations along the MP 543 to MP 733 segment would be similar to those described for the GCF to MP 536 segment (Section 4.19.4.3.1.2.3).

4.19.4.3.4.2.4. CMTs

For the indirect impact area, four CMTs could potentially experience indirect effects; the sites have no determination of eligibility. CMTs often indicate areas of harvesting or markers for travel across the landscape; many times, the area associated with the CMTs is considered important by those who modified the trees or by their descendants who may continue to use the area. Simply avoiding the CMT itself may not prevent all effects and impacts to character and setting may occur to those CMTs located in the indirect

impact area. Continued access to these cultural resources are also important considerations.

4.19.4.3.4.2.5. Historic Artifact/Activity Areas

For the indirect impact area, 12 historic artifact/activity areas could potentially experience indirect effects. Three of the sites are not eligible and would not experience adverse effects. One site is eligible and the others have no determinations of eligibility (8) and could experience adverse indirect effects. Indirect effects to historic artifact/activity areas along the MP 543 to MP 733 segment would be similar to those described for the GCF to MP 536 segment (Section 4.19.4.3.1.2.5).

4.19.4.3.4.2.6. Isolate – Prehistoric/Historic

For the indirect impact area, two isolates could potentially experience indirect effects. One of the sites is not eligible and would not experience adverse effects. The remaining site with no determination of eligibility could experience adverse indirect effects. Indirect effects to isolates along the MP 543 to MP 733 segment would be similar to those described for the GCF to MP 536 segment (Section 4.19.4.3.1.2.6).

4.19.4.3.4.2.7. Linear Transportation Feature

For the indirect impact area, 27 linear transportation features could potentially experience indirect effects. Three of the sites are not eligible and would not experience adverse effects. The remaining eligible (4) and those with no determination (20) could experience adverse indirect effects. Primary indirect effects would be related to changes in regard to character and setting. Indirect effects to linear transportation features along the MP 543 to MP 733 segment would be similar to those described for the GCF to MP 536 segment (Section 4.19.4.3.1.2.7).

4.19.4.3.4.2.8. Multicomponent

For the indirect impact area, five multicomponent sites could potentially experience indirect effects. Two eligible multicomponent sites and three with no determination could experience adverse indirect effects. Indirect effects to multicomponent sites along the MP 543 to MP 733 segment would be similar to those described for the GCF to MP 536 segment (Section 4.19.4.3.1.2.8).

4.19.4.3.4.2.9. Other

For the indirect impact area, two other sites could potentially experience indirect effects. Both have no determination of eligibility and could experience adverse indirect effects. Indirect effects to other cultural resources along the MP 543 to MP 733 segment would be similar to those described for the GCF to MP 536 segment (Section 4.19.4.3.1.2.9).

4.19.5. Alternative 2 – Denali NPP Route Variation

Aspects of Alternative 2 that could affect cultural resources include the Denali NPP Route Variation, Yukon River aerial crossing option, and use of VSMs for the first 62 miles of the Mainline that are aboveground. All other cultural resource impacts from other proposed Project components and support facilities associated with Alternative 2 (*e.g.,* maintenance buildings, material sites, construction camps) would be the same as those described for the Mainline.

4.19.5.1. Denali NPP Route Variation

At MP 535.8, Alternative 1 and Alternative 2 diverge from one another. The Alternative 2 alignment would generally parallel the Parks Highway corridor into the Park on flatter terrain. The southern end of the Denali NPP Route Variation moves southeast to exit the park and avoid construction and operational impacts to the McKinley Village area. The potential for unanticipated discovery of archaeological deposits would be equal to that of the corresponding Alternative 1 segment, as this alternative would occur in previously undisturbed lands which parallel the Parks Highway.

The types of direct and indirect effects from construction and operation of the Denali NPP Route Variation would be the same as those described above under "Pipeline Right-of-Way Mainline."

4.19.5.2. Use of Vertical Support Members

Alternative 2 would include use of VSMs to support an aboveground pipeline between MP 0 and MP 62. Several construction and operation impacts from Alternative 2 would be similar to those described above for Alternative 1 (*e.g.,* same footprint, construction schedule, cleared ROW, access roads). However, the presence of an elevated pipeline on VSMs in the first 62 miles could introduce additional/heightened impacts that could negatively affect the visual setting and character of cultural resource sites as it would add another, more visible element to the landscape with the presence of an elevated pipeline versus a buried one. Also, the presence of an elevated pipeline for the first 62 miles could make access to traditional used areas within the Nuiqsut Cultural Landscape and to other cultural resources more difficult, however, the terrain is flat tundra with few barriers to travel. Besides the Nuiqsut Cultural Landscape, the only cultural resource sites within the direct impact area of the elevated portion of the proposed Project are the Dalton Highway and a smaller historic dirt road. The four cultural resource sites within the indirect impact area include two prehistoric sites, that would likely not be affected by presence of elevated pipeline as they are typically important for their information potential, the Dalton Highway, and the Prudhoe Bay discovery well. Because the Dalton Highway, Prudhoe Bay discovery well, and historic dirt road are associated with oil and gas development the presence of an additional elevated pipeline in the vicinity would not represent an adverse effect.

4.19.5.3. Yukon River Aerial Crossing Option

Alternative 2 includes an aerial crossing of the pipeline across the Yukon River using a new suspension bridge. The aerial crossing option would not directly impact cultural resource sites; however, several cultural resource sites are within the indirect impact area and could experience visual impacts.

4.19.5.4. Alternative 2 Site Impact Analysis

For the Denali NPP Route Variation segment, there are no previously-reported cultural resource sites that could potentially experience direct effects from the proposed Project construction and 15 cultural resource sites that fall within the area for potential indirect effects, although future work may identify previously unknown cultural resource sites (Table 4.19-3). Additionally, the route has not been surveyed for the proposed Project, although portions have been studied in past projects associated with highway, fiber optic cable, and railroad activities. AGDC would carry out a cultural resource survey to support ROW application through the Park prior to construction should the route be selected. No RS 2477 trails would be crossed by the proposed Project within this segment (Table 4.19-4). No place names are located within the direct impact area of the Alternative 2 segment. Three place names are within the indirect impact area of this segment (Table 4.19-5). All other numbers of potentially affected cultural resource sites would be the same as those described for Alternative 1, as the proposed Project segments are the same.

4.19.5.4.1. Indirect Effects

4.19.5.4.1.1. Built Environment

For the indirect impact area, seven built environment areas could potentially experience indirect effects. One of the sites is not eligible and would not experience adverse effects. The remaining six sites have no determination of eligibility and could experience adverse indirect effects. Indirect effects to built environment resources along the Denali NPP Route Variation segment would be similar to those described for the GCF to MP 536 segment (Section 4.19.4.3.1.2.2).

4.19.5.4.2. Districts/Landscapes

For the indirect impact area, one district/landscapes could potentially experience indirect effects. The Denali Park Road (and associated Park Road District) is eligible and could experience visual impacts from the proposed Project. The impact would be less in Alternative 2 due to the greater visibility of Alternative 1 within the district's viewshed.

4.19.5.4.3. Historic Artifact/Activity Areas

For the indirect impact area, three historic artifact/activity areas could potentially experience indirect effects. All three have no determinations of eligibility and could experience adverse indirect effects. Indirect effects to historic artifact/activity areas

along the Denali NPP Route Variation segment would be similar to those described for the GCF to MP 536 segment (Section 4.19.4.3.1.2.5).

4.19.5.4.4. Isolate – Prehistoric/Historic

For the indirect impact area, two isolates could potentially experience indirect effects. Both have no determination of eligibility and could experience adverse indirect effects. Indirect effects to isolates along the Denali NPP Route Variation segment would be similar to those described for the GCF to MP 536 segment (Section 4.19.4.3.1.2.6).

4.19.5.4.5. Linear Transportation Feature

For the indirect impact area, one linear transportation features could potentially experience indirect effects. This feature is the Denali Park Road associated with the Park Road District and impacts would be similar to those discussed in Section 4.19.4.3.3.2.5.

4.19.5.4.6. Other

For the indirect impact area, one other site could potentially experience indirect effects. The site has no determination of eligibility and could experience adverse indirect effects. Indirect effects to other cultural resources along the Denali NPP Route Variation segment would be similar to those described for the GCF to MP 536 segment (Section 4.19.4.3.1.2.9).

4.19.6. Alternative 3 – No Action

No direct or indirect effects would occur to cultural resource sites within the ROW or within the 1-mile perimeter of the proposed Project Area where the Project is not undertaken.

4.19.7. Conclusions

4.19.7.1. Comparison of Alternatives

Table 4.19-10 provides a summary of the number of cultural resource sites by geographic region that could potentially experience direct and indirect adverse effects (*i.e.,* eligible for the NRHP or those with no determination). In general, the impacts to cultural resource sites between alternatives would be similar due to the minor physical variations between the two alternatives (*e.g.,* the 7-mile MP 536 to MP 543 segment compared to the Denali NPP Route Variation). In terms of numbers of cultural resource sites within the direct and indirect impact areas, Alternative 1 (MP 536 to MP 543) has two more cultural resource sites in the direct impact area and five fewer cultural resource sites in the indirect impact area potentially affected than the corresponding Alternative 2 Denali NPP Route Variation. Other minor differences between the two alternatives are that the likelihood for cultural resource sites to be inadvertently discovered would be greater in Alternative 1 in the first 62 miles of construction due to the greater depth and footprint of subsurface ground disturbance from a buried

pipeline, but the likelihood for impacts to character and setting would be greater in Alternative 2 due to the presences of an elevated pipeline from MP 0 to MP 62. Table 4.19-11 provides a summary of the number of potentially affected cultural resource types by alternative followed by a summary discussion of the numbers of cultural resource sites potentially affected by site type and summary of the site-by-site impact assessment for sites within the direct impact area. Table 4.19-12 presents the results of the site-by-site impact assessment organized by proposed Project segment, impact ranking, and site type.

Table 4.19-10 Comparison of Alternatives - Number of Potentially Affected Cultural Resource Sites (Direct & Indirect Impact Areas)

Project Segment	Potential Impact Description	Alternative 1 Cultural Resource Sites		Alternative 2 Cultural Resource Sites		Alternative 3 Cultural Resource Sites	
		Direct Impact Area	Indirect Impact Area	Direct Impact Area	Indirect Impact Area	Direct Impact Area	Indirect Impact Area
GCF to MP 536	See Section 4.19.2, Methods for description of impact types	*88*	*372*	*88*	*372*	*No Action*	
Fairbanks Lateral		*2*	*38*	*2*	*38*	*No Action*	
MP 536 to MP 543		*2*	*9*	*Not Applicable*		*No Action*	
Denali NPP Route Variation		*Not Applicable*		*0*	*14*	*No Action*	
MP 543 to MP 733		*29*	*125*	*29*	*125*	*No Action*	
Total		***121***	***544***	***119***	***549***		

Counts do not include cultural resources that are not eligible for the NRHP (Alternative 1: 81 direct and 51 indirect and Alternative 2: 77 direct and 52 indirect), but do include eligible cultural resources and cultural resources without a determination of eligibility. Additional cultural resources may be documented following further surveys in unsurveyed areas of the proposed project route.

Table 4.19-11 Eligibility Status of AHRS Sites within the Direct and Indirect Impact Areas of Alternative 1 and Alternative 2

Resource Type	Direct			Indirect			Total
	Eligible[a]	Not Eligible	No Determination[b]	Eligible[a]	Not Eligible	No Determination[b]	
Prehistoric	46 (44)	28 (26)	26	16 (15)	15	249	**380 (375)**
Built Environment	3	3	1	12	14 (15)	72 (76)	**105 (110)**
Cemetery/Graves/Human Remains						9	**9**
CMTs		3				4	**7**
Districts / Landscapes[c]	1		1	4	1	2	**9**
Historic Artifact/Activity Areas	5	16	5	2	4	32 (35)	**64 (67)**
Isolate - Prehistoric/Historic		16 (14)	7		4	40 (39)	**67 (64)**
Linear Transportation Feature	16	10	9	14	9	45	**103**
Multicomponent	1			4	3	3	**11**
Other		2			1	21	**24**
Paleontological		3				15	**18**
Total	**72 (70)**	**81 (77)**	**49**	**52 (51)**	**51 (52)**	**492 (498)**	**797 (797)**

(Numbers in parentheses represent Alternative 2 counts; otherwise counts are same as Alternative 1)
a Includes National Historic Landmarks, treated as eligible under PA, determined to be eligible as a contributing element to an eligible district (DXS), and determined eligible through keeper (DOE-K)
b No determination includes those pending consultation (DOE-P-S)
c Districts/Landscapes includes the Nuiqsut Cultural Landscape not listed in the AHRS

Table 4.19-12 Summary of Site-by-Site Impact Assessment – Direct Impact Area

Cultural Resource	Site Type	NRHP Status/ Criteria	Surface/ Subsurface	Site within Footprint of Proposed Project Component?	Construction Impact Ranking	Operation Impact Ranking	CRMP Mitigation	Segment
PSM00186	Historic Artifact/ Activity Area	NDE	Surface	Yes	Major	Major	No mitigation in CRMP. Site eligibility for these sites is pending consultation or has no determination; specific mitigation dependent on resulting eligibility assessment	GCF-MP536
SAG00076	Historic Artifact/ Activity Area	NDE	Surface	Yes	Major	Major		GCF-MP536
LIV00779	Isolate	NDE	Subsurface	Yes	Major	Major		GCF-MP536
WIS00434	Linear Transportation Feature	NDE	Surface	Yes	Major	Major		GCF-MP536
BET00018	Prehistoric	NDE	Subsurface	Yes	Major	Major		GCF-MP536
BET00082	Prehistoric	NDE	Surface	Yes	Major	Major		GCF-MP536
LIV-00552	Prehistoric	NDE	Subsurface	Yes	Major	Major		GCF-MP536
PSM-00059	Prehistoric	DOE-P-S	Subsurface	Yes	Major	Major		GCF-MP536
PSM-00172	Prehistoric	DOE-P-S	Surface/ subsurface	Yes	Major	Major		GCF-MP536
PSM-00500	Prehistoric	DOE-P-S	Surface/ subsurface	Yes	Major	Major		GCF-MP536
PSM-00597	Prehistoric	DOE-P-S	Subsurface	Yes	Major	Major		GCF-MP536
PSM-00606	Prehistoric	DOE-P-S	Surface/ subsurface	Yes	Major	Major		GCF-MP536
WIS- 00005	Prehistoric	NDE	Surface	Yes	Major	Major		GCF-MP536
LIV-00284	District/ Landscape	DOE-S/ D	Surface/ subsurface	Yes	Moderate	Moderate	Data recovery and spatial analysis of sites within district and analysis of collected material from sites within district	GCF-MP536

Cultural Resource	Site Type	NRHP Status/ Criteria	Surface/ Subsurface	Site within Footprint of Proposed Project Component?	Construction Impact Ranking	Operation Impact Ranking	CRMP Mitigation	Segment
FAI-02390	Historic Artifact/ Activity Area	DOE-S/ D	Surface/ subsurface	Yes	Moderate	Moderate	Archival research and development of historic context for Lower Tanana settlement during this period	GCF-MP536
CHN-00025	Historic Artifact/ Activity Area	DXS/A and D	Surface/ subsurface	Yes	Moderate	Moderate	Data recovery	GCF-MP536
CHN-00125	Historic Artifact/ Activity Area	DOE-S/ A and D	Surface/ subsurface	Yes	Moderate	Moderate	Data recovery	GCF-MP536
HEA-00619	Historic Artifact/ Activity Area	NDE	Surface	No	Moderate	Moderate	No mitigation in CRMP. Site eligibility for these sites is pending consultation or has no determination; specific mitigation dependent on resulting eligibility assessment	GCF-MP536
BET00183	Isolate	NDE	Surface	No	Moderate	Moderate		GCF-MP536
HEA-00062	Multicomponent	DOE-S/ D	Surface/ subsurface	Yes	Moderate	Moderate	AGDC would conduct field visit to determine data recovery method (excavation of undisturbed portion of site and/or analysis of previously collected materials)	GCF-MP536
BET-00074	Prehistoric	DOE-S/ D	Surface	No	Moderate	Moderate	Additional consultation with PA parties needed. This is a unique site that has been extensively excavated and disturbed by looting	GCF-MP536
LIV-00055	Prehistoric	DOE-S/ D	Surface/ subsurface	Yes	Moderate	Moderate	AGDC would conduct field visit to determine data recovery method (excavation of undisturbed portion of site and/or analysis of previously collected materials)	GCF-MP536
CHN-00124	Prehistoric	DOE-S/ D	Subsurface	Yes	Moderate	Moderate	Data recovery	GCF-MP536
LIV-00776	Prehistoric	DOE-S/ D	Subsurface	Yes	Moderate	Moderate	Data recovery	GCF-MP536
SAG-00109	Prehistoric	DOE-S/ D	Subsurface	Yes	Moderate	Moderate	Data recovery	GCF-MP536

Cultural Resource	Site Type	NRHP Status/ Criteria	Surface/ Subsurface	Site within Footprint of Proposed Project Component?	Construction Impact Ranking	Operation Impact Ranking	CRMP Mitigation	Segment
WIS-00436	Prehistoric	DOE-S/ D	Surface/ subsurface	Yes	Moderate	Moderate	Data recovery	GCF-MP536
HEA-00595	Prehistoric	DOE-S/ D	Subsurface	Yes	Moderate	Moderate	Data recovery including testing for deeply buried deposits, consideration of field school, or community archaeology project	GCF-MP536
BET-00206	Prehistoric	DOE-S/ D	Surface/ subsurface	Yes	Moderate	Moderate	Data recovery, spatial analysis, and analysis of collected material	GCF-MP536
LIV-00553	Prehistoric	DOE-S/ D	Subsurface	Yes	Moderate	Moderate	Data recovery, spatial analysis, and analysis of collected material	GCF-MP536
LIV-00748	Prehistoric	DOE-S/ D	Subsurface	Yes	Moderate	Moderate	Data recovery, spatial analysis, and analysis of collected material	GCF-MP536
LIV-00749	Prehistoric	DOE-S/ D	Subsurface	Yes	Moderate	Moderate	Data recovery, spatial analysis, and analysis of collected material	GCF-MP536
WIS-00288	Prehistoric	DOE-S/ D	Subsurface	Yes	Moderate	Moderate	Data recovery, spatial analysis, and analysis of collected material	GCF-MP536
PSM-00075	Prehistoric	DOE-S/ A and D	Surface/ subsurface	Yes	Moderate	Moderate	See CRMP Galbraith Lake Area Discussion	GCF-MP536
PSM-00192	Prehistoric	DOE-S/ D	Surface/ subsurface	Yes	Moderate	Moderate	See CRMP Galbraith Lake Area Discussion	GCF-MP536
PSM-00498	Prehistoric	DOE-S/ D	Surface/ subsurface	Yes	Moderate	Moderate	See CRMP Galbraith Lake Area Discussion	GCF-MP536
PSM-00578	Prehistoric	DOE-S/ D	Subsurface	Yes	Moderate	Moderate	See CRMP Galbraith Lake Area Discussion	GCF-MP536
PSM-00197	Prehistoric	DOE-S/ D	Surface/ subsurface	Yes	Moderate	Moderate	See CRMP Gallagher Flint Station Mitigation Discussion	GCF-MP536
PSM-00573	Prehistoric	DOE-S/ D	Surface/ subsurface	Yes	Moderate	Moderate	See CRMP Gallagher Flint Station Mitigation Discussion	GCF-MP536
PSM-00601	Prehistoric	DOE-S/ D	Subsurface	Yes	Moderate	Moderate	See CRMP Gallagher Flint Station Mitigation Discussion	GCF-MP536
BET-00083	Prehistoric	DOE-P-S	Surface/ subsurface	No	Moderate	Moderate	No mitigation in CRMP. Site eligibility for these sites is pending	GCF-MP536

Cultural Resource	Site Type	NRHP Status/ Criteria	Surface/ Subsurface	Site within Footprint of Proposed Project Component?	Construction Impact Ranking	Operation Impact Ranking	CRMP Mitigation	Segment
BET-00121	Prehistoric	NDE	Surface/ subsurface	No	Moderate	Moderate	consultation or has no determination; specific mitigation dependent on resulting eligibility assessment	GCF-MP536
BET-00208	Prehistoric	NDE	Surface	No	Moderate	Moderate		GCF-MP536
PSM-00199	Prehistoric	DOE-P-S	Surface/ subsurface	No	Moderate	Moderate		GCF-MP536
CHN-00018	Built Environment	DOE-S/ D	Surface/ subsurface	No	Minor	Negligible	Data recovery	GCF-MP536
Nuiqsut Cultural Landscape	District/ Landscape	NDE	Surface/ subsurface	Yes	Minor	Minor	No mitigation in CRMP. Site eligibility for these sites is pending consultation or has no determination; specific mitigation dependent on resulting eligibility assessment	GCF-MP536
BET-00253	Isolate	DOE-P-S	Subsurface	No	Minor	Minor		GCF-MP536
HEA-00657	Isolate	NDE	Subsurface	No	Minor	Minor		GCF-MP536
FAI-02102, LIV-00556	Linear Transportation Feature	DOE-S/ A	Surface	Yes	Minor	Minor	Minimize effects through vegetation and existing trail condition maintenance, providing continuity of access and scheduling of construction activities during period of low use	GCF-MP536
FAI-02177	Linear Transportation Feature	DOE-S/ A	Surface	Yes	Minor	Minor	Minimize effects through vegetation and existing trail condition maintenance, providing continuity of access and scheduling of construction activities during period of low use	GCF-MP536
FAI-02366	Linear Transportation Feature	DOE-S/ A	Surface	Yes	Minor	Minor	Minimize effects through vegetation and existing trail condition maintenance, providing continuity of access and scheduling of construction activities during period of low use	GCF-MP536

Cultural Resource	Site Type	NRHP Status/ Criteria	Surface/ Subsurface	Site within Footprint of Proposed Project Component?	Construction Impact Ranking	Operation Impact Ranking	CRMP Mitigation	Segment
LIV-00392	Linear Transportation Feature	DOE-P-S	Surface	Yes	Minor	Minor	No mitigation in CRMP. Site eligibility for these sites is pending consultation or has no determination; specific mitigation dependent on resulting eligibility assessment	GCF-MP536
SAG-00098	Linear Transportation Feature	NDE	Surface	Yes	Minor	Minor		GCF-MP536
LIV-00047	Prehistoric	DOE-S/D	Surface/ subsurface	No	Minor	Negligible	AGDC would conduct field visit to determine data recovery method (excavation of undisturbed portion of site and/or analysis of previously collected materials)	GCF-MP536
LIV-00104	Prehistoric	DOE-S/D	Surface/ subsurface	No	Minor	Negligible	AGDC would conduct field visit to determine data recovery method (excavation of undisturbed portion of site and/or analysis of previously collected materials)	GCF-MP536
BET-00202	Prehistoric	DOE-S/D	Surface/ subsurface	No	Minor	Negligible	Data recovery	GCF-MP536
LIV-00106	Prehistoric	DOE-S/D	Surface/ subsurface	No	Minor	Negligible	Data recovery	GCF-MP536
PSM-00604	Prehistoric	DOE-S/D	Surface/ subsurface	No	Minor	Negligible	Data recovery	GCF-MP536
PSM-00607	Prehistoric	DOE-S/D	Surface/ subsurface	No	Minor	Negligible	Data recovery	GCF-MP536
PSM-00588	Prehistoric	DOE-S/D	Surface/ subsurface	No	Minor	Negligible	Data recovery, spatial analysis, and analysis of collected material	GCF-MP536
BET-00250	Prehistoric	DOE-S/D	Surface	No	Minor	Negligible	Data recovery, spatial analysis, and analysis of collected material	GCF-MP536
LIV-00402	Prehistoric	DOE-S/D	Surface	No	Minor	Negligible	Data recovery and spatial analysis of sites within district and analysis of collected material from sites within district	GCF-MP536

Cultural Resource	Site Type	NRHP Status/ Criteria	Surface/ Subsurface	Site within Footprint of Proposed Project Component?	Construction Impact Ranking	Operation Impact Ranking	CRMP Mitigation	Segment
BET-00081	Prehistoric	DOE-S/ D	Surface/ subsurface	No	Minor	Negligible	Data recovery, spatial analysis, and analysis of collected material	GCF-MP536
BET-00213	Prehistoric	DOE-S/ D	Surface/ subsurface	No	Minor	Negligible	Data recovery, spatial analysis, and analysis of collected material	GCF-MP536
PSM-00049	Prehistoric	DOE-S/ A and D	Surface/ subsurface	No	Minor	Negligible	See CRMP Galbraith Lake Area Discussion	GCF-MP536
PSM-00076	Prehistoric	DOE-S/ A and D	Surface/ subsurface	No	Minor	Negligible	See CRMP Galbraith Lake Area Discussion	GCF-MP536
PSM-00572	Prehistoric	DOE-S/ D	Surface/ subsurface	No	Minor	Negligible	See CRMP Gallagher Flint Station Mitigation Discussion	GCF-MP536
BET-00122	Prehistoric	NDE	Subsurface	No	Minor	Minor	No mitigation in CRMP. Site eligibility for these sites is pending consultation or has no determination; specific mitigation dependent on resulting eligibility assessment	GCF-MP536
PSM-00499	Prehistoric	DOE-P-S	Subsurface	No	Minor	Minor		GCF-MP536
PSM-00582	Prehistoric	NDE	Subsurface	No	Minor	Minor		GCF-MP536
FAI-02386	Historic Artifact/ Activity Area	DOE-S/ D	Subsurface	No	Negligible	Negligible	Data recovery	GCF-MP536
BET-00200, CHN-00070, LIV-00501, PSM-00570, SAG-00097, TAN-00118, WIS-00408	Linear Transportation Feature	DOE-S/ A, C, Other	Surface	Yes	Negligible	Negligible	Additional consultation needed with ADOT&PF to determine effect and appropriate minimization or mitigation measures	GCF-MP536
BET-00055	Prehistoric	DOE-S/ D	Subsurface	No	Negligible	Negligible	Data recovery	GCF-MP536
WIS-00437	Prehistoric	DOE-S/ D	Subsurface	No	Negligible	Negligible	Data recovery	GCF-MP536
CHN-00077	Prehistoric	DOE-S/ D	Subsurface	No	Negligible	Negligible	Data recovery, spatial analysis, and analysis of collected material	GCF-MP536

Cultural Resource	Site Type	NRHP Status/ Criteria	Surface/ Subsurface	Site within Footprint of Proposed Project Component?	Construction Impact Ranking	Operation Impact Ranking	CRMP Mitigation	Segment
LIV-00726	Prehistoric	DOE-S/ D	Subsurface	No	Negligible	Negligible	Data recovery, spatial analysis, and analysis of collected material	GCF-MP536
WIS-00413	Prehistoric	DOE-S/ D	Subsurface	Yes	Negligible	Negligible	No mitigation recommended, site has been extensively tested and only produced a single flake, which was collected	GCF-MP536
PSM-00501	Prehistoric	DOE-S/ D	Subsurface	No	Negligible	Negligible	See CRMP Galbraith Lake Area Discussion	GCF-MP536
PSM-00050	Prehistoric	DOE-S/ D	Subsurface	No	Negligible	Negligible	See CRMP Gallagher Flint Station Mitigation Discussion	GCF-MP536
PSM-00596	Prehistoric	DOE-S/ D	Subsurface	No	Negligible	Negligible	See CRMP Gallagher Flint Station Mitigation Discussion	GCF-MP536
PSM-00605	Prehistoric	DOE-S/ D	Subsurface	No	Negligible	Negligible	See CRMP Gallagher Flint Station Mitigation Discussion	GCF-MP536
LIV-00778	Prehistoric	DOE-S/ D	Subsurface	Yes	Negligible	Negligible	This site could likely be avoided	GCF-MP536
FAI-02298	Historic Artifact/ Activity Area	NDE	Surface	No	Moderate	Moderate	No mitigation in CRMP. Site eligibility for these sites is pending consultation or has no determination; specific mitigation dependent on resulting eligibility assessment	Fairbanks Lateral
FAI-02119	Linear Transportation Feature	DOE-S/ A and C	Surface	Yes	Minor	Minor		Fairbanks Lateral
HEA-00658	Prehistoric	DOE-S/ D	Subsurface	Yes	Moderate	Moderate	Data recovery, spatial analysis, and analysis of collected material	MP536-543
HEA-00662	Prehistoric	DOE-S/ D	Surface/ subsurface	No	Minor	Negligible	Data recovery	MP536-543
TYO-00205	Historic Artifact/ Activity Area	NDE	Surface	Yes	Major	Major	No mitigation in CRMP. Site eligibility for these sites is pending consultation or has no determination; specific mitigation dependent on resulting eligibility assessment	MP543-733
HEA-00600	Isolate	NDE	Subsurface	Yes	Major	Major		MP543-733
HEA-00680	Prehistoric	NDE	Surface/ subsurface	Yes	Major	Major		MP543-733

Cultural Resource	Site Type	NRHP Status/ Criteria	Surface/ Subsurface	Site within Footprint of Proposed Project Component?	Construction Impact Ranking	Operation Impact Ranking	CRMP Mitigation	Segment
HEA-00601	Prehistoric	NDE	Subsurface	Yes	Major	Major		MP543-733
TYO-00178	Prehistoric	NDE	Subsurface	Yes	Major	Major		MP543-733
TYO-00204	Prehistoric	NDE	Surface	Yes	Major	Major		MP543-733
TAL-00181	Built Environment	DOE-S/ A, B, and D	Surface/ subsurface	Yes	Moderate	Moderate	HABS level documentation of the cabin, testing and data recovery of surface and subsurface historic features	MP543-733
HEA-00188	Built Environment	NDE	Surface	No	Moderate	Moderate	No mitigation in CRMP. Site eligibility is pending consultation or has no determination; specific mitigation dependent on resulting eligibility assessment	MP543-733
TLM-00327	Prehistoric	DOE-S/ D	Subsurface	Yes	Moderate	Moderate	Data recovery	MP543-733
HEA-00597	Prehistoric	NDE	Surface/ subsurface	No	Moderate	Moderate	No mitigation in CRMP. Site eligibility for these sites is pending consultation or has no determination; specific mitigation dependent on resulting eligibility assessment	MP543-733
TAL-00188	Prehistoric	DOE-P-S	Surface	No	Moderate	Moderate		MP543-733
TAL-00189	Prehistoric	NDE	Surface	No	Moderate	Moderate		MP543-733
TYO-00208	Prehistoric	NDE	Surface	No	Moderate	Moderate		MP543-733
TYO-00315	Prehistoric	NDE	Surface	No	Moderate	Moderate		MP543-733
HEA-00066	Built Environment	DOE-S/ A	Surface	No	Minor	Negligible	Data recovery	MP543-733
TAL-00180	Historic Artifact/ Activity Area	DOE-S/ D	Surface/ subsurface	No	Minor	Negligible	Data recovery	MP543-733
HEA-00604	Isolate	NDE	Subsurface	No	Minor	Minor	No mitigation in CRMP. Site eligibility for these sites is pending	MP543-733

Cultural Resource	Site Type	NRHP Status/ Criteria	Surface/ Subsurface	Site within Footprint of Proposed Project Component?	Construction Impact Ranking	Operation Impact Ranking	CRMP Mitigation	Segment
HEA-00607	Isolate	NDE	Subsurface	No	Minor	Minor	consultation or has no determination; specific mitigation dependent on resulting eligibility assessment	MP543-733
TYO-00084	Linear Transportation Feature	DOE-S/ A	Surface	Yes	Minor	Minor	Minimize effects through vegetation and existing trail condition maintenance, providing continuity of access and scheduling of construction activities during period of low use	MP543-733
TYO-00224	Linear Transportation Feature	DOE-S/ A and Other	Surface	Yes	Minor	Minor	Minimize effects through vegetation and existing trail condition maintenance, providing continuity of access and scheduling of construction activities during period of low use	MP543-733
TYO-00228	Linear Transportation Feature	DOE-S/ A	Surface	Yes	Minor	Minor	Minimize effects through vegetation and existing trail condition maintenance, providing continuity of access and scheduling of construction activities during period of low use	MP543-733
TYO-00164	Linear Transportation Feature	NDE	Surface	Yes	Minor	Minor	No mitigation in CRMP. Site eligibility for these sites is pending consultation or has no determination; specific mitigation dependent on resulting eligibility assessment	MP543-733
TYO-00170	Linear Transportation Feature	NDE	Surface	Yes	Minor	Minor		MP543-733
TYO-00184	Linear Transportation Feature	NDE	Surface	Yes	Minor	Minor		MP543-733

Cultural Resource	Site Type	NRHP Status/ Criteria	Surface/ Subsurface	Site within Footprint of Proposed Project Component?	Construction Impact Ranking	Operation Impact Ranking	CRMP Mitigation	Segment
TYO-00225	Linear Transportation Feature	NDE	Surface	Yes	Minor	Minor		MP543-733
TYO-00226	Linear Transportation Feature	NDE	Surface	Yes	Minor	Minor		MP543-733
TYO-00201	Linear Transportation Feature	NDE	Surface	No	Minor	Minor		MP543-733
TYO-00179	Prehistoric	NDE	Subsurface	No	Minor	Minor		MP543-733
HEA-00450	Linear Transportation Feature	DOE-S/ A	Surface	Yes	Negligible	Negligible	Additional consultation needed with ADOT&PF to determine effect and appropriate minimization or mitigation measures	MP543-733

4.19.7.1.1. Prehistoric Sites

A total of 100 prehistoric sites could potentially experience direct effects from the proposed Project (Table 4.19-11). Alternative 2 would have four fewer sites that could potentially be affected, however, two of the additional sites that could be impacted in Alternative 1 are not eligible. Within the direct impact area, 28 of the 98 sites would not experience adverse effects from the proposed Project as they have previously undergone extensive evaluation under the Section 106 process and are not eligible for listing on the NRHP. The remaining 72 sites (46 eligible and 26 with no determination) could experience adverse direct effects from the proposed Project.

For the indirect impact area, 280 sites could experience indirect effects; Alternative 2 would have one fewer site that could experience indirect effects. Fifteen of the sites are not eligible and would not experience adverse effects. The remaining eligible (16) and those with no determination (249) could experience adverse indirect effects.

In summary, both alternatives would result in 13 major impacts, 29 moderate impacts, 18 minor impacts, and 10 negligible impacts to prehistoric sites in the direct impact area during the construction phase of the proposed Project. Fourteen sites would reduce from minor to negligible impacts for the operational phase of the proposed Project. Alternative 1 would result in one additional moderate (HEA-00658) and one additional minor (HEA-00662) impact; the minor impact would reduce to negligible during the operational phase of the proposed Project. For the indirect impact area, based on the available information, Alternative 1 would also impact one additional eligible prehistoric site. Overall, Alternative 2 would have a slightly lower magnitude of impacts to prehistoric sites compared to Alternative 1.

4.19.7.1.2. Built Environment

A total of seven built environment cultural resources could potentially experience direct effects from both alternatives (Table 4.19-11). Within the direct impact area, three of the nine cultural resources would not experience adverse effects from the proposed Project as they are not eligible for listing on the NRHP. The remaining four built environment resources (three eligible and one with no determination) could experience adverse effects from the proposed Project.

For the indirect impact area, 98 built environment resources within Alternative 1 could experience indirect effects; Alternative 2 would have five additional built environment resources that could experience indirect effects; one is listed as not eligible. In total, 15 of the built environment cultural resources are not eligible and would not experience adverse effects. The remaining eligible (12) and those with no determination (76) could experience adverse indirect effects.

In summary, both alternatives would result in two moderate impacts and two minor impacts to built environment resources in the direct impact area during the construction phase of the proposed Project. Two sites would reduce from minor to negligible impacts

for the operational phase of the proposed Project. For the indirect impact areas, based on the available information, Alternative 2 would indirectly impact four additional built environment cultural resources that currently have no determination of eligibility.

4.19.7.1.3. Cemetery/Graves/Human Remains

No cemeteries, graves, or human remains are located within the direct impact area (Table 4.19-11). Therefore, there would be no expected direct adverse effects to this type of resource from the proposed Project.

For the indirect impact area, nine cemeteries, graves, or human remains could experience indirect effects from both alternatives. All nine have had no determinations of eligibility. Therefore, all nine could experience adverse indirect effects.

Based on the available information, Alternative 1 and 2 would indirectly impact the same number of cemeteries, graves, or human remains.

4.19.7.1.3.1. CMTs

A total of three CMTs could potentially experience direct effects from both alternatives (Table 4.19-11). All three CMTs are not eligible and would not experience adverse effects.

For the indirect impact area, four CMTs could experience indirect effects from both alternatives. All four have no determination of eligibility. Therefore, all four could experience adverse indirect effects.

Based on the available information, Alternative 1 and 2 would impact the same number of CMTs in the direct and indirect impact areas.

4.19.7.1.4. District/Landscapes

Two districts/landscapes (Rosebud and Nuiqsut Cultural Landscape) could potentially experience direct effects from both alternatives; due to their size both landscapes extend into the indirect impact area as well (Table 4.19-11). Both of the districts/landscapes are either eligible (1) or have no determination (1). Therefore, both could experience adverse effects from the proposed Project.

For the indirect impact area, seven districts/landscapes could experience indirect effects from both alternatives. One of the districts/landscapes is not eligible and would not experience adverse effects. The remaining are either eligible (4) or with no determination (2) and could experience adverse indirect effects.

In summary, both alternatives would result in one moderate impact and one minor impact to districts/landscapes in the direct impact area. Alternative 2 would have a slightly greater magnitude of impact due to the presence of an elevated pipeline in the Nuiqsut Cultural Landscape.

4.19.7.2. Historic Artifact/Activity Areas

A total of 26 historic artifact/activity areas could potentially experience direct effects from both alternatives (Table 4.19-11). Within the direct impact area, 16 of the 26 areas would not experience adverse effects from the proposed Project as they are not eligible for listing on the NRHP. The remaining 10 areas (five eligible and five with no determination) could experience adverse effects from the proposed Project.

For the indirect impact area, 38 areas within Alternative 1 could experience indirect effects; Alternative 2 would have three additional areas that could experience indirect effects. Four of the areas are not eligible and would not experience adverse effects. The remaining eligible (2) and those with no determination (35) could experience adverse indirect effects.

In summary, both alternatives would result in three major impacts, five moderate impacts, one minor impact, and one negligible impact to historic artifact/activity areas in the direct impact area during the construction phase of the proposed Project. One site would reduce from minor to negligible impacts for the operational phase of the proposed Project. Based on the available information, Alternative 2 could indirectly impact three additional historic artifact/activity area and would therefore have a slightly higher magnitude of impacts to these types of cultural resources compared to Alternative 1.

4.19.7.2.1. Isolate – Prehistoric/Historic

A total of 23 isolates could potentially experience direct effects from Alternative 1 (Table 4.19-11). Alternative 2 would impact two fewer isolates, however, the two additional isolates that could be impacted in Alternative 1 are not eligible. In total, 16 of the isolates are not eligible and would not experience adverse effects. The remaining seven with no determination or determinations pending could experience adverse effects from the proposed Project.

For the indirect impact area, 44 isolates could experience indirect effects from Alternative 1 with one fewer in Alternative 2. Four of the isolates are not eligible and would not experience adverse effects. The remaining are those with no determination or determinations pending (40) and could experience adverse indirect effects.

In summary, both alternatives would result in two major impacts, one moderate impact, and four minor impacts to isolate sites in the direct impact area. For the indirect impact areas, based on the available information, Alternative 2 would impact one fewer isolate.

4.19.7.2.2. Linear Transportation Feature

A total of 35 linear transportation features (some of which are crossed multiple times in different regions) could potentially experience direct effects from both alternatives (Table 4.19-11). Within the direct impact area, 10 of the 35 features would not experience adverse effects from the proposed Project as they are not eligible for listing on the

NRHP. The remaining 25 (16 eligible and nine with no determination) could experience adverse effects from the proposed Project.

For the indirect impact area, 68 linear transportation features could experience indirect effects from both alternatives. Nine of the transportation features are not eligible and would not experience adverse effects. The remaining eligible (14) and those with no determination (45) could experience adverse indirect effects. Twenty RS 2477 trails are crossed by the proposed Project (many of which have corresponding AHRS numbers) and could be affected.

In summary, both alternatives would result in one major impact, 16 minor impacts, and eight negligible impacts to linear transportation features in the direct impact area. For the indirect impact areas, based on the available information, Alternative 1 and 2 would impact the same number of linear transportation features.

4.19.7.2.3. Multicomponent

One multicomponent cultural resource could potentially experience direct effects from both alternatives (Table 4.19-11). This multicomponent cultural resource is eligible for the NRHP. Therefore, it could experience adverse effects from the proposed Project.

For the indirect impact area, 10 multicomponent cultural resources could experience indirect effects from both alternatives. Three of these are not eligible and would not experience adverse effects. The remaining are either eligible (4) or with no determination (3) and could experience adverse indirect effects.

In summary, both alternatives would result in one moderate impact to a multicomponent site in the direct impact area. For the indirect impact areas, based on the available information, both alternatives would indirectly impact seven additional multicomponent cultural resources that are eligible or that currently have no determination of eligibility.

4.19.7.2.4. Other

A total of two other cultural resources could potentially experience direct effects from both alternatives (Table 4.19-11). Both of the other cultural resources are not eligible and would not experience adverse effects.

For the indirect impact area, 22 other cultural resources could experience indirect effects from both alternatives. One of these is not eligible and would not experience adverse effects. The remaining have no determination (21) and could experience adverse indirect effects.

Based on the available information, Alternative 1 and 2 would impact the same number of other cultural resources.

4.19.7.2.5. Paleontological

A total of three paleontological sites could potentially experience direct effects from both alternatives (Table 4.19-11). All three paleontological sites are not eligible and would not experience adverse effects.

For the indirect impact area, 15 paleontological sites could experience indirect effects from both alternatives. All 15 have no determination of eligibility. All 15 could experience adverse indirect effects.

Based on the available information, Alternative 1 and 2 would impact the same number of paleontological sites.

4.19.7.3. Summary

Figure 4.19-1 displays the cultural resource context figure of potential impacts to cultural resources from the proposed Project based on the additional details on the level of impacts by site number and site type presented in Table 4.19-12. In summary, 13 eligible cultural resources within the direct impact area of the GCF to MP 536 segment would experience major effects, 30 moderate effects, 27 minor effects, and 18 negligible effects. Fifteen sites would reduce to negligible during the operational phase of the proposed Project. An additional 372 cultural resources could experience indirect effects.

For the Fairbanks Lateral, one cultural resource within the direct impact area of the Fairbanks Lateral would experience moderate effects and one would experience minor effects. An additional 38 cultural resources could experience indirect effects.

For the MP 536 to MP 543 segment, one cultural resource within the direct impact area of the MP 536 to MP 543 segment would experience moderate effects and one would experience minor effects. An additional nine cultural resources could experience indirect effects.

For the Denali NPP Route Variation, there are no cultural resources within the direct impact area of the Denali NPP Route Variation. Fourteen cultural resources could experience indirect effects. Additional cultural resources may be documented if this route is selected due to the route not being completely surveyed.

Lastly, for the MP 543 to 733 segment, six cultural resources within the direct impact area of the MP 543 to 733 segment would experience major effects, eight moderate effects, 14 minor effects, and one negligible effect. Two sites would reduce to negligible during the operational phase of the proposed Project. An additional 125 cultural resources could experience indirect effects.

In total, the direct impact area for Alternative 1 would have 19 major effects, 40 moderate effects, 43 minor effects, and 19 negligible effects; 18 of the sites with minor effects in construction would reduce to negligible in operations (Table 4.19-13). The remainder of sites would experience the same level of effects from construction through operation and beyond due to the damage or destruction to the site that would occur or continued likelihood for other effects such as increased access. The indirect impact area

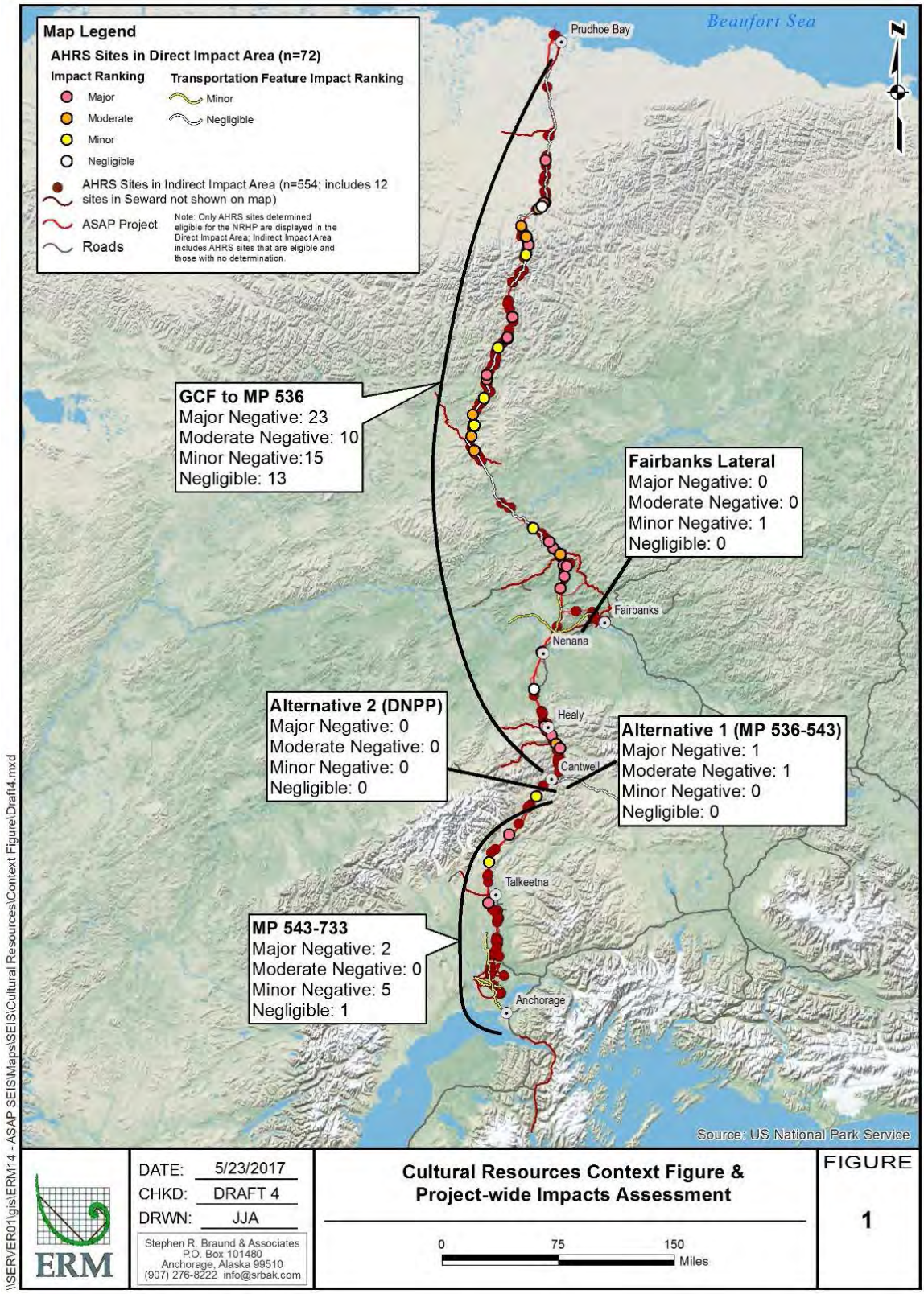
could potentially affect 544 sites. The direct impact area for Alternative 2 would have 19 major effects, 39 moderate effects, 42 minor effects, and 19 negligible effects. Seventeen of the sites with minor effects in construction would reduce to negligible in operations; the remainder would experience the same level of effects. The indirect impact area could potentially affect 549 sites.

Table 4.19-13 Cultural Resource Impact Summary (Direct & Indirect Effects)

Type of Effect	Alternative 1		Alternative 2		Alternative 3	
	Construction	Operation	Construction	Operation	Construction	Operation
	Impact Rating		Impact Rating		Impact Rating	
Effects to Direct Impact Area	*Major (19)*	*Major (19)*	*Major (19)*	*Major (19)*	*Negligible*	
	Moderate (40)	*Moderate (40)*	*Moderate (39)*	*Moderate (39)*		
	Minor (43)	*Minor (25)*	*Minor (42)*	*Minor (25)*		
	Negligible (19)	*Negligible (37)*	*Negligible (19)*	*Negligible (36)*		
Effects to Indirect Impact Area	*544*		*549*		*0*	

Table 4.19-13 differs in appearance from other resource impact summary tables included in this SEIS because impact criteria (e.g., magnitude, duration, extent) are not typically used in the NEPA assessments of cultural resources. Instead, the assessment is based simply on the alternatives that could cause impacts and the type of effect that could result. Major, moderate, minor, and negligible effects are assessed for eligible sites, sites with no determination, or those pending consultation within the direct impact area. Indirect impact area counts include sites that are eligible and those with no determination. See Section 4.19.2, Methods for description of impact types.

Figure 4.19-1 Cultural Resources Context Figure



4.20. Subsistence

4.20.1. Introduction

This section describes potential impacts to subsistence associated with the construction and operation of the proposed Project and discusses potential mitigation measures that would avoid or minimize the potential impacts. The information, data, methods, and/or analyses used in this discussion are based on information provided in the 2012 FEIS (USACE, 2012a), as well as new circumstances or information relevant to environmental concerns that have become available since the publication of the 2012 FEIS, including the proposed changes in route and design described in the alternatives. In some instances, the information is replicated with relatively minor changes and updates; while in other instances, the material is entirely new or substantially altered. Specifically, the following items have been substantially updated from the 2012 FEIS related to impacts to subsistence:

- A new section (Section 4.20.2, Methods) was added to explain the procedures used to evaluate the potential impacts associated with the proposed Project and alternatives;
- Mitigation measures were carried over from the 2012 FEIS and expanded upon to include recommendations from federal and state agencies; and
- The impacts were updated based on new alternatives, and a summary of those results was added.

4.20.1.1. Incomplete or Unavailable Information

In compliance with CEQ guidance (see Section 4.3), this section addresses incomplete or unavailable information pertinent to analyzing impacts of the alternatives on subsistence. Various information sources have been used to assess impacts to the subsistence uses of study communities potentially affected by the proposed Project. Assessments for this SEIS are based on the most updated and accessible documents. In regards to unavailable information, a large number of ASAP subsistence study communities have recently had subsistence information (*i.e.*, household harvest surveys and subsistence mapping studies) updated as part of the Alaska LNG baseline studies; however, these studies are not yet completed or published. Alaska LNG survey data would only be used for the proposed Project if agreed upon by AGDC and the information would be limited to the proposed Project footprint and its vicinity.

4.20.2. Methods

Subsistence use and harvest studies conducted in the study communities indicate use along nearly the entire length of the proposed Project Area. Subsistence use impacts common to all alternatives include direct and indirect effects on subsistence use areas, user access, resource availability, competition, costs and time associated with subsistence activities, and culture. Assessment of the consequences noted below is guided by prior assessments made for similar studies in the area of the proposed Project.

For example, EIS' for similar projects with corridors (*e.g.*, roads, pipelines) published by BLM (*e.g.*, the renewal of the federal grant for the TAPS ROW [BLM, 2002] and the Alpine Satellite Development Project [BLM, 2004]), EPA Supplemental EIS for the Red Dog Mine Extension Project (EPA, 2009), and USACE Point Thomson Project EIS (USACE, 2012c) were reviewed and the results incorporated into this analysis. Additionally, reports documenting the local (*e.g.*, SRB&A, 2009; 2013c) and statewide assessments (NRC, 2003a) of the impact of oil industry development on subsistence in Alaska were incorporated into this analysis.

4.20.2.1. Description of Effects

4.20.2.1.1. Subsistence Use Areas

If a portion of a community's subsistence use area is within the proposed Project footprint, then a direct effect on subsistence use would occur. With the exception of downstream effects, the farther a community's subsistence use area is from the proposed Project Area, the less the potential exists for a direct impact on residents' subsistence uses.

4.20.2.1.2. Resource Availability

Successful subsistence harvests depend on continued availability of resources, in adequate numbers and health, in traditional use areas. Subsistence availability is affected by resource mortality or health changes, displacement from traditional harvest locations, or contamination (including actual and/or perceived contamination of resources and habitat or habituation of resources to development activities). Resource availability impacts may also occur as an indirect effect of user avoidance of an area. Where possible, impacts to resource availability are based on identified impacts in Section 4.10, Wildlife; Section 4.11, Fish; Section 4.12, Marine Mammals; and Section 4.14, Threatened & Endangered Species. The impacts on resource use are also developed from prior studies such as BLM, 2002, 2004; NRC, 2003a; SRB&A, 2009, 2013d; EPA, 2009; and USACE, 2012b.

4.20.2.1.3. User Access

Successful subsistence harvests depend on continued access to subsistence resources and use areas without physical, regulatory, or social barriers. Access could be negatively affected or enhanced by a project.

4.20.2.1.4. Competition

Changes in access could result in changes in harvester competition for resources. Increased access to an area may result in more competition for resources from outsiders and/or from community or nearby community residents who did not previously use the area. A decrease in access may decrease competition in the potentially affected area and introduce additional competition in new areas, as harvesters would no longer be able access previously used hunting or fishing areas. A decrease in resource availability may

result in increased competition among harvesters trying to meet their harvest needs from a depleted or displaced resource stock.

4.20.2.1.5. Costs and Time

Displacement of resources, resource population decline, competition, and economic changes could affect costs and effort associated with subsistence harvest activities. Harvest activity costs are often directly related to distance traveled, in addition to other factors (*e.g.*, gas prices, time spent away from home). Indirect effects of increased travel distances or time required to locate and harvest subsistence resources include increased safety risks. While development may result in increased costs and time associated with subsistence activities, job opportunities from a development activity could result in increased income to support subsistence activities. However, time available for subsistence activities could also be negatively affected by a development activity if new local job opportunities and/or rising local costs of living cause harvesters to work longer hours. The magnitude of these impacts is dependent on subsistence leave policies associated with available jobs.

4.20.2.1.6. Culture

Harvests of local resources are dependent on subsistence knowledge and skills. Such skills are transmitted between generations largely through multigenerational harvesting, processing, and sharing activities. Disruption of harvest activities could also disrupt learning and transmission of subsistence skills. Harvesting activities, including distribution and processing of harvest products, foster and maintain social ties that are also important to overall wellbeing. Disruption of harvest activities could weaken those social ties by reducing social interactions. In addition, satisfaction that comes from eating traditional foods is also important to overall wellbeing, and disruptions to harvests of resources could affect the ability to consume subsistence foods. Other potential impacts to culture include avoidance of traditional use areas, loss of the integrity of a culturally significant place, and decreased autonomy (*i.e.*, control over traditional lands, tribal government, development activities).

4.20.2.2. Impact Criteria

This section employs the following criteria in the assessment of potential impacts to subsistence from the proposed Project. These impact components are based on NEPA guidance, which requires consideration of both context and intensity when assessing significant impacts (40 CFR 1508.27). The impact criteria focus on the magnitude (*i.e.*, rural/nonrural status of study community), geographic extent, duration or frequency, and likelihood of each impact to subsistence using the following guidelines (Table 4.20-1).

Table 4.20-1 Impact Criteria for Subsistence

Impact Component	Impact Level			
	Major	**Moderate**	**Minor**	**Negligible**
Magnitude or Intensity	The effect would alter a federally designated **rural** community's subsistence uses of a top three resource.	The effect would alter a federally designated **rural** community's subsistence uses of other resources (*i.e.*, not top three).	The effect would alter a federally designated **nonrural** community's subsistence uses or there would be minimally perceivable effect to a federally designated **rural** community.	No perceivable effect to **rural** or **nonrural** community's subsistence uses.
Geographic Extent	Proposed Project bisects community or the subsistence use area.	Proposed Project • Intersects little to no portion of use area; and/or • There is road access between communities located within 30 miles of the proposed Project.	Proposed Project • Intersects little to no portion of use area; and/or • There is no road access or winter road access only; or • Road access is between communities located farther than 30 miles from the proposed Project.	The effect would be limited to a specific, contained location.
Duration or Frequency	The effect would occur for greater than 5 years' duration or through operations of the proposed Project.	The effect would occur intermittently and/or for 2 to 5 years' duration.	The effect would occur intermittently and/or less than a 2-year duration.	The effect, if perceived, would be limited to less than a 1-month duration.
Likelihood	Definite No avoidance - impact occurs under typical operating conditions.	Probable Impact would likely occur under typical operating conditions.	Possible Impact may occur under typical operating conditions.	Unlikely Impact not likely to occur.

For magnitude/intensity, the rationale that an effect to a rural community may be of greater magnitude, whereas a similar effect to a nonrural community may only be minor (or negligible), is based on the fact that nonrural (*i.e.*, urban) communities have reduced dependence/reliance on subsistence (Wolfe and Walker, 1985). Furthermore, if an effect were to impact a top three resource contributing to the material harvest of a community (see Chapter 3, Section 3.16 of this SEIS), then that effect would be of a greater magnitude compared to a similar effect to a resource contributing a smaller amount to the material harvest.

The geographic extent of impacts to subsistence would vary. Communities that are located along the proposed Project ROW or whose use areas are bisected (*e.g.*,

intersecting in or near the middle of the use area) by the proposed Project would likely experience greater impacts versus those communities that are located farther away or only have a small portion of their use areas intersected by the proposed Project. As noted in Chapter 3, Section 3.16, subsistence use area data are not available for some communities located near the proposed Project, such as Livengood, Anderson, and Ferry. The rationale that the magnitude of an impact would be greater when the proposed Project bisects a community's use area (versus on the periphery of a community's use area) is based on an analysis of subsistence use area mapping studies that record the number of harvesters by use area.

For example, Figure 4.20-1 shows Nuiqsut subsistence use areas for the 1995-2006 time period (SRB&A, 2010a) by number of harvesters. The red areas are locations where multiple harvesters reported use areas; the yellow areas represent locations where fewer harvesters reported use areas. As shown on Figure 4.20-1, the majority of red overlapping use areas are located near the community and gradually reduce in frequency of subsistence use area overlaps (*i.e.*, red to orange to yellow shading) as they extend farther from the community. The yellow shaded areas, which indicate the fewest harvesters, are located on the outer edge of Nuiqsut's overall subsistence use area. For the proposed Project, the ROW passes through an area in which only 3 of 33 Nuiqsut harvesters reported hunting during the 1995-2006 time period. This analysis assumes that a project that passes through an area used by multiple harvesters, versus an area used by a few harvesters, would have a greater impact because it affects a greater number of harvesters. Other studies have termed this use of an intensively used core area as a "central-based use area" pattern in which a core area surrounding the community supports most of the food production with larger, less frequently used subsistence use areas extending beyond the intensively-used core (Wolfe, 2003).

There is not enough data for the majority of communities along the proposed Project corridor to conduct this type of analysis (*e.g.*, number of harvester overlaps along proposed Project); however, a review of the communities in which these data are available (*e.g.*, Utqiagvik, Kaktovik, Anaktuvuk Pass, Tyonek, Beluga) confirmed the same results as described above for Nuiqsut. Thus, the same rationale (*i.e.*, fewer harvesters go to use areas located furthest from the community) was applied to the other study communities. The analysis includes exceptions if the outer edge is close to the community and limited by a regulatory boundary (*e.g.*, Cantwell's use along Denali NPP) or prominent natural feature (*e.g.*, coastline or mountain range).

Figure 4.20-1 Nuiqsut Subsistence Use Areas by Individual

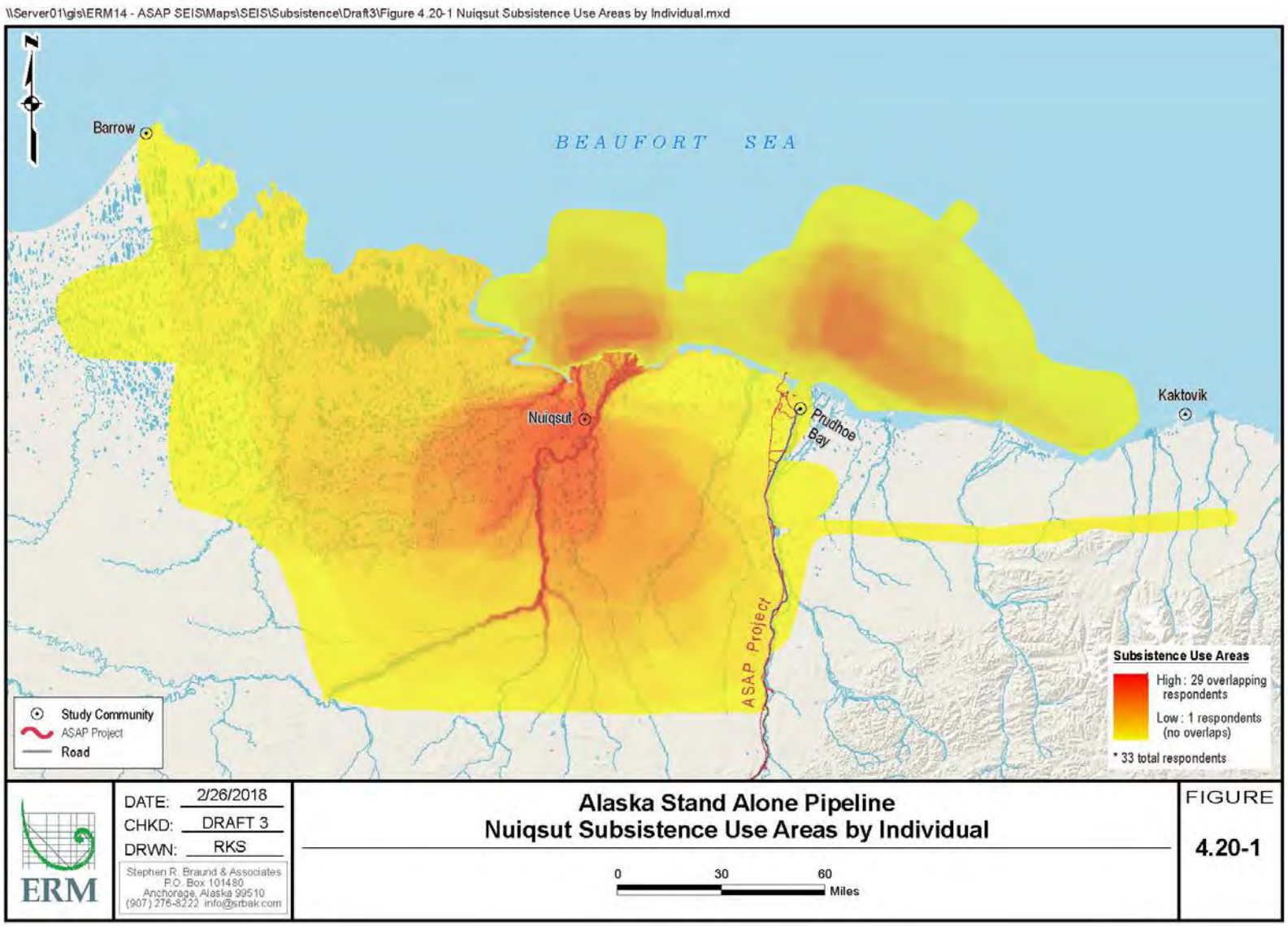


Table 4.20-2 provides information that assists in the determination of the magnitude (i.e., rural or nonrural status of a study community) and geographic extent (i.e., whether use area bisected, overlapped, or is within 30 miles) of impacts to study communities discussed in the follow sections by alternatives.

Table 4.20-2 Magnitude and Geographic Extent Related to Study Communities

Region	Magnitude / Intensity Context	Geographic Extent		
	Federal Subsistence Designation	A Proposed Project Bisects Community or the Subsistence Use Area	B Proposed Project • Intersects little to no portion of use area • And/or there is road access between community located within 30 miles of the proposed Project	C Proposed Project • Intersects little to no portion of use area • And/or there is no road access or winter road access only • Or road access is between community located farther than 30 miles of the proposed Project
North Slope	Rural	Prudhoe Bay	--	Utqiagvik Nuiqsut Kaktovik Anaktuvuk Pass
Interior (Yukon River Subregion)	Rural	Wiseman Coldfoot	--	Evansville Bettles Alatna Allakaket Stevens Village Beaver Rampart
Interior (Tanana River Subregion)	Rural	Minto Nenana Four-Mile Road Anderson Ferry Healy McKinley Park	Manley Hot Springs Livengood	Tanana
	Nonrural	--	Fairbanks	--
Southcentral (Cook Inlet Subregion)	Rural	Cantwell Talkeetna Trapper Creek Susitna North Willow	Petersville	Chase Susitna (Alexander Creek) Skwentna Beluga Tyonek Chickaloon Lake Louise Hope Point Possession
	Nonrural	--	Wasilla Palmer Eklutna Anchorage Municipality	--

Region	Magnitude / Intensity Context	Geographic Extent		
	Federal Subsistence Designation	**A** **Proposed Project Bisects Community or the Subsistence Use Area**	**B** **Proposed Project** • **Intersects little to no portion of use area** • **And/or there is road access between community located within 30 miles of the proposed Project**	**C** **Proposed Project** • **Intersects little to no portion of use area** • **And/or there is no road access or winter road access only** • **Or road access is between community located farther than 30 miles of the proposed Project**
Southcentral (Copper River/PWS Subregion)	Rural	--	--	Glennallen Copper Center Kenny Lake Gakona McCarthy Whittier
	Nonrural	--	--	Valdez

Table 4.20-3 defines the general types of effects the proposed Project and activities may have on subsistence that are assessed in this SEIS. Mitigation measures are described in Section 4.20.3 and in Table 4.20-3. Potential impacts that remain after mitigation measures have been implemented are described for each alternative in the following sections.

Table 4.20-3 Types of Effects and Impacts on Subsistence

Type of Effect	Proposed Action Causing Potential Impact
• Removal or disruption of subsistence use areas • Temporary decrease in resource availability • Temporary reduction in harvester access to the proposed Project Area • Contamination (real or perceived)	Construction activities (*e.g.*, construction noise, traffic, human presence, barging, water use requirements)
• Decrease in resource availability due to proposed Project infrastructure • Loss of subsistence use areas due to direct overlap with proposed Project infrastructure • Decreased harvester access and/or avoidance of proposed Project Area by harvesters due to proposed Project infrastructure • Increase in competition from outside harvesters due to increased access	Proposed Project operational infrastructure (*e.g.*, roads, material sites, ROW)
• Decrease in resource availability due to sensory effects (*e.g.*, visual, auditory, olfactory) • Decreased harvester access and/or avoidance of proposed Project Area by harvesters due to sensory effects, firearm discharge, and general avoidance of industry activities • Contamination (real or perceived) • Increased subsistence harvester access through use of proposed Project roads	Operation activities (*e.g.*, traffic, maintenance and security activities, proposed Project policies)

Type of Effect	Proposed Action Causing Potential Impact
• Impacts to culture due to avoidance of traditional use areas; disruption to resources; decreased participation in harvesting, sharing, transfer of knowledge, satisfaction of eating traditional food, and processing of resources; integrity of culturally significant place; and autonomy • Increased costs and time due to seeking alternative use areas and/or not finding resources in traditional areas at expected times • Increased competition among local harvesters who avoid the proposed Project Area and hunt in other areas used by other residents	General proposed Project

4.20.3. Proposed Design Features, Mitigation Measures, Best Management Practices, and Project Management Plans

4.20.3.1. Applicant-Proposed Design Features, Mitigation Measures, Best Management Practices, and Project Management Plans

AGDC identified five mitigation measures in the 2012 FEIS (USACE, 2012a) that are carrying forward to address effects to subsistence (copied verbatim below). AGDC proposed Mitigation Measure Nos. 4 through 6 in their 2016 ASAP EED, and Mitigation Measure No. 7 has been added by AGDC in this SEIS as part of their ROW lease stipulations. Other measures that would indirectly help to mitigate impacts to subsistence are discussed in other sections, and include measures that address effects to wildlife, fish, and marine mammals, use of access roads, and safety measures. These measures have been taken into consideration when evaluating potential impacts on cultural resources under Alternatives 1 and 2 during the construction and operations phases. A complete list of mitigation measures and BMPs are also provided in Appendix M.

Proposed mitigation measures would include:

1. Identify locations and times when subsistence activities occur, and minimize work during these times and in these areas to the maximum extent practicable.

   Analysis – In establishing the final construction schedule, AGDC would consult with resource agencies, including ADF&G and U.S. Department of the Interior (DOI), as well as with subsistence users, to identify areas of most concern for subsistence activities. To the maximum extent practicable, AGDC would either schedule construction to avoid disturbance of subsistence activities or would provide access for subsistence users to areas near the work sites.

   Effectiveness – Consultation among AGDC, regulatory staff, and subsistence users of the area would develop the appropriate schedule to the extent most practicable for construction of the proposed Project. Local knowledge and regulatory input would produce the best result for negotiating subsistence activities with the timeline of the proposed Project. Subsistence activities would not likely be adversely impacted due to collaborations of all entities.

2. Schedule work (*e.g.*, blasting) to avoid conflict with subsistence activities when possible.

   Analysis – AGDC would consult with resource agencies, such as ADF&G and DOI, as well as with subsistence users, to identify areas of most concern for subsistence activities. To the maximum extent practicable, AGDC would either schedule construction to avoid disturbance of subsistence activities or would provide access for subsistence users to areas near the work sites.

   Effectiveness – AGDC would reduce impacts to subsistence users by scheduling blasting activities as much as practicable when subsistence activities are not occurring.

3. Notify workers that subsistence activities are ongoing in the area and direct them to avoid activities that may affect the activities (*e.g.*, not removing trap line markers).

   Analysis – AGDC would notify employees as much as possible by posting and updating subsistence activities information. This may include involving the public in educational events held by AGDC in the community. Communication between AGDC and local tribes and Alaska Native Claims Settlement Act (ANCSA) corporations would occur on a regular basis, through meetings and other regular correspondence, in particular if Native land would be accessed. Ongoing consultation with Alaska Native Tribes would provide a foundation for communication that would help address issues that arise over construction of the proposed Project.

   Effectiveness – Informing workers of the subsistence activities as they occur would reduce impacts to subsistence users and subsistence activities due to disturbance from construction. Informing the workers directly would reduce impacts through awareness. Making the communities aware of construction schedules and specific events would reduce impacts to subsistence activities. Maintaining regular correspondence with Alaska Native Tribes and ANCSA corporations along the proposed Project route would provide for knowledge-sharing opportunities to protect and respect subsistence resources, traditions and their private land.

4. Coordinate with whaling groups and agencies to employ appropriate mitigation measures to avoid and minimize disturbance of noise and vessel traffic to subsistence species and activities.

5. Marine vessel traffic: To avoid and minimize impacts on subsistence whaling, AGDC has met with and received comments from the NSB Planning Department (Utqiagvik), the NSB Department of Wildlife Management (Utqiagvik), the Alaska Eskimo Whaling Commission, and the Kuukpik Corporation (Nuiqsut). AGDC would continue to meet with Utqiagvik and Nuiqsut whalers, other stakeholders,

the NSB, and regulatory agencies to implement appropriate mitigation measures, avoid and minimize impacts on whale movements, and avoid conflicts with whalers.

6. Biological assessment mitigation measure: AGDC would consult with PACs and appropriate subsistence user organizations to discuss potential conflicts with subsistence marine mammal hunting caused by the location, timing, and methods of proposed operations and support activities (AGDC, 2017c). Additionally, the ASAP Biological Assessment is provided as Appendix N, Part II.
7. Hunting, fishing, trapping, and camping: In areas where a lease is required from the SPCS or federal grant of ROW is required from BLM, with respect to AGDC's agent, employees, contractors, and the employees of each of them, AGDC would prohibit hunting, trapping, shooting, and camping within the leased area. The agent, employees, and contractors of AGDC would not use proposed Project equipment, including transportation to and from the job site, for the purpose of hunting, fishing, shooting, and trapping.

4.20.3.2. Agency-Recommended Mitigation Measures

A variety of mitigation measures and best practices have been recommended by the cooperating agencies (Appendix M). Many of these recommendations have been incorporated in the proposed Project and are included in Table 4.20-4 below. The impacts discussed in this chapter are based upon the Applicant-proposed measures. These additional agency recommended measures are not included in the impact analysis.

Table 4.20-4 Subsistence Resources Agency-Recommended Mitigation Measures

Additional Measure Consideration	Agency Proposing Mitigation Measure	Agency Jurisdiction	Authority (*i.e.*, CWA, RHA, ESA)	Affected Resources	Comment Code
When new access roads/airstrips are created on public land, consult with ADF&G when considering whether to allow for possible public access for hunting, particularly in areas with underutilized wildlife populations.	ADF&G	ADF&G, BLM, ADNR	Alaska Hunting Regulations; Federal Land Policy and Management Act	Recreation, Land Use, Subsistence	WLD_22
A large number of Applicant-proposed design features, mitigation measures, BMPs, and project management plans listed in the Draft SEIS contain the language, "In areas where a lease is required from the State Pipeline Coordinator's Section" or "a federal grant of ROW is required from BLM ..." These measures generally represent a best management approach that we recommend using to the maximum extent possible along the entire pipeline route, while acknowledging the outstanding need to complete coordination with private landowners.	EPA	--	--	Numerous	MIT_35

AAC = Alaska Administrative Code
ADF&G = Alaska Department of Fish and Game
ADEC = Alaska Department of Environmental Conservation
ADNR = Alaska Department of Natural Resources
AGDC = Alaska Gasline Development Corporation
APDES = Alaska Pollution Discharge Elimination System
BLM = Bureau of Land Management
BMP = Best Management Practice
CAA = Clean Air Act
CWA = Clean Water Act
DHSS = Alaska Department of Health and Social Services
EPA = U.S. Environmental Protection Agency
MBTA = Migratory Bird Treaty Act
NMFS = National Marine Fisheries Service
RHA = Rivers and Harbors Act of 1899
SEIS = Supplemental Environmental Impact Statement
USACE = U.S. Army Corps of Engineers
USFWS = U.S. Fish and Wildlife Service

4.20.4. Alternative 1 – Proposed Action

Alternative 1 is designated the proposed Action (proposed ASAP Project). This alternative is described in Chapter 2 in detail. The 36-inch, 733-mile-long pipeline and 12-inch, 30-mile lateral pipeline would cross several regions from the North Slope to Southcentral Alaska and a number of study communities' subsistence use areas within those regions. This section provides an analysis of construction and operation impacts to subsistence along the route from the pipeline ROW, Fairbanks Lateral, GCF, West Dock DH3 and causeway upgrades, and access roads. Subsistence impacts from other proposed Project components and support facilities (*e.g.*, maintenance buildings, Yukon River crossing, construction camps) would be negligible or are addressed under Mainline (*e.g.*, influx of workers, material sites in undeveloped areas adding to disturbance associated with the Mainline).

4.20.4.1. Construction

4.20.4.1.1. Pipeline Right-of-Way Mainline

Construction related activities resulting from the development of the proposed Project would have both direct and indirect effects on subsistence resources, use areas, and subsistence users in terms of availability, access, and competition, as well as hunter responses and effects on culturally important activities. These impacts would occur for the duration of construction activities and may continue throughout operations and maintenance (*e.g.,* introduction of invasive plants and fish). Construction activities under the proposed Project (including access road construction, construction campsite development, and Fairbanks Lateral) would occur over a 3.5-year period. However, several sections of the proposed Project are estimated to be completed during one winter or summer construction season, with pre-construction activities (*e.g.*, access roads, laydown yards, and camps) constructed during the previous year. Thus, impacts to subsistence during the construction phase are expected to be minor in duration. The degree of impacts from construction would depend on whether the timing of pre-construction and construction activities conflicts with subsistence activities for a community. Because construction would occur during both summer and winter, it is likely that there would be direct conflicts with subsistence activities for certain construction activities. Subsistence impacts would be most acute in the area around Minto Flats, which is largely undeveloped, whereas other areas of the proposed Project already experience impacts associated with the TAPS and Parks Highway corridors or are located in state designated nonsubsistence areas. AGDC is committed to identifying locations and times when subsistence activities occur and minimizing work during these times and in these areas to the maximum extent practicable (see Mitigation Measure No. 1 in Section 4.20.3). The extent to which proposed Project activities would conflict with subsistence activities is unknown and the likelihood for impacts still remains high for the following reasons:

1. AGDC has not yet identified where and when activities would be minimized to not conflict with subsistence activities to assess the effectiveness of this mitigation; and
2. Because other considerations (*e.g.*, wildlife and wetland mitigation often required by agency policies or regulations) also influence the timing of construction.

4.20.4.1.1.1. Subsistence Use Areas

Impacts to subsistence use areas during construction are, in short, determined by whether or not the proposed Project overlaps with a documented subsistence use area for a community. If a community's use areas are not overlapped, then an impact to subsistence use areas would be unlikely; however, impacts could still occur to user access, resource availability, competition, costs and time, and culture. In the instances where no use area data are available for a study community, then the proximity of the community to the proposed Project, proximity to state designated nonsubsistence areas, federal rural/nonrural status, and other factors (*e.g.*, temporary workforce, recreational users) are considered to determine the likelihood of impacts to subsistence use areas.

4.20.4.1.1.1.1. North Slope Region

In the North Slope region, the proposed Project would intersect with the eastern portion of Nuiqsut use areas and even smaller portions of Anaktuvuk Pass, Utqiagvik, and Kaktovik use areas (Figure 3.16-5). Nuiqsut, as well as Utqiagvik on previous occasions, have winter ice road access to the Dalton Highway and the proposed Project Area; there is no road access to the proposed Project for Anaktuvuk Pass or Kaktovik. In regards to whether or not the proposed Project overlaps use areas associates with a top three resource in terms of pounds harvested (see magnitude criteria in Table 4.20-2 and Figure 3.16-7), the proposed Project intersects with use areas in all four communities for caribou (a top three resource). For Nuiqsut, the proposed Project also overlaps bowhead whale use areas, which is another top three resource for that community. Lastly, the proposed Project overlaps Kaktovik fishing near the Sagavanirktok River, which may include Arctic char fishing (another top three resource in that community). The proposed Project bisects the community of Prudhoe Bay, which is a federally designated rural community. However, no use area data exist for this community and it is primarily made up of temporary or part-time residents who are employed by the oil industry and support operations and work shifts based out of Prudhoe Bay (ADCCED, 2016) rather than living full-time and conducting subsistence activities.

4.20.4.1.1.1.2. Interior Region

4.20.4.1.1.1.2.1. Yukon River Subregion

The Interior region is comprised of communities in the Yukon and Tanana River subregions (Figures 3.16-10 and 3.16-11). For the Yukon River subregion, the proposed Project bisects the Wiseman and Coldfoot subsistence use areas, overlaps the eastern border of Evansville, Bettles, and Rampart use areas, and overlaps the western portion

of Stevens Village use areas (Figure 3.16-10). In regards to whether the proposed Project overlaps use areas associated with a top three resource in terms of pounds harvested (see Figure 3.16-14), the data show that all top three resources for Wiseman (*i.e.,* moose, caribou, and ptarmigan) and Stevens Village (*i.e.,* moose, Chinook salmon, and chum salmon[11]) are overlapped by the proposed Project. Coldfoot use area data, which are only available for vegetation, show that the proposed Project overlaps use areas for blueberries, which is a top three resource for that community. Although Evansville and Bettles use areas are overlapped by the proposed Project, none of the use areas that are overlapped are for a top three resource. Rampart does not have harvest data available to make the determination of whether or not a top three resource use area is overlapped. The proposed Project comes within 5 miles of Alatna, Allakaket, and Beaver use areas. Road access to the proposed Project for the Yukon River subregion communities only exists for Wiseman and Coldfoot, and the 4-month winter road that provides access for Evansville and Bettles.

4.20.4.1.1.1.2.2. Tanana River Subregion

For the Tanana River subregion, the proposed Project bisects Minto, Nenana, Healy, and McKinley Park subsistence use areas; the proposed Project also passes through the communities of Four-Mile Road, Anderson, Ferry, and Livengood, all of which have no available subsistence use area data. A small eastern portion of Manley Hot Springs subsistence use areas are overlapped by the proposed Project; Tanana's closest subsistence use areas are within 20 miles of the proposed Project. In regards to whether the proposed Project overlaps use areas associated with a top three resource in terms of pounds harvested (see Figure 3.16-15), the data show that all top three resources for Minto, Healy, and McKinley Park (*i.e.,* moose, chum salmon, and Chinook salmon) are overlapped by the proposed Project. Although Manley Hot Springs use areas are overlapped by the proposed Project, none of the use areas that are overlapped are for a top three resource. Nenana does not have harvest data available to make the determination of whether or not a top three resource use area is overlapped. All communities, except for Tanana, have road access to the proposed Project. A recently constructed road (August 2016) terminates 6 miles to the east of Tanana on the south side of the Yukon River and connects to the Elliot Highway; ice roads could potentially be constructed that provide Tanana with winter access to the proposed Project.

Fairbanks and the outlying CDPs are Interior region communities within 30 miles of the proposed Project, which is the cutoff for communities included in the SEIS analysis.

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[11] Salmon use areas are often provided at the resource category level (*i.e.*, no species listed), but top three resource harvest data are often available at the species level (*e.g.*, Chinook salmon, sockeye salmon, coho salmon). Therefore, if a salmon species, such as sockeye salmon, is a top three resource for a community, but use area data are only available for the resource category or salmon, then it is assumed that the proposed Project would overlap with use areas for the sockeye salmon.

These communities do not have documented use area data; however, all of these communities are located along the road system, likely have use areas crossed by the proposed Project, and could experience impacts to subsistence use areas. It should be noted, however, that several of the areas to the east of the proposed Project, between Livengood and McKinley Park that are nearest to Fairbanks and its outlying CDPs, are in the Fairbanks nonsubsistence area (Figure 3.16-2). Furthermore, residents of Fairbanks and surrounding CDPs are classified as nonrural and not qualified to hunt on federal land under federal subsistence regulations; a large majority of the proposed Project is located on federal lands from the Yukon River to north of the Brooks Range and thus not open to federally designated subsistence uses by nonrural residents. The nearest state lands along the proposed Project open to subsistence uses for Fairbanks residents are north of the Brooks Range along the Dalton Highway and south of the Yukon River to the west of the proposed Project.

4.20.4.1.1.1.3. Southcentral Region

4.20.4.1.1.1.3.1. Cook Inlet Subregion

The Southcentral region is comprised of communities in the Cook Inlet and Copper River/PWS subregions (Figure 3.16-21 and 3.16-22). In the Cook Inlet subregion, the proposed Project directly intersects the use areas of Cantwell, Trapper Creek, and Talkeetna (Figure 3.16-21). The proposed Project also overlaps smaller portions of use areas associated with Chase and Susitna (Alexander Creek). Data shows that the proposed Project overlaps use areas associated with a top three resource in terms of pounds harvested (see Figure 3.16-25) for Cantwell (*i.e.,* moose, caribou, and sockeye salmon), Talkeetna (*i.e.,* caribou, coho salmon, and sockeye salmon), and Trapper Creek (*i.e.,* moose, coho salmon, and sockeye salmon). The proposed Project also overlaps Susitna moose use areas (a top three resource for that community), although these use areas are located in a nonsubsistence area. Although Chase use areas are overlapped by the proposed Project, none of the overlapped use areas includes a top three resource.

The proposed Project would not intersect with, but would approach within 30 miles of the use areas of Chickaloon, Skwentna, Eklutna, Beluga, Tyonek, Hope, and Lake Louise. Similar to Fairbanks and its outlying CDPs, the proposed Project would also pass directly through the communities of Susitna North and Willow, for which there are no documented subsistence use areas, and come within 30 miles of the additional communities and associated CDPs surrounding Wasilla, Palmer, Anchorage, and Point Possession, which do not have documented use area data. However, all of these communities are located along the road system and likely have use areas crossed by the proposed Project. As with Fairbanks, it should be noted that all of the areas along the proposed Project south of the Trapper Creek/Talkeetna area are located in a nonsubsistence area (Figure 3.16-2). Furthermore, residents of Wasilla, Palmer, Anchorage and surrounding CDPs are classified as nonrural and not qualified to hunt on federal land under federal subsistence regulations. The nearest large swaths of state lands along the proposed Project open to subsistence uses for Southcentral residents

begin near Denali State Park to McKinley Park, with smaller state tracts north of McKinley Park to the Nenana/Four-Mile Road area, and north to the Yukon River in areas west of the proposed Project. The remaining state lands closer to these communities are located in the Anchorage-Mat-Su-Kenai nonsubsistence area.

4.20.4.1.1.1.3.2. Copper River/PWS Subregion

For the Copper River/PWS subregion, four communities (*i.e.*, Copper Center, Kenny Lake, McCarthy, and Whittier) have use areas that overlap with the proposed Project. However, these use areas are isolated use areas at the outer reaches of the communities' use areas and located primarily along the Denali Highway; in the case of McCarthy, there is one isolated use area located near Wiseman. In the case of Whittier, the use areas that overlap the proposed Project are located in a nonsubsistence area. In regards to whether the proposed Project overlaps use areas associated with a top three resource in terms of pounds harvested (see Figure 3.16-26), the data show that the top three resource of moose is overlapped in Copper Center, Kenny Lake, and Whittier. Kenny Lake caribou use areas (another top three resource) are also overlapped by the proposed Project. Although McCarthy use areas are overlapped by the proposed Project, none of the use areas that overlapped are for a top three resource. The other three communities of Gakona, Glennallen, and Valdez do not have use areas overlapped by the proposed Project; however, the use areas are located within 30 miles.

4.20.4.1.1.2. Resource Availability

As stated in the 2012 FEIS (USACE, 2012a), construction activities include ditch excavation, soil blasting, brush clearing, and pipe placement. In the short-term, blasting could displace or divert resources due to the noise associated with such activities. Further, blasting destroys the vegetation and surrounding habitat for resources such as caribou, moose, or Dall sheep. The clearing of trees and brush, stripping of the surface layer, and associated erosion potential could have a direct effect on resource habitat, particularly for herbivores that depend on surface vegetation. The seasonal migration of animals, such as caribou, which use land within all three study regions, could be displaced or diverted due to increased human and material presence, noise, and/or contamination and dust from construction activities. The removal of surface vegetation could have an effect on the availability of subsistence resources in the area due to changes in water quality as a result of unstable soils that could likely damage aquatic habitats. During construction and the preparation for the construction (placing of supplies), the open trench and stored pipeline sections could disrupt the movement of large and small animals across the ROW (see Section 4.10, Wildlife). This general disturbance of wildlife could result in subsistence resources being unavailable at the time and place that subsistence users are accustomed to finding them.

During all construction activities, noise and traffic are a concern due to equipment, pipe installation, vehicles, aircraft and helicopters, and personnel. Resources could be displaced and/or diverted, and resources may decline as a result of death/injury to

animals due to collisions with vehicles (see Section 4.10, Wildlife). Traffic itself causes a physical barrier for migratory animals, particularly caribou, and could also displace or divert resources when herds are separated (Vistnes and Nellemann, 2008; Wolfe *et al.*, 2000). Further, increased traffic in a use area has the potential to habituate animals.

The proposed ROW would cross an estimated 181 fish bearing streams (see Section 4.11, Fish). Potential impacts from these activities include habitat alteration and loss as well as reduced survival and/or productivity for fish resources due to direct and indirect mortality, reproductive, growth, health, and distribution effects, effects to habitat (*e.g.*, short term barriers, loss of riparian vegetation, changes in water quality, interference of water flows and benthic invertebrates) (see Table 4.11-2). Habitat loss and displacement and/or reduced survival and productivity would affect the availability of fish for communities located along the proposed Project. The introduction of invasive species (both fish and/or aquatic plants) could also impact fish habitat and/or productivity and impact fish availability to subsistence users. Unlike the other construction impacts that are expected to be short-term, the introduction of invasive species could become a long-term impact if their spread is uncontrolled, thus potentially signaling a long-term reduced fish availability for subsistence users along the proposed Project. In addition to the study communities, other communities located farther downstream (*e.g.*, Hughes, Galena, Kaltag) and upstream of the proposed Project (*e.g.*, Fort Yukon, Birch Creek, Circle) could also experience reduced fish availability if there were a large-scale reduction in fish populations. Invasive species controls, such as equipment inspection and washing, would be in place to prevent the spread of invasive species, the likelihood for this impact to occur would be unlikely.

4.20.4.1.1.3. User Access

The proposed Project construction activities could also impact communities' subsistence use areas and affect user access. User access could be temporarily impinged due to both physical and regulatory barriers related to the use of explosives, water extraction efforts, pipe laydown, noise, traffic, and other construction activities. Subsistence users may be temporarily blocked from certain waterways and existing trails during pipe installation and thus unable to access their traditional harvest areas. Even if regulatory and physical barriers do not exist in certain areas of the proposed Project, subsistence users may choose not to access nearby subsistence use areas any longer because construction-related sites, smells, lights, noises, and activities may disturb resources, reduce the potential for a successful harvest, and negatively affect the harvester's experience.

4.20.4.1.1.4. Competition, Costs and Time, and Culture

As identified in the 2016 ASAP EED (AGDC, 2016b) or 2012 FEIS (USACE, 2012a), the proposed Project has a variety of potential socioeconomic effects, including:

- Increased employment opportunities and workforce development (*i.e.*, 6,000 personnel for pipeline over 3.5 years);

- Changes in community demographics (*i.e.*, population numbers and characteristics; increase in seasonal residents);
- Communities experiencing an influx of cash;
- Creation of localized employment opportunities; and
- Changes in the aesthetics of a community (temporary and permanent structures).

Each of these effects has its own cost and benefit with regards to subsistence. These effects begin during the construction phase and may continue on throughout operations and maintenance.

Where increased employment and workforce development are concerned, subsistence users might have less time available for subsistence activities due to employment commitments and might travel less to traditional places. Furthermore, a decline in the consumption of traditional foods means an increased cost for obtaining substitute foods. Employment does, however, provide the benefit of increased income, which residents could in turn use to support and participate in subsistence activities. Changes in community demographics, particularly an increase in seasonal outside workers, could mean increased competition for use areas and increased access to resources. The increase of cash in a mixed economy could have effects on culturally significant activities. When communities decrease their use and consumption of traditional foods, they increase their expenses on substitute foods. This, in turn, has broader impacts on the practice of harvesting, participating in harvests, sharing fish and wildlife, and producing or processing traditional foods. Further, communities' sharing and transferring of knowledge could begin to decline. Finally, changes in community aesthetics could affect the integrity of the community as its own culturally significant place.

Indirect effects also include concerns of contamination, in particular dust and smoke, from soil disturbance, burning wastes, and clearing and burning brush. The concerns of contamination from dust and smoke are often related to harvest of vegetation, which occurs in all communities to varying degrees. There is a possibility of water contamination as a result of erosion and/or drilling, as drilling fluid could escape due to seepage or hydraulic fracture during horizontal directional drilling. Indirectly, subsistence users may decrease consumption of a resource if there is a fear of contamination.

Competition among and within subsistence communities could also experience short-term increases due to the influx of construction workers. Changes in resource availability and user access could lead to increased competition in other use areas and also require subsistence users to augment their efforts, costs, and risks. Increased hunting efforts, costs, and risks are usually a result of the need to work harder and travel farther to access less familiar or more distant subsistence use areas. Those subsistence users who cannot or choose not to travel farther to find displaced or diverted resources may experience indirect effects associated with reduced use and consumption of traditional foods and other culturally significant activities such as

traditional harvesting, processing, and sharing practices. Subsistence users hunting or harvesting resources in the vicinity of the proposed Project may have alternative harvest areas available to them. However, certain locations in the vicinity of the proposed Project could have traditional and historic associations with certain communities and harvesters. Those areas could be preferred by harvesters because of familiarity based on long-time use of the area patterned by culturally based rules of land use, tenure, and association. As stated above, construction related impacts are expected to be temporary and in many areas would only occur during one season. AGDC is committed to notifying workers that subsistence activities are ongoing and direct them to avoid activities that may affect subsistence (*e.g.*, not removing trap line markers) (see Mitigation Measure No. 3 in Section 4.20.3).

4.20.4.1.2. Fairbanks Lateral

Construction impacts would be temporary in duration and of minimal impact to subsistence as the majority of the lateral line (everything but the first mile) is located within the Fairbanks nonsubsistence area.

4.20.4.1.3. Gas Conditioning Facility

Construction of the GCF would occur within existing infrastructure of Prudhoe Bay. While construction of the GCF may displace resources such as caribou, there are no documented subsistence uses in the vicinity of the proposed GCF, and therefore, potential subsistence impacts would be negligible.

4.20.4.1.4. West Dock Head 3 and Causeway Upgrades

A total of 23 coastal barges would bring 53 prefabricated modules to West Dock during a single-year sealift; dredging would occur in winter while pile driving may occur during summer as described in Chapter 2. Barge traffic may affect subsistence resource availability if it displaces offshore resources in the vicinity of the proposed Project during subsistence activities. Nuiqsut residents are the only study community that hunts marine mammals (primarily bowhead) in the vicinity of the proposed Project and these uses are based off of Cross Island, approximately 14 miles to the northeast of West Dock. A 12-year bowhead whaling study from 2001-2012 demonstrated that the vast majority of bowhead whaling tracks occurred to the north and east of Cross Island with tracks near West Dock occurring in only 3 study years (*i.e.*, 2002, 2005, and 2006) (Galginaitis, 2014). As indicated during scoping and review comments compiled for this SEIS, Utqiagvik residents also conduct fall whaling activities, and these activities could potentially be affected by returning barge traffic. Section 4.12, Marine Mammals indicates that barging and related summer activities are not expected to affect marine mammals, and with standard mitigation measures for vessel speed and activities in place (as described in Section 4.12, Marine Mammals), the impacts to marine mammals are expected to be minor. AGDC is also committed to avoiding and minimizing impacts on subsistence whaling through meetings with local stakeholders, NSB, and regulatory

agencies to implement appropriate mitigation measures that would avoid and minimize disturbance of noise and vessel traffic to subsistence species and activities (see Mitigation Measure No. 4 in Section 4.20.3).

4.20.4.1.5. Access Roads

Construction of new access roads could have direct effects on resource availability (such as migrating caribou) resulting in changes in resource abundance and habitat loss due to damaged surface vegetation. Resources, such as caribou or moose, could also be displaced or diverted due to new physical barriers and/or increased human presence.

4.20.4.2. Operations and Maintenance

Operations-related activities resulting from the development of the proposed Project would have both direct and indirect effects on subsistence resources, resource use areas, and subsistence users in terms of availability, access, and competition, as well as hunter responses and effects on culturally significant activities. In particular, waste, toxicity, maintenance activities, noise, and the physical presence of the ROW would be ongoing issues for the duration of the proposed Project. These impacts would occur throughout operations and maintenance, which could exceed 30 years and may, in some instances (*e.g.*, use of the ROW), extend beyond the duration of operations.

4.20.4.2.1. Pipeline Right-of-Way Mainline

4.20.4.2.1.1. Subsistence Use Areas

Impacts to subsistence use areas under operations would be the same as those described under construction (Section 4.20.4.1); however, the duration would be extended for the life of the proposed Project, and in some instances beyond operations.

4.20.4.2.1.2. Resource Availability

Resource availability of terrestrial wildlife could be affected through human activity, including aerial and ground-based pipeline inspections, along the pipeline ROW resulting in wildlife disturbance and potential direct wildlife mortality from vehicle-animal collision and wildlife harvests (see Section 4.10, Wildlife). Noise from maintenance includes vehicles, small fixed-wing aircraft and helicopters, and equipment. Noise above ambient levels could displace or divert resources from traditional areas. As discussed above, the introduction of non-native plants and fish during construction could affect fish availability and extend into the operations and maintenance phase of the proposed Project. Attraction to job opportunities may draw in outside workers to settle permanently in study communities located along the ROW. An increase in the number of permanent residents in a community could add to the pressure on available resources. Reduced availability of wildlife and fish during operations could result in subsistence resources being unavailable at the time and place that subsistence users are accustomed to finding them.

Natural gas is hazardous due to its low flashpoint and flammability. In the case of a potential leak, the low flashpoint and flammability could lead to an increased risk of forest fires. Forest fires have a direct effect on resource availability; habitat loss, resource damage, and resource displacement/diversion are potential consequences where fires are concerned.

4.20.4.2.1.3. User Access

After construction, increased user access along the proposed Project ROW, particularly in the Minto Flats region, would be a long-term concern and could affect subsistence uses. A cleared ROW may attract additional harvesters to an area who use off road vehicles (*e.g.*, snow machines and ATVs) to travel along the ROW. Because the proposed Project ROW generally follows existing or officially designated transportation and utility corridors including the Dalton Highway/TAPS corridor and Parks Highway, an increase in user access and in additional harvesters would not be expected in these areas. However, increased access in areas that do not follow existing transportation or utility corridors, particularly between the TAPS corridor and Parks Highway in the Minto Flats vicinity, could have an impact on subsistence uses. Preventative access measures such as boulders, berms, or fencing near entry points would be put in place at the request of landowners to help to limit access to the proposed Project ROW. These preventative measures would then help lessen the impact of increased use along the ROW, although they would not likely eliminate the impact. In addition, if these measures result in reduced access for subsistence users who already use these areas, then the measures could have a negative impact on subsistence uses.

4.20.4.2.1.4. Competition, Costs and Time, and Culture

Concern about contamination, risk of fires, decreased resource availability, and increased competition along certain parts of the ROW, especially near Minto Flats, have potential indirect implications for hunters' efforts, costs, and risks associated with having to travel to other places in search of resources or obtaining substitute foods. Any reduction in the pursuance and consumption of traditional foods may, depending on the magnitude of that reduction, have effects on culturally significant activities such as: harvest effort, participation, production, and processing; sharing; transfer of knowledge; having the satisfaction of eating traditional foods; and a sense of autonomy.

4.20.4.2.2. Fairbanks Lateral

Operation impacts would be of minimal impact to subsistence as the majority of the lateral line is located within the Fairbanks nonsubsistence area.

4.20.4.2.3. Gas Conditioning Facility

Similar to construction, the operation of the GCF may displace resources, such as caribou (see Section 4.10, Wildlife); there are no documented subsistence uses in the vicinity of the proposed GCF and potential subsistence impacts would be negligible.

4.20.4.2.4. West Dock Head 3 and Causeway Upgrades

Operation activities would be land based and not expected to affect marine mammals (see Section 4.12, Marine Mammals) and subsistence uses.

4.20.4.2.5. Access Roads

In addition to changes in access from a cleared ROW, user access also changes with the introduction of new roads. Competition could increase, causing local subsistence users increased effort, costs, and risks associated with having to travel farther afield to obtain resources and/or purchase substitute foods. Areas of the proposed Project that do not already have available nearby access avenues (*e.g.*, Dalton Highway, Parks Highway) could experience increased user access and an accompanying rise in the number of non-local harvesters to the area due to the new access roads. This could result in increased competition for resources, affecting nearby subsistence users who already used areas adjacent to these access roads. Access roads would add to the impact of a cleared ROW by increasing the ease of access to this portion of the proposed Project, particularly in the Minto Flats area. AGDC has indicated that access roads would be designated as private and not for use by the general public. Designation of access roads as private, particularly in rural, remote areas of the proposed Project would likely not wholly prevent unauthorized use. Preventative access measures such as boulders, berms, or fencing near entry points would be installed at the request of the landowners and may help to limit users along the access roads. These preventative measures would then help lessen the impact of increased use, although they would not likely eliminate the impact. Furthermore, if measures to prevent unauthorized use also limit access for local harvesters who had previously used the area, then they could have negative impacts on subsistence uses for local communities. In some cases, access roads could provide increased local opportunities for harvesting activities to resources and areas that were previously limited in accessibility.

4.20.5. Alternative 2 – Denali NPP Route Variation

Aspects of Alternative 2, Denali NPP Route Variation, that differ from Alternative 1, proposed Action, that could affect subsistence uses include the Denali NPP Route Variation, use of DH2, and use of VSMs and Horizontal Support Members (HSMs) from MP 0 to MP 62. Subsistence impacts from other proposed Project components and support facilities associated with Alternative 2 (*e.g.*, maintenance buildings, Yukon River crossing, construction camps) would be negligible or are addressed under the pipeline ROW Mainline (*e.g.*, influx of workers, material sites in undeveloped areas adding to disturbance associated with the Mainline) discussion of Alternative 1.

4.20.5.1. Denali NPP Route Variation

The Denali NPP Route Variation is a 7-mile variation located within the Denali NPP that would be generally located along the Parks Highway corridor. Types of potential construction (*e.g.*, resource disturbance due to noise) and operation-related subsistence

impacts would be similar to those described for the Mainline under Alternative 1. Subsistence related impacts from the Denali NPP Route Variation would likely be less than the corresponding route between MP 536 and MP 543 because the route is immediately adjacent to the Parks Highway where noise and disturbance are already occurring.

4.20.5.2. Dock Head 2

Use of DH2 would cause impacts to subsistence similar to the impacts discussed for use of DH3, which are described under Alternative 1. The primary subsistence impacts associated with the use of the DHs result from barging activities during construction, which would be similar regardless of the alternative.

4.20.5.3. Use of Vertical and Horizontal Support Members

Alternative 2 would include use of VSMs and HSMs (support members) to support an aboveground pipeline between MP 0 to MP 62 on the North Slope. Construction and operation impacts from an aboveground pipeline would be similar to those described above for Alternative 1 (*e.g.*, same footprint, construction schedule, cleared ROW, access roads). However, the use of support members specifically could introduce additional/heightened impacts to resource availability, user access, costs and time, and culture. As discussed in Section 4.10, Wildlife, pipelines may deflect subsistence resources, especially for resources such as caribou; this is supported by numerous public testimony comments and traditional knowledge observations from subsistence harvesters, particularly from North Slope residents. For example, subsistence users have observed that the physical presence of pipelines and glare from pipelines cause caribou to change their migratory routes, thus reducing their availability to local residents (SRB&A, 2009).

The proposed pipeline, depending on the level of ground clearance, could impact local subsistence users trying to cross the ROW to reach traditional harvesting areas. Kaktovik and Nuiqsut have documented subsistence use areas between MP 0 and MP 62; however, these use areas are located on the periphery of these communities' overall use areas. This effect could be exacerbated during the winter if snowdrifts reduce the clearance between the pipeline and ground. If this occurs, then residents may have difficulty navigating areas of the pipeline and may have to travel farther to reach subsistence hunting destinations. Furthermore, avoidance of the area could be at a greater distance than the footprint, and therefore, the loss of subsistence use area could be larger than the direct overlap of the proposed Project with documented use areas. Subsistence harvesters often avoid areas of development due to concerns about contamination and because of residents' discomfort about hunting near human or industrial activity (BLM, 2004). Concerns about shooting near or toward pipelines could cause residents to avoid hunting along the entire length of the elevated pipeline or unintentional damage to the pipeline.

Reduced resource availability and decreased user access associated with the elevated pipeline could subsequently lead to increases in costs and time as harvesters seek resources in unfamiliar and/or more distant use areas.

4.20.6. Alternative 3 – No Action

Under Alternative 3 (No Action), the proposed Project would not be constructed and as a result, there would be no expected impacts on subsistence uses. The existing conditions of subsistence uses described in Chapter 3, Section 3.16, Subsistence, including use areas, user access, resource harvests, and the seasonal round of activities, would remain the same. One potential benefit from the proposed Project that would not occur under Alternative 3 is the increase in employment opportunities for communities along the proposed Project corridor. Increased employment and wages could result in increased opportunities to participate in subsistence activities.

4.20.7. Conclusions and Comparison of Alternatives

This section summarizes the various impacts discussed above by applying the impact criteria for the impact categories of subsistence use areas, resource availability, and user access to each study community. Impact criteria are not applied to the impact categories of competition, costs and time, and culture, as these three are typically indirect effects resulting from impacts to subsistence use areas, resource availability, and user access. The analysis assumes that the greater the magnitude, geographic extent, duration, and likelihood for a community to experience impacts to subsistence use areas, resource availability, and user access, the greater the resulting impact would be for competition, costs and time, and culture to that community.

The impact criteria of magnitude and geographic extent developed for the proposed Project are community specific (*i.e.*, do not change for the various impact categories). The impact criterion of duration is Project-activity-specific. The impact criterion of likelihood varies according to each impact category, the proposed Project action that is causing an impact, the proximity of the community and/or use areas to the proposed Project, and the duration of the impact. Tables 4.20-5 and 4.20-6 compare the impact categories for construction and operation by study community for Alternatives 1 and 2 and include summary rankings for each community based on the four impact levels (major – 3, moderate – 2, minor – 1, and negligible – 0) with a maximum of 18 (most impacted) to minimum of 0 (no impact). Table 4.20-6 for Alternative 2 only shows the North Slope region due to the difference in impacts caused by an elevated pipeline from MP 0 to MP 62; the impacts would be similar between Alternative 1 and 2 for the remainder of the study regions (see Table 4.20-5).

Table 4.20-5 Subsistence Impact Criteria Assessment – Alternative 1

Region	Community	Community Specific Criteria		Construction					Operations				
		Magnitude	Geographic Extent	Duration	Subsistence Use Areas Likelihood	Resource Availability Likelihood	User Access Likelihood	Construction Impact Ranking (18 max)	Duration	Subsistence Use Areas Likelihood	Resource Availability Likelihood	User Access Likelihood	Operation Impact Ranking (18 max)
North Slope	Nuiqsut	Major	Minor	Minor	Possible	Possible	Possible	8	Minor	Unlikely	Unlikely	Unlikely	5
	Anaktuvuk Pass	Major	Minor	Minor	Unlikely	Possible	Unlikely	6	Minor	Unlikely	Unlikely	Unlikely	5
	Kaktovik	Major	Minor	Minor	Unlikely	Unlikely	Unlikely	5	Minor	Unlikely	Unlikely	Unlikely	5
	Utqiagvik	Major	Minor	Minor	Unlikely	Unlikely	Unlikely	5	Minor	Unlikely	Unlikely	Unlikely	5
	Prudhoe Bay	Negligible	Negligible	Negligible	Unlikely	Unlikely	Unlikely	0	Negligible	Unlikely	Unlikely	Unlikely	0
Interior (Yukon River Sub-region)	Wiseman	Major	Major	Minor	Definite	Probable	Definite	15	Major	Probable	Possible	Possible	13
	Coldfoot	Major	Major	Minor	Definite	Probable	Definite	15	Major	Probable	Possible	Possible	13
	Evansville	Moderate	Minor	Minor	Unlikely	Possible	Unlikely	5	Minor	Unlikely	Unlikely	Unlikely	4
	Bettles	Moderate	Minor	Minor	Unlikely	Possible	Unlikely	5	Minor	Unlikely	Unlikely	Unlikely	4
	Stevens Village	Moderate	Minor	Minor	Unlikely	Possible	Unlikely	5	Minor	Unlikely	Unlikely	Unlikely	4
	Rampart	Moderate	Minor	Minor	Unlikely	Possible	Unlikely	5	Minor	Unlikely	Unlikely	Unlikely	4
	Alatna	Minor	Minor	Minor	Unlikely	Possible	Unlikely	4	Minor	Unlikely	Unlikely	Unlikely	3
	Allakaket	Minor	Minor	Minor	Unlikely	Possible	Unlikely	4	Minor	Unlikely	Unlikely	Unlikely	3
	Beaver	Minor	Minor	Minor	Unlikely	Possible	Unlikely	4	Minor	Unlikely	Unlikely	Unlikely	3
Interior (Tanana River Sub-region)	Minto	Major	Major	Minor	Definite	Probable	Definite	15	Major	Probable	Probable	Definite	16
	Nenana	Moderate	Major	Minor	Definite	Probable	Definite	14	Major	Probable	Probable	Definite	15
	Healy	Major	Major	Minor	Definite	Possible	Definite	14	Major	Probable	Possible	Possible	13
	McKinley Park	Major	Major	Minor	Definite	Possible	Definite	14	Major	Probable	Possible	Possible	13
	Four-Mile Road	Moderate	Major	Minor	Definite	Possible	Definite	13	Major	Probable	Possible	Possible	12
	Anderson	Moderate	Major	Minor	Definite	Possible	Definite	13	Major	Probable	Possible	Possible	12
	Ferry	Moderate	Major	Minor	Definite	Possible	Definite	13	Major	Probable	Possible	Possible	12
	Livengood	Moderate	Major	Minor	Definite	Possible	Definite	13	Major	Probable	Possible	Possible	12
	Fairbanks	Minor	Moderate	Minor	Possible	Unlikely	Possible	6	Major	Possible	Unlikely	Unlikely	7
	Manley Hot Springs	Moderate	Minor	Minor	Unlikely	Possible	Unlikely	5	Minor	Unlikely	Unlikely	Unlikely	4
	Tanana	Minor	Minor	Minor	Unlikely	Unlikely	Unlikely	3	Minor	Unlikely	Unlikely	Unlikely	3
South-central (Cook Inlet Sub-region)	Cantwell	Major	Major	Minor	Definite	Possible	Definite	14	Major	Probable	Possible	Possible	13
	Talkeetna	Major	Major	Minor	Definite	Possible	Definite	14	Major	Probable	Possible	Possible	13
	Trapper Creek	Major	Major	Minor	Definite	Possible	Definite	14	Major	Probable	Possible	Possible	13
	Chase	Moderate	Minor	Minor	Unlikely	Possible	Unlikely	5	Minor	Unlikely	Unlikely	Unlikely	4
	Petersville	Minor	Moderate	Minor	Possible	Unlikely	Unlikely	5	Minor	Unlikely	Unlikely	Unlikely	4
	Susitna North	Minor	Moderate	Minor	Possible	Unlikely	Unlikely	5	Minor	Unlikely	Unlikely	Unlikely	4
	Willow	Minor	Moderate	Minor	Possible	Unlikely	Unlikely	5	Minor	Unlikely	Unlikely	Unlikely	4
	Susitna (Alexander Creek)	Minor	Minor	Minor	Unlikely	Unlikely	Unlikely	3	Minor	Unlikely	Unlikely	Unlikely	3
	Skwentna	Minor	Minor	Minor	Unlikely	Unlikely	Unlikely	3	Minor	Unlikely	Unlikely	Unlikely	3

Region	Community	Community Specific Criteria		Construction					Operations				
		Magnitude	Geographic Extent	Duration	Subsistence Use Areas Likelihood	Resource Availability Likelihood	User Access Likelihood	Construction Impact Ranking (18 max)	Duration	Subsistence Use Areas Likelihood	Resource Availability Likelihood	User Access Likelihood	Operation Impact Ranking (18 max)
	Beluga	Minor	Minor	Minor	Unlikely	Unlikely	Unlikely	3	Minor	Unlikely	Unlikely	Unlikely	3
	Tyonek	Minor	Minor	Minor	Unlikely	Unlikely	Unlikely	3	Minor	Unlikely	Unlikely	Unlikely	3
	Wasilla	Minor	Minor	Minor	Unlikely	Unlikely	Unlikely	3	Minor	Unlikely	Unlikely	Unlikely	3
	Palmer	Minor	Minor	Minor	Unlikely	Unlikely	Unlikely	3	Minor	Unlikely	Unlikely	Unlikely	3
	Anchorage Municipality	Minor	Minor	Minor	Unlikely	Unlikely	Unlikely	3	Minor	Unlikely	Unlikely	Unlikely	3
	Point Possession	Minor	Minor	Minor	Unlikely	Unlikely	Unlikely	3	Minor	Unlikely	Unlikely	Unlikely	3
	Eklutna	Negligible	Negligible	Minor	Unlikely	Unlikely	Unlikely	1	Minor	Unlikely	Unlikely	Unlikely	1
	Chickaloon	Negligible	Negligible	Minor	Unlikely	Unlikely	Unlikely	1	Minor	Unlikely	Unlikely	Unlikely	1
	Lake Louise	Negligible	Negligible	Minor	Unlikely	Unlikely	Unlikely	1	Minor	Unlikely	Unlikely	Unlikely	1
	Hope	Negligible	Negligible	Minor	Unlikely	Unlikely	Unlikely	1	Minor	Unlikely	Unlikely	Unlikely	1
South-central (Copper River/ PWS Sub-region)	Copper Center	Major	Minor	Minor	Unlikely	Possible	Unlikely	6	Minor	Unlikely	Unlikely	Unlikely	5
	Kenny Lake	Major	Minor	Minor	Unlikely	Unlikely	Unlikely	5	Minor	Unlikely	Unlikely	Unlikely	5
	Gakona	Minor	Minor	Minor	Unlikely	Possible	Unlikely	4	Minor	Unlikely	Unlikely	Unlikely	3
	Glennallen	Minor	Minor	Minor	Unlikely	Possible	Unlikely	4	Minor	Unlikely	Unlikely	Unlikely	3
	McCarthy	Moderate	Minor	Minor	Unlikely	Unlikely	Unlikely	4	Minor	Unlikely	Unlikely	Unlikely	4
	Whittier	Negligible	Negligible	Minor	Unlikely	Unlikely	Unlikely	1	Minor	Unlikely	Unlikely	Unlikely	1
	Valdez	Negligible	Negligible	Minor	Unlikely	Unlikely	Unlikely	1	Minor	Unlikely	Unlikely	Unlikely	1

Impact Ranking Scale: major – 3, moderate – 2, minor – 1, and negligible – 0; or definite – 3, probable – 2, possible – 1, unlikely - 0

Table 4.20-6 Types of Effects and Impacts on Subsistence – Alternative 2

Region	Community	Community Specific Criteria		Construction					Operations				
		Magnitude	Geographic Extent	Duration	Subsistence Use Areas Likelihood	Resource Availability Likelihood	User Access Likelihood	Construction Impact Ranking (18 max)	Duration	Subsistence Use Areas Likelihood	Resource Availability Likelihood	User Access Likelihood	Operation Impact Ranking (18 max)
North Slope	Nuiqsut	Major	Minor	Minor	Possible	Possible	Possible	8	Minor	Unlikely	Possible	Possible	7
	Anaktuvuk Pass	Major	Minor	Minor	Unlikely	Possible	Unlikely	6	Minor	Unlikely	Unlikely	Unlikely	5
	Kaktovik	Major	Minor	Minor	Unlikely	Unlikely	Unlikely	5	Minor	Unlikely	Unlikely	Possible	6
	Utqiagvik	Major	Minor	Minor	Unlikely	Unlikely	Unlikely	5	Minor	Unlikely	Unlikely	Unlikely	5
	Prudhoe Bay	Negligible	Negligible	Negligible	Unlikely	Unlikely	Unlikely	0	Negligible	Unlikely	Unlikely	Unlikely	0

Remaining Alternative 2 construction and operational impacts for Interior and Southcentral regions are the same as those identified in Table 4.20-5.
Impact Ranking Scale: major – 3, moderate – 2, minor – 1, and negligible – 0; or definite – 3, probable – 2, possible – 1, unlikely - 0

4.20.7.1. Alternative 1

This section discusses the specific impacts of Alternative 1 by study region, which form the basis of the assessed impact criteria in Table 4.20-5. The assessments provided in Table 4.20-5 are based in part on the impact method Tables 4.20-1 and 4.20-2. The rankings in Table 4.20-5 inform the conclusions presented at the end of this section in Table 4.20-7.

4.20.7.1.1. North Slope Region

Impacts to subsistence (including construction and operation) would be of major magnitude to Nuiqsut, Anaktuvuk Pass, Utqiagvik, and Kaktovik (rural communities and overlapping top three resource) and minor geographic extent (proposed Project intersects little of community's use areas) based in Tables 4.20-1 and 4.20-2. Because there are no data documenting subsistence uses by Prudhoe Bay employees and subsistence uses are not known to occur by the work force in the vicinity of Prudhoe Bay, effects to Prudhoe Bay would be negligible in magnitude (not perceivable), negligible in geographic extent (limited to specific contained location), and negligible duration (effect not perceived); the likelihood of impacts for Prudhoe Bay would be unlikely.

4.20.7.1.1.1. Construction

As mentioned in Section 4.20.3, the proposed Project only overlaps a small portion of Anaktuvuk Pass, Utqiagvik, and Kaktovik use areas and a slightly larger portion of Nuiqsut use areas. Therefore, the likelihood of impacts to subsistence use areas would be possible for Nuiqsut (may occur) due to the greater portion of use areas that are overlapped and unlikely for Utqiagvik, Kaktovik, and Anaktuvuk Pass as the proposed Project only intersects the fringe of these communities' use areas. The chance that subsistence users from these communities would be conducting harvesting activities at these locations at the same time and place as construction of the proposed Project is unlikely.

Resource availability impacts during construction, particularly for caribou (see Section 4.10, Wildlife), would be possible for Nuiqsut and Anaktuvuk Pass because of their closer proximity to the proposed Project. Of all study communities, Anaktuvuk Pass has the greatest reliance on caribou (nearly 80 percent of total harvest) to meet their subsistence needs. AGDC would avoid constructing in areas and during time periods that caribou are known to migrate as a way to reduce impacts. Resource availability impacts to Utqiagvik and Kaktovik would be unlikely due to their distance from the proposed Project. Impacts to bowhead whale resource availability would be possible as well for Nuiqsut due to their close proximity to West Dock operations and unlikely for Utqiagvik and Kaktovik; the implementation of Mitigation Measure No. 4 and 5 (see Section 4.20.3) with these communities would further reduce the likelihood of impacts.

User access impacts would be unlikely for all study communities as the proposed Project is on the fringe of North Slope region study communities' use areas; the proposed Project would not constrict access over the wide-open tundra, and it would not introduce new access routes as it generally parallels the TAPS and Dalton Highway corridors.

All construction impacts for subsistence use areas, resource availability, and user access would be minor in duration (less than 2 years).

4.20.7.1.1.2. Operations and Maintenance

Impacts to Nuiqsut, Anaktuvuk Pass, Utqiagvik, and Kaktovik subsistence use areas, resource availability, and user access could occur if monitoring and maintenance activities affect resource availability and/or user access and subsistence use areas should subsistence activities occur at the same time and place as operational activities. However, the likelihood for these events to occur is unlikely due to the distance of the community from the proposed Project and relative infrequency of maintenance activities, and any impacts would be intermittent (minor duration).

4.20.7.1.2. Interior Region - Yukon River Subregion

Impacts to subsistence (including construction and operation) for Wiseman and Coldfoot would be of major magnitude (rural communities and overlapping top three resource) and major geographic extent (proposed Project bisects communities and use areas). Impacts to Evansville, Bettles, Stevens Village, and Rampart subsistence users would be of moderate magnitude (rural communities and overlapping other resources [*i.e.*, not top three]) and minor geographic extent (little to no use area intersected and no road access or only winter road access). Impacts to Alatna, Allakaket, and Beaver subsistence users would be of minor magnitude (minimally perceivable to rural community) and minor geographic extent.

4.20.7.1.2.1. Construction

The proposed Project bisects the use areas and communities of Wiseman and Coldfoot, and therefore, the likelihood of impacts to subsistence use areas would be definite; whereas the proposed Project overlaps little to no use areas for the remaining communities in the region and thus, would be unlikely to impact subsistence users in use areas at the same time and place as construction activities.

Impacts to subsistence resources from habitat disturbance or direct/indirect mortality during construction would have the greatest effect for subsistence users in communities that lie directly along the proposed Project (*e.g.*, Wiseman, Coldfoot). Disruption of migratory resources, such as caribou, may affect a greater number of communities. Land mammals (*e.g.*, moose, caribou, Dall sheep) provide approximately 60 percent of the harvest for the Yukon River subregion (Figure 3.16-12) and any impacts to resource availability to land mammals would be the most acute to local Yukon River area residents. Therefore, resource availability impacts during construction, particularly for

large land mammals, would be probable for Wiseman and Coldfoot because of their closer proximity to the proposed Project. The remaining Yukon River subregion study communities are located farther from the proposed Project with little to no use areas crossed by the proposed Project. However, because the proposed Project has a greater likelihood of impacting important calving areas around the Middle and South forks of the Koyukuk River (Section 4.10, Wildlife), and impacts to fish are increased in the Interior region due to primarily summer construction schedule versus winter construction schedule in the North Slope (Section 4.11, Fish), the likelihood of resource availability impacts to these more distant study communities would be possible. Both Sections 4.10 and 4.11 discuss minimization and mitigation measures aimed to further reduce the impacts to wildlife and fish.

User access impacts would be definite for Wiseman and Coldfoot, again due to their close proximity to the proposed Project. For all remaining study communities in the Yukon River subregion, the proposed Project is on the fringe of study communities' use areas, and the proposed Project would not constrict these communities' access, as it generally parallels the TAPS and Dalton Highway corridors.

All construction impacts for subsistence use areas, resource availability, and user access would be minor in duration (less than 2 years).

4.20.7.1.2.2. Operations and Maintenance

Impacts to Yukon River subregion study communities' subsistence use areas could occur if monitoring and maintenance activities occur at the same time and place as operational activities. For the life of the proposed Project, the likelihood of these events occurring would be probable for Wiseman and Coldfoot due to their close proximity to the proposed Project, but not definite due to the relative infrequency of monitoring and maintenance activities. Impacts would be unlikely for the remaining study communities of the region, because they are located farther from the proposed Project.

Impacts to resource availability could continue with operational activities near Wiseman and Coldfoot; however, the likelihood would only be possible as the disruption of habitat occurs near the TAPS and Dalton Highway corridors. Additionally, the ROW and access roads in this area are not expected to draw in additional hunters to compete for available resources, as the Dalton Highway already provides access to the area. Because other communities' use areas in the region have little to no overlap with the proposed Project and are located farther away, resource availability impacts during operations would be unlikely.

No increased user access is expected in this subregion, particularly around previously documented study community use areas, as the proposed Project parallels the Dalton Highway. Therefore, user access impacts would be unlikely for the majority of communities in this region. User access impacts may be slightly greater for Wiseman and Coldfoot due to the proximity of the proposed Project and would be, therefore, possible.

Because these effects could be expected to occur over the life of the proposed Project, they would be major in duration for Wiseman and Coldfoot where the impacts would be probable/possible. For the remaining communities, because use area, resource availability, and user access impacts would be unlikely due to the distance of the community from the proposed Project and relative infrequency of maintenance activities any impacts would be intermittent (minor duration).

4.20.7.1.3. Interior Region - Tanana River Subregion

Impacts to subsistence (including construction and operation) for Minto, Healy, and McKinley Park would be of major magnitude (rural communities and overlapping top three resource) and major geographic extent (proposed Project bisects communities and/or use areas). Impacts to Nenana, Four-Mile Road, Anderson, Ferry, and Livengood subsistence users would be of moderate magnitude (rural communities and overlapping other resources [*i.e.*, not top three resource]) and major geographic extent. Impacts to Manley Hot Springs would be similar in magnitude, but only minor in geographic extent (intersects small portion of use area and community road access greater than 30 miles from the proposed Project) for Manley Hot Springs. Impacts to Fairbanks subsistence users would be of minor magnitude (alteration of a nonrural community's subsistence use based on proximity to proposed Project) and moderate geographic extent. Finally, impacts to Tanana would also be minor in magnitude (minimally perceivable) and minor geographic extent.

4.20.7.1.3.1. Construction

The proposed Project bisects the use areas and/or communities of Minto, Healy, McKinley Park, Nenana, Four-Mile Road, Anderson, Ferry, and Livengood, and therefore, the likelihood of impacts to subsistence use areas would be definite due to the high level of activity associated with construction and the close proximity to the communities and/or their use areas. No use area data are available for Fairbanks, but based on their proximity to the proposed Project and easy road access, the likelihood of impacting subsistence use areas would be possible. Because Manley Hot Springs use areas are only overlapped by the proposed Project on the outer fringe of the community's subsistence extent, and Tanana subsistence use areas are within 20 miles of the proposed Project, it would be unlikely for the proposed Project to impact subsistence users in use areas from these two communities at the same time and place as construction activities.

Impacts to subsistence resources from habitat disturbance or direct/indirect mortality during construction would have the greatest effect for subsistence users in communities that lie directly along the proposed Project (*e.g.*, Healy, McKinley Park, Four-Mile Road, Anderson, Ferry, and Livengood) and in particular for communities who have more intense use in the undisturbed habitat of the Minto Flats region (*e.g.*, Minto, Nenana). The proposed Project also traverses a relatively undisturbed area west of the Nenana River between MP 473 and 498 that would increase impacts to Nenana subsistence users.

Fish provide 74 percent of the harvest for the Tanana River subregion (Figure 3.16-13) and any impacts to resource availability to fish would be the most noticeable to local Tanana River area residents. As mentioned for the Yukon River subregion, impacts to fish are increased in the Interior region due to primarily summer construction schedule versus winter construction schedule in the North Slope (Section 4.11, Fish). The Minto Flats also provide important nesting habitat, and impacts to waterfowl during construction are considered moderate (Section 4.10, Wildlife). Moose are another important subsistence resource to Tanana River subregion communities (often a top three resource) and several communities' moose use areas are overlapped by the proposed Project; impacts to moose availability would also affect subsistence uses in the region. The likelihood of resource availability impacts to Minto and Nenana would be probable due to their proximity to the proposed Project and use of the undisturbed Minto Flats area. Resource availability impacts would be possible for other communities directly along the proposed Project route (*e.g.*, Healy, McKinley Park, Four-Mile Road, Anderson, Livengood, and Ferry), or for communities that are farther away but use the Minto Flats (*e.g.*, Manley Hot Springs). Impacts to these communities may be less perceivable due to the already disturbed habitat and presence of the Parks Highway or because the communities are located farther away. Resource availability impacts to Fairbanks and Tanana subsistence users would be unlikely, as Tanana does not have use areas that overlap the proposed Project, and they are located approximately 100 miles from the proposed Project Area; Fairbanks is within the nonsubsistence area, and because displacement of resources is already occurring from surrounding infrastructure, impacts would not be perceivable. Both Sections 4.10 and 4.11 discuss minimization and mitigation measures aimed to further reduce the impacts to wildlife and fish.

User access impacts during construction would be definite for Minto, Healy, McKinley Park, Nenana, Four-Mile Road, Anderson, Ferry, and Livengood again due to their close proximity to the proposed Project and the high level of activity associated with construction. Impacts to Fairbanks would be possible as the community is farther from the proposed Project and nonrural (*i.e.*, fewer areas along the proposed Project open to subsistence uses), and impacts would be unlikely for the communities of Manley Hot Springs and Tanana, which are even farther from the proposed Project.

All construction impacts for subsistence use areas, resource availability, and user access would be minor in duration (less than 2 years).

4.20.7.1.3.2. Operations and Maintenance

Impacts to Tanana River subregion study communities' subsistence use areas could occur if monitoring and maintenance activities occur at the same time and place as operational activities. For the life of the proposed Project, the likelihood of these events occurring would be probable for all Tanana River study communities located along the proposed Project due to the close proximity to the proposed Project, but not definite due to the relative infrequency of monitoring and maintenance activities. Impacts would be possible or unlikely for the remaining study communities of Fairbanks, Manley Hot

Springs, and Tanana, which are located farther from the proposed Project and, in the case of Fairbanks, located in a nonsubsistence area.

Impacts to resource availability could continue with operational activities near communities located directly along the proposed Project (Livengood, Anderson, Four-Mile Road, Ferry, Healy, and McKinley Park); however, the likelihood would only be possible as the disruption of habitat and resources occurs near the Parks and Dalton highway corridors with already high levels of activity. Impacts to resource availability for Minto and Nenana, which use the Minto Flats area, would be probable due to the long-term fragmentation of habitat in the Minto Flats (Section 4.10, Wildlife) and the potential increase in user access to the area due to the cleared ROW and new access roads in a previously undeveloped area. Increased access would likely bring in additional outside hunters to compete for available resources. Because other communities' use areas in the region have little to no overlap with the proposed Project or are located farther away, resource availability impacts would be unlikely during operations.

Increased user access is expected in this subregion, particularly in the Minto Flats area, as a cleared ROW and access roads provide new access to a previously undeveloped area. The ROW and access roads associated with the Fairbanks Lateral that connects to Murphy Dome Road would further open up the area to Fairbanks harvesters who previously had more limited access to the Minto Flats area. While mitigation measures to put up signage or barriers to restrict access and indicate that the area is private may help to reduce impacts, they would not eliminate unauthorized use in this rural, remote region. Therefore, user access impacts would be definite for Minto and Nenana, communities with high use of the Minto Flats area. User access impacts may be slightly impeded or opened up to additional hunters for other communities located along the proposed Project, but as these areas are located along the Parks Highway in general the likelihood would be possible and unlikely for communities located farther away (*i.e.*, Fairbanks, Manley Hot Springs, and Tanana).

Because these effects could be expected to occur over the life of the proposed Project, they would be major in duration for those where the impact would be definite/probable/possible. For the remaining communities, because use area, resource availability, and user access impacts would be unlikely due to the distance of the community from the proposed Project and relative infrequency of maintenance activities, any impacts would be intermittent (minor duration).

4.20.7.1.4. Southcentral Region – Cook Inlet Subregion

Impacts to subsistence (including construction and operation) for Cantwell, Talkeetna, and Trapper Creek subsistence users would be of major magnitude (rural communities and overlapping top three resource) and major geographic extent (proposed Project bisects communities and/or use areas). Impacts to Chase subsistence users would be of moderate magnitude (rural community and overlapping other resources [*i.e.*, not top

three]) and minor geographic extent (proposed Project intersects little to no use areas and no road access). Although the proposed Project bisects the communities of Susitna North and Willow, which have no use area data, the community locations are within the state nonsubsistence area, and therefore, the extent would be moderate because these communities have road access and are within 30 miles of the proposed Project. Likewise, the extent of impacts to Petersville would be moderate due to road access to the proposed Project within 30 miles. For all three communities, the magnitude of effects would be minor (minimally perceivable to a rural community). Impacts to Skwentna, Beluga, Tyonek, Point Possession, Wasilla, Palmer, and Anchorage subsistence users would be of minor magnitude (alteration of a nonrural community's subsistence use based on proximity to the proposed Project or minimally perceivable to rural community) and minor geographic extent (community road access greater than 30 miles from proposed Project or Project intersects little to no use areas). Although Susitna (Alexander Creek) has moose use areas (a top three resource) overlapped by the proposed Project, these use areas are in a nonsubsistence area, and thus the magnitude of impacts for Susitna would be minor, as the nearest effects in subsistence areas would be those occurring west of the Susitna River at a greater distance from proposed Project-related activities, and therefore, would be minimally perceivable. Impacts to the remaining study communities of Chickaloon, Lake Louise, Hope, and Eklutna would be of negligible magnitude (not perceivable) and negligible extent, as the only documented use areas within 30 miles of the proposed Project are located in a nonsubsistence area.

4.20.7.1.4.1. Construction

The proposed Project bisects the use areas and/or communities of Cantwell, Talkeetna, and Trapper Creek, and therefore, the likelihood of impacts to subsistence use areas would be definite due to the high level of activity associated with construction and the close proximity to the communities. Although Susitna (Alexander Creek) use areas are overlapped by the proposed Project, these use areas lie within a state nonsubsistence area, and thus, impacts to subsistence use areas would be unlikely. Chase use areas that are overlapped by the proposed Project are in subsistence areas. However, these use areas are on the fringe of the community's core area, and it would be unlikely for the proposed Project to impact Chase subsistence users in use areas at the same time and place as construction activities. No use area data are available for Petersville, Susitna North, or Willow, but based on their proximity to the proposed Project and easy road access, the likelihood of impacting subsistence use areas for those communities would be possible. The impact likelihood would only be possible because the communities are located in a nonsubsistence area and uses closest to the communities do not qualify as subsistence. Only if residents traveled to areas farther north along the proposed Project would subsistence uses potentially be impacted. For the remaining study communities in the region, the proposed Project intersects little to no use areas, or the communities have no use area data but are located farther from the proposed Project. Therefore, it would be unlikely for the proposed Project to impact subsistence users from these communities in use areas at the same time and place as construction activities.

Impacts to subsistence resources from habitat disturbance or direct/indirect mortality during construction would have the greatest effect for subsistence users in communities that lie directly along the proposed Project with use areas near the proposed Project outside nonsubsistence areas (*e.g.*, Cantwell, Talkeetna, Trapper Creek). Fish and land mammals provide substantial portions of the harvest for the Cook Inlet River subregion (Figure 3.16-23) and impacts to these resources would be noticeable to local Cook Inlet area residents. While the Cook Inlet area is home to sensitive salmon stock populations, the impacts from construction to these species would be minor considering the winter timing of construction in that region (Section 4.11, Fish). The Susitna Flats also provide important nesting habitat and impacts to waterfowl during construction are considered moderate (Section 4.10, Wildlife); however, because the Susitna Flats lie within the state nonsubsistence area, impacts to waterfowl in this area would not directly affect subsistence uses. Similar to the Interior region, moose are an important subsistence resource to Cook Inlet subregion communities (often a top three resource) and several communities' moose use areas are overlapped by the proposed Project, although as with other resources these impacts would be highest in areas outside the nonsubsistence area for communities like Cantwell, Talkeetna, and Trapper Creek. Due to their proximity to the proposed Project and location of use areas along the proposed Project outside the state nonsubsistence area, the likelihood of resource availability impacts to Cantwell, Talkeetna, Trapper Creek, and Chase would be possible as the impacts may be less perceivable due to the already disturbed habitat and presence of the Parks Highway. Resource availability impacts to the remaining study communities in the Cook Inlet subregion would be unlikely as the communities are located farther from the proposed Project and/or are located in the nonsubsistence area. Both Sections 4.10 and 4.11 discuss minimization and mitigation measures aimed to further reduce the impacts to wildlife and fish.

User access impacts during construction would be definite for Cantwell, Talkeetna, and Trapper Creek, again due to their close proximity to the proposed Project and the high level of activity associated with construction. User access impacts to the remaining study communities in the Cook Inlet subregion would be unlikely as the communities are located farther from the proposed Project and/or are located in the nonsubsistence area.

All construction impacts for subsistence use areas, resource availability, and user access would be minor in duration (less than 2 years).

4.20.7.1.4.2. Operations and Maintenance

Impacts to Cook Inlet subregion study communities' subsistence use areas could occur if monitoring and maintenance activities occur at the same time and place as operational activities. For the life of the proposed Project, the likelihood of these events occurring would be probable for Cantwell, Talkeetna, and Trapper Creek due to their location along the proposed Project and because they have use areas outside nonsubsistence areas, but these impacts would not be definite due to the relative infrequency of monitoring and maintenance activities. Subsistence use area impacts to the remaining

study communities in the Cook Inlet subregion would be unlikely as little to no use areas are intersected by the proposed Project or because the use areas are located in the nonsubsistence area.

Impacts to resource availability could continue with operational activities near communities located directly along the proposed Project (*i.e.,* Cantwell, Talkeetna, and Trapper Creek); however, the likelihood would only be possible as the disruption of habitat and resources would occur near the Parks Highway corridor with already high levels of activity. Because other communities' use areas in the region have little to no overlap with the proposed Project and/or are located farther away or in a nonsubsistence area, resource availability impacts would be unlikely during operations.

User access may be slightly impeded or opened up to hunters for communities located along the proposed Project, but as these areas are generally located along the Parks Highway the likelihood would be possible for Cantwell, Talkeetna, and Trapper Creek and unlikely for the remaining communities located farther away or in a nonsubsistence area.

Because effects of operation could be expected to occur over the life of the proposed Project, they would be major in duration for those where the impact would be probable/possible. For the remaining communities, because use area, resource availability, and user access impacts would be unlikely due to the distance of the community from the proposed Project and relative infrequency of maintenance activities, any impacts would be intermittent (minor duration).

4.20.7.1.5. Southcentral Region – Copper River / PWS Subregion

Impacts to subsistence (including construction and operation) for Copper Center and Kenny Lake subsistence users would be of major magnitude (rural communities and overlapping top three resources) and minor geographic extent (little to no use area overlap and community road access greater than 30 miles from proposed Project). Impacts to McCarthy would be similar as above, but only of moderate magnitude, as the proposed Project does not overlap a top three resource. Construction impacts to Glennallen and Gakona subsistence use areas would be minor in magnitude (minimally perceivable to rural community) and of minor geographic extent. Although Whittier has moose (a top three resource) use areas overlapped by the proposed Project, these use areas are in a nonsubsistence area, and thus the magnitude and extent of impacts for Whittier would be negligible. Valdez use areas do not intersect with the proposed Project, but are within 30 miles; however, these use areas within 30 miles are located in the nonsubsistence area and so the magnitude and extent for Valdez would be negligible as well.

4.20.7.1.5.1. Construction

The proposed Project overlaps little to no use areas for the Copper River/PWS subregion study communities. Thus, impacts would be unlikely to affect subsistence

users in use areas at the same time and place as construction activities. Furthermore, the use areas from Whittier and Valdez that are located nearest to the proposed Project are located in a nonsubsistence area.

Impacts to subsistence resources from habitat disturbance or direct/indirect mortality during construction would have the greatest effect for subsistence users in communities that lie directly along the proposed Project. No Copper River/PWS communities are located along the proposed Project, but several (Copper Center, Gakona, and Glennallen) have use areas near the proposed Project along the Denali Highway. As indicated in scoping/review comments received for the proposed Project, while overall subsistence impacts would be less for communities in this region than for communities located closer to the proposed Project, Ahtna, of the Copper River area (*e.g.*, Native Village of Gakona, Native Village of Kluti-Kaah), has traditional use of resources nearer to the proposed Project, particularly along the Denali Highway and near the Ahtna Native Village of Cantwell. While impacts to traditional subsistence use areas of the Ahtna (Copper River) subregion along the Denali Highway and near Cantwell would be unlikely, the potential for impacts to the availability of traditional resources, such as caribou and moose, would be greater. Due to their traditional ties and emphasis of use along the Denali Highway, the likelihood of resource availability impacts to Copper Center, Gakona, and Glennallen would be possible. Resource availability impacts to the remaining study communities of Kenny Lake, McCarthy, Whittier, and Valdez would be unlikely as the communities are located farther from the proposed Project and/or their use areas nearest the proposed Project are located in a nonsubsistence area. Both Sections 4.10 and 4.11 discuss minimization and mitigation measures aimed to further reduce the impacts to wildlife and fish.

User access impacts to the study communities in the Copper River/PWS subregion would be unlikely, as the communities are located farther from the proposed Project, and/or have use areas closest to the proposed Project located in a nonsubsistence area.

All construction impacts for subsistence use areas, resource availability, and user access would be minor in duration (less than 2 years).

4.20.7.1.5.2. Operations and Maintenance

Impacts to Copper River/PWS subregion study communities' subsistence use areas could occur if monitoring and maintenance activities occur at the same time and place as operational activities. For the life of the proposed Project, the likelihood of these events occurring would be unlikely, as little to no use areas are intersected by the proposed Project, or the use areas are located in a nonsubsistence area.

Impacts to resource availability could continue with operational activities; however, these impacts would be unlikely, as the disruption of habitat and resources occurs near the Park Highway corridor with already high levels of activity. This is further supported because the communities' use areas in the region have little to no overlap with the proposed Project and/or are located farther away or in a nonsubsistence area.

User access impacts would be unlikely because the communities' use areas in the region have little to no overlap with the proposed Project and/or are located farther away or in a nonsubsistence area.

Because use area, resource availability, and user access impacts would be unlikely due to the distance of the community from the proposed Project and relative infrequency of maintenance activities, any impacts would be intermittent (minor duration).

4.20.7.2. Alternative 2

Alternative 2 construction impacts would be the same as those identified for Alternative 1 for all study regions. Operational impacts would also be the same as Alternative 1 except for the North Slope region, where the presence of an elevated pipeline could create additional operation impacts to user access and resource availability. The Denali NPP Route Variation under Alternative 2 may have a slightly decreased likelihood for effects to subsistence as it parallels an existing transportation corridor, where activity is already occurring. However, this would only be a minor change given the relatively short distance of the route variation.

4.20.7.2.1. North Slope Region

In the North Slope region, under Alternative 2, the likelihood of impacts to resource availability would elevate from unlikely to possible for Nuiqsut based on the documented impacts that elevated pipelines have on subsistence resources, particularly caribou distribution. Even if resources are available near the aboveground pipeline in subsistence use areas, if users avoid the area due to the presence of a second large-scale aboveground pipeline in the area then resource availability would also be diminished.

The likelihood of impacts to user access would increase from unlikely to possible for Nuiqsut and Kaktovik as the aboveground pipeline could decrease access by acting as a barrier for travel across the ROW or cause increased user avoidance due to the presence of a second large-scale aboveground pipeline. However, the elevated pipeline portion of the proposed Project would still be located on the fringe of these communities' use areas.

4.20.7.3. Alternative 3

Under the No Action alternative, the proposed Project would not be developed, and therefore, there would be no direct or indirect impacts to subsistence.

4.20.7.4. Comparison of Alternatives

Impacts under Alternative 2 would be slightly greater to subsistence than Alternative 1 due to the presence of an elevated pipeline from MP 0 - MP 62. Magnitude and geographic extent would remain the same between alternatives, as the footprint of the proposed Project does not substantially change save for the Denali NPP Route Variation. The presence of an elevated pipeline from MP 0 – MP 62, however, raises the likelihood of resource availability and user access impacts to occur during operations for Nuiqsut and Kaktovik. Table 4.20-7 provides a comparison of construction and operational

impacts based on the rankings provided in Tables 4.20-5 and 4.20-6. While construction impacts would be similar between alternatives, the operational impacts of Alternative 2 would be marginally increased for two study communities (Nuiqsut and Kaktovik); however, the overall impact rankings as shown in Table 4.20-7 are the same between alternatives, as the differences between alternatives are relatively minor and do not constitute a large enough change to affect overall impact rankings.

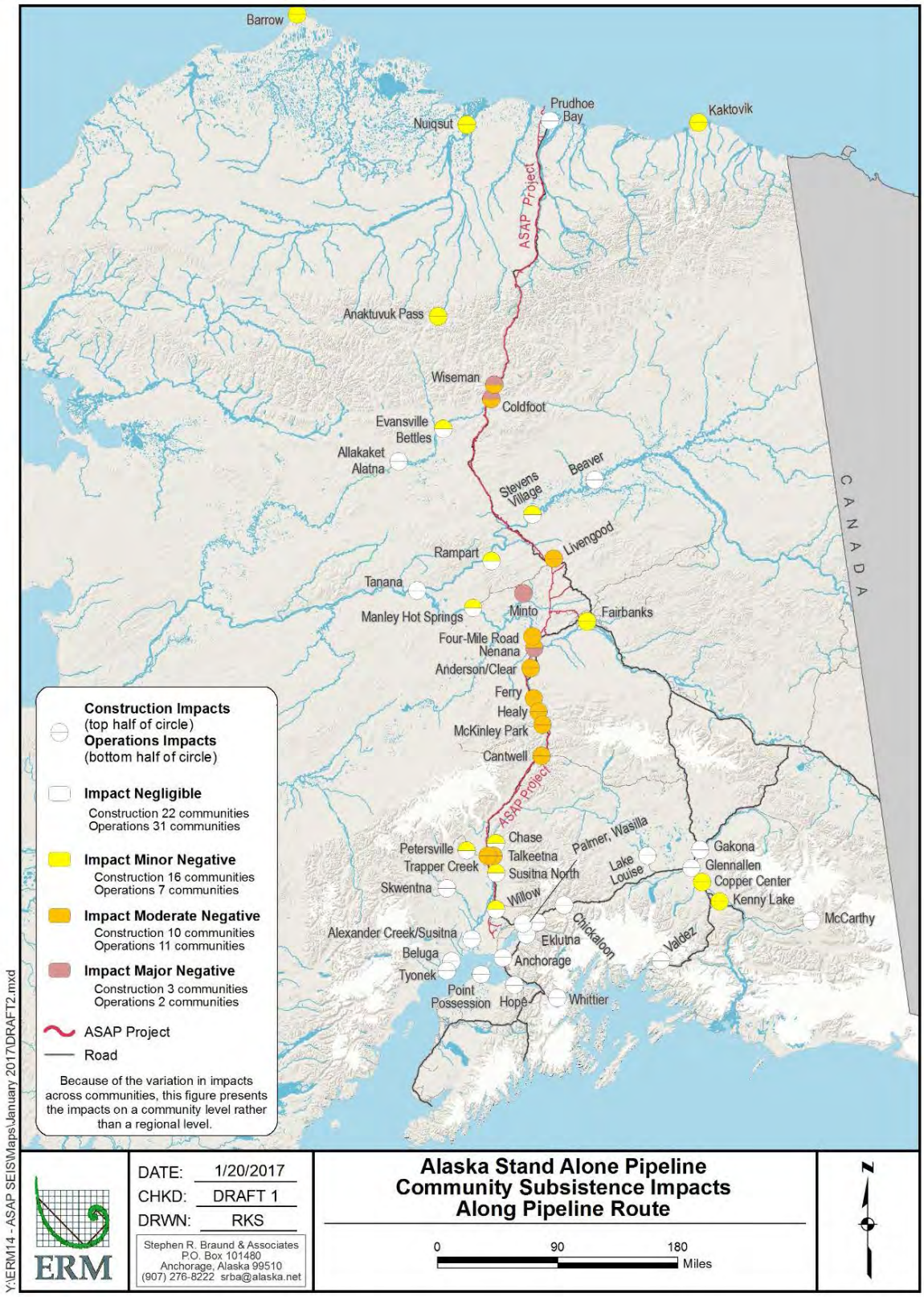
Figure 4.20-2 summarizes the anticipated level of impact (*e.g.*, negligible, minor, moderate, or major) to subsistence during construction and operation for each study community. This figure does not show impacts by alternative because the impact ratings are the same between alternatives. This figure provides geographic location by community for the potential impacts of the proposed Project, as described in detail in this section. Based on the impact analysis, Figure 4.20-2 illustrates the following potential impacts on the proposed Project map using a color scheme consistent with the impact summary table (Table 4.20-7):

- The results of the impact analysis indicate that the major impacts to subsistence discussed in this section and summarized in Table 4.20-7 are concentrated in rural communities with subsistence use areas that lie directly along the proposed Project or have greater use of areas of undisturbed habitat (*e.g.*, Minto Flats) crossed by the ASAP Project and where impacts to user access and resource availability would be elevated. For construction, these major impacts are anticipated for Wiseman, Coldfoot, and Minto. For operation, these major impacts are anticipated for Minto and Nenana.
- Moderate impacts in construction and/or operations are expected for the remainder of rural communities located directly along the proposed Project route and who reside outside state designated nonsubsistence areas (*i.e.*, communities between Wiseman in the north and Talkeetna in the south).
- Minor impacts in construction and/or operations are expected for rural communities (and the nonrural community of Fairbanks) that are located farther from the proposed Project but who are more likely to harvest in subsistence areas crossed by the proposed ASAP Project or possibly experience effects related to user access and resource availability.
- Negligible impacts in construction and/or operations are expected for the remaining study communities, which are primarily nonrural, or located the farthest from proposed Project activities and to who effects related to user access and resource availability are more unlikely. Many of the communities south of Willow, where impacts are expected to be negligible, are also located in a state-designated nonsubsistence area.

Table 4.20-7 Comparison of Alternatives Summary for Subsistence (Direct & Indirect)

Subsistence Effect	Potential Impact Description	Alternative 1		Alternative 2		Alternative 3
		Construction	Operations	Construction	Operations	Construction/ Operations
		Impact Rating		Impact Rating		Impact Rating
Number of Communities with Impact Ranking: 15-18	**See Methods Section 4.20.2 for a description of impact types**	*Major – 3 Study Communities*	*Major – 2 Study Communities*	*Major – 3 Study Communities*	*Major – 2 Study Communities*	*Negligible*
Number of Communities with Impact Ranking: 10-14		*Moderate – 10 Study Communities*	*Moderate – 11 Study Communities*	*Moderate – 10 Study Community*	*Moderate – 11 Study Communities*	*Negligible*
Number of Communities with Impact Ranking: 5-9		*Minor – 16 Study Communities*	*Minor – 7 Study Communities*	*Minor – 16 Study Communities*	*Minor – 7 Study Communities*	*Negligible*
Number of Communities with Impact Ranking: 0-4		*Negligible – 22 Study Communities*	*Negligible – 31 Study Communities*	*Negligible – 22 Study Communities*	*Negligible – 31 Study Communities*	*Negligible*

Figure 4.20-2 Community Subsistence Impacts Along Pipeline Route



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4.21. Public Health

4.21.1. Introduction

This section assesses potential impacts to public health (both positive and negative) resulting from proposed Project construction and operations, as well as two alternatives, within the PACs identified along the proposed pipeline route. The three alternatives evaluated are described in detail in Chapter 2; the components relevant to public health are summarized below.

- Alternative 1: Proposed Action (proposed ASAP Project) including:
  - Use of DH3 at West Dock;
  - HDD at the Yukon River; and
  - Burial of the pipeline for the extent of the route, except at elevated bridge crossings, fault crossings, pigging facilities, and valves.
- Alternative 2: Denali NPP Route Variation:
  - Use of DH2 at West Dock;
  - Pipeline above ground from MP 0 to MP 62;
  - Aerial crossing at the Yukon River; and
  - Pipeline is within Denali NPP from MP 535.8 – MP 543.
- Alternative 3: No Action.

In this analysis, it is assumed that Alternatives 1 and 2 would have the same number of camp locations (*i.e.,* 13 camps) and worker capacity (*i.e.,* 11,200 workers), as well as the same number of employees (*i.e.,* Mainline construction: 6,000 workers; GCF construction: 130+ workers; operations and maintenance: 240 workers). Camp locations and capacity, and employment numbers are presented in Table 2.2-1 in Chapter 2, Alternatives. Transport of pipe to construction locations would require an estimated 6,000 rail cars and 17,700 truckloads of pipe, for both alternatives. This is a change from the alternative evaluated in the 2012 FEIS, which proposed 9,000 rail cars and 3,800 truckloads of pipe. Construction activities are scheduled to occur over an approximate 2.5-year period. The construction schedule (*i.e.,* Construction Spread Plan) for Alternative 1 segments is presented in Chapter 2, Section 2.2.12, Table 2.2-7. This analysis assumes the same schedule would apply to Alternative 2.

4.21.1.1. Incomplete and Unavailable Information

In compliance with CEQ guidance (see Section 4.3), this section addresses incomplete or unavailable information pertinent to analyzing impacts of the alternatives on public health. For example, when specific information on a given health effect category (*e.g.,* disease rates or incidents of accidents or injuries) could not be obtained, a qualitative assessment has been undertaken. With regard to the assessment of pipeline reliability

and safety, no comparable (*i.e.,* large-scale, large-diameter, buried) pipeline crossing large permafrost areas could be identified in North America for comparison purposes. Regional data was used when available. Statewide data was used in place of regional data when regional or local data was not available.

4.21.2. HSSE Management System, Applicant-Proposed Mitigation Measures, Best Management Practices, and Project Management Plans

Mitigation measures are proposed by AGDC to reduce proposed Project impacts to public health (as described in Appendix M). These measures include the development and implementation of the AGDC HSSE Management System (as described in the EED; AGDC, 2016b), as well as compliance with all state and federal regulatory requirements regarding pipeline design, construction and safety, and standard public health practices (*e.g.*, education and outreach on pipeline awareness) to minimize health impacts to PACs. This section describes the HSSE Management System, engineering design features, mitigation measures, BMPs, and Project Management Plans developed to avoid or minimize proposed Project impacts to public health within the PACs. These measures and plans were taken into consideration when evaluating potential impacts to public health under Alternatives 1 and 2 during the construction and operations phases.

4.21.2.1. HSSE Management System

The AGDC HSSE Management System would be the key mitigation tool used to minimizing impacts to public health in the PACs. It is described in detail in Section 5.15, Public Health, of the EED (AGDC, 2016b), and is summarized here. AGDC would implement a structured approach to managing HSSE resulting in a system that demonstrates HSSE leadership, a commitment to continual improvement, and responsibility to stakeholders, including clients, employees, suppliers, shareholders, local, state, and federal entities, and the communities in which the company operates. The scope of this HSSE Management System applies to all of the company's office locations, company employees, and contractors. The HSSE Management System is based on best practices and in conformance with international standards. Enterprise-wide tools, such as compliance management systems, training systems, and document control systems, would be implemented to achieve efficiency and a high level of quality.

The HSSE Management System consists of 16 key elements that form the basis of a systematic business process leading to continual performance improvement over time. The 16 elements are described in Section 5.15 of the EED, and are as follows:

1. HSSE Policy
2. Aspects, Hazards, and Risks
3. Compliance Assurance
4. Objectives and Targets
5. HSSE Management Programs

6. Structure and Responsibility
7. Training, Awareness and Competence
8. Consultation and Communication
9. Document and Data Control
10. Operational Control
11. Emergency Preparedness and Response
12. Performance Measurement and Monitoring
13. Accidents, Incidents, Non-Conformance, and Corrective and Preventive Action
14. Records and Records Management
15. Audit
16. Management Review

4.21.2.2. Proposed Mitigation Measures and BMPs

4.21.2.2.1. Applicant-Proposed Design Features, Mitigation Measures, Best Management Practices, and Project Management Plans

The following design features, mitigation measures, and BMPs are proposed by AGDC. A complete list of mitigation measures and BMPs is also provided in Appendix M. These mitigation measures are also discussed in each relevant section below for context. Additional mitigation measures applicable to public health are discussed in the following sections:

- Section 4.7, Water
- Section 4.18, Socioeconomics
- Section 4.20, Subsistence
- Section 4.22, Air Quality, Climate Change, and Greenhouse Gas Emissions
- Section 4.23, Noise
- Section 4.25, Reliability and Safety

Note that some of the measures are specific SPCS ROW Lease stipulations that are currently only applicable to locations where the proposed Project Area crosses state-owned land. However, AGDC is currently negotiating with other landowners along the ROW and plans to use these stipulations as the basis for construction and operations processes and procedures throughout the proposed Project Area.

SPCS lease stipulations/BLM federal grant of ROW stipulations are applicable to locations where the proposed Project Area crosses state-owned or federally-owned land (note: the state ROW lease applies to state lands, except Mental Health Trust, university, and railroad land; the federal grant applies to federal land except Denali NPP land [not

proposed] and trust land [allotments]). AGDC has worked with BLM to develop the federal grant of ROW with similar draft stipulations as the SPCS ROW lease. AGDC would use these stipulations as the basis for operations processes and procedures, which would be used throughout the proposed Project Area.

Proposed mitigation measures and/or BMPs would include:

1. Surveillance and Monitoring – In areas where a lease is required from the SPCS or a federal grant of ROW is required from BLM, a surveillance and monitoring program for the proposed pipeline would be approved by SPCS/BLM prior to start-up of the proposed pipeline. The program shall be designed, at a minimum, to provide for and protect public health and safety. AGDC would develop education programs on pipeline damage prevention.
2. Hazards and Incidents – As required by the SPCS and BLM, AGDC would take all measures necessary to protect the health and safety of all persons affected by its activities performed in connection with the construction, operation, maintenance, or termination of the pipeline, and shall immediately abate any health or safety hazards. AGDC would immediately notify the SPCS/BLM of all serious accidents, which occur in connection with such activities. This mitigation measure applies specifically to areas where a lease is required from the SPCS or a federal grant of ROW is required from BLM.
3. Pesticides, Herbicides, Preservatives, and Other Chemicals – In areas where a lease is required from the SPCS or a federal grant of ROW is required from BLM, AGDC would use only non-persistent and immobile types of pesticides, herbicides, preservatives, and other chemicals. Each chemical to be used and its application constraint would be approved by the SPCS/BLM prior to use. Avoid or minimize construction and operational activities during sensitive periods in lifecycles such as calving, denning, nesting, and migration. The use of pesticides and herbicides are regulated by ADEC's Environmental Health Division through 18 AAC 90 and may require a permit.
4. Public Access – In areas where a lease is required from the SPCS or a federal grant of ROW is required from BLM, AGDC would regulate or temporarily prohibit public access and vehicular traffic on roads on state land, which are not managed or owned by the ADOT&PF, as required for activities in the immediate vicinity of the pipeline and related facilities. AGDC would provide appropriate warnings, flagging, barricades, and other safety measures when AGDC is regulating public areas. AGDC would make provisions for suitable permanent crossings for the public, where the leasehold or access roads cross existing roads, foot trails, winter trails, easements, or other ROW, unless otherwise authorized by the SPCS/BLM.
5. Off-ROW Traffic – In areas where a lease is required from the SPCS, AGDC would not operate mobile ground equipment off of the leased area, access roads, state

highways, or authorized areas, unless approved by the SPCS or when necessary to prevent harm to any person.

6. Fire Hazards – In areas where a lease is required from the SPCS or a federal grant of ROW is required from BLM, AGDC would promptly notify the SPCS of any fires on, or which may threaten any portion of the pipeline and shall take all measures necessary for the prevention and suppression of fires in accordance with applicable law. Use of open fires in connection with the pipeline activities is prohibited on state land unless approved by the SPCS and performed in accordance with state law.

Management of air quality impacts in the following ways could minimize impacts to public health:

7. Implement BMPs during construction activities to mitigate fugitive dust and reduce particulate matter emissions.
8. Use best available control technology (BACT) for combustion equipment to mitigate nitrogen oxides (NOx) and carbon monoxide (CO) emissions. BACT are pollution control standards based on the maximum degree of emission reduction achievable through application of production processes and available methods, systems, and techniques, and are required under EPA's new source review program. BACT requirements are established to address the specific conditions of the facility.
9. Use ultra-low sulfur diesel (ULSD) fuel for construction equipment and non-natural gas combustion equipment (to mitigate sulfur dioxide [SO_2] emissions), particulate matter emissions and volatile organic compound (VOC) emissions.
10. Operate all combustion equipment in accordance with manufacturer's specifications to mitigate NOx, CO, VOC, and particulate emissions resulting from incomplete combustion.
11. Maintain emissions control equipment in accordance with manufacturer's specifications to mitigate emissions and maintain emission control efficiency.

4.21.2.2.2. Agency-Recommended Mitigation Measures

A variety of mitigation measures and best practices have been recommended by the cooperating agencies (Appendix M). Many of these recommendations have been incorporated in the proposed Project and are included in Table 4.21-1 below. The impacts discussed in this chapter are based upon the Applicant-proposed measures. These additional agency recommended measures are not included in the impact analysis.

Table 4.21-1 Public Health Resources Agency-Recommended Mitigation Measures

Additional Measure Consideration	Agency Proposing Mitigation Measure	Agency Jurisdiction	Authority (*i.e.*, CWA, RHA, ESA)	Affected Resources	Comment Code
Surveillance/monitoring parameters (*i.e.*, which health outcomes, who monitors them, etc.) should be presented with proposed mitigations and BMPs.	DHSS	DHSS	--	Public Health	MIT_28
Include specific fugitive dust control measures, such as speed limits and frequency of watering during non-winter months, that would be implemented to achieve control limits.	EPA	EPA, ADEC	--	Vegetation, Wetlands, Fish, Public Health, Air Quality	MIT_34
Include on-site mitigation to reduce potential impacts to drinking water along the proposed pipeline route. Avoid construction in close proximity to private drinking water wells to the maximum extent practicable by making any available adjustments to trench location within the ROW.	EPA	USACE, EPA	--	Water, Public Health	EFF_26
Include compensation for any unavoidable impacts to quantity or quality of drinking water (*e.g.*, drilling a new drinking water well if needed).	EPA	EPA, ADEC, ADNR	--	Water, Public Health	MIT_33
A large number of Applicant-proposed design features, mitigation measures, BMPs, and project management plans listed in the Draft SEIS contain the language, "In areas where a lease is required from the State Pipeline Coordinator's Section" or "a federal grant of ROW is required from BLM ..." These measures generally represent a best management approach that we recommend using to the maximum extent possible along the entire pipeline route, while acknowledging the outstanding need to complete coordination with private landowners.	EPA	--	--	Numerous	MIT_35

AAC = Alaska Administrative Code
ADF&G = Alaska Department of Fish and Game
ADEC = Alaska Department of Environmental Conservation
ADNR = Alaska Department of Natural Resources
AGDC = Alaska Gasline Development Corporation
APDES = Alaska Pollution Discharge Elimination System
BLM = Bureau of Land Management
BMP = Best Management Practice
CAA = Clean Air Act
CWA = Clean Water Act
DHSS = Alaska Department of Health and Social Services
EPA = U.S. Environmental Protection Agency
MBTA = Migratory Bird Treaty Act
NMFS = National Marine Fisheries Service
RHA = Rivers and Harbors Act of 1899
SEIS = Supplemental Environmental Impact Statement
USACE = U.S. Army Corps of Engineers
USFWS = U.S. Fish and Wildlife Service

4.21.2.3. Project Management Plans

The following Project Management Plans and proposed Project programs relevant to the protection of public health have been developed to guide the proposed Project activities during construction and operations:

- HSSE Management System (described above and in the EED [AGDC, 2016b])
- A surveillance and monitoring program of the proposed pipeline would be approved by the SPCS prior to start-up of the proposed pipeline. The program shall be designed at a minimum where a lease is required from the State of Alaska. Development of a surveillance and monitoring program for the proposed pipeline would be required to provide for and protect public health and safety.
- Camps and any associated structures are required to have building plan reviews through the Office of the State Fire Marshal before construction or placement.

4.21.3. Methods

As described in Chapter 3, Section 3.17, Public Health, the *Alaska HIA Toolkit* (ADHSS, 2015a) defines eight potentially relevant health effects categories (HECs). These HECs are described in Table 3.17-2 in Chapter 3. Potential impacts of the proposed Project on public health within each PAC during construction and operation were identified for each of these HECs, as presented in Table 4.21-2. Note that the HEC "Social Determinants of Health" consists of several subcategories: maternal health status; depression/anxiety prevalence; substance abuse rate; suicide rate; teen pregnancy rates; domestic violence and family stress; and economy and employment.

PACs evaluated are presented in Chapter 3, Figure 3.17-1 and in Table 3.17-3. PACs have not changed since the publication of the 2012 FEIS (USACE, 2012a), and are therefore, described in detail in the 2012 FEIS. This SEIS incorporates that information by reference. Baseline public health conditions within PACs are described in Section 3.17, Public Health.

The potential proposed Project impacts to public health within the PACs along the pipeline route were based on the existing conditions within each PAC, a review of available proposed Project descriptions and reports, public comments received after the publication of the 2012 FEIS and during the public scoping period for the SEIS held in 2014, and review of public comments received on the Draft SEIS during the July/August 2017 public comment period. Impacts to public health were evaluated separately for the 2.5-year construction period, and for a 30-year operations and maintenance period.

Table 4.21-2 Types of Effects and Impacts on Public Health

Type of Effect[1]	Proposed Action Causing Potential Impact	
	Construction	**Operations and Maintenance**
Social Determinants of Health (SDH) Positive or negative change in: • Maternal Health Status • Depression/anxiety prevalence • Substance abuse rate • Suicide rate • Teen pregnancy rates • Domestic violence and family stress • Economy and employment	• Worker camps - presence of outside workers could exacerbate social problems or stress and impact mental health for PACs • Employment opportunities could alleviate family stress by improving family income, and the local economy • Increase in truck and rail traffic in PACs along the rail line and highways	• Presence of gas in the pipeline - PACs may experience anxiety or depression if residents of PACs experience fear of catastrophic incident linked to the proposed Project and/or perceptions that the proposed Project threatens a way of life • Employment opportunities could alleviate family stress by providing construction jobs and family income, improving the local economy and reducing unemployment
Accidents and Injuries • Increase in unintentional injury (*e.g.,* drowning, falls, snow machine, ATB injury) rates • Increase in roadway incidents and injuries • Decrease in safety during subsistence activities	Fatal and nonfatal injuries due to: • General construction activities • Increased rail transport (*e.g.,* rail-auto collisions, trespassing, train accidents and highway-rail crossing accidents) • Increased trucking- injuries to truck drivers, other motorists and pedestrians from trucks hauling pipes; transportation of GCF; bussing construction workers to camps; and additional truck deliveries and pickups linked to construction • Seaborne transit-related injuries • Increase in truck and rail traffic in PACs along the rail line and highways	• Fatal and nonfatal injuries due to leaks, fires, or explosions (Alternatives 1 and 2 would comply with requirements of the PHMSA) • Increased rail transport (*e.g.,* rail-auto collisions, trespassing, train accidents and highway-rail crossing accidents) • Increased trucking- injuries to truck drivers, other motorists and pedestrians from trucks hauling pipes; transportation of GCF; bussing construction workers to camps; and additional truck deliveries and pickups linked to construction
Exposure to Hazardous Materials • Increase in physiologic contaminant levels such as fugitive dust, criteria pollutants, persistent organic pollutants, and VOCs • Increased levels of the same substances noted above in subsistence resources (*e.g.,* plants, fish, wildlife)	Human exposure linked to air emissions (fugitive dust, criteria pollutants, VOCs): • Diesel-powered mobile equipment • Increase in truck and rail traffic in PACs along the rail line and highways • Fugitive dust due to vehicle traffic on unpaved roads and general construction activities (especially during summer) •	• Potential fugitive emissions from pipeline connections • Operations of GCF would emit combustion-related pollutants, such as NOx, CO, PM, VOCs and SO_2 • Potential for other toxic / hazardous substances – components of natural gas and NGLs (*e.g.,* isobutene, pentanes, hexanes, hydrogen sulfide, butane, and ethane) as well as paints, solvents, petroleum products and fertilizers • Operation would result in various emissions when the natural gas is consumed in Fairbanks, Anchorage and other cities

Type of Effect[1]	Proposed Action Causing Potential Impact	
	Construction	**Operations and Maintenance**
Food, Nutrition, and Subsistence Activity • Decrease in amount of dietary consumption of subsistence resources • Change (positive or negative) in composition of diet • Change (positive or negative) in food security	Construction activities (*e.g.*, construction noise, traffic, human presence, barging, water use requirements) causing: • Removal or disruption of subsistence use areas • Temporary decrease in resource availability • Temporary reduction in harvester access to the proposed Project Area • Contamination (real or perceived)	O&M could lead to a decrease in dietary consumption of subsistence resources, resulting in a change in diet composition and a decrease in food security due to: • Cleared ROW and construction of new access roads attracting new harvesters • New access roads, and increased traffic and noise from aerial and ground-based pipeline inspections, which could displace or reduce availability of terrestrial wildlife for subsistence uses • Resource availability could be reduced in the unlikely event that a leak in the pipeline led to a forest fire
Infectious Disease Positive or negative change in: • Transmission of pediatric or adult respiratory disease rates • STD rates, gastro intestinal outbreaks, and antibiotic-resistant staph skin infections	Transmission of disease by infected resident or non-resident construction workers (often coming from out of state) stationed at worker camps or in PACs	Transmission of disease by infected resident or non-resident operations and maintenance workers stationed at worker camps or in PACs
Water and Sanitation • Change in potable water access • Positive or negative change in water quantity or quality • Change in demand on water and sanitation infrastructure due to the influx of non-resident workers	Change in water quality due to: • Solid waste generated due to construction activities; • Domestic waste water produced from worker camps • Hazardous materials from construction activities Change in potable water access due to use of surface water for construction activities as well as for hydro-testing and horizontal directional drilling Change in demand on water and sanitation infrastructure due to demand on existing services while construction work camps are being utilized	Change in potable water access due to use of water for O&M
Non-Communicable and Chronic Disease Positive or negative change in: • Cardiovascular disease rates • Type 2 Diabetes rates • Chronic lower respiratory disease rates • Cancer rates	Asthma, Chronic Obstructive, Pulmonary, Cardiovascular Disease: • Project emissions of criteria pollutants, particularly PM2.5 Diabetes: • Change in diet from loss of subsistence resources	Changes in air quality in Fairbanks and probable changes in the rate of exceedances of the $PM_{2.5}$ National Ambient Air Quality Standard (NAAQS). However, these changes depend on expansion of the gas distribution network in Fairbanks. Therefore, this issue is further addressed in the cumulative impact section rather than here)

Type of Effect[1]	Proposed Action Causing Potential Impact	
	Construction	**Operations and Maintenance**
Health Services Infrastructure and Capacity Increase in: • Number or quality of clinics and staff • Accessibility of health care • Utilization/clinic burden from non-resident influx	Potential increased use of health infrastructure resources / clinic burden due to resident or worker injuries or illness during construction	Impacts expected only to the degree that operations could result in increased injuries from pipeline accidents or increased need for medical services.

4.21.3.1. Impact Criteria

The criteria used to analyze impacts to public health are presented in Table 4.21-3. For each HEC presented in Table 4.21-2, impact levels were assessed based on the impact components (*i.e.*, magnitude/intensity, geographic extent, duration/frequency, resilience/ability to adapt, and likelihood). Mitigation measures to reduce impacts to public health (as described in Appendix M), including development and implementation of environmental health and safety measures, compliance with all state and federal regulatory requirements regarding pipeline design, construction and safety, and standard public health practices to minimize health impacts to PACs, were also taken into account to determine a final integrated impact result of negligible, minor, moderate, or major.

Table 4.21-3 Impact Criteria for Public Health

Impact Component	Severity Rating			
	Major	**Moderate**	**Minor**	**Negligible**
Magnitude/ Intensity	Severe risk or benefit: marked change in mortality and morbidity patterns (intervention needed, if negative)	Moderate risk or benefit to public health (intervention needed, if negative)	Minor risks or benefit to injury or illness patterns (no intervention needed)	Effect is minimal or not perceptible
Geographic Extent	Extends beyond PACs; regional, national, international	Entire PACs; village level	Local; small limited impact to households	Individual cases
Duration or Frequency	Long-term: more than 6 years/ life of proposed Project and beyond	Medium-term: 1 to 6 years	Short-term: 1 to 12 months	Less than 1 month
Resiliency/ Ability to Adapt	(-) Those impacted would not be able to adapt to the health impact or to maintain pre-impact level of health (+) Those impacted would see noticeable major improvements in health and overall quality of life	(-) Those impacted would be able to adapt to the health impact with some difficulty and would maintain pre-impact level of health with support (+) Those impacted would experience beneficial impacts to health for specific populations; some maintenance may still be required	(-) Those impacted would be able to adapt to the health impact with relative ease and maintain pre-impact level of health (+) Those impacted would see noticeable but limited and localized improvements to health conditions	Those impacted are resilient to changes in their environment and have the resources to maintain pre impact level of health and wellness. Therefore, those impacted would not see noticeable improvements to health conditions

Impact Component	Severity Rating			
	Major	Moderate	Minor	Negligible
Likelihood	Most likely (Effects are those that have greater than 75% chance of arising from reasonable or demonstrated mechanisms due to the action)	Likely (Effects are those that have a 50% to 75% chance of arising from reasonable or demonstrated mechanisms due to the actions)	Somewhat likely (Effects are those that have a 10% to 50% chance of arising from reasonable or demonstrated mechanisms due to the action)	Unlikely (Effects are those that have less than 10% chance of arising from reasonable or demonstrated mechanisms due to the action)

(+) indicates a beneficial effect; (-) indicates an adverse effect.

4.21.4. Alternative 1 – Proposed Action

This section discusses the potential impacts of construction, operation and maintenance of Alternative 1 on public health, for each individual HEC presented in Table 4.21-2 above. Results of the impact ratings are presented in Table 4.21-4 below. Impact ratings for Alternative 1 follow those presented in the 2012 FEIS, Section 5.15, Public Health (as summarized in Table 5.15-37).

4.21.4.1. Construction

Construction is expected to occur over a 2.5-year period, with more limited exposure to proposed Project construction within each individual PAC. The primary pathways of construction impact to public health evaluated were 1) the presence of work camps; 2) air emissions from equipment and burning of cleared material; and 3) increase in accidents due to increased road and rail traffic. During peak pipeline construction, 6,000 workers would be required, housed in 13 temporary construction camp locations. Locations of the temporary construction camps and PSYs are depicted on Figure 2.2-18 in Chapter 2, Alternatives, and are described in the EED (AGDC, 2016b). SCCs could house between approximately 600 and 1,000 workers and would range in size from 15 to 40 acres. Approximately 800 workers may be housed in the GCF construction camp in Prudhoe Bay.

Additional aspects of proposed Project construction specific to each HEC evaluated are included in the subsections below, including individual impact ratings for each of the impact criteria listed in Table 4.21-3. During construction, transport of pipe to construction locations would require an estimated 6,000 rail cars and 17,700 truckloads of pipe. Each type of effect in Table 4.21-2 is discussed below. A summary of results of the impacts anticipated during construction are presented in Table 4.21-4, Comparison of Alternatives Summary for Public Health.

4.21.4.1.1. Social Determinants of Health

The assessment of potential construction impacts to each of the individual sub-categories of Social Determinants of Health (SDH) (as presented in Table 4.21-3 above) is described in detail in the 2012 FEIS. Subcategories of SDH that were evaluated are as follows: maternal health status; depression/anxiety prevalence; substance abuse rate;

suicide rate; teen pregnancy rates; domestic violence and family stress; and economy and employment.

Proposed Project construction and work camps could potentially exacerbate existing problems that impact SDHs within individual households or PACs, for the duration of construction. The presence of outside workers could exacerbate social problems or stress and impact mental health for PACs, particularly in smaller communities. Households or PACs impacted would be expected to adapt to the presence of outside workers with some difficulty, but could maintain pre-impact level of health with support from community or regionally-based public health programs. PACs located within the rail belt and on a highway, would be expected to be impacted by the increase in truck and rail traffic during construction, which could cause mental stress and anxiety regarding the real or perceived issues of safety and environmental health associated with the increased rail and truck traffic.

Proposed Project construction could also potentially have short-term positive impacts resulting from increased employment opportunities that could in turn alleviate family stress by improving family income, and the local economy. However, as discussed in the 2012 FEIS, employment-related positive impacts would be short-term during construction jobs and the need for workers to travel to other communities for extended periods of time could increase family stress. Therefore, while the positive effects of employment during construction may occur, other stresses associated with the requirement to travel as the pipeline is constructed could negate these effects.

Overall, potential adverse impacts to the SDHs evaluated within the PACs would likely be moderate during construction, with individual impact criteria rated as follows:

- Magnitude/Intensity – Moderate risk to SDHs, with intervention potentially needed to mitigate the stress of the presence of outside workers and increased truck and rail traffic.
- Geographic Extent – Individual households or an entire PAC. Smaller PACs may experience greater magnitude of impact from the construction workforce than larger communities.
- Duration/Frequency – Medium-term, for the duration of construction near a given PAC.
- Resiliency/Ability to Adapt – Moderate, as households or PACs impacted would be expected to adapt to the presence of outside workers with some difficulty, but could maintain pre-impact level of health with support from community or regionally-based public health programs.
- Likelihood – Somewhat likely or likely chance that construction would impact the SHDs within a given PAC.

The following mitigation measures, described above in Section 4.21.2.2 (Proposed Mitigation Measures and BMPs) and in Appendix M, are proposed by AGDC to address impact to SDH: Mitigation Measure Nos. 1 through 5, 13, 15, and 16.

4.21.4.1.2. Accidents and Injuries

Construction and associated road and rail traffic could perceptibly increase accidents and injuries during the period when construction is occurring in the vicinity of all PACs located on the rail belt and on the highway system. During construction transport of pipe to construction locations would require an estimated 6,000 rail cars and 17,700 truckloads of pipe, which would significantly increase the level of rail and truck traffic within PACs near and adjacent to the Parks Highway and the railroad line. The 2012 FEIS presents detailed estimates of accident and injury during pipeline construction, as a result of construction activities, and the rail, truck, and bus traffic associated with construction. The proposed Action would increase truck traffic by approximately 14,000 truckloads during construction, compared to what was analyzed in the 2012 FEIS. Accidents and injuries to both workers and the public would be minimized through the implementation of proposed Project health and safety programs, and limiting access to construction areas by the public during active construction.

Therefore, any increase in accidents or injuries resulting from increased truck or rail traffic would be temporary, and limited to individual households or PACs (defined as a moderate potential impact; Table 4.21-3).

Overall, potential adverse impacts on the rate of accidents and injuries in the PACs would likely be moderate during construction, with individual impact criteria rated as follows:

- Magnitude/Intensity – Moderate risk to the accident and injury rate, with intervention potentially needed to mitigate the impacts of increased truck and rail traffic.
- Geographic Extent – Local, limited to individual households where a household member experiences an accident or injury. PACs located along highways or the rail line would be most impacted by increased road and rail traffic, and associated potential increase in accident and injury rate.
- Duration/Frequency – Medium-term, for the duration of construction in the region of a PAC.
- Resiliency/Ability to Adapt – Moderate to major depending on the severity of the accident or injury; those impacted may or may not be able to adapt or to maintain a pre-impact level of health.
- Likelihood – Somewhat likely chance that the rate of accidents or injury may increase within PACs during construction.

The following mitigation measures, described above in Section 4.21.2.2 and in Appendix M, are proposed by AGDC to address potential accidents and injuries: Mitigation Measure Nos. 1 through 3, 5, 7, and 8 through 12.

4.21.4.1.3. Exposure to Hazardous Materials

Potential pathways for exposure to residents of PACs to hazardous materials during construction include:

- Exposure to leaks and spills from equipment, including spills from truck rollovers and accidents;
- Exposure to emissions from increased construction traffic, equipment, and rail transport; and
- Exposure to fugitive dust during the summer;

Increased truck and rail traffic during construction could cause an increase in air quality contaminants for PACs located along the rail line and within the highway corridor. Given the increased road traffic during construction, there is also potential for increased truck rollovers or accidents resulting in spills of vehicle fluids. The exposure of residents within PACs to such spills would be minimized by the implementation of an SPCC Plan, and other mitigation measures required by regulation (as described in the 2012 FEIS).

Potential health effects associated with construction-related emissions from the operation of diesel-powered construction equipment and fugitive dust are expected to be perceptible but temporary, given the implementation of proposed mitigation measures. As stated in the 2012 FEIS, Section 5.16.2, Air Quality Environmental Consequences (USACE, 2012a):

> *Because pipeline construction moves through an area relatively quickly, air emissions typically would be localized, intermittent, and short-term. As a result, if the [Project] complies with applicable regulations, the proposed Project emissions from mainline construction-related activities would not significantly affect local or regional air quality.*

The proposed Project would implement BMPs during construction activities to mitigate and reduce particulate matter emissions from fugitive dust. These measures are described in detail in Appendix M, but could include activities such as the use of ULSD fuel, fugitive dust control on unpaved roads and in construction areas, and compliance with state air quality regulations. As described in Mitigation Measure No. 7, AGDC shall take all measures necessary for the prevention and suppression of fires in accordance with applicable law. Potential construction impacts to air and water quality, and associated mitigation measures, are discussed in detail in their respective sections in Chapter 4.

Overall, the potential adverse impact of construction on the rate of exposure to hazardous materials within each PAC would likely be moderate, primarily due to the increased truck and rail traffic. Individual impact criteria were rated as follows:

- Magnitude/Intensity – Minor to moderate risk of exposure to hazardous materials in the PACs, with intervention potentially needed to mitigate the impacts of air quality contaminants, and spills and leaks associated with increased truck and rail traffic.
- Geographic Extent – Local, limited to individual households located directly along the highway, rail line, or construction areas. PACs located along highways or the rail line would be most impacted by increased road and rail traffic, and associated potential increase in air contaminants or leaks/spills.
- Duration/Frequency – Occurring with intermittent frequency during isolated events (*e.g.*, in the event of a spill), for the duration of construction in the region of a household or PAC.
- Resiliency/Ability to Adapt – Minor, as those affected by a spill/leak, or intermittent air quality contamination could be able to adapt and maintain their pre-impact level of health.
- Likelihood – Unlikely to somewhat likely chance that the exposure to hazardous materials within individual households or PACs would increase during construction.

The following mitigation measures, described above in Section 4.21.2.2 and in Appendix M, are proposed by AGDC to address impacts of exposure to hazardous materials: Mitigation Measure Nos. 1 through 4, and 8 through 12.

4.21.4.1.4. Food, Nutrition, and Subsistence Activity

As described in Chapter 3, Section 3.17, Public Health, this category includes health outcomes and determinants related to food security, dietary choices, and the consumption of subsistence foods. Income level (discussed in Section 4.18, Socioeconomics) is a major determinant of food security, and in turn nutrition. Income level within households where a member is employed by the proposed Project would be expected to increase temporarily during construction, which could in turn temporarily increase food security and nutrition levels within that household. However, in PACs where subsistence harvest makes up a large proportion of the diet, food security and nutrition are driven by the availability of and access to subsistence resources. In these subsistence-based communities, the increased income-based food security could be offset by the potential negative impacts to subsistence harvest activities.

Section 4.20, Subsistence, details the potential impact of construction of the proposed Project on subsistence activities. Table 4.20-5 in Section 4.20 presents the impact categories for construction and operation by study community (which is analogous to PAC for the purpose of this SEIS). The potential impact on subsistence, and in turn on food and nutrition, would vary by the regions assessed. Potential impacts of the

proposed Action (Alternative 1) to subsistence communities during construction and operation are presented in Table 4.20-7. The impact to the highest percent of the 51 study communities (22 communities) would likely be negligible during construction. The impact would likely be major in three communities, moderate in 10 communities, and minor in 16 communities (Table 4.20-7). The impact of construction on subsistence activities was ranked the highest in the communities of Wiseman, Coldfoot, and Minto (Table 4.20-5).

Construction and the associated work camps would be expected to have a temporary and limited, but perceptible effect on subsistence resources available to a PAC. In turn, the amount of subsistence resources consumed during the period when construction is occurring in the vicinity of a given PAC would also be effected. This effect could result from reduced access to subsistence areas during construction or from the perception of subsistence users due to fear of contamination of subsistence resources by construction activities.

The increased presence of construction workers and equipment within subsistence hunting areas could also temporarily displace wildlife. Extensive mitigation measures for the protection of fish, wildlife, and habitat would be required to be implemented during proposed Project construction to comply with state and federal regulations (*e.g.*, USFWS and ADF&G regulations). These mitigation measures would in turn reduce the impacts of construction on subsistence activities and consumption of subsistence foods within PACs.

The overall adverse impact of construction of the proposed Action on food, nutrition, and subsistence activity within each PAC would likely be moderate, with individual impact criteria rated as follows:

- Magnitude/Intensity – Minor, moderate, or major severity, depending on the PAC (see Table 4.20-5), with intervention potentially needed to mitigate the impacts of construction and work camps on the availability of and access to subsistence resources.
- Geographic Extent – Subsistence-based PACs or within the region of subsistence-based PACs. The impact of construction on subsistence activities was ranked the highest in the communities of Wiseman, Coldfoot, and Minto (Table 4.20-5).
- Duration/Frequency – Medium-term, occurring for the duration of construction in the region of a subsistence-based PAC.
- Resiliency/Ability to Adapt – Minor, as subsistence-based PACs affected by an impact to subsistence resources or access would be able to adapt post-construction and maintain their pre-impact level of food security and nutrition.
- Likelihood – Somewhat likely to likely chance of impact to subsistence, which would in turn impact food security and nutrition.

Mitigation measures specific to the protection of fish and wildlife are presented in Sections 4.10 and 4.11, respectively, as well as the complete list of mitigation measures for all resources provided in Appendix M. The following mitigation measures, described above in Section 4.21.2.2 and in Appendix M, are proposed by AGDC to address impacts to food, nutrition, and subsistence activities: Mitigation Measure Nos. 1, 4 through 6, and 13.

4.21.4.1.5. Water and Sanitation

Construction activities and the associated work camps are not expected to change PAC access to potable water, water quantity, or change the demand on water and sanitation infrastructure due to the influx of non-resident workers.

The following potential pathways were evaluated to determine potential impact to this HEC: 1) water use for construction activities (hydro-testing and HDD); 2) water quality contamination (via leaks/spills); and 3) water use and sanitation at construction camps. All water use during construction would require the granting of applicable regulatory permits for water withdrawals, minimizing potential impact to water quantity within or adjacent to PACs. Water contamination from leaks and spills from construction equipment would be unlikely considering mitigation measures required by regulation. Potential construction impacts to water quality, and associated mitigation measures, are discussed in greater detail in Section 4.7, Water. All wastewater and solid waste associated with construction and construction camps would be managed according to ADEC regulations and under permits obtained from the department, minimizing potential impact to water resources within or adjacent to PACs.

Overall, the potential adverse impact of construction on water resources and sanitation is anticipated to be minor, with individual impact criteria rated as follows:

- Magnitude/Intensity – Minor severity of impact on water resources and sanitation with no intervention needed to maintain water quality, quantity, and adequate sanitation within the PACs.
- Geographic Extent – Individual cases of water quality, quantity, or sanitation issues may arise, that may impact individuals or households within PACs.
- Duration/Frequency – Infrequent or very short duration water and sanitation issues may occur.
- Resiliency/Ability to Adapt – Negligible to minor, as individuals impacted would be resilient to change, or adapt and maintain pre-impact level of health.
- Likelihood – Unlikely that water and sanitation issues would result from construction or work camps, given the design infrastructure and proposed mitigation measures.

The following mitigation measures, described in Section 4.21.2.2 and Appendix M, are proposed by AGDC to address potential water and sanitation impacts: Mitigation Measure Nos. 1 and 4.

4.21.4.1.6. Infectious Disease

The potential adverse impact to infectious disease rates during construction would be moderate, as the presence of construction work camps have the potential to increase infectious disease rates for the duration that construction is occurring adjacent to a given PAC. Changes in transmission of the following infectious diseases were evaluated as part of this HEC: acute respiratory diseases; STDs; gastrointestinal outbreaks; and antibiotic-resistance staph skin infections. Of these, the transmission of STDs is considered to have the greatest potential for increase in PACs, associated with the influx of construction workers in camps.

Proposed measures to mitigate contraction and transmission of infectious diseases, including STDs, include: policies within work camps to minimize sexual transmission (*e.g.*, access controls); the presence of medical technicians at each construction camp to provide prevention education, vaccines, testing, and treatment of infectious diseases. While the duration of construction is rather short-term, the effects of contracting an infectious disease could be long-term, particularly if it goes untreated.

Overall, the potential adverse impact of construction on infectious diseases is anticipated to be moderate, with individual impact criteria rated as follows:

- Magnitude/Intensity – Moderate severity of impact on infectious disease rates with intervention needed particularly to minimize the transmission of STDs.
- Geographic Extent – Increase of infectious diseases would likely be limited to individual cases or households.
- Duration/Frequency – Short-term, during construction when workers would be in the region.
- Resiliency/Ability to Adapt – Moderate to major, as those infected may or may not be able to adapt and maintain pre-impact level of health, depending on the infectious disease, and whether it remains untreated.
- Likelihood – Somewhat likely that the infectious disease rate would increase, particularly for STDs.

The following mitigation measure, described in Section 4.21.2.2 and Appendix M, is proposed by AGDC to address potential affects from infectious diseases: Mitigation Measure No. 1.

4.21.4.1.7. Non-Communicable and Chronic Disease

Changes in rates of the following non-communicable and chronic disease were evaluated as part of this HEC: cardiovascular diseases; type 2 Diabetes Mellitus; chronic

lower respiratory diseases (*e.g.*, asthma and emphysema); and cancer. The potential for proposed Project construction to increase the exposure of individuals or PACs to pollutants that exacerbate or cause these diseases (*e.g.*, leaks, particulate matter from fugitive dust or diesel equipment or other emissions reducing air quality) would likely be moderate. The moderate rating resulted primarily from the increased truck and rail traffic during construction, which could cause an increase in air quality contaminants for PACs located along the rail line and within the highway corridor, and in turn a potential increase in chronic respiratory diseases.

Individual impact ratings are as follows:

- Magnitude/Intensity – Moderate risk of increase in non-communicable and chronic diseases, due to the potential for increased exposure to air quality contaminants.
- Geographic Extent – Local, individuals, households or PACs located directly adjacent to the highway, rail line, or construction areas.
- Duration/Frequency – Short-term, during construction adjacent to a PAC.
- Resiliency/Ability to Adapt – Moderate, as those impacted would be expected to adapt and maintain pre-impact level of health with support.
- Likelihood – Somewhat likely that construction would increase the rate of non-communicable and chronic diseases.

Potential construction impacts to air quality that could exacerbate or cause non-communicable or chronic diseases, and associated mitigation measures, are discussed in detail in their respective sections in this chapter. The following mitigation measures, described in Section 4.21.2.2 and Appendix M, are proposed by AGDC to address potential non-communicable and chronic disease impacts: Mitigation Measure Nos. 1 and 8 through 12.

4.21.4.1.8. Health Services Infrastructure and Capacity

Many PACs have limited capacity for first responder, medical, and fire response, and instead rely on volunteer-based services. The potential increase in vehicle accidents due to increased traffic during construction could potentially strain existing medical services; however, any increase in the use of health services is expected to be temporary (during construction within each PAC), and limited in geographic scope to each individual PAC.

Construction and the associated work camps are expected to have only a very limited perceptible effect on the number of health clinics, staff, or health services available to a PAC, during the period when construction is occurring in the vicinity of a given PAC. Each construction camp would be staffed with one or more medical technicians, to mitigate the impact of the non-resident influx on the health services within the local PACs. Those with debilitating illnesses or injured personnel would be transported to Fairbanks or Anchorage.

Overall, the potential impact to health services infrastructure and capacity is expected to be minor during construction, with individual impact ratings as follows:

- Magnitude/Intensity – Minor risk of perceptible impact on health services infrastructure and capacity due to the presence of construction workers or the increase in accidents associated with road or rail traffic.
- Geographic Extent – PACs located near construction work camps with existing health services infrastructure, including volunteer emergency services.
- Duration/Frequency – Short-term, during construction adjacent to a PAC.
- Resiliency/Ability to Adapt - Minor, as PACs impacted would be able to adapt and maintain the pre-impact level of health services infrastructure or emergency services.
- Likelihood – Unlikely to somewhat likely that health infrastructure services and capacity would be negatively impacted during proposed Project construction.

The following mitigation measures, described in Section 4.21.2.2, are proposed by AGDC to address potential water and sanitation impacts: Mitigation Measure No 1, which describes the surveillance and monitoring program and Mitigation Measure No. 4, which describes access restrictions state and federal land.

4.21.4.2. Operations and Maintenance

The primary mechanisms that could result in impacts during operations and maintenance include: 1) maintenance activities along the pipeline ROW; 2) permanent presence of the pipeline ROW; and 3) (real or perceived) potential exposure to leaks, fires, and explosions associated with natural gas transport in the pipeline. An estimated 240 workers would be required for operations and maintenance along the length of the pipeline post-construction, resulting in minimal workers for each pipeline segment. Maintenance activities along individual pipeline segments are expected to be minimal.

Individual impact ratings for each of the impact criteria listed in Table 4.21-3 are provided for HECs where overall impacts to the HEC were rated as minor, moderate, or major. A summary of results of the impact ratings during construction are presented in Table 4.21-4 in Section 4.21.7, Conclusions and Comparison of Alternatives.

4.21.4.2.1. Social Determinants of Health

Potential health impacts to each of the individual sub-categories of SDH during operations are presented in Table 4.21-3 and described in detail in the 2012 FEIS. The primary adverse impact to SDHs during proposed Project operations and maintenance would result from the possible fear and anxiety within PACs over the real or perceived potential for gas leaks, fires, and explosions along the pipeline. A limited number of workers would be required during the 30-year operations and maintenance period, thus the potential adverse effects on SDHs would be negligible during this period.

Overall the potential impact to SDHs is expected to be moderate during operations and maintenance, with individual impact ratings as follows:

- Magnitude/Intensity – Minor risk to SDHs due to potential for the presence of a natural gas pipeline to cause increased anxiety regarding the possibility of gas leaks, fires, or explosions.
- Geographic Extent – Local, limited to individuals or households located near the pipeline.
- Duration/Frequency – Long-term, for the life of the proposed Project.
- Resiliency/Ability to Adapt - Minor to moderate, as individuals or households may or may not be able to adapt and maintain the pre-impact level of health services infrastructure or emergency services.
- Likelihood – Somewhat likely that SDHs would be negatively impacted during proposed Project operations.

Given the limited employment within PACs resulting from proposed Project operation and maintenance, this period is not expected to result in positive impacts resulting from increased employment opportunities that could in turn, alleviate family stress by improving family income, and the local economy.

The following mitigation measures, described above in Section 4.21.2.2 and in Appendix M, are proposed by AGDC to address impacts to SDH: Mitigation Measure Nos. 1 through 5, 13, 15, and 16. Mitigation measures here are the same as those listed during the construction phase.

4.21.4.2.2. Accidents and Injuries

The potential adverse impact of operation and maintenance on the rate of accidents and injuries within each PAC is expected to be moderate, given that although unlikely, accidents and injuries to individuals or PACs resulting from gas leaks, explosions and fires would be of high severity, and could occur over a period of 30 years. While it is considered highly unlikely that pipeline leaks resulting in exposure to gas, fire, or explosions would occur given the strict engineering controls and safety mitigation measures that would be implemented, this potential effect would still be considered moderate given the potential magnitude of such an event occurring.

Safety standards applicable to construction and operation of the proposed pipeline are detailed in this SEIS in Section 4.25, Reliability and Safety. Regulatory measures associated with USDOT PHMSA, and ADNR, Division of Oil and Gas Petroleum Systems Integrity Office, would be implemented during operation and maintenance of the pipeline.

Section 5.19, Reliability and Safety, of the 2012 FEIS analyzed the potential risk of accidents and injuries resulting from natural gas pipelines in the existing distribution system in the U.S. This included detailed statistics on the causes of significant safety

incidents (*e.g.,* pipeline corrosion, excavation, and natural force incidents), and a comparison to other types of accidents nationwide (*i.e.,* motor vehicle, poisoning, falls). Additionally, Section 5.19 of the 2012 FEIS concluded that (USACE, 2012a):

> *The available data show that natural gas transmission pipelines continue to be a safe, reliable means of energy transportation. From 1991 to 2010 [in the U.S.], there were an average of 57 significant incidents and two fatalities per year. The number of significant incidents over the more than 300,000 miles of natural gas transmission lines [in the U.S.] indicates the risk is low for an incident at any given location. The operation of the proposed Project would represent only a slight increase in risk to the nearby public.*

Section 4.25, Reliability and Safety, of this SEIS concurred with this finding. It should be noted that while the risk of accidents resulting from natural gas pipelines is considered low based on nationwide statistics, the proposed Project would be the first major large-diameter natural gas pipeline constructed in the U.S. and could potentially have distinct safety considerations.

There is not expected to be any perceptible increase in rail or road traffic during the operations and maintenance period; therefore, no increase in accidents and injuries related to traffic would be expected and is considered negligible. Accidents and injuries to the public would be minimized through the implementation of proposed Project health and safety programs, limiting access to the proposed pipeline ROW by the public where possible, and through education programs on pipeline damage prevention.

In summary, potential adverse impacts on the rate of accidents and injuries in the PACs would likely be moderate during operations, with individual impact criteria rated as follows:

- Magnitude/Intensity – Minor to severe, depending on the nature of the accident or injury. Considered severe if a fire, leak, or explosion causes significant injury or mortality.
- Geographic Extent – Local, limited to individuals or households.
- Duration/Frequency – Long-term, for the duration of proposed Project operations.
- Resiliency/Ability to Adapt – Minor to major, depending on the severity of the accident or injury.
- Likelihood – Highly unlikely that a serious accident or injury would result during operations, *e.g.,* from a fire, leak, or explosion, given the extensive pipeline safety protocol.

The following mitigation measures, described above in Section 4.21.2.2 and in Appendix M, are proposed by AGDC to address potential accidents and injuries: Mitigation Measure Nos. 1 through 3, 5, 7, and 8 through 12. Mitigation measures here are the same as those listed during the construction phase.

4.21.4.2.3. Exposure to Hazardous Materials

The potential adverse impact of operations and maintenance on the rate of exposure to hazardous materials is expected to be minor, as operation and maintenance are expected to have a limited perceptible effect on the presence of hazardous materials within or adjacent to PACs. Exposure to hazardous materials from leaks and spills, or emissions, was considered unlikely given the limited presence of equipment and trucks and mitigation measures required by regulation (as described in Appendix M). It is also considered highly unlikely that pipeline leaks (resulting in exposure to gas, fire, or explosions) would occur, given the strict engineering controls and safety mitigation measures that would be implemented (see Mitigation Measure No. 7 regarding fire safety).

Section 4.22, Air Quality, Climate Change, and Greenhouse Gas Emissions, cited (perceptible) air quality impacts for the operations and maintenance period with the pipeline itself, or with the connection valves, stating that "…while there may be fugitive emissions [from operation of the valves], such emissions are generally very minor in nature and typically are not subject to the requirement to obtain an [air quality] permit."

In addition, Fairbanks is currently classified as an air quality Non-attainment Area by ADEC and USEPA. The Fairbanks air quality non-attainment is described in Section 3.18 (Air Quality). The proposed Project could result in an indirect positive impact the air quality in the Fairbanks area by reducing the dependence on energy sources that result in greater air impacts. The degree of the positive impact would depend on the number of homes, businesses, and industrial facilities in and around Fairbanks that convert from current heat sources, such as oil, coal, and wood, to natural gas. Air quality in other communities or regions along the pipeline corridor may also be improved if natural gas distribution systems are established and users choose to convert to natural gas for heating and electrical power generation.

Overall, the potential adverse impact of operations on the rate of exposure to hazardous materials within each PAC would likely be minor, with individual impact criteria were rated as follows:

- Magnitude/Intensity – Negligible to minor risk of exposure to hazardous materials from leaks, spills, or emissions from maintenance equipment or vehicles.
- Geographic Extent – Individual cases or very local exposure.
- Duration/Frequency – Limited frequency during isolated events for the duration of operations and maintenance.
- Resiliency/Ability to Adapt – Minor, limited to those affected by a spill/leak; individuals would be able to adapt and maintain their pre-impact level of health.
- Likelihood – Unlikely chance that the exposure to hazardous materials within individual households or PACs would increase during operations.

The following mitigation measures, described above in Section 4.21.2.2 and in Appendix M, are proposed by AGDC to address impacts of exposure to hazardous materials: Mitigation Measure Nos. 1 through 4, and 8 through 12. Mitigation measures here are the same as those listed during the construction phase.

4.21.4.2.4. Food, Nutrition, and Subsistence Activity

This section includes health outcomes and determinants related to food security, dietary choices, and the consumption of subsistence foods. Section 4.20, Subsistence details the potential impact of operation of the proposed Action (Alternative 1) on subsistence activities. Table 4.20-5 presents the impact categories for operation by study community (which is analogous to PAC for the purpose of this SEIS). The potential impact on subsistence, and in turn on food and nutrition, would vary by the regions assessed in Section 4.20. Potential impacts of the proposed Action to subsistence communities during construction and operation are presented in Table 4.20-7. During operations, the impact on subsistence in most of the study communities (31 communities) would likely be negligible during operation. The impact would likely be major in two communities, moderate in 11 communities, and minor in seven communities (Table 4.20-7). The impact of operation on subsistence activities was ranked the highest (major) in the communities of Minto and Nenana (Table 4.20-5).

Based on the assessment provided in the Section 4.20, the overall potential adverse impact to food, nutrition, and subsistence activity during operations and maintenance would likely be moderate, with limited, but potentially perceptible effects, to subsistence resources and PACs. Maintenance would be limited during operations. While disturbance to wildlife is expected to be minimal, new access roads and increased traffic and noise from aerial and ground-based pipeline inspections have the potential to displace and reduce the availability of terrestrial wildlife for subsistence users. A cleared ROW and the construction of new access roads could also attract additional harvesters, who use ATVs, to the ROW, as well as, other pipeline support features, including: new or expanded borrow areas, access roads to PSYs, worker camps and borrow or disposal areas. Pipeline operation and maintenance activities are not expected to limit access to subsistence users.

The overall adverse impact of operations on food, nutrition, and subsistence activity within each PAC would likely be moderate, with individual impact criteria rated as follows:

- Magnitude/Intensity – Minor to moderate severity, depending on the PAC (see Table 4.20-5) due to the potential displacement of wildlife by new access roads and increased traffic and noise from aerial and ground-based inspections.
- Geographic Extent – Subsistence-based PACs, or within the region of subsistence-based PACs. The impact of operations and maintenance activities on subsistence activities was ranked the highest in the communities of Minto and Nenana (Table 4.20-5).

- Duration/Frequency – Long-term, for the duration of the proposed Project.
- Resiliency/Ability to Adapt – Minor to moderate, as subsistence-based PACs affected by an impact to subsistence resources should be able to adapt (*e.g.*, by finding new harvest areas) and maintain their pre-impact level of food security and nutrition.
- Likelihood – Somewhat likely chance of impact to subsistence, which would in turn impact food security and nutrition.

The following mitigation measures, described above in Section 4.21.2.2 and in Appendix M, are proposed by AGDC to address impacts to food, nutrition, and subsistence activities: No. 1, 4 through 6, and 13. Mitigation measures here are the same as those listed during the construction phase.

4.21.4.2.5. Water and Sanitation

The potential adverse impact to water resources and sanitation during the proposed Project construction would be negligible, as operation and maintenance activities are not expected to change PAC access to potable water, water quantity, water quality, or to change the demand on water and sanitation infrastructure. The proposed Project would obtain the necessary permits prior to any water withdrawal required for operations and maintenance, minimizing impact to PAC potable water supplies. The number of proposed Project workers would be minimal, and is therefore, not expected to cause a perceptible increase in water use.

The following mitigation measures, described in Section 4.21.2.2 and Appendix M, are proposed by AGDC to address potential water and sanitation impacts: Mitigation Measure Nos. 1 and 4. Mitigation measures here are the same as those listed during the construction phase.

4.21.4.2.6. Infectious Disease

The potential adverse impact to infectious disease rates during operations and maintenance would be moderate, with perceptible effects likely limited to the individual or household, and individuals affected would be expected to be able to adapt with medical care. The operations and maintenance period would require limited workers for each pipeline segment, and most are expected to be Alaska residents, often from the local PACs, limiting exposure of PACs to infectious diseases from outside the area.

Individual impact criteria were rated as follows:

- Magnitude/Intensity – Minor to moderate severity of impact on infectious disease rates associated with the limited maintenance work force; intervention may be needed particularly to minimize the transmission of STDs.
- Geographic Extent – Increase of infectious diseases would likely be limited to individual cases.

- Duration/Frequency – Long-term, during the extent of operations and maintenance.
- Resiliency/Ability to Adapt – Moderate to major, as those infected may or may not be able to adapt and maintain pre-impact level of health, depending on the infectious disease, and whether it remains untreated.
- Likelihood – Unlikely to somewhat likely that the infectious disease rate would increase, particularly for STDs, given the limited operations and maintenance workforce required.

The following mitigation measure, described in Section 4.21.2.2 and Appendix M, is proposed by AGDC to address potential affects from infectious diseases: Mitigation Measure No. 1. The mitigation measure listed here is the same as the measure listed during the construction phase.

4.21.4.2.7. Non-Communicable and Chronic Disease

The potential adverse impact to non-communicable and chronic disease rates during operations and maintenance would be negligible, as this period is expected to have no perceptible effect on the exposure of individuals or PACs pollutants that exacerbate or cause the non-communicable and chronic diseases evaluated.

The proposed Action could potentially result in a positive impact on air quality in the Fairbanks area, resulting from a reduction in particulate matter associated with reduced use of wood stoves after the natural gas distribution system becomes available in Fairbanks. Assuming a reduction in the use of wood heat, the reduction in particulate matter and improved air quality would be expected to reduce chronic respiratory diseases. However, these changes depend on expansion of the gas distribution network in Fairbanks, and the number of homes that would transition from wood, coal, or oil heat to natural gas is unknown. Therefore, the impact is considered to potentially have only a minor positive impact.

Individual impact ratings for the positive minor impact are as follows:

- Magnitude/Intensity – Moderate potential benefit (reduction in rate of chronic lung diseases) resulting from increased household access to natural gas as a heat source, and a reduction in wood or coal as a heat source (in turn improving air quality).
- Geographic Extent – For PACs (specifically Fairbanks), poor air quality (particulate emissions) could be reduced by the use of natural gas as a heat source rather than from wood or coal burning.
- Duration/Frequency – Long-term, for the duration of the proposed Project.
- Resiliency/Ability to Adapt – Moderate, as those impacted could experience beneficial impacts to health for specific populations (*e.g.*, Fairbanks residents with chronic lung diseases that are exacerbated by poor air quality).

- Likelihood – Likelihood is unknown and depends on expansion of the gas distribution network in PACs with poor air quality (*e.g.*, Fairbanks), and the number of homes that would transition from wood, coal, or oil heat to natural gas.

The following mitigation measure, described in Section 4.21.2.2 and Appendix M, is proposed by AGDC to address potential non-communicable and chronic disease impacts: Mitigation Measure No. 1.

4.21.4.2.8. Health Services Infrastructure and Capacity

The potential impact to this HEC within each PAC would be negligible, as operation and maintenance activities are expected to have only a very limited perceptible effect on the number of health clinics, staff, or health services available to a PAC. The proposed Project operations and maintenance activities are not expected to perceptibly increase the rate of accidents and injuries within PACs, and injuries resulting from pipeline fires or explosions (although highly unlikely) would likely be serious enough to require transport to Fairbanks or Anchorage for treatment.

Mitigation Measure No. 1, described in Section 4.21.2.2, is proposed to address potential non-communicable and chronic disease impacts by reducing the risk of exposure to contaminants through implementing a surveillance and monitoring program.

4.21.5. Alternative 2 – Denali NPP Route Variation

This section discusses and rates the potential impacts of construction and operation of the proposed Project for Alternative 2 (Denali NPP Route Variation) on public health, for each individual HEC presented in Table 4.21-2 above. Results of the impact ratings for Alternative 2 are presented in Table 4.21-4, below. Potential impacts to public health related to Alternative 2 are expected to be the same as those described for Alternative 1, with the following exceptions related to the Denali NPP Route Variation and the placement of the pipeline above ground between MP 0 and MP 62. While these proposed Project design changes may present slightly differing impacts to public health, neither was considered materially significant enough to change the overall impact rating for each HEC from that described for Alternative 1. Any changes to individual impact ratings are discussed in each section.

AGDC-proposed mitigation measures listed at the end of each of the subsections above, Sections 4.21.4.1.1 through 4.21.4.2.8, apply equally to the associated Alternative 2 construction and operation health effect categories.

4.21.5.1. Denali NPP Route Variation

The Denali NPP Route Variation would route the pipeline through a corner of Denali NPP (Figure 2.4-1 in Chapter 2, Alternatives), between Mainline (Alternative 1) MPs 535.8 and 543. The route would generally parallel the highway corridor into Denali NPP on flatter terrain, including within the area of commercial businesses located just north of the park entrance.

The placement of the pipeline within the Parks Highway ROW would potentially cause a greater adverse impact on the McKinley Park PAC, for three of the HECs evaluated: accidents and injuries; exposure to hazardous materials; and SDHs. This increased impact would be expected given that all of the proposed Project construction would be occurring within the PAC under Alternative 2, rather than partially outside of the PAC, as proposed for Alternative 1. However, the slight increased impact for these HECs in the McKinley Park PAC under Alternative 2 would not likely be significant enough to increase the overall rating from moderate to major, as the impact would still be temporary, and limited to individual households or the PAC.

4.21.5.2. MP 0 to 62 Pipeline Aboveground

Under Alternative 2, the pipeline would be placed above ground on VSMs from MP 0 to 62. The elevation of the pipeline would add an additional aboveground feature on the landscape, as portions of it would be located near the existing TAPS ROW. As discussed in Section 4.10, Wildlife, the elevation of the pipe could introduce additional impacts to caribou, and in turn food, nutrition, and subsistence. On the other hand, an elevated pipe is expected to have less impact on the North Slope wildlife habitat than a buried pipeline, as a buried pipeline would be expected to alter the thermal stability of the permafrost, causing hydrologic changes and impacts to wildlife habitat. Therefore, the impact of Alternative 2 on wildlife, and in turn on food, nutrition, and subsistence, is expected to remain moderate, as rated for Alternative 1.

An elevated pipeline could be more easily targeted by vandalism or terrorist attacks than one hidden below ground. Along with damage to the environment, accident and injury impacts to public health could result from the initial incident as well as during repair the damaged infrastructure. Additionally, interruption of service for natural gas customers, especially in the winter, could result in negative public health impacts due to a lack of heating energy during freezing winter months.

4.21.6. Alternative 3 – No Action

Under Alternative 3 (No Action), the proposed Project would not be developed, and there would be no impacts to public health within the evaluated PACs, with one exception. The FNSB, State of Alaska and EPA are actively working on solutions to reduce particulate matter emissions in the Fairbanks area. Assuming the development of a gas distribution network in the Fairbanks area, and the transition of households from wood and coal to natural gas as a heat source, the proposed Project could be part of the solution for reducing particulate emissions. However, given the uncertainties of the transition of households to natural gas, the degree of potential impact of Alternative 3 is rated as only a minor negative impact. Section 4.26, Cumulative Impact Assessment, also discusses the potential cumulative effects of changing the source of heating fuel in Fairbanks.

4.21.7. Conclusions and Comparison of Alternatives

The potential impacts of the three alternatives on public health HECs are presented in Table 4.21-4. Overall, Alternatives 1 and 2 were determined to have the same impact to public health in the PACs along the proposed Project route during the construction and operations periods. For Alternatives 1 and 2, most impacts were evaluated to have either a negligible impact, or a minor or moderate adverse impact during construction and operation. Alternatives 1 and 2 could potentially have a positive moderate impact on air quality in the Fairbanks area, and in turn chronic disease (respiratory diseases). However, these changes depend on expansion of the gas distribution network in Fairbanks. Therefore, the impact of Alternatives 1 and 2 operations is considered to potentially have only a minor positive impact.

The impact of Alternative 3 (No Action) would likely have no impact (negligible) on public health, with the exception that not developing the pipeline could potentially have a minor negative impact on the chronic disease HEC as related to the continued exceedance of air quality standards for particulate matter in and near Fairbanks. However, this would depend on the degree to which households transitioned from wood, coal, or oil heat, to natural gas.

Figure 4.21-1 places the key findings from the impact analysis into a geographic context. The single difference between the impact ratings presented in Table 4.21-4 and Figure 4.21-1 is that the minor positive rating for the non-communicable and chronic disease health indicator for Alternatives 1 and 2 is assigned exclusively to the Fairbanks area, where any transition to natural gas from wood or coal fired heat may have a positive impact on this health indicator. The impact ratings for all other health indicators are identical throughout the PACs for the construction and operations periods.

Table 4.21-4 Comparison of Alternatives Summary for Public Health

Health Effect Categories (HECs)	Alternative 1		Alternative 2		Alternative 3	
	Construction	Operations	Construction	Operations	Construction	Operations
	Impact Rating		Impact Rating		Impact Rating	
Social Determinants of Health	*Moderate (-)*	*Moderate (-)*	*Moderate (-)*	*Moderate (-)*	*Negligible*	*Negligible*
Accidents and Injuries	*Moderate (-)*	*Moderate (-)*	*Moderate (-)*	*Moderate (-)*	*Negligible*	*Negligible*
Exposure to Hazardous Materials	*Moderate (-)*	*Minor (-)*	*Moderate (-)*	*Minor (-)*	*Negligible*	*Negligible*
Food, Nutrition, and Subsistence Activity	*Moderate (-)*	*Moderate (-)*	*Moderate (-)*	*Moderate (-)*	*Negligible*	*Negligible*
Infectious Disease	*Moderate (-)*	*Moderate (-)*	*Moderate (-)*	*Moderate (-)*	*Negligible*	*Negligible*
Water and Sanitation	*Minor (-)*	*Negligible*	*Minor (-)*	*Negligible*	*Negligible*	*Negligible*
Non-Communicable and Chronic Disease	*Moderate (-)*	*Minor (+)*	*Moderate (-)*	*Minor (+)*	*Negligible*	*Minor (-)*
Health Services Infrastructure and Capacity	*Minor (-)*	*Negligible*	*Minor (-)*	*Negligible*	*Negligible*	*Negligible*

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▲ City or Village

ASAP v6.1 Mainline

FBX v4.1 Lateral (Belowground)

Potentially Affected Communities (Excluding Fairbanks North Star Borough)

Fairbanks North Star Borough

Effect Rating

Major Positive

Moderate Positive

Minor Positive

Negligible

Minor Negative

Moderate Negative

Major Negative

Effect Indicators

SDH: Social Determinants of Health

A&I: Accidents and Injuries

EHM: Exposure to Hazardous Materials

FN&S: Food, Nutrition, and Subsistence Activity

ID: Infectious Disease

W&S: Water and Sanitation

NC&CD: Non-Communicable and Chronic Disease

HSI&C: Health Services Infrastructure and Capacity

Potentially Affected Communities

Construction

	SDH
	A&I
	EHM
	FN&S
	ID
	W&S
	NC&CD
	HSI&C

Operations

	SDH
	A&I
	EHM
	FN&S
	ID
	W&S
	NC&CD
	HSI&C

Fairbanks North Star Borough

Construction

	SDH
	A&I
	EHM
	FN&S
	ID
	W&S
	NC&CD
	HSI&C

Operations

	SDH
	A&I
	EHM
	FN&S
	ID
	W&S
	NC&CD
	HSI&C

Beaufort Sea

MP 0 Prudhoe Bay

MP 100

MP 200 Wiseman Coldfoot

MP 300

MP 400 Livengood

Gold Stream College Fairbanks Ester

Four Mile Road Nenana Anderson

MP 500 Healy

McKinley Park Cantwell

MP 600

Trapper Creek Talkeetna North Susitna

MP 700 Willow Wasilla

MP 733 Big Lake

Point MacKenzie

U.S.A.

CANADA

Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

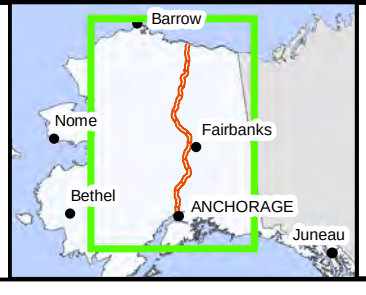
ERM

825 W. 8th Ave., Anchorage, AK 99501, (907) 258-4880

DATE: MAR 2018
CHKD: K.A.
DRWN: A.V.K.
PROJ. No.: 0416166

Figure 4.21-1: PUBLIC HEALTH IMPACTS CONTEXT MAP ALASKA STAND ALONE PIPELINE

0 30 60 120 180 Miles



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4.22. Air Quality, Climate Change, and Greenhouse Gas Emissions

4.22.1. Introduction

This section describes the potential direct and indirect effects of the proposed Project and the alternatives described in Chapter 2 on air quality, climate change, and GHG emissions. This section outlines the proposed Project Area and defining frequently used terms, describes what information was incomplete or unavailable and how that has influenced this analysis, describes the methods for determining the level of impact to air quality, climate change, and GHG emissions, and finally, presents the results of the assessment. This section describes some of the mitigation measures that would aid in avoiding or minimizing the potential impacts. Additional information on proposed mitigation and monitoring is provided in Appendix M. The information used in this section builds on the 2012 FEIS (USACE, 2012a) and incorporates new data and information relevant to environmental concerns associated with the alternatives that have become available since the 2012 FEIS. Importantly, the proposed changes in route and design described in Alternative 1 are the focus of this assessment. The information provided here supersedes the information provided in the 2012 FEIS; in some instances, the information is replicated with relatively minor changes and updates, while other material is entirely new or substantially altered. The following items have been added to the 2012 FEIS information related to impacts to the SEIS to these resources:

- A new section (Section 4.22.2, Methods) was added to explain the procedures used to evaluate the potential impacts associated with the proposed Project and alternatives;
- New information on proposed construction equipment and associated emissions;
- Updated BACT analysis for emissions of NOx, CO, VOC, SO_2, PM_{10}/$PM_{2.5}$, and GHG from the GCF;
- Open burning is no longer proposed and is, therefore, not discussed in this analysis; and
- Updates to impacts based on new alternatives and a summary of those results.

4.22.1.1. Incomplete or Unavailable Information

In compliance with CEQ guidance (see Section 4.3), this section addresses incomplete or unavailable information pertinent to analyzing impacts of the alternatives on air quality, climate change, and GHG emissions. For example, as described in the 2012 FEIS, site-specific air quality monitoring data are not available in much of the proposed Project Area. Consequently, representative data have been used as described in Section 4.22.2, Methods. Additionally, the assessment of Fairbanks air quality includes a scenario whereby the construction of a natural gas pipeline (Alternative 1 or 2) could result in improvements to air quality, assuming fewer buildings use wood, coal or fuel oil for heating. The assessment presented on this topic is qualitative in nature due to the difficulty in predicting how many buildings would tie in to natural gas, how

significantly air quality would improve, and when that would occur. Generally, where specific data or modeling have not been undertaken or are not currently available, a qualitative assessment of the potential impacts on air quality is presented to compare and contrast the alternatives.

4.22.2. Methods

The potential impacts for the proposed Project presented below are based on publicly available data on air quality within the proposed Project Area, the proposed construction equipment, other proposed Project details (*i.e.*, GCF facility emissions), public comments received after the publication of the 2012 FEIS and during the public scoping period for the SEIS held in 2014, and review of public comments received on the Draft SEIS during the July/August 2017 public comment period.

Potential impacts were analyzed by assessing the magnitude, extent, duration, and likelihood of occurrence, as presented in Table 4.22-2, Impact Criteria for Air Quality. The information presented in Table 4.22-2 was gathered from publicly available sources from monitoring stations operated by private entities and local, state, and federal agencies and has been organized to represent the North Slope, Interior Alaska and Alaska Range, and Southcentral and Cook Inlet regions. Results depicted for the North Slope were generated using seven datasets from North Slope oil and gas facilities and remote locations. The Interior data was generated primarily from FNSB, located off the proposed Project Mainline area, and is a nonattainment area for $PM_{2.5}$. The majority of southcentral datasets were collected from Anchorage urban areas or areas used to characterize fugitive dust in the Matanuska Valley (Alaska LNG, 2017b).

A summary of the available regional background air quality concentrations is presented in Table 4.22-1. Estimated air emissions from construction and operation (*i.e.*, criteria pollutants) associated with the alternatives were compared to federal and state regulatory requirements to determine applicability and impacts. The National Ambient Air Quality Standards (NAAQS)/Alaska Ambient Air Quality Standards (AAAQS) for different pollutants have different averaging periods and statically determined threshold limits (*i.e.*, NOx [1 hour standard] = 98^{th} percentile of 1-hour daily maximum concentration, average over 3 years). Percentage value is used to describe how close the current air quality has become to a (complex or simple) NAAQS/AAAQS standard. A higher percentage indicates a lesser achievement of the NAAQS/AAAQS standards. The proposed construction spread (*i.e.*, schedule) for the pipeline is presented in Chapter 2, Table 2.2-7 (Alternative 1: ASAP Construction Spread Plan).

Table 4.22-1 Regional Background Air Quality Concentrations for the Proposed Project Area

	NSB - Prudhoe Bay	Interior Alaska and Alaska Range[a]	Southcentral Alaska and Cook Inlet
PM_{10}			
24-hour	50 µg/m^3 (33% of AAAQS)[a]	15 – 111 µg/m^3 (10 – 74% of AAAQS)	40 µg/m^3 (26.7% of AAAQS)[a]
$PM_{2.5}$			
Annual	3.7 µg/m^3 (31% AAAQS)	1.45 – 13.2[b] µg/m^3 (12.1 – 110% AAAQS)	3.7 µg/m^3 (30.% of AAAQS)
24-hour	15 µg/m^3 (42.8 % AAAQS)	11.2 – 83.2[b] µg/m^3 (32 – 237.7% of AAAQS)	12 µg/m^3 (34.3% AAAQS)
SO_2			
Annual	1.8 µg/m^3 (2.3% of AAAQS)	1.33 -33.2 µg/m^3 (1.7 – 41.5% of AAAQS)	0.0 µg/m^3 (0% of AAAQS)
24-hour	8.12 µg/m^3 (2.2% of AAAQS)[a]	5.33 – 85.9 µg/m^3 (1.5 – 23.5% of AAAQS)	2.4 µg/m^3 (0.7% of AAAQS)
3-hour	20.96 µg/m^3 (1.6% of AAAQS)[a]	5.33 – 131 µg/m^3 (0.4 – 10.1% of AAAQS)	5.0 µg/m^3 (0.4% AAAQS)
CO			
8-hour	1.15 mg/m^3 (11.5% of AAAQS)	0.3 – 3.21 mg/m^3 (3 – 32.1% of AAAQS)	1.145 mg/m^3 (11.5% AAAQS)
1-hour	1.15 mg/m^3 (2.9% of AAAQS)	0.7 – 5.41 mg/m^3 (1.8 – 13.5% of AAAQS)	1.145 mg/m^3 (2.9% AAAQS)
NO_2			
Annual	6.0 µg/m^3 (6% of AAAQS)	1.91 µg/m^3 (1.9% of AAAQS)	2.6 µg/m^3 (2.6% of AAAQS)
O_3			
8-hour	0.056 ppmv (80% of AAAQS)	0.054 – 0.064 ppmv (77.14 – 91.42% AAAQS)	0.047 ppmv (63.9% of AAAQS)

Source: Alaska LNG, 2017b
µg/m3 = micrograms per cubic meter
mg/m3 = milligrams per cubic meter
AAAQS = Alaska Ambient Air Quality Standards
ppmv = parts per million in volume
a Concentrations for short-term standards (1 to 24 hours) based on design calculations for the standards
b Includes measured concentrations from the Fairbanks urban PM2.5 nonattainment area

4.22.2.1. Description of Types of Effects on Air Quality

The proposed Project would generate air emissions from a number of construction and operation activities, including NOx, CO, VOC, SO_2, and CO_2-e, breathable particulate matter, and some hazardous air pollutants (HAPs) associated with combustion of fossil fuels. Impacts to air quality associated with proposed Project construction would include fugitive dust and emissions from fossil fuel-fired construction equipment, combustion emissions (*i.e.*, camp generators), and temporary fuel transfer systems and

associated storage tanks. Operation of the GCF and other aboveground facilities has also been taken into account in this analysis. Information used as the basis for the analysis was taken from sources including the 2012 FEIS, the ASAP Project Gas Conditioning Facility Regulatory Review and Best Available Control Technology Analysis (2015), and the 2016 ASAP EED (AGDC, 2016b).

4.22.2.1.1. Fugitive Dust

Fugitive dust is a source of breathable airborne PM, including PM of 10.0 µ in diameter or smaller (PM_{10}) and PM of 2.5 µ in diameter or smaller ($PM_{2.5}$). Land clearing, grading, excavation, blasting and vehicle traffic (including construction camp traffic) on paved and unpaved roads create fugitive dust. The type and duration of activities affects the amount of dust generated, as well as the type of ground surface (*i.e.*, silt or sand), moisture content of the soil, wind speed, frequency of precipitation, traffic volume, vehicle trackout (on to paved roads), vehicle types, and roadway characteristics.

4.22.2.1.2. Fossil-Fueled Construction Equipment

Construction camp generators, excavators and other earth-moving equipment, trucks, non-road engines, and other mobile sources fueled by diesel or gasoline would be sources of combustion emissions, including NOx, CO, VOCs, SO_2, PM_{10}, $PM_{2.5}$, and small amounts of HAPs. Gasoline and diesel engines must comply with EPA mobile source regulations in Title 40 of the CFR 86 for on-road engines and 40 CFR 89 and 90 for non-road engines. EPA has established rules in 40 CFR 80 that require significant reductions in the sulfur content of diesel fuel used in on-road and non-road engines. Since December 1, 2010, EPA requires use of ULSD fuel (*i.e.*, does not exceed 15 ppm sulfur) for all on- and off-road diesel engines.

4.22.2.2. Impact Criteria

Table 4.22-2 summarizes the criteria used to determine the level of impact based on the magnitude, extent, duration, and likelihood of occurrence. Table 4.22-3 defines the types of effects the proposed Project and activities may have on air quality assessed in this SEIS. Mitigation measures are described in Appendix M of this SEIS. Potential impacts that remain after mitigation measures have been implemented are described for each alternative in the following sections.

Table 4.22-2 Impact Criteria for Air Quality

Impact Component	Impact Level			
	Major	**Moderate**	**Minor**	**Negligible**
Magnitude or Intensity	Air quality concentrations would exceed NAAQS thresholds for criteria pollutants or health impact thresholds for HAPs.	Air quality would be degraded and pollutant concentrations would approach HAPs, criteria pollutant thresholds, or applicable air quality related values.	Emissions and dust would occur but would fall below applicable regulatory thresholds and permitting standards.	No effect
Geographic Extent	The effect would occur on a statewide or regional basis, or throughout the study area.	The effect would occur at a borough or community level, or on a limited portion of the study area.	The effect would be site-specific or occur within a few isolated locations.	The effect would be limited to a specific, isolated location.
Duration or Frequency	The effect would occur for a duration of greater than 3 years or through operations of the proposed Project. Chronic and long-term changes not likely to be reversed over several years or operational life.	The effect would occur intermittently for a duration of 1 to 3 years. Periodic, temporary, or short-term changes could be reversed in an annual or several seasonal cycles.	The effect would occur intermittently for a duration of less than 1 year. Periodic, temporary, or short-term changes could be reversed over one or two seasons.	So intermittent and limited duration that effect dissipates rapidly.
Likelihood	Most likely (effects are those that have greater than 75% chance of arising from reasonable or demonstrated mechanisms due to the action)	Likely (effects are those that have 50% to 75% chance of arising from reasonable or demonstrated mechanisms due to the actions)	Somewhat likely (effects are those that have a 10% to 50% chance of arising from reasonable or demonstrated mechanisms due to the action)	Unlikely (effects are those that have less than 10% chance of arising from reasonable or demonstrated mechanisms due to the action)

Table 4.22-3 Types of Effects and Impacts on Air Quality

Type of Effect	Proposed Action Causing Potential Impact	
	Construction	Operations & Maintenance
Increase in levels of air contaminant concentrations (criteria pollutants, GHGs, and HAPs): • Potential impacts to human health • Potential impacts to ecosystem	Operation of fossil fuel- fired vehicles and equipment	On-going operation and maintenance of aboveground facilities and fugitive pipeline methane emissions.
Increase in fugitive dust emissions	Excavation and transportation activities. Disturbance of ground cover during construction includes use of 89 material sites, 13 construction camps and 26 PSY locations, transportation of materials, workers and equipment	On-going operation and maintenance of pipeline and aboveground facilities
Decreased emissions as a result of improved access to natural gas	Not applicable	Increased opportunities for natural gas energy, and decreased reliance on heating oil, coal, and wood

4.22.3. Proposed Design Features, Mitigation Measures, Best Management Practices, and Project Management Plans

4.22.3.1. Applicant-Proposed Design Features, Mitigation Measures, Best Management Practices, and Project Management Plans

The following design features, mitigation measures, and BMPs are proposed by AGDC, and have been taken into consideration when evaluating potential impacts on air quality under Alternatives 1 and 2 during the construction and operations phases. A complete list of mitigation measures and BMPs are also provided in Appendix M. Additionally, GCF criteria pollutant and GHG BACT are described in detail in the *Gas Conditioning Facility Regulatory Review and Best Available Control Technology Analysis* document (Attachment 7 to the 2015 EED, publicly available at: http://asapgas.agdc.us/documents.html).

Applicant-proposed air quality mitigation measures include the following:

- Implement BMPs during construction activities to mitigate fugitive dust and reduce particulate matter emissions.
- Use BACT for combustion equipment to mitigate NOx and CO emissions.
- Use ULSD fuel for construction equipment and non-natural gas combustion equipment (to mitigate SO_2 emissions), PM emissions, and VOC emissions.
- Operate all combustion equipment in accordance with manufacturer's specifications to mitigate NOx, CO, VOC, and PM emissions resulting from incomplete combustion.

- Maintain Emissions control equipment in accordance with manufacturer's specifications to mitigate emissions and maintain emission control efficiency.
- In areas where a lease is required from the SPCS or a federal grant of ROW is required from BLM, AGDC would operate all facilities and devices used in connection with the proposed pipeline so as to avoid or minimize air pollution and ice fog. Facilities and devices that cannot be prevented from producing ice fog would be located so as not to interfere with airfields, communities, or roads.
- Dust suppression: The proposed Project would perform dust suppression using water, if necessary. AGDC would follow the approved ASAP Fugitive Dust Control Plan to do so (see Appendix S).
- Implement the use of Tier 4 EPA-certified engines within the FNSB $PM_{2.5}$ Nonattainment Area.

Proposed mitigation measures applicable to climate change and GHG emissions impacts, not previously mentioned for air quality, include the following to maintain carbon stocks such as permafrost and vegetation:

- Minimization of impacts to permafrost through winter construction activities.
- Revegetation would be conducted as soon as practicable and, if necessary, would be repeated until vegetation is successful, unless otherwise approved by SPCS/BLM.
- For riparian vegetation clearing, vegetation would be cut off at ground level to leave the existing root systems in place to provide streambank stability. Where conditions allow, riparian vegetation would be restored with native plant species.
- AGDC has reviewed delineated wetland data to avoid and minimize impacts to wetlands along the entire proposed Project route.
- Pipeline construction across wetlands would be scheduled during winter to the maximum extent possible to minimize ground disturbance.
- To avoid a "French-drain effect" in wetlands that are trenched for the pipeline, trench breakers would be installed to stop water from flowing along the trench.

4.22.3.2. Agency-Recommended Mitigation Measures

A variety of mitigation measures and best practices have been recommended by the cooperating agencies (Appendix M). Many of these recommendations have been incorporated in the proposed Project and are included in Table 4.22-4 below. The impacts discussed in this chapter are based upon the Applicant-proposed measures. These additional agency recommended measures are not included in the impact analysis.

Table 4.22-4 Air Quality, Climate Change, and Greenhouse Gas Resources Agency-Recommended Mitigation Measures

Additional Measure Consideration	Agency Proposing Mitigation Measure	Agency Jurisdiction	Authority (*i.e.*, CWA, RHA, ESA)	Affected Resources	Comment Code
Include specific fugitive dust control measures, such as speed limits and frequency of watering during non-winter months, that would be implemented to achieve control limits.	EPA	EPA, ADEC	--	Vegetation, Wetlands, Fish, Public Health, Air Quality	MIT_34
We recommend that the Final SEIS list specific fugitive dust control measures, such as speed limits and frequency of watering during non-winter months, that would be used to achieve this level of control.	EPA	EPA, ADEC	CAA	Air, Wetlands, Vegetation, Human Health, Recreation	AIR_22

AAC = Alaska Administrative Code
ADF&G = Alaska Department of Fish and Game
ADEC = Alaska Department of Environmental Conservation
ADNR = Alaska Department of Natural Resources
AGDC = Alaska Gasline Development Corporation
APDES = Alaska Pollution Discharge Elimination System
BLM = Bureau of Land Management
BMP = Best Management Practice
CAA = Clean Air Act
CWA = Clean Water Act
DHSS = Alaska Department of Health and Social Services
EPA = U.S. Environmental Protection Agency
MBTA = Migratory Bird Treaty Act
NMFS = National Marine Fisheries Service
RHA = Rivers and Harbors Act of 1899
SEIS = Supplemental Environmental Impact Statement
USACE = U.S. Army Corps of Engineers
USFWS = U.S. Fish and Wildlife Service

4.22.4. Alternative 1 – Proposed Action

Alternative 1 is designated as the proposed Action (proposed ASAP Project). This alternative is described in Chapter 2 in detail. The 36-inch, 733-mile-long pipeline, and 12-inch, 30-mile lateral pipeline would cross various habitats and ecoregions from the North Slope to the existing ENSTAR pipeline system in the Mat-Su Borough. This section discusses the analysis of impacts to air quality effects along the route.

Air quality impacts from the proposed Project fall into two categories: 1) temporary impacts resulting from construction, and 2) long-term or permanent impacts resulting from operation of the facilities. Emission calculations for both construction and operation of the proposed Project are included in Appendix L.

4.22.4.1. Construction

4.22.4.1.1. Gas Conditioning Facility

Estimates for emissions generated from GCF construction activities are presented in Table 4.22-5. Detailed GCF emission estimates by year of construction are included in Appendix L. Additionally, the Alaska LNG Project Gas Treatment Plant Air Qualilty Impact Analysis has also been included in Appendix L for comparison and for the detailed historical measurements documented in the report. Construction emissions for NOx, CO, VOC, SO_2, and CO_2-e from the GCF are also included in the Mainline construction emissions shown in Table 4.22-7. Site-specific emissions from fugitive dust (PM, PM_{10}, and $PM_{2.5}$) for the GCF construction would be 52.47 TPY for PM and PM_{10} and 52.47 TPY for $PM_{2.5}$.

Table 4.22-5 GCF Annual Construction Emission Summary

Emission Source	NOx (TPY)	CO (TPY)	VOC (TPY)	SO_2 (TPY)	PM_{10} (TPY)	$PM_{2.5}$ (TPY)	HAPs (TPY)	CO_2-e[f] (TPY)
On-site Sources[a]	6.07	5.10	0.33	0.036	0.46	0.46	0.11	3.63
On-road Sources	29.6	102.4	3.48	0.10	2.43	1.91	4.88	7,456
Non-Road Equipment	1,268	499	75.2	1.58	76.1	76.1	6.60	167,220
Annual Construction Emission[b]	1,304	607	79	1.71	79	78.5	11.6	174,680
Total Construction Emissions for All Years[c]	3,640.9	1,652.7	223.73	4.75	220.87	219.25	34.27	484,984

a On-site sources include emissions from stationary sources (*i.e.*, boilers).
b Annual construction emission represents the emissions from the construction year excepted to generate the most emissions (Construction Year 1).
c Total construction emissions for all years represents the summation of all estimated GCF emissions generated for all years.

This assumes approximately 90.6 acres of land disturbance for the GCF and workpad, and an additional 20.2 acres of land disturbance for construction of the camp. Emission estimates also include West Dock dredging and updates and marine transportation and offloading. A detailed inventory of construction emissions, including source types and quantities of units, is included in Appendix L.

Each air pollution source contributes to the air quality within the air shed. An air shed is defined as "a part of the atmosphere that behaves in a coherent way with respect to the dispersion of emissions." The main air pollutant emissions associated with the construction of the GCF are fugitive dust from land disturbance and diesel emissions from engines. The particulate (air pollutants) from these operations are large and heavy and settle out quickly. Thus, they are not usually transported out of the immediate air shed. The site-specific area includes the total acres disturbed (110.8 acres) plus the surrounding air shed. The overall impact of the proposed Project construction on GCF contaminant concentrations and fugitive dust is expected to be direct and minor, for the following reasons:

- Contaminant emissions and fugitive dust would occur, but would meet permitting standards.
- Geographic Extent: The effect would be site-specific to the air around GCF.
- Duration or Frequency: The effect would occur intermittently during the construction phase of the GCF.
- Likelihood: The likelihood of the emissions from GCF construction of the proposed Project is estimated to be most likely.

4.22.4.1.2. Pipeline Right-of-Way Mainline

Air quality effects associated with construction of the proposed Project Mainline would include emissions from fossil fuel-fired vehicles, construction equipment, and fugitive dust. Under Alternative 1, AGDC would operate all fossil-fueled vehicles and construction equipment in accordance with manufacturer's recommendations to minimize construction-related emissions resulting from incomplete combustion.

Equipment associated with pipeline construction under Alternative 1 listed in Table 4.22-6 is a typical construction spread. It is assumed that the same equipment units would be used for each spread. The Mainline would be constructed in four construction spreads or completed lengths. Simultaneous activity would occur on all four spreads. A detailed inventory of construction equipment including unit types, quantities, and emission estimates is included in Appendix L of this SEIS.

Table 4.22-6 Construction Equipment

Equipment Type	
Backhoes	6-7 CY Loader
Ironwolf 1040 on 966 Carrier	8-9 CY Loader
Rough Terrain Crane	Bobcat Skidsteer Loader
Cone and Screen	Wheel Loader
Jaw Crusher	Medium Wheel Loader
Portable Impact Crusher	Chainsaw
Horizontal Shaft Crusher	Manlift
Radial Stacker	Pumper
Superior Conveyor	Drill
Overland Conveyor	Roller Vibratory Screen

Equipment Type	
Crawler Dozer	Trench Roller
Track Dozer	Large Screen
Bulldozer	Truck Scales with Generator
Small Excavator	Tucker Terra Sno-Cat Snow Machine
Medium Excavator	Flatbed Truck
Large Excavator	Mechanic Truck (Large)
Telehandler Forklift	Powder Truck
Large Telehandler Forklift	Heavy Semi Tractor
30-kW Generator	Volvo Haul Truck
100-kW Generator	Caterpillar Water Truck (Off-road)
750-kW Generator	Terex Water Truck
1,000-kW Generator	Water Truck (Off-road)
Grader	Envirovac - skid-mounted

The number of units of equipment is not available at this time. Only total hours of operation information was provided by MBJ.
CY – cubic yard
kW – kilowatt

Fugitive dust would be a source of respirable airborne PM, including PM_{10} and $PM_{2.5}$. Examples of activities that would create fugitive dust include proposed land clearing, grading, excavation, concrete work, blasting, and vehicle traffic on paved and unpaved roads. Dry summer and autumn weather, and construction in fine-textured soils throughout portions of the proposed Project Area could contribute to increased overall PM emissions. Additionally, on-road vehicle emissions would be greater in areas such as the NSB, where cold weather requires that vehicles be left running rather than turned off during short periods of non-use. ADEC regulations (18 AAC 50.110) state, "No person may permit any emission which is injurious to human health or welfare, animal or plant life, or property, or which would unreasonably interfere with the enjoyment of life or property." Under Alternative 1, BMPs discussed in Section 4.22.3 would be implemented during construction activities to mitigate fugitive dust and reduce PM emissions.

Emissions from construction equipment combustion and fugitive dust would be controlled to the extent required by EPA. Emissions for the proposed Project from construction of each Mainline spread are provided in Table 4.22-6. A detailed inventory of total construction emissions per spread is included in Appendix L. Also included in this appendix is a detailed inventory of sources, units, and emissions used to generate total spread calculations. Emissions were calculated to represent a worst-case (most conservative) scenario of operating all construction equipment 24 hours per day for 6 winter months, and 12 hours per day for 6 summer months. Upon finalizing the construction schedule and prior to the start of construction, AGDC would review and, if necessary, update the emissions calculations to obtain all necessary permits.

Construction would occur simultaneously on all four spreads lasting a total of 2.5 years, but would only last about 90 to 120 days (3 to 4 months) at any single point along the Mainline. To calculate emissions, the total miles within each spread were divided to be the length of time the spread would be in construction to determine the miles per month of construction. The fugitive dust emissions were then allocated to the winter or summer months in accordance with the schedule and divided between the 3 planned

construction years according to the number of workers on each spread for each time period. Due to the frozen ground and wet conditions, it is assumed no fugitive dust emissions would occur during the winter construction. For summer fugitive dust emission estimates, a controlled emission factor based on 1.2 tons per acre per month (ref. EPA AP-42, Vol. 1, 1993, Section 13.2.3.3) times 0.5 (controlled factor assumes 50 percent credit for watering) was used for 60 feet of a 120-foot of ROW. The remaining 60 feet of disturbed ROW would be used for vehicle travel.

Vehicle travel fugitive emissions were calculated using unpaved road emissions factors calculated using the methodology from EPA's AP 42, Chapter 13.2.2 (EPA, 2006), the number of vehicles and vehicle hours of use were provided by Michael Baker Jr., Inc. in the report Equipment Use by Equipment (MBJ, 2014), and assuming an average vehicle speed of 25 miles per hour. In the calculation method used to determine vehicle travel fugitive emissions, total PM fugitive dust is assumed equal to PM_{10} fugitive dust. $PM_{2.5}$ fugitive dust is estimated at 10 percent of PM_{10}, based on the study conducted by Midwest Research Institute in 2006 (Background Document for Revisions to Fine Fraction Ratios Used for AP-42 Fugitive Dust Emission Factors) for the Western Governors Association to better characterize the $PM_{2.5}/PM_{10}$ ratio in fugitive dust. This report has been accepted by EPA as an approved adjustment to the emission factors in EPA AP-42, Section 13.2. The unpaved road dust size factors from AP 42 Section 13.2.3.3 were used for PM, PM_{10}, and $PM_{2.5}$ emissions from the portion of the ROW allocated for vehicle travel (EPA, 1993).

Although mobile sources, including 17,700 truckloads of pipe and 6,000 rail cars of pipe, would contribute to emissions and fugitive dust, there are no applicable permits for emissions for mobile sources. Emissions associated with mobile sources are estimated based on publicly available information. Emissions from mobile sources (on-road and non-road) and fugitive dust during construction phase are included in Table 4.22-7.

The following describes calculations, assumptions, and sources used to generate the emission estimates included in Table 4.22-7.

- Emission rates for on-road vehicles were calculated based on an average of winter and summer emissions rates from the EPA MOVES Model for the NSB, using default fuel formulation, meteorology, fuel type mixture, and age distribution for 2016 (EPA, 2010a). The use of MOVES and non-road emission factors were approved by ADEC for the ASAP Fairbanks $PM_{2.5}$ Non-Attainment Area Emissions Inventory and Conformity Applicability Analysis (AGDC, 2016b). These factors were also used for these emission estimates for emission inventory consistency for all environmental documents. A conservative 25 miles per hour per vehicle speed rate assumption was used.
- Emission factors for non-mobile generators and equipment are based on the EPA NON-ROAD Model (non-road engines, equipment, and vehicles) (EPA, 2008). Emissions of SO_2 were calculated using mass balance computations at 15 ppm sulfur content (ULSD fuel) for diesel fuel. The HAPs emission factors used are from EPA's

AP 42, Fifth Edition, Compilation of Air Pollutant Emission Factors, Chapter 3.3, Table 3.3-2 for engines smaller than 600 horsepower (hp) and Chapter 3.4, Tables 3.4-3 and 3.4 – 4 for engines 600 hp and larger (EPA, 1996).

- The NSB factors were used because NSB is the coldest region along the proposed pipeline route with the oldest vehicle fleet. This assumption would lead to the highest emission factors when compared to the other regions along the pipeline route.
- Emission factors for off-road vehicle exhaust and heavy equipment were calculated using emission factors taken from EPA Report No. NR-009d – Exhaust Crankcase Emission Factors for Non-road Engine Modeling – Compression Ignition (EPA, 2010a). Deterioration values used were obtained from the same report. Conservatively, the factors for Base/Tier 0 Engines were used.
- Fuel density of 7.1 pounds per gallon and fuel heat content of 0.138 million British thermal units (MMBtu) per gallon were also used in the calculations.
- Transient adjustment and load factors were determined using EPA Report No. NR-005d – Median Life, Annual Activity and Load Factor Values for Non-road Engine Emissions Modeling (EPA, 2010b).
- The use of non-road emission factors were approved by ADEC for the ASAP Fairbanks $PM_{2.5}$ Non-Attainment Area Emissions Inventory and Conformity Applicability Analysis (AGDC, 2016b). For inventory consistency, non-road emission factors were also used for mobile heavy equipment emission estimates.

Non-road engines are portable and transportable engines that remain at any single location for 12 months or less and otherwise meet the non-road engine criteria in 40 CFR 89.2. Consequently, stationary source emissions from construction activities would not trigger the requirements for a prevention of significant deterioration (PSD), minor, or Title V permit as long as all mobile construction sources qualify as on-road or non-road. Because pipeline construction moves through an area relatively quickly, air emissions would typically be localized, intermittent, and short-term. As a result of compliance with applicable regulations, the increased contaminant concentrations and fugitive dust that could occur under Alternative 1 from Mainline construction-related activities would moderately affect local or regional air quality, for the following reasons:

- Emissions and dust would occur, but would fall below regulatory thresholds.
- Geographic Extent: The effect would be site-specific to the air around current construction spread.
- Duration or Frequency: The effect would occur intermittently for less than 1 year at each constriction spread location. However, the emissions from train and truckloads of pipeline would occur throughout the entire proposed Project Area during construction of the pipeline.

- Likelihood: The likelihood of the emissions from the proposed pipeline construction described above are most likely to occur.

Table 4.22-7 Mainline Construction Emissions[a] for Construction Equipment Only

Emission Source	NOx (TPY)	CO (TPY)	VOC (TPY)	SO_2 (TPY)	PM (TPY)	PM_{10} (TPY)	$PM_{2.5}$ (TPY)	HAPs (TPY)	CO_2-e[b] (TPY)
Mobile Sources[c]	34,994	12,558	1,611	43	1,884	1,884	1,882	111	4,521,273
Non-Mobile Sources[d]	1,478	443	79	2	84	84	84	4	184,488
Fugitive Dust	--	--	--	--	19,539	5,707	571	--	--
Total Construction Emissions Per Spread[c]	36,473	13,001	1,690	45	21,507	7,674	2,536	115	4,705,761
Total Construction Emissions for All Four Spreads[c]	126,743	45,178	5,872	154	81,182	24,922	8,639	400	16,352,520

Source: AGDC, 2016b; USACE, 2012a

a Emissions calculations used the length of each spread as estimated in the ASAP Construction Spread Plan. Equipment lists and hours of equipment operation were provided by Michael Baker Jr., Inc. in the 5/20/14 Equipment Use by Equipment report. For mobile and non-mobile sources, all particulate matter emissions are considered to be 2.5 micrometers or less except for stationary non-road engines greater than 600 hp in size. For engines greater than 600 hp, $PM_{2.5}$ emissions were calculated to be 97% of PM_{10} emissions in accordance with EPA's AP 42, Fifth Edition, Compilation of Air Pollutant Emission Factors, Chapter 3.4, Table 3.4-2 (EPA, 1996).

b GHG emissions (CO_2-e) for all emission sources, except for mobile vehicles (see note b), are based on emission factors in 40 CFR 98 Tables A-1, C-1, and C-2. Applicability to the GHG reporting rule is dependent upon actual emissions from the stationary (non-mobile) source (*i.e.,* CO_2-e actual emissions equal to or greater than a threshold of 25,000 metric TPY).

c Total in tons per spread represents maximum values calculated for any one spread in any construction year. For all sources except site disturbance fugitive dust, the second year of construction on Spread 3 had the highest emissions of any spread in any construction year because more workers would be working on this spread during the summer of this year than any other spread in any year. The total construction emissions are the highest emissions projected to occur during any one calendar year for all 4 spreads. This is year 2 of construction.

4.22.4.1.3. Construction Camp Operation

AGDC proposes to establish 13 SCCs (12 along the Mainline, plus one at the GCF). Construction emissions for NOx, CO, VOC, SO_2, and CO_2-e from construction camps and PSYs are included in the Mainline construction emissions shown in Table 4.22-7. Site-specific emissions from fugitive dust (PM, PM_{10}, and $PM_{2.5}$) would be 485.63 TPY for PM and $PM_{10,}$ and 48.56 TPY for $PM_{2.5}$ assuming 126.5 acres of land disturbance for each camp and pipeline yard construction.

SCCs would remain at the site for 12 months or more and would be used to house proposed Project personnel, for fuel and equipment storage, and as laydown yards.

Impacts to air quality as a result of construction camp operation would include emissions from support equipment that combusts fossil fuels (*i.e.*, generators, incinerators and waste oil heaters) and emits combustion-related to air pollutants such

as NOx, CO, PM, VOCs, and SO_2. The camp engines would be considered non-road engines under 40 CFR 89.2 if they meet the definitions of portable or transportable, and are at a location for less than 12 consecutive months. Non-road engine emissions would be excluded from the determination of "potential to emit" for permit applicability purposes in accordance with the Clean Air Act (CAA).

Estimated emissions resulting from construction camp operation are provided in Table 4.22-8. A detailed inventory of potential construction camp unit-types and quantities is included in Appendix L. AGDC did not identify any equipment ratings for the camp equipment provided; therefore, emissions were calculated based on several potential camps at a worst-case (most conservative) operating scenario. AGDC would need to refine the emissions calculations using vendor-specific emission factors upon equipment selection. As indicated in Table 4.22-8, preliminary emission estimates trigger the requirement for a minor permit for NOx for all SCCs (excluding temporary construction camps that qualify as non-road). The minor permit process would require AGDC to perform an air quality impact analysis to comply with the NOx air quality standards in 18 AAC 50.010. Consequently, the proposed Project, as permitted by ADEC, would not cause or contribute to a violation of any federal, state, or local air quality standards.

Table 4.22-8 Potential Camp Operations Maximum 12-month Emissions

Camp Name	VOC Emissions (STPY)	NOx Emissions (STPY)	CO Emissions (STPY)	SO_2 Emissions (STPY)	PM_{10} Emissions (STPY)	$PM_{2.5}$ Emissions (STPY)	CO_2-e Emissions (STPY)	HAP Emissions (STPY)
Cantwell	36.2	35	4.4	0.63	3.7	3.6	54,402	2.1
Dietrich	50.5	49	6.1	0.88	5.1	5.1	75,860	2.9
Dunbar	39.7	39	4.8	0.69	4.0	4.0	59,655	2.3
Five Mile	57.8	57	7.0	1.01	5.9	5.8	86,900	3.3
Franklin Bluffs	57.7	56	6.9	1.01	5.9	5.8	86,722	3.3
Galbraith Lake	86.4	85	10.4	1.51	8.8	8.7	129,905	5.0
Happy Valley	67.0	65	8.1	1.17	6.8	6.7	100,612	3.9
Healy	56.1	55	6.7	0.98	5.7	5.6	84,229	3.2
Livengood	86.7	85	10.4	1.51	8.8	8.7	130,350	5.0
Prospect	84.7	83	10.2	1.48	8.6	8.5	127,234	4.9
Prudhoe Bay	43.6	43	5.2	0.76	4.4	4.4	65,442	2.5
Rustic Wilderness	52.4	51	6.3	0.91	5.3	5.3	78,709	3.0
Swan Lake	45.2	44	5.4	0.79	4.6	4.5	67,935	2.6

Source: AGDC, 2016b
Only emissions from on-site stationary sources are summarized in this table. The emissions information presented for the construction camps is current as of information available on August 1, 2014.

The increased contaminant concentrations and fugitive dust that could occur under Alternative 1 as a result of camp operations are expected to moderately affect local or regional air quality, for the following reasons:

- Emissions and dust would occur but would fall below regulatory thresholds (*i.e.*, meet permitting standards)

- The effect would be limited to the area around the 13 camp facilities
- The effect would occur throughout construction for a period of 2.5 years
- The emissions related to camp operations described above are likely to occur

4.22.4.1.4. Fairbanks Lateral

Fairbanks is currently classified as an air quality Non-Attainment Area by ADEC and EPA. As described in 3.18.3.13, the Fairbanks Lateral would cross into the FNSB nonattainment boundary for $PM_{2.5}$ and would require a General Conformity determination. However, in a letter dated March 9, 2016, ADEC indicated that the most current proposed Project emission estimates are below the *de minimis* threshold of 100 TPY and a full General Conformity analysis would not be required (ADEC, 2016c). The Fairbanks air quality Non-Attainment is described in Chapter 3, Section 3.18, Air Quality. Air quality impacts associated with construction of the Fairbanks Lateral would be similar to the air quality impacts associated with construction of the Mainline, including emissions from fossil fuel-fired vehicles and construction equipment and fugitive dust (see Table 4.22-7). A detailed inventory of emission source types, unit numbers, and quantitative emission estimates is included in Appendix L of this report.

Emissions were calculated to represent a worst-case (most conservative) scenario of operating all construction equipment 12 hours per day for 4 summer months. Construction on one spread would be completed in one summer season, lasting a total of 4 months. For emission estimate calculations, the total miles of the Fairbanks Lateral (30.33) were divided by the length of time the spread would be in construction to determine the miles per month of construction. For emission estimates, a controlled emission factor based on 1.2 tons per acre per month (ref. EPA AP-42, Vol. 1, 1993, Section 13.2.3.3) times 0.5 (controlled factor assumes 50 percent credit for watering) was used for 50 feet of the anticipated 100-foot lateral ROW. The remaining 50 feet of disturbed ROW would be used for vehicle travel.

Vehicle travel fugitive emissions were calculated using unpaved road emissions factors calculated using the methodology from EPA's AP 42, Chapter 13.2.2 (EPA, 2006), the number of vehicles and vehicle hours of use were provided by Michael Baker Jr., Inc. in the 5/20/14 Equipment Use by Equipment report, and assuming an average vehicle speed of 25 miles per hour. In the calculation method used to determine vehicle travel fugitive emissions, total PM fugitive dust is assumed equal to PM_{10} fugitive dust for construction dust. $PM_{2.5}$ fugitive dust is estimated at 10 percent of PM_{10}, based on the study conducted by Midwest Research Institute in 2006 (Background Document for Revisions to Fine Fraction Ratios Used for AP-42 Fugitive Dust Emission Factors) for the Western Governors Association to better characterize the $PM_{2.5}/PM_{10}$ ratio in fugitive dust. EPA has accepted this report as an approved adjustment to the emission factors in EPA AP-42, Section 13.2. The unpaved road dust size factors from AP 42 Section 13.2.3.3 were used for PM, PM_{10}, and $PM_{2.5}$ emissions from the portion of the ROW allocated for vehicle travel (EPA, 1993).

For permitting applicability, stationary source emissions from construction activities would not trigger the requirements for a PSD, minor, or Title V permit as long as all mobile construction sources qualify as on-road or non-road. Because pipeline construction moves through an area relatively quickly, air emissions would typically be localized, intermittent, and short-term and would, therefore, be considered minor. Emissions from construction equipment combustion and fugitive dust would be controlled to the extent required by ADEC. As previously stated, under Alternative 1, AGDC would refine the emissions calculations once the equipment selection and construction schedule is finalized for permitting.

The following describes calculations, assumptions, and sources used to generate the emission estimates included in Table 4.22-9.

- Emission rates for on-road vehicles were calculated based on the maximum of either winter or summer emission rates from the EPA MOVES Model for the FNSB, using default fuel formulation, meteorology, fuel type mixture, and age distribution for 2008 (EPA, 2010a).
- Emission factors for off-road vehicle exhaust and heavy equipment were calculated using emission factors taken from EPA Report No. NR-009d – Exhaust Crankcase Emission Factors for Non-road Engine Modeling – Compression Ignition (EPA, July 2010). Deterioration values used were obtained from the same report. Conservatively, the factors for Base/Tier 0 Engines were used.
- Transient adjustment and load factors were determined using EPA Report No. NR-005d – Median Life, Annual Activity and Load Factor Values for Non-road Engine Emissions Modeling (EPA, 2010b). A conservative assumption of 25 miles per hour per vehicle for speed rate was used.
- Emissions of SO_2 were calculated using mass balance computations at 15 ppm sulfur content (ULSD fuel) for diesel fuel.
- The HAPs emission factors used are from EPA's AP 42, Fifth Edition, Compilation of Air Pollutant Emission Factors, Chapter 3.3, Table 3.3-2 for engines smaller than 600 hp and Chapter 3.4, Tables 3.4-3 and 3.4 - 4 for engines 600 hp or larger (EPA, 1996).
- Emission factors used in air quality analyses are determined by the guidance provided by regulating air districts. The use of Non-road emission factors was approved by ADEC for the ASAP Fairbanks $PM_{2.5}$ Non-Attainment Area Emissions Inventory and Conformity Applicability Analysis (AGDC, 2016b). The non-road emission factors were also used for mobile heavy equipment for these emissions estimates for emission inventory consistency for all of the Fairbanks Lateral.
- Emission factors for non-mobile generators and equipment are based on the EPA NON-ROAD Model (non-road engines, equipment, and vehicles) (EPA, 2008).

The GHG impacts associated with the construction of the Fairbanks Lateral would be similar to the GHG impacts associated with the construction of the Mainline. Emissions of CO_2 and methane would occur and may fall in with levels associated with major source GHG thresholds. The geographic extent is global reaching and goes beyond the site-specific environment. The duration of major amounts of GHG emissions may only last for 2.5 years, but the effect on earth's atmosphere would continue for decades.

The contaminant (HAP and criteria pollutant) and fugitive dust emissions that could occur under Alternative 1 from Fairbanks Lateral construction-related activities would moderately affect local or regional air quality, for the following reasons:

- Emissions and dust would occur, but would fall below regulatory thresholds (*i.e.*, meet permitting standards).
- Geographic Extent: The effect would be site-specific to the air around current construction spread.
- Duration or Frequency: The effect would occur intermittently for less than 1 year at each constriction spread location. However, the emissions from train and truckloads of pipeline would occur throughout the entire proposed Project Area during construction of the pipeline.
- Likelihood: The likelihood of the emissions from the pipeline construction described above are most likely to occur.

Table 4.22-9 Fairbanks Lateral Construction Emissions[a]

Emission Source	NOx (TPY)	CO (TPY)	VOC (TPY)	SO_2 (TPY)	PM (TPY)	PM_{10} (TPY)	$PM_{2.5}$ (TPY)	HAPs (TPY)	CO_2-e[b] (TPY)
Mobile Sources	59.4	16.7	4.5	0.09	3.35	3.35	3.35	5.08	9,537
Non-Mobile Sources	5.7	1.8	0.37	0.01	0.34	0.34	0.34	0.02	864
Fugitive Dust	--	--	--	--	304	173	17.3	--	--
Total Construction Emissions	65.1	18.5	4.83	0.1	308	177	21	5.1	10,401

Source: AGDC, 2016b; USACE, 2012a

a Emissions for the Fairbanks Lateral Construction were calculated in two segments: inside the FNSB $PM_{2.5}$ Non-Attainment Area and outside the Non-Attainment Area. Emission estimates for the entire pipeline used the methodology required by ADEC for the ASAP Fairbanks $PM_{2.5}$ Non-Attainment Area Emissions Inventory and Conformity Applicability Analysis (AGDC, 2016b). Hours of equipment operation were provided by Michael Baker Jr., Inc. in the 5/20/14 Equipment Use by Equipment report. All emissions calculations used conservative assumptions of 432 hours for a 36-day period for the 8 miles of lateral pipeline in the Non-Attainment Area, and 1,596 hours for 133 days for the remaining 22.33 miles of lateral pipeline (12 hours per day); 138,000 Btu per gallon heat rate; 7.1 pounds per gallon fuel density. For mobile and non-mobile sources, all PM emissions are considered to be 2.5 micrometers or less except for stationary non-road engines greater than 600 hp in size. For engines greater than 600 hp, $PM_{2.5}$ emissions were calculated to be 97 percent of PM_{10} emissions in accordance with EPA's AP 42, Fifth Edition, Compilation of Air Pollutant Emission Factors, Chapter 3.4, Table 3.4-2 (EPA, 1996).

b The total construction emissions reflect the construction emissions for the entire Fairbanks Lateral, both inside and outside the Non-Attainment Area.

4.22.4.1.5. GHGs and Climate Change

Based on the estimates provided in Tables 4.22-6 through 4.22-8, the proposed Project would emit approximately 17.5 million TPY (CO_2-e) during the construction period. These emissions would result directly through mobile and non-mobile sources during Mainline and Fairbanks Lateral pipeline construction, and during routine operation of the 13 proposed construction camps. Generally, GHGs are emitted from the combustion of fossil fuels and fugitive emissions of uncombusted natural gas within the pipeline (*i.e.*, methane). Significant (major) amounts would be emitted during the construction phase of the proposed Project. However, the duration of these emissions would be limited. Mitigation measures mentioned in Section 4.22.3, such as use of combustion equipment BACT, operation of equipment based on the manufacturer's specifications, and maintenance of emission control equipment, would reduce GHG emissions during construction activities. What was significant during construction begins tapers off to minor emissions amounts for normal operations.

The proposed Project's fugitive emissions of the GHG methane during operational activities are not included in the tables above. In 2014, natural gas systems were the largest anthropogenic source of methane emissions in the United States (EPA, 2016d). Fugitive methane may be released during production, processing, or transporting of natural gas through accidental releases from pipeline leaks. Fugitive methane emissions reported in the 2016 EPA *Inventory of U.S. Greenhouse Gas Emissions and Sinks (1990-2014)*, for natural gas Mainline pipeline leaks was 3.9 million metric tons of CO_2 equivalent (MMT CO_2 Eq.) in 2013 and 3.8 MMT CO_2 Eq. in 2014. The 2016 EPA GHG Inventory used data from over 100 natural gas system emission sources to calculate GHG emissions to summarize the emissions for each natural gas segment. Overall, natural gas systems in the United States emitted a total of 176.1 MMT CO_2 Eq. of methane in 2014 (EPA, 2016d). Fugitive emissions from Mainline leaks accounted for roughly two percent of the total estimated methane emissions.

The Joint Institute for Strategic Energy Analysis (JISEA) finalized a report titled *Estimating U.S. Methane Emissions from the Natural Gas Supply Chain: Approaches, Uncertainties, Current Estimates, and Future Studies* in August 2015. The report used past and present EPA GHG Inventory data to suggest opportunities to strengthen the EPA's accuracy reduce uncertainty in estimating GHG emissions. Table 4 of the report includes emission estimates for natural gas pipelines, categorized by pipeline construction (cast iron, unprotected steel, plastic, etc.). Protected steel Mainlines are reported as contributing an estimated 3.1 thousand cubic feet (Mcf) of methane per mile of pipeline per year on average (Heath *et al*., 2015). Application of this emission factor generated by JISEA for the proposed Project's 733 mile coated steel pipeline, would estimate possible fugitive methane Mainline emissions at around 2,300 Mcf of methane per year. Note that this is an estimated value based on natural gas pipelines in the U.S. and emissions are likely to vary significantly depending on several factors including the age of the pipeline, size of the pipeline, pipeline design, monitoring and maintenance, throughput, and composition of the natural gas.

Unlike criteria emissions, GHG emissions add to the earth's collective pool of GHGs and have been shown to impact weather stability, cause the rise in ocean levels, and cause a general warming of the earth's atmosphere. Projected annual temperatures vary based on assumptions of economic and population growth, changes in energy and land use, and resource availability; however, NOAA reports the average annual average temperature across the state of Alaska has increased 3.0 degrees Fahrenheit (°F) between 1949 and 2011. The cities of Utqiagvik and Talkeetna have seen an annual temperature increase of 4.9°F, Fairbanks an increase of 3.3°F, and Anchorage an increase of 3.2°F (NOAA, 2013).

Plants can naturally remove GHGs from the atmosphere by absorption of carbon dioxide and sequestering it in their tissues and the soil. Through this process, plants contribute to a systems' carbon stock. The carbon stock is the absolute quantity of carbon held within a reservoir of carbon (such as vegetation or soils) at a specified time. Carbon sequestration (uptake) is the process of increasing the carbon content of a carbon reservoir other than the atmosphere. A loss of stored carbon released by disturbing these biogenic resources can result in GHG emissions.

Vegetation (including wetland vegetation, forested land) acts as a carbon stock. To create an accessible permanent ROW, trees would be removed, resulting in a reduction of approximately 7,959 acres of forest currently acting as a carbon stock. Although some carbon would be released into the atmosphere through disposal of the biomass, the relatively minimal amount of forested land affected is not expected to result in a significant impact to air quality or climate change. The majority of upland and wetland vegetation would be restored via natural colonization or proposed Project-related revegetation activities following construction, as discussed in the proposed Project's Revegetation Plan (Appendix E, Part I). However, tundra vegetation on the Beaufort Coastal Plain may not recover due to altered hydrology from trenching and forested vegetation within the permanent ROW would not be allowed to fully recover because of regular ROW mowing. Approximately 17,356 total acres of vegetation, of which 8,015.0 acres are wetlands, would be impacted permanently by aboveground facilities and gravel placement (Tables 4.8-3 and 4.9-5, respectively). Although this vegetation would no longer be available to sequester carbon, the carbon stock would likely be transferred to the soil through degradation of the biomass, rather than released to the atmosphere.

Potential exists for soil organic carbon stocks to be released to the atmosphere as a result of permafrost degradation. As described in Section 4.6, Soils and Geology, propagation of permafrost thaw may occur directly adjacent to the pipeline or, due to the flow of suprapermafrost groundwater or surface water, at some distance to the pipeline. AGDC's initial geothermal modeling shows that with revegetating the ROW in discontinuous permafrost terrain, the indirect permafrost thaw affected zone over a period of 30 years would be limited to less than 10 m (35 feet) beyond the directly impacted area.

Proposed mitigation measures would reduce the impact to vegetation loss, soil disturbance, and permafrost impacts.

4.22.4.2. Operations and Maintenance

4.22.4.2.1. Gas Conditioning Facility

Table 4.22-10 provides the proposed equipment to be used at the proposed GCF. Flares would be included with the emergency blowdown systems at the GCF and would be designed for ignition in the event of a facility upset or other condition requiring venting of gas. At the GCF, for each conditioning train, there would be one flare sized for worst-case gas and liquid flow (full plant blowdown) with a capacity of 535 MMscfd. The flare would require an 850-foot offset from other equipment due to radiant heat issues. This equipment combusts fossil fuels and emits combustion-related pollutants such as NOx, CO, PM, VOCs, and SO_2.

Table 4.22-10 Gas Conditioning Facility Emission Unit Inventory

Item	# of Units	Purpose	Rated Capacity	Fuel	Change from the 2012 FEIS Project Design*
Power Generation Turbines	3	To generate power for the GCF	29 MW	Treated and Untreated Gas	New Equipment[c]
Feed-gas Compressor Turbines	2	To drive CO_2 compressor	22 MW	Treated and Untreated Gas	New Equipment[c]
CO_2 Compressor Turbines	2	To drive Feed-gas Compressor	11.93 MW	Treated and Untreated Gas	New Equipment[c]
Emergency Power Generators	4	Emergency	2.5 MW	ULSD	Same as 2012 Project Design
Heaters	4 (3 Operating, + 1 Spare)	To heat Propylene Glycol from 150°F to 240°F	129.60 MMBtu/hr (LHV)	Treated and Untreated Gas	New Equipment[c]
Flares	2	To burn HC at 100 psig	35,625 MMBtu/hr (LHV)	Treated and Untreated Gas	Same as 2012 Project Design
	2	To burn HC at 10 psig	990 MMBtu/hr (LHV)	Treated and Untreated Gas	Same as 2012 Project Design
Fire Pump Generators	4	To extinguish fires inside a module during an emergency event	0.4 MW	ULSD	New Equipment[c]
Other Emergency Generators	2	Generators for infrastructure, camps, and shops Emergency use only after construction	1.5 MW	ULSD	Same as 2012 Project Design
Burn Pit	1	Burn excess HC liquid from the Flare Knockout Drum during an emergency flaring event	TBD	-	New Equipment[c]

Source: AGDC, 2016b; *USACE, 2012a
°F - degrees Fahrenheit
CO_2 - carbon dioxide
HC - hydrocarbon
LHV - lower heating value
MMBTU/hr - million British thermal units per hour
MW - megawatt
psig - pound per square inch gauge
TBD - to be determined
ULSD - ultra-low sulfur diesel

Emissions for the proposed Project from operation of the GCF are provided in Table 4.22-11. These emissions were calculated to represent a worst-case (most conservative) scenario. Under Alternative 1, AGDC would need to refine the emissions calculations using vendor-specific emission factors upon equipment selection.

As indicated in Table 4.22-11, preliminary emission estimates trigger the requirement for a PSD permit for NOx, CO, VOC, PM_{10}, $PM_{2.5}$, and GHGs. The PSD permit process would require AGDC to perform an air quality impact analysis to comply with air quality standards and increments in 18 AAC 50.010 and 18 AAC 50.020. The permit would also require BACT on emission units to minimize air pollution. BACT is an emissions limitation based on the maximum degree of control that can be achieved at a major stationary source. It is a case-by-case decision that considers energy, environmental impact, and economic impact. BACT can be add-on control equipment or modification of the production processes or methods. Ultimately, ADEC would decide which control technology must be used on the equipment to meet BACT. AGDC would provide the information necessary (such as equipment types) for ADEC to make these decisions.

Preliminary emission estimates also indicate the GCF would trigger the requirement for a Title V operating permit, and would be considered a HAP major source. Affected sources would be required to implement emission standards equivalent to the Maximum Achievable Control Technology (MACT) standards set forth in 40 CFR 63. MACT standards are designed to reduce HAP emissions to a maximum achievable degree, taking into consideration the cost of reductions and other factors. Consequently, the proposed Project as permitted by ADEC would not cause or contribute to a violation of any federal, state, or local air quality standards. The *Gas Conditioning Facility Regulatory Review and Best Available Control Technology Analysis* document (Attachment 7 to the 2015 EED, publicly available at: http://asapgas.agdc.us/documents.html) describes in more detail the required BACT analysis for GCF emissions summarized here. The analysis also includes, but is not limited to, a regulatory review of New Source Performance Standards, National Emission Standards for Hazardous Air Pollutants, Mandatory GHG Reporting, Alaska Air Quality Management, and review of Criteria Pollutant and GHG BACT.

Emission estimates described in Table 4.22-11 were generated under the following assumptions and using the following regulatory guidance:

- Normal operations assumes gas-fired equipment operating on treated gas only.
- Emissions were calculated for stationary emission units listed in Table 4.22-7. Mobile sources (on-road and non-road) used during facility operations and maintenance were not included in the estimate and have yet to be determined (AGDC, 2016b).
- EPA's emission factors in AP-42 Tables 3.1-1, 3.1-2a, 3.1-3, and 3.2-2, and Tables 1.4-1 and 1.4-2 were used for calculations of NOx, CO, VOC, PM, PM_{10}, $PM_{2.5}$, and HAPs for natural gas-fired combustion units.

- The most conservative AP-42 emission factor was used for internal combustion engines (*i.e.*, uncontrolled 4 stroke lean burn engines) in AP-42 Table 3.2-2.
- All emissions calculations used conservative assumptions of 8,760 hours per year of operation; 7,000 Btu per hp per hour maximum fuel rating for generator engines; and 10,000 Btu per hp per hour maximum fuel ratings for gas compressors. All PM emissions are considered to be 2.5 micrometers or less in size due to a lack of specific emission factors for differing sized particulates.

A detailed inventory of GCF construction equipment (emission sources) is included in Appendix L, which is provided from the 2016 EED.

Table 4.22-11 Gas Conditioning Facility Unit Emissions

Equipment	NOX (TPY)	CO (TPY)	PM_{10} (TPY)	$PM_{2.5}$ (TPY)	SO_2[e] (TPY)	VOC (TPY)	HAP (TPY)	CO_2-e[f] (TPY)
Power Generation Turbines[a]	340.25	217.42	21.15	21.15	1.91	71.1	3.29	375.295
Feed Gas Compressor Turbines[b]	205.02	124.76	14.70	14.70	1.33	46.24	2.28	260,756
CO_2 Compressor Turbines[c]	109.24	133.06	7.91	7.91	0.72	38.11	1.24	140,347
Emergency Generator (2.5 MW)	5.54	24.11	0.25	0.25	0.04	1.57	0.04	3,945
Fire Pump Generator	0.53	3.86	0.026	0.026	0.005	0.25	0.01	691
Emergency Generator (1,350 kW)	2.24	9.77	0.10	0.10	0.015	0.64	0.02	1,569
Emergency Generator (1,000 kW)	1.66	7.23	0.07	0.07	0.012	0.47	0.01	1,231
Heaters[d]	119.21	63.01	8.17	8.17	1.15	5.11	3.04	199,411
HP Flare	4.58	1.98	0.07	0.07	0.02	5.58	0.09	4,130
LP Flare	1.11	0.48	0.02	0.02	0.004	1.35	0.02	1,001
Total Emissions	789.37	585.69	52.47	52.47	5.20	171.84	11.41	1,029,221

Source: AGDC, 2016b

a Power Generation Turbines Annual potential to emit (PTE) is based on the worst-case scenario at 20°F between scenario 1: All three turbines operate at 66% or scenario 2: two turbines operate at 100%, one turbine operates at 0%. Scenario 1 applies to NOx, PM, VOC, SOx, sulfuric acid, and CO2-e emissions. Scenario 2 applies to CO emissions.

b Feed Gas Compressor Turbine Annual PTE is based on 100% load at 10°F operation.

c CO2 Compressor Turbines Annual PTE is based on 100% load at 20°F operation.

d Assumes only three of the heaters would be operating at any one time.

e SO2 emissions were calculated using mass balance computations at 4 ppm H2S concentration in natural gas.

f GHG emissions (CO2-e) are based on emission factors in 40 CFR 98 Tables A-1, C-1, and C-2. Applicability to the GHG reporting rule is dependent on actual emissions from the stationary source *(i.e.*, CO2-e actual emissions equal to or greater than a threshold of 25,000 metric TPY) unless the facility is considered an applicable petroleum and natural gas facility.

AGDC has conducted initial NAAQS modeling for the GCF as part of the initial permitting effort for the proposed facility. The results of this modeling are presented in Table 4.22-12. The modeling results presented in Table 4.22-12 were based on methodology to evaluate the GCF impact on air quality with respect to NAAQS and PSD Increment Standards for Class II areas. The methodology was developed based on and accordance with the EPA's *Guidelines on Air Quality Models* and ADEC 's *Modeling Review Procedures* and *Alaska Air Quality Control Rules*. Modeling procedures were developed to conform with the ADEC *Air Quality Modeling Protocol Outline for PSD Permit Applications* (AGDC, 2015g).

Table 4.22-12 NAAQS GCF Modeling Results

Pollutant	Averaging Period	Modeled Result for SIL (µg/m³)	SIL (µg/m³)	Exceeds SIL	Modeled Result for the NAAQS (µg/m³)	NAAQS (µg/m³)	Exceeds NAAQS?
PM_{10}	24-Hour	4.7	5	No	--	--	--
PM_{10}	Annual	0.44	1	No	--	--	--
$PM_{2.5}$	24-Hour	3.7	1.2	Yes	12.2	35	No
$PM_{2.5}$	Annual	0.92	0.3	Yes	3.8	12	No
CO	1-Hour	4,952	2,000	Yes	12,609	40,000	No
CO	8-Hour	214	500	No	--	--	--
NO_2	1-Hour	209.1	7.5	Yes	187.2	188	No
NO_2	Annual	4.6	1	Yes	25.6	100	No

µg/m³ = micrograms per cubic meter
CO = carbon dioxide
NAAQS = National Ambient Air Quality Standard
NO = nitrogen dioxide
PM = particulate matter
SIL = significant impact level

The significant impact levels (SILs) described in Table 4.22-12 are de minimis threshold values applied to an individual facility that applies for a permit to emit a regulated pollutant in an area that meets the AAAQS/NAAQS. The state and EPA determine if emissions from the facility would cause the air quality to worsen and is a measure of whether a source may cause or contribute to a violation of PSD increments or the NAAQS. SIL values are used to determine if emissions from an individual facility would cause worsening in air quality and if more intensive air quality modeling is required. As described in Table 4.22-12, some modeled results do exceed SILs; however, the modeled results for NAAQS are all within allowable limits. This initial modeling demonstrates that emissions from the proposed facility are not expected to cause a NAAQS violation.

The overall impact of the operation of the GCF is expected to be minor, for the following reasons:

- Emissions and dust would occur, but would fall below regulatory thresholds (*i.e.*, emissions would be required to meet permitting standards, resulting in emissions below these regulatory thresholds).
- Geographic Extent: The effect would be site-specific to the air around the GCF.

- Duration or Frequency: The effect would occur throughout GCF operations. As described in Section 4.1, Project Area and Scope for Analysis, a period of 10 years is assumed.
- Likelihood: The likelihood of the emissions from GCF construction of the proposed Project is estimated to be most likely.

If proper permitting and air impact analyses are performed, as described in the above bulleted list, including requirements for clean fuels and air pollution control equipment, a facility should have minor impact on human health and the environment.

4.22.4.2.2. Pipeline Right-of-Way Fairbanks Lateral

With respect to natural gas pipeline operations, a pipeline itself generally does not have any significant air emissions associated with its operation. There is potential for fugitive emissions from pipeline connections (*i.e.*, valves) and fugitive dust prior to establishment of vegetation in areas where vegetation was stripped. Impacts as a result of pipeline operations are expected to be negligible.

Fairbanks is currently classified as an air quality Non-Attainment Area by ADEC and EPA. The Fairbanks air quality Non-Attainment is described in Chapter 3, Section 3.18, Air Quality, of this SEIS. The proposed Project could result in an indirect positive impact for the air quality in the Fairbanks area by reducing the dependence on energy sources that result in greater air impacts. The degree of the positive impact would depend on the number of homes, businesses, and industrial facilities in and around Fairbanks that convert from current heat sources, such as oil, coal, and wood, to natural gas. Air quality in other communities or regions along the pipeline corridor may also be improved if natural gas distribution systems are established and if users choose to convert to natural gas for heating and electrical power generation.

Positive impacts to air quality are possible throughout the geographic extent of the proposed Project Area, if residents and business start to use natural gas as a heat source instead of oil and wood, specifically along the Fairbanks Lateral within the Non-Attainment Area, throughout the duration of operations. Given that the FNSB is currently classified as an air quality Non-Attainment Area, access to natural gas as a form of home heating fuel could improve air quality in the area, resulting in a positive impact. However, these changes depend on expansion of the gas distribution network in Fairbanks, and the number of homes that would transition from wood, coal, or oil heat to natural gas is unknown. Therefore, the impact is considered to potentially have only a minor positive impact.

4.22.4.2.3. Construction Camps

Construction camps would not be required during pipeline operations and maintenance.

4.22.4.2.4. GHGs and Climate Change

A climate change lifecycle analysis is a technique used to evaluate the environmental aspects and impacts (in this case GHGs) that are associated with a product, process, or service from raw materials acquisition through production, use, and end-of-life. Lifecycle (well-to-wheels) GHG emissions are associated with extracting, processing, transportation and pipeline compression, transmission and distribution, as well as combustion of the natural gas. There are significant potential releases of natural gas in all of these well-to-wheel steps that could affect climate change as a large percentage of natural gas is methane. Methane content of natural gas ranges from 91 to 95 percent based on a cursory review of safety data sheets. Methane emissions occur in all sectors of the natural gas industry, from production, through processing and transmission, to distribution. Methane emissions from field production operations come from venting of associated gas and/or oil wells and storage tanks. Venting can occur through equipment design or operational practices, such as the bleeding of natural gas from pneumatic devices. These devices control gas flows, levels, temperatures, and pressures in the associated equipment. In addition to vented emissions, methane losses can occur from leaks and upset conditions in all parts of the infrastructure, from connections between pipes and vessels, to valves and equipment. Production related equipment such as gas dehydrators, flares, pig traps and pneumatic devices can emit measurable amounts of GHGs. The types of GHGs from dehydrators and flare combustion include CO_2, nitrous oxide, O_3, besides methane.

Combustion (end use) of natural gas usually occurs in internal or external combustion sources. In general, the combustion of 1.0 MMscfd natural gas results in 71.6 tons of GHGs for internal combustion sources, and 60.4 tons for external sources. The maximum capacity for the proposed Project Mainline is 500 MMscfd; the capacity of the Fairbanks Lateral is 30 MMscfd. Based on the assumption that 71.6 tons of GHGs are produced for every 1.0 MMscfd of natural gas combusted, the following GHG emissions for end use in Southcentral Alaska and the FNSB:

- **Southcentral Alaska:** Internal and external combustion sources could result in the generation of between 30,200 and 35,800 tons of GHGs per day. This range is based on 100 percent of the Mainline daily natural gas capacity being used solely by either internal **OR** external combustion sources.
- **FNSB:** Internal and external combustion sources could result in the generation of between 1,812 and 2,148 tons of GHGs per day. This range is based on 100 percent of the Fairbanks Lateral daily natural gas capacity being used solely by either internal **OR** external combustion sources.

The ADEC Greenhouse Gas Inventory and Reference Case Projections 1990-2020 document (ADEC, 2007) was developed to aid in concluding emission estimates and exploring opportunities to reduce emissions. Additionally, on October 31, 2017, Alaska Office of the Governor issed Administrative Order No. 289 (AS 44.19.145(c)), establishing the Alaska Climate Change Strategy and the Climate Action for Alaska

Leadership Team, to "advise the Governor on critical and timely actions to address climate change challenges that will safeguard Alaska now and for future generations."

Based on the magnitude of GHG emissions estimated in Table 4.22-11, the duration (lifetime of the proposed Project), and likelihood of these impacts occurring, the overall impact to climate change would be moderate.

4.22.5. Alternative 2 – Denali NPP Route Variation

4.22.5.1. Construction

Air quality impacts associated with construction of Alternative 2 (Denali NPP Route Variation) would be similar to the air quality impacts associated with construction of the Mainline, including emissions from fossil fuel-fired vehicles, construction equipment and fugitive dust. As such, the impact of the Denali NPP Route Variation Alternative on contaminant and fugitive dust emissions is expected to be moderate. For permitting applicability, stationary source emissions from construction activities would not trigger the requirements for a PSD, minor, or Title V permit as long as all mobile construction sources qualify as on-road or non-road.

As described in Chapter 2, Alternative 2 would include dredging and updates to DH2 and ocean disposal of dredge material. Emission estimates for dredging and updates to DH3 (under Alternative 1) are detailed in Appendix L. Activities at DH2 would generate similar emissions to those described under Alternative 1 with limited exceptions. Additional dredging required for DH2 and transport of dredging material for ocean disposal could result in increased emissions from those included under Alternative 1.

Some planned camps with potential fossil-fuel combustion sources would be located within 10 miles of a Class I area (Denali NPP), and as such, the proposed Project would be subject to Regional Haze Rule requirements (40 CFR 51.308). Regional haze modeling would need to be performed to evaluate potential visibility impairments that could result from construction activities. The proposed design evaluated in the 2012 FEIS included fossil-fuel combustion sources, which were a potential concern for the Regional Haze Rule and the Alaska Regional Haze State Implementation Plan study area in Denali NPP. These combustion sources are no longer part of the proposed Project and regional haze impacts are not anticipated. The current design of the proposed Project does not include permanent operational facilities within Denali NPP. As pipeline construction moves through an area relatively quickly, air emissions typically would be localized, intermittent, and short-term. Emissions from vehicles, construction equipment combustion, and fugitive dust would be controlled to the extent required by ADEC. As a result, if AGDC complies with applicable regulations, the proposed Project emissions from the Denali NPP Route Variation construction-related activities would not significantly affect local or regional air quality.

4.22.5.2. Operations and Maintenance

As explained previously in Alternative 1, with respect to natural gas pipeline operations, a pipeline itself generally does not have any significant air emissions associated with its operation. Operation of the proposed Denali NPP Route Variation could result in similar minor positive indirect impacts on air quality in the Fairbanks area, as those described above in Alternative 1.

4.22.5.3. Yukon River Aerial Bridge

Alternative 2 includes aerial crossing of the pipeline across the Yukon River using a new suspension bridge. This option was analyzed in detail in the 2012 FEIS and is carried forward as part of Alternative 2 in this SEIS. No permanent structures, such as footings, would be installed within the Yukon River under this alternative. Chapter 2, Figure 2.4-3 depicts the conceptual Yukon River suspension bridge crossing details, while Figure 2.4-4 provides a graphic depiction of the footprint for the aerial crossing.

4.22.5.3.1. Construction

Construction of the proposed aerial crossing of the pipeline across the Yukon River would have similar impacts on air quality as construction of the pipeline ROW described above in Alternative 1, including potential short-term effects resulting from the use of construction equipment and vegetation removal. Short-term impacts include the potential for increased fugitive dust during as a result of vegetation removal during construction of bridge abutments. The impact of the aerial bridge construction is not expected to affect the overall ratings provided for construction within the pipeline ROW for Alternative 2. Impacts to the proposed Project as a result of the Yukon River aerial bridge are expected to be moderate for the reasons described in Section 4.22.4.1.2, Pipeline Right-of-Way Mainline.

4.22.5.3.2. Operations and Maintenance

Operation of the proposed aerial crossing of the pipeline across the Yukon River would have similar impacts on air quality as pipeline operations described for Alternative 1 and would be negligible. The possibility of more fugitive dust to occur during the operation and maintenance phase would be where vegetation that was removed during construction at the bridge supports does not regrow.

4.22.5.4. Aboveground Pipeline

4.22.5.4.1. Construction

As in Alternative 1, air quality effects associated with the construction of the proposed Mainline would include emissions from fossil fuel-fired vehicles, construction equipment, and fugitive dust. Under Alternative 2, AGDC would operate all fossil-fueled vehicles and construction equipment in accordance with manufacturer's recommendations to minimize construction-related emissions resulting from incomplete combustion. The first 62 miles of the proposed pipeline in Alternative 2 would be above

ground. The use of VSMs would require additional shipping and trucking of VSM pipe, anchorage, and other supplies and equipment to the ACP. This could result in additional impacts from emissions on air quality. The use of VSMs could reduce vegetation disruption resulting in less fugitive dust. The reduction in fugitive dust and the increase in emissions from transporting VSM-associated material would not change the moderate impact rating for pipeline construction described in Section 4.22.4.1.2, Pipeline Right-of-Way Mainline.

4.22.5.4.2. Operation and Maintenance

With respect to natural gas pipeline operations, a pipeline itself generally does not have any significant air emissions associated with its operation. While there may be fugitive emissions from pipeline connections (*i.e.*, valves), such emissions are generally very minor in nature. For these reasons, the impacts on contaminant and fugitive dust concentrations as a result of the aboveground construction are expected to be negligible.

4.22.6. Alternative 3 – No Action

Under Alternative 3 (No Action), the proposed Project would not be constructed or operational. Consequently, no effects to air quality would occur as far as resulting from emissions associated with the proposed Project. However, it is known that natural gas combustion has fewer air quality impacts than from combustion of the more commonly (and currently) used fuel oil, coal, or wood burning stoves. Fairbanks buildings would continue to be heated using fuel oil, coal or wood, in addition to LNG that is trucked into the area, and therefore, air quality would likely continue to exceed air quality standards due to emissions. The use of LNG trucked into the area may contribute to an improvement in air quality; however, it may not be enough to remove the community from its Non-Attainment status.

The FNSB, State of Alaska, and EPA are currently working to manage and decrease air pollution in this Non-Attainment Area. The No Action alternative, unlike Alternative 1 and Alternative 2, would not produce a viable option for reducing reliance on higher pollutant emitting fuels and increasing LNG availability to the FNSB.

4.22.7. Conclusions and Comparison of Alternatives

Alternatives 1 and 2 would result in similar impacts to air quality during both construction and operations phases of the proposed Project (*e.g.,* emissions from fossil fuel-fired vehicles and construction equipment and fugitive dust, etc.). These impacts are based on the reasoning described throughout this section and are summarized below in Table 4.22-13. The effects to air quality as a result of most of the proposed Project components described in the section could be divided into two types of effects: increased levels of air contaminant concentrations (pollutants and HAPs) and fugitive dust. For this reason, the ratings provided in Table 4.22-13 represent the overall effect to air contaminants and fugitive dust concentrations as a result of all proposed Project components combined. Under Alternative 3 (No Action), the proposed Project would

not be developed and there would be, therefore, no impacts to air quality for construction or operational phases. The No Action alternative would restrict future natural gas availability and quantities in Fairbanks. This would limit alternative options for heating buildings (*e.g.*, fuel oil, coal or wood for burning) and over time could result in a worsening air quality conditions in the FNSB.

Independent of the proposed Project, GHG emissions and climate change would continue to affect the proposed Project Area as well as the rest of the state. According to the U.S. Global Change Research Program's 2014 National Climate Assessment, Alaska has warmed twice as fast as the rest of the nation. Regarding warming trends in Alaska, the Assessment states (U.S. Global Change Research Program, 2014):

> *Because of its cold-adapted features and rapid warming, climate change impacts on Alaska are already pronounced, including earlier spring snowmelt, reduced sea ice, widespread glacier retreat, warmer permafrost, drier landscapes, and more extensive insect outbreaks, and wildfires.*

Climate change scenarios and their impacts to individual resources are discussed in detail in Section 4.26, Cumulative Impact Assessment.

Figure 4.22-1 illustrates some of the key findings from the impact analysis. The figure intends to provide context for the description of potential impacts of alternatives as described in detail in this section. By illustrating the potential impacts on the proposed Project map using a color scheme consistent with the impact summary table (Table 4.22-13), we could begin to draw a few conclusions. Examples are provided below:

- Figure 4.22-1 illustrates both the detrimental and beneficial impacts to air quality from the proposed Project. In general, negative impacts to air quality would be localized to the areas of construction, and are represented in the figure by the red ASAP v6.1 proposed Mainline and Fairbanks Lateral. As described in Section 4.22.4.1.1, the impact rating for construction of the GCF differs from that of the Mainline and the Fairbanks Lateral, and therefore, is represented separately on Figure 4.22-1.
- Similar to Figure 4.18-1 in Section 4.18, Socioeconomics, the beneficial impacts of the proposed Project are also depicted on this figure. Based on conclusions made in Section 4.18, a 60-mile radius from the proposed Project was used to imply communities that could potentially access natural gas from the proposed pipeline. These communities, along with their distance from the pipeline, are included on Figure 4.22-1. It is assumed that these communities could access natural gas via the construction of offshoot gas lines.
- Communities outside of the 60-mile radius, but those with the potential to access natural gas via roadways (*e.g.,* through trucking of natural gas), are also depicted on Figure 4.22-1.
- Table 4.22-13 presents a summary of impact ratings for effects of the proposed Project and alternatives on air quality.

Table 4.22-13 Comparison of Alternatives Summary for Impacts to Air Quality (Direct & Indirect)

Effect	Potential Impact Description	Alternative 1		Alternative 2		Alternative 3
		Construction	Operations	Construction	Operations	Construction/Operations
		Impact Rating		Impact Rating		Impact Rating
Increased levels of air contaminant concentrations (criteria pollutants, GHGs, and HAPs): • Potential impacts to human health • Potential impacts to ecosystem	• Operation of fuel-fired vehicles and equipment during construction • Ongoing operation and maintenance of aboveground facilities	*Moderate (-)*	*Minor (-)*	*Moderate (-)*	*Minor (-)*	*Negligible*
Increased fugitive dust emissions	• Excavation activities and disturbance of ground cover during construction includes use of 89 material sites, 13 construction camps, and 26 PSY locations • Ongoing operation and maintenance of aboveground facilities	*Moderate (-)*	*Minor (-)*	*Moderate (-)*	*Minor (-)*	*Negligible*
Decreased emissions as a result of improved access to natural gas	Increased reliance on natural gas energy, and decreased reliance on heating oil, coal, and wood	*Negligible*	*Minor (+)*	*Negligible*	*Minor (+)*	*Negligible*

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City or Village
ASAP v6.1 Mainline
FBX v4.1 Lateral (Belowground)
Communities Within 60 Miles of the Proposed Pipeline Route with Potential Spur Pipeline Access
Gas Conditioning Facility
Communities with Indirect Access

Effect Rating

Major Positive
Moderate Positive
Minor Positive
Negligible
Minor Negative
Moderate Negative
Major Negative

Effect Indicators

FUG: Fugitive Dust
IAC: Increased Air Contaminant Concentrations
DEC: Decreased Emissions

Pipeline ROW & Fairbanks Lateral
Construction: FUG, IAC, DEC
Operations: FUG, IAC, DEC

Gas Conditioning Facility
Construction: FUG, IAC, DEC
Operations: FUG, IAC, DEC

Communities with Indirect Access
Construction: FUG, IAC, DEC
Operations: FUG, IAC, DEC

Beaufort Sea
MP 0
MP 100
Anaktuvuk Pass (51.8 mi)
MP 200
Wiseman (0.6 mi)
Bettles (28.8 mi)
Alatna (55.9 mi)
Allakaket (52.8 mi)
MP 300
Stevens Village (18.0 mi)
Rampart (27.2 mi)
Livengood (4.5 mi)
MP 400
Minto (18.7 mi)
Four Mile Road (0.3 mi)
Nenana (0.7 mi)
Two Rivers (24.6 mi)
Fairbanks (28.5 mi)
Pleasant Valley (29.1 mi)
Anderson (3.2 mi)
MP 500
Healy (2.3 mi)
Ferry (5.9 mi)
McKinley Park (1.7 mi)
Cantwell (1.2 mi)
MP 600
Petersville (15.8 mi)
Talkeetna (4.9 mi)
Skwentna (34.0 mi)
MP 700
Willow (2.9 mi)
Susitna (9.7 mi)
MP 733
Anchorage (17.2 mi)
Circle
Central
Circle Hot Springs
Big Delta
Delta Junction
Paxson
Glennallen
Nelchina
Mendeltna
U.S.A.
CANADA

Esri, DeLorme, GEBCO, NOAA NGDC, and other contributors

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PROJ. No.: 0416166

Figure 4.22-1: AIR QUALITY IMPACTS CONTEXT MAP ALASKA STAND ALONE PIPELINE

0 30 60 120 180 Miles

Barrow
Nome
Fairbanks
Bethel
ANCHORAGE
Juneau

N

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4.23. Noise

4.23.1. Introduction

This section describes the potential direct and indirect effects of the alternatives described in Chapter 2 on airborne noise and how it impacts residential receptors and recreational visitors. The direct and indirect effects of the alternatives on wildlife (airborne noise) and marine mammals (underwater noise) are described in Section 4.10, Wildlife, and Section 4.12, Marine Mammals, respectively. This section identifies incomplete or unavailable information and how the lack thereof influenced this analysis, describes methods for determining the level of impact to airborne noise on residential receptors and recreational visitors, and presents the results of the assessment. This section also describes some of the mitigation measures that would aid in avoiding or minimizing the potential impacts. The information used in this section builds on the 2012 FEIS (USACE, 2012a) and incorporates new data and information relevant to environmental concerns associated with the alternatives that have become available since the original 2012 FEIS document. While this assessment tiers from the 2012 FEIS, importantly, proposed changes in route and design described for Alternative 1 are emphasized. In some instances, information from the 2012 FEIS is replicated with relatively minor changes and updates, while other material is entirely new or substantially altered. For this SEIS, the following elements have been added to the assessment of impacts to airborne noise:

- A new section (Section 4.23.2, Methods) was added to explain the procedures used to evaluate the potential impacts associated with the proposed Project and alternatives;
- Mitigation measures were carried over from the 2012 FEIS and expanded upon to include new proposed Project information; and
- Updates to impacts based on new alternatives (*e.g.*, new separation distances between revised Mainline pipeline alignment and some communities, elimination of some aboveground noise sources) and a summary of those results.

4.23.1.1. Incomplete or Unavailable Information

In compliance with CEQ guidance (see Section 4.3), this section addresses incomplete or unavailable information pertinent to analyzing impacts of the alternatives on airborne noise. A good example relates to quantification of airborne noise associated with the proposed Project construction and operation. While sound source modeling to establish the acoustic profiles of major airborne noise sources have not been undertaken, a more qualitative assessment of the likely effects of airborne noise generated by these sources is presented to evaluate potential effects to sensitive receptors (*i.e.*, residential and recreational areas) that could occur. In addition, actual increases above existing noise levels could not been quantified for the alternatives because ambient noise measurements have not been undertaken at the nearest sensitive receptor locations. A more qualitative assessment of the likely changes to surrounding noise levels is

presented based on the type of land use (*e.g.*, wooded residential, wilderness areas, etc.), the duration of the activity, and proximity to sensitive receptors.

4.23.2. Methods

The potential airborne noise impact for the proposed Project presented below are based on the evaluation of the sensitive receptors along the proposed Project corridor, review of available proposed Project descriptions and reports, and public comments received after the publication of the 2012 FEIS. Distance of closest sensitive receptors were obtained from a combination of sources including the 2012 FEIS, 2016 EED, and recent aerial photography, all of which are provided in Chapter 7, Literature Cited, of this SEIS.

Potential impacts for this SEIS were analyzed by assessing the magnitude, extent, duration and likelihood of occurrence as presented in Table 4.23-1, Impact Criteria for Airborne Noise. Effects that were assessed include:

- Disturbance during construction and operation; and
- Stress and biological impacts during construction and operation.

4.23.2.1. Disturbance during Construction and Operation

Anthropogenic disturbance could result from airborne noise and physical presence. Effects of disturbance on humans could be long- or short-term and depends on the sensitivity of the individual and the context of the disturbance. Responses to disturbance include physiological, physical, and behavioral. Short-term disturbance is typically more reversible than long-term. In humans, disturbance from airborne noise could have a direct impact on the quality of life by interfering with spoken communication, sleep quality, and performance at work, or causing a hearing impairment.

Airborne noise associated with the alternatives would result from operating heavy construction equipment during construction of the Mainline and Fairbanks Lateral, material sites, construction camps, pipe yards, HDD crossings, and the GCF. During the proposed Project operation, continuous operation of aboveground facilities, such as the GCF (power generation turbines, feed gas compressors, and CO_2 compressor turbines), would result in increased airborne noise levels in its immediate vicinity. Intermittent noise could also occur from pressure relief valves and pipeline blowdowns as well as aviation and land-based vehicles during routine pipeline inspection and maintenance. Inspection patrolling could include walking, driving, flying, or other appropriate means of traversing the right-of-way. Aerial surveys may be accomplished by either fixed or rotary wing aircraft. Flight altitude would be such that the inspection could be accomplished in a safe manner while still collecting the appropriate data (typically between 150 to 500 feet for visual observation).

4.23.2.2. Stress and Biological Impacts during Construction and Operation

Emerging data suggest that nocturnal environmental airborne noise may be the most worrying form of noise pollution in terms of its health consequences, possibly because of

its synergistic direct and indirect (through sleep disturbances) influence on biological systems (Halperin, 2014). Airborne noise, especially at night, could affect biological systems in the form of a stress response causing the release of stress hormones, which in turn affects factors such as blood pressure and heart rate, and may also increase the risk of cardiovascular morbidity. These biological responses to noise during sleep are most of the time unnoticed (Halperin, 2014).

Airborne noise from the same proposed Project activities described above for disturbance could result in stress and biological impacts, particularly if the activities occur at night.

4.23.2.3. Existing Noise Conditions

Existing background noise measurements have not been undertaken for majority of the pipeline route, except within the Denali NPP where the National Park Service has undertaken an extensive inventory of natural acoustic environments in Denali (Betchkal, 2013a, Betchkal, 2013b, Withers, 2010, Withers, 2011, Withers, 2012, and Withers and Betchkal, 2013). Natural ambient sound data collected during the winter season at monitoring sites within the same elevation band and habitants as the Denali NPP would be used to represent baseline noise conditions at the park (particularly for the Denali NPP Route Variation [Alternative 2]). The two sites meeting those criteria had natural ambient levels of 20.1 and 21.2 dBA (the loudest natural ambient condition at any winter site sampled in the park over the last decade was 27.1 dBA). Therefore, for the purpose of this assessment, baseline noise conditions at Denali NPP are approximately 20 dBA during the winter months (summer construction would not occur during the summer season at this park).

4.23.2.4. Impact Criteria

Table 4.23-1 summarizes the criteria used to determine the level of impact based on the magnitude, extent, duration and likelihood of occurrence. Table 4.23-2 defines the types of effects the proposed Project activities may have on the airborne noise resources that are assessed in this SEIS. Though not shown in Table 4.23-1, the impact criteria also considered the sensitivity of the receptors. Receptor sensitivity is rated medium for all residential receptors, except residents in close proximity to 24-hour HDD activity, where sensitivity is considered high to account for peoples' sensitivity to night-time drilling noise (sleep disturbance). Receptor sensitivity is rated medium for most recreational visitors/viewers; however, sensitivity is considered high at recreational features designated as scenic resources with high concentrations of tourists during the summer season (*e.g.,* Denali NPP and Denali State Park). Once an impact magnitude is rated "negligible," the overall impact rating remains "negligible," regardless of the receptor sensitivity rating.

Applicant-proposed design features, mitigation measures, and BMPs may reduce impact to airborne noise. These design elements and mitigation measures to reduce airborne noise and ground-borne vibration impacts on residents, recreation and tourism, have

been taken into account to determine a final integrated impact result of negligible, minor, moderate, or major.

Potential impacts that remain after mitigation measures have been implemented are described for each alternative in the following sections.

Table 4.23-1 Impact Criteria for Airborne Noise

Impact Component	Impact Level			
	Major	Moderate	Minor	Negligible
Magnitude or Intensity	Changes to the surrounding noise levels at a greater than medium or large decibel level (increase of ≥ 10 dBA).	Changes to the surrounding noise levels at a medium decibel level (increase of 5 dBA to < 10 dBA).	Changes to the surrounding noise levels at a small decibel level (increase of 3 to < 5 dBA).	No or minimal perceivable effect (increase of 0 to < 3 dBA).
Geographic Extent	Regional impacts observed, sound source is adjacent to (up to 50 feet) sensitive receptor locations.	Effects realized in multiple locations, sound source is near sensitive receptor locations (> 50 feet; ≤ 1 mile).	Effects realized at one location further away from receptors.	The effect would be limited to specific, contained location.
Duration or Frequency	The effect would occur for a duration of greater than 3 years or through operations of the proposed Project. Chronic and long-term changes not likely to be reversed over several years or operational life.	The effect would occur for a duration of 1 to 3 years. Persistent changes that could be reversed in an annual or several seasonal cycles.	The effect would occur intermittently for a duration of less than 1 year. Periodic, temporary, or short-term changes that are reversed over one or two seasons.	So intermittent, and limited duration that effect, if perceived, dissipates rapidly.
Likelihood	Most likely	Likely	Somewhat likely	Unlikely

Table 4.23-2 Types of Effects and Impacts on Airborne Noise Resources

Type of Effect	Proposed Project Causing Potential Impact	
	Construction	Operations & Maintenance
Effects to Ambient Noise Levels Disturbance Stress and Biological Impacts	Localized, intermittent, and short term noise effects associated with construction activities	• Ongoing operation and maintenance of the pipeline and aboveground facilities (steady noise). • Pressure relief valves and pipeline blow downs (intermittent noise).

4.23.3. Applicant-Proposed Design Features, Mitigation Measures, Best Management Practices, and Project Management Plans

4.23.3.1. Applicant-Proposed Design Features, Mitigation Measures, Best Management Practices, and Project Management Plans

The following design features, mitigation measures and BMPs are proposed by AGDC, and have been taken into consideration when evaluating potential impacts on airborne noise under Alternatives 1 and 2 during the construction and operations phases. A complete list of mitigation measures and BMPs are also provided in Appendix M.

AGDC would be required to develop a Blast Control Plan for blasting and use of explosives along pipeline route, specifically in areas where a lease is required from the SPCS. The plan would include blasting techniques to reduce or minimize airblast overpressures and ground-borne vibration levels associated with blasting. Any blasting not previously approved by the blasting plan would need to be approved by the SPCS. This plan has not yet been drafted and therefore is not considered a mitigation measure in this analysis.

Proposed mitigation measures would include:

1. Maintain all construction equipment in accordance with manufacturer's specifications.
2. Schedule pipeline construction within the Denali NPP Route Variation during the winter, where possible, when there is little commercial and recreational activity to minimize noise impact on recreational visitors and travelers along the Parks Highway. Work along the highway and through the commercial area would not start until after Labor Day and would occur through late November to avoid the majority of the tourist season around the commercial area and the Denali NPP. Summer work would take place from the Nenana crossing at Moody to the Yanert Fork crossing on the east side of the Nenana River, and on the mountainside due to avalanche danger in the winter.
3. Implement mitigation measures to minimize construction impacts on recreation and tourism. These measures include:
    - Restrict access (*e.g.,* AGDC would prohibit hunting, trapping, shooting, and camping in areas where a lease is required from the SPCS);
    - Minimize or shut down activities in areas with tourist-related facilities during high-use periods (for the Denali NPP Commercial Area, the area would be shut down to summer tourism at that time, so work would continue 24 hours per day next to the highway to complete as soon as possible – construction noise is expected to be masked by the highway traffic noise);
    - Minimize activities in areas with public recreation facilities during high-use periods;

- Minimize creating new public vehicular access to remote areas;
- Schedule preconstruction work to minimize activity during peak periods of tourism and recreation; and
- Conduct early and continuing consultation with the public, tourism, and recreation businesses.

4. Where requested by the landowner, limit public access to ROW for recreation or hunting by blocking entry areas with large boulders, berms, or fencing.

4.23.3.2. Agency-Recommended Mitigation Measures

A variety of mitigation measures and best practices have been recommended by the cooperating agencies (Appendix M). Many of these recommendations have been incorporated in the proposed Project and are included in Table 4.23-3 below. The impacts discussed in this chapter are based upon the Applicant-proposed measures. These additional agency recommended measures are not included in the impact analysis.

Table 4.23-3 Noise Resources Agency-Recommended Mitigation Measures

Additional Measure Consideration	Agency Proposing Mitigation Measure	Agency Jurisdiction	Authority (*i.e.*, CWA, RHA, ESA)	Affected Resources	Comment Code
A large number of Applicant-proposed design features, mitigation measures, BMPs, and project management plans listed in the Draft SEIS contain the language, "In areas where a lease is required from the State Pipeline Coordinator's Section" or "a federal grant of ROW is required from BLM ..." These measures generally represent a best management approach that we recommend using to the maximum extent possible along the entire pipeline route, while acknowledging the outstanding need to complete coordination with private landowners.	EPA	--	--	Numerous	MIT_35

AAC = Alaska Administrative Code
ADF&G = Alaska Department of Fish and Game
ADEC = Alaska Department of Environmental Conservation
ADNR = Alaska Department of Natural Resources
AGDC = Alaska Gasline Development Corporation
APDES = Alaska Pollution Discharge Elimination System
BLM = Bureau of Land Management
BMP = Best Management Practice
CAA = Clean Air Act
CWA = Clean Water Act
DHSS = Alaska Department of Health and Social Services
EPA = U.S. Environmental Protection Agency
MBTA = Migratory Bird Treaty Act
NMFS = National Marine Fisheries Service
RHA = Rivers and Harbors Act of 1899
SEIS = Supplemental Environmental Impact Statement
USACE = U.S. Army Corps of Engineers
USFWS = U.S. Fish and Wildlife Service

4.23.4. Alternative 1 – Proposed Action

Alternative 1 is designated the proposed Action (proposed ASAP Project). This alternative is described in detail in Chapter 2. The 733-mile-long, 36-inch diameter Mainline pipeline (MP 0 to MP 733) and a 30-mile-long, 12-inch diameter lateral pipeline terminating in Fairbanks, would cross various habitats and ecoregions from the North Slope to the existing ENSTAR pipeline system in the Mat-Su Borough. This section evaluates potential impacts to airborne noise on sensitive receptors (*i.e.*, residential and recreation areas) along the route. The airborne noise and ground-borne vibration assessment for Alternative 1 focuses on the following pipeline segments and associated activities/ infrastructure:

- Channel Dredging and Access Construction on Prudhoe Bay, which includes vibratory piling and dredging near West Dock
- Mainline:
    - Mainline Segment 1a: MP 0 to MP 62 (GCF to TAPS PS2), which includes construction of the Mainline itself, GCF near MP 0, 36-inch aboveground pipeline (4,200 feet) connecting the existing CGF to the GCF, and multiple proposed Project support facilities along the segment (access roads, construction camps, pads, PSYs, TWs, and material sites);
    - Mainline Segment 1b: MP 62 to MP 400 (TAPS PS2 to Livengood), which includes the Mainline itself, multiple proposed Project support facilities along the segment (access roads, construction camps, pads, PSYs, TWs, and material sites), and one HDD site (Yukon River HDD near MP 356);
    - Mainline Segment 2: MP 400 to MP 535 Livengood to Denali NPP, which includes the Mainline itself, multiple proposed Project support facilities along the segment (access roads, construction camps, pads, PSYs, TWs, and material sites), and one HDD site (Tanana River HDD near MP 472);
    - Mainline Segment 3: MP 535 to MP 634 Denali NPP to Byers Lake in Denali State Park, which includes the Mainline itself, multiple proposed Project support facilities along the segment (access roads, construction camps, pads, PSYs, TWs, and material sites), and two HDD sites (Denali NPP Commercial Area HDD near MP 536 and 537 and Honolulu Creek HDD near MP 596); and
    - Mainline Segment 4: MP 634 to End (MP 733), which includes the Mainline itself, multiple proposed Project support facilities along the segment (access roads, construction camps, pads, PSYs, TWs, and material sites), and four HDD sites (Troublesome Creek HDD near MP 638, Chulitna River HDD near MP 639 and 640, Kashwitna River HDD near MP 694 and 695, and Willow Creek HDD near MP 705 and 706).

- Fairbanks Lateral:
    - Along Murphy Dome and Old Murphy Dome Roads: FLMP 1 to FLMP 30, which includes the Fairbanks Lateral itself and multiple proposed Project support facilities along the route (access roads, one facility pad, one TW, and one material site)

Results of the impact assessment are summarized in Table 4.23-8, and described in the sections below.

4.23.4.1. Construction

Construction would increase airborne noise levels in the vicinity of proposed Project activities, and the noise levels would vary during the construction period, depending on the construction phase. Construction noise levels are rarely steady in nature, but instead, fluctuate depending on the number and type of equipment in use at any given time. There would be times when no equipment is operating and noise would be at or near ambient levels. In addition, construction-related noise levels experienced by a sensitive receptor in the vicinity of construction activity would be a function of distance.

Table 4.23-4 lists maximum noise levels (Lmax) produced by typical construction machinery at 50 feet in units of the A-weighted decibel scale (dBA). The table also includes the acoustical usage factor, which is the fraction of time each piece of construction equipment is operating at full power (*i.e.*, its loudest condition) during a construction operation. Table 4.23-5 lists vibration source levels produced by typical construction machinery and activities at 25 feet in units of vibration decibels (VdB).

Table 4.23-4 Estimated Maximum Noise Levels and Usage Factors for Construction Equipment (dBA)

Equipment	Acoustical Use Factor (%)	Specified Lmax at 50 feet (dBA)
Pickup truck	40	55
Welding (or cutting) torch	40	73
Pump (dewatering)	50	77
Backhoe (with loader)	40	80
Compactor (ground)	20	80
Compressor (air)	40	80
Concrete pump truck	20	82
Generator (general purpose utility)	50	82
Excavator (hydraulic)	40	85
Dozer (crawler tractor)	40	85
Grader	40	85
Scraper	40	85
Concrete mixer truck	40	85
Crane	16	85
Pneumatic tool	50	85
Jackhammer	20	85

Equipment	Acoustical Use Factor (%)	Specified Lmax at 50 feet (dBA)
Rock drill	20	85
Paver (asphalt)	50	85
Chain saw	20	85
Roller (vibratory)	20	85
Pile driver (impact)	20	95
Pile driver (vibratory)	20	95

Source: DOT FHWA, 2006
Lmax = maximum sound level; dBA = sound level from A-weighted decibel scale.

Table 4.23-5 Vibration Source Levels for Construction Equipment (VdB)

Equipment	VdB at 25 feet
Pile Driver (impact type)	104-112
Pile Driver (sonic or vibratory type)	93-105
Vibratory Roller	94
Large Bulldozer	87
Caisson Drilling	87
Loaded Trucks	86
Jackhammer	79
Small Bulldozer	58

Source: Federal Transportation Administration, 2006
VdB = vibration decibels

4.23.4.1.1. Channel Dredging and Access Construction on Prudhoe Bay

The West Dock causeway would require widening and infrastructure modifications as described in Chapter 2 and in the ASAP Dredge and Disposal Plan. Activities would occur during a 2-year construction period in advance of the sealift to prepare DH3 and the West Dock causeway to allow vibratory pile driving and sheet pile installation, infrastructure improvements, and module movement. Most marine construction activities would also occur in winter (on ice); some dock improvements such as pile driving and module offloading would occur in late summer.

Marine dredging at DH3 and nearshore disposal would include use of dredgers and vibratory pile drivers. The major airborne noise source associated with this construction stage would be vibratory pile driving during installation of mooring dolphins at West Dock. Table 4.23-4 shows a vibratory pile driver has an Lmax of 95 dBA at 50 feet. There are no residential or recreation features within 1 mile from the West Dock. Therefore, airborne noise impacts from vibratory pile driving and other noise sources would be perceived as insignificant, thus creating no airborne noise or ground-borne vibration impact (negligible impact). As indicated in Section 4.23.1, Introduction, underwater noise impacts on marine mammals during marine dredging and disposal and in-water vibratory pile driving at the West Dock (Prudhoe Bay) is described in Section 4.12, Marine Mammals.

4.23.4.1.2. Mainline Segment 1a – MP 0 to MP 62 (Belowground)

AGDC proposes both winter and summer seasons for Mainline Segment 1a construction. Furthermore, Mainline Segment 1a construction equipment would operate 24 hours per day for 6 winter months (November 1 through April 30), and 12 hours per day for 4 summer months (May 1 through October 31). Construction would occur simultaneously on all four spreads lasting a total of approximately 2.5 years, but would only last about 90 to 120 days (3 to 4 months) at any single point along the Mainline.

For the purpose of this noise assessment (*i.e.*, construction of the pipeline itself and associated infrastructure such as access roads, pads, GCF, construction camps, etc.), it was assumed that five construction machinery (*e.g.,* an excavator, a dozer, a chainsaw, a vibratory roller, and a crane), each having an Lmax of 85 dBA at 50 feet, would be operating concurrently at any given time along the pipeline spread. The total Lmax from all five units would result to approximately 92 dBA at 50 feet, which is equivalent to an average equivalent sound level of approximately 86 dBA at 50 feet (after accounting for appropriate usage factor for each equipment). The exact value would depend on the number of sources operating at this distance.

The Mainline Segment 1a construction is not in close proximity to any residential or recreation feature. Therefore, Mainline Segment 1a construction would not result in any airborne noise impact on residential and recreational visitors (*i.e.,* negligible impact).

Most of the heavy equipment used during pipeline construction (*e.g.,* vibratory roller, bulldozer, and loaded trucks) would not constitute an impact to ground-borne vibration levels. The predicted ground-borne vibration levels at nearest sensitive receptors from these heavy construction equipment are expected to be below the U.S. Federal Transportation Administration (2006) human perceptibility threshold (65 VdB) and damage threshold for buildings (100 VdB).

There are no HDDs along Mainline Segment 1a.

4.23.4.1.3. Mainline Segment 1b – MP 62 to MP 400 (Belowground)

The construction schedule and equipment specification for the pipeline and associated infrastructure for this segment would be similar to that for Mainline Segment 1a discussed above. The nearest residential receptors to Mainline Segment 1b would be Coldfoot Camp (0.6 mile [3,168 feet]) and Community of Wiseman (0.7 mile [3,696 feet]), which are census-designated places in YKCA (Table 3.19-1). Based on a typical 6 dB reduction per doubling of distance, projected noise contribution from Mainline Segment 1b construction and associated infrastructure (92 dBA Lmax at 50 feet) at Coldfoot Camp and Wiseman would be 50.3, and 49.0 dBA, respectively (after accounting for acoustical usage factors for each equipment). Existing background noise measurements have not been undertaken at these sensitive receptor locations so changes to the surrounding noise levels could not be determined. However, based on the short-term construction duration (3-4 months), distance to construction activity, and inclusion of the AGDC mitigation measures and BMPs listed in Section 4.23.5 (Mitigation Measure No. 1), the

airborne noise and ground-borne vibration effects of Mainline Segment 1b construction on the nearest residents is considered minor (*i.e.*, small impact magnitude and medium receptor sensitivity).

Aside from the nearest residential areas (*i.e.*, census-designated places), the Mainline Segment 1b construction could also affect recreational visitors during activities including, but not limited to, fishing, camping, hiking, and bird watching at the nearest recreation features. Table 3.12-1 lists the closest recreation features by MPs and their distance away from proposed Project components. The Mainline Segment 1b construction would occur less than 0.2 mile (1,056 feet) from ANWR, Five Mile Campground, and Marion Creek Campground (Table 3.12-1). None of these recreation features is a scenic resource. Considering that Mainline Segment 1b construction would be short-term (3 to 4 months), intermittent, and localized, airborne and ground-borne vibration impacts on recreational visitors would likely be minor (*i.e.*, small impact magnitude and medium receptor sensitivity) at the closest recreation features.

The construction of Mainline Segment 1b would result in one HDD crossing across the Yukon River near MP 356 (waterbody crossing). The Yukon River HDD is scheduled to occur for 24-hours per day until pipe placement is complete (typically 10-25 weeks)[12]. Anticipated equipment at the HDD entry point would be determined by the construction contractor, but is anticipated to include a drill rig, mud pumps, electric generator sets, mud tank with pumps, hydraulic truck crane, wheeled backhoe loader, and engine-driven light plants (*i.e.*, mobile light towers and towable generators) for nighttime operation. Similarly, anticipated equipment at the HDD exit point would be determined by the construction contractor, but is anticipated to include mud pump, electric generator set, mud tank with pumps, wheeled backhoe loader, welders, and engine-driven light plants for nighttime operation. Sensitive receptors close to HDD entry points typically experience higher noise impacts than those closer to the exit points due to the presence of the drill rig (*i.e.*, the most dominant noise source) at the entry point. Table 4.23-6 presents the sensitive noise receptors located within a 1-mile radius of the Yukon River HDD entry and exit points.

Table 4.23-6 Sensitive Noise Receptors within a 1-Mile Radius of Yukon River HDD Entry and Exit Points along Mainline Segment 1b

HDD Site	Nearest Pipeline Mileposts	Nearest Sensitive Receptors	Distance and Direction of Sensitive Receptors to Drill Site (miles)
Yukon River Entry	MP 356	Yukon River Camp	0.55 WNW
Yukon River Exit	MP 356	Yukon River Camp	0.76 NW

[12] The 25-week timeframe is an approximate duration for the Yukon HDD, Denali NPP Commercial HDD, and perhaps the Tanana HDD. Other HDDs would be less than 25 weeks, with some being as short as 10 weeks. It should be noted that drilling is not continuous and typically occurs for about a third of the total time, with mud handling activities occurring for a little bit more time.

The nearest sensitive residential receptors to the Yukon River HDD entry and exit points is the Yukon River Camp located 0.55 mile (2,904 feet) west-northwest and 0.76 mile (4,013 feet) northwest, respectively. The nearest recreation feature (Yukon Flats National Wildlife Refuge) to the Yukon River HDD entry and exit points is located 1.73 miles (9,134 feet) away.

Because HDD would occur continuously over a 24-hour period, receptor sensitivity is considered high to account for sleep disturbance at nighttime. Therefore, airborne noise and ground-borne vibration impacts on sensitive residential receptors during construction of the Yukon River HDD is expected to be moderate (*i.e.*, small impact magnitude and high receptor sensitivity). In addition to the high receptor sensitivity, this impact rating accounts for the distance to the closest residential receptor (*i.e.*, 0.55 mile from the camp), short-term duration (10-25 weeks), small geographic area (*i.e.*, localized), and inclusion of AGDC-proposed mitigation measures and BMPs described in Section 4.23.5 (Mitigation Measure No. 1).

The airborne noise and ground-borne vibration impact on the nearest recreational visitors during construction of the Yukon River HDD is expected to be negligible (*i.e.*, negligible impact magnitude and high receptor sensitivity). In addition to the high receptor sensitivity, this impact rating accounts for the distance to the closest recreation feature (*i.e.*, 1.73 miles away), the short-term duration (10-25 weeks), small geographic area (*i.e.*, localized), and inclusion of AGDC-proposed mitigation measures and BMPs described in Section 4.23.5 (Mitigation Measure Nos. 1, 2, 3, and 4).

4.23.4.1.4. Mainline Segment 2 (MP 400 to MP 535), Segment 3 (MP 535 to MP 634), and Segment 4 (MP 634 to MP 733)

The construction schedule and equipment specification for the pipeline and associated infrastructure for Mainline Segment 2, 3, and 4 would be similar to that for Mainline Segment 1a discussed above. The nearest census-designated place or community is along Mainline Segment 2: Community of Nenana (0.5 mile [2,640 feet]) (Table 3.19-1), which is within the YKCA. The nearest residential receptors to Mainline Segment 3 and 4 are at least a mile or more away. For example, the nearest census-designated places or communities to Mainline Segments 3 and 4 are Cantwell (1 mile [5,280 feet]) in the Denali Borough, and Willow (3 miles [15,840 feet]) in the Mat-Su Borough, respectively (Table 3.19-1).

Based on a typical 6 dB reduction per doubling of distance, projected noise contribution from pipeline and infrastructure construction (92 dBA Lmax at 50 feet) at Nenana, Cantwell, and Willow, would be 51.9, 45.9, and 36.3 dBA, respectively (after accounting for acoustical usage factors for each equipment). Existing background noise measurements have not been undertaken at these sensitive receptor locations, so changes to the surrounding noise levels could not be determined. However, based on the short-term construction duration (3 to 4 months), distance to construction activity, and proposed mitigation measures and BMPs listed in Section 4.23.3 (Mitigation Measure No. 1), the airborne noise and ground-borne vibration impacts are expected to

range from negligible (*i.e.*, negligible impact magnitude and medium receptor sensitivity) at residential receptors near Mainline Segment 3 and 4, to minor (*i.e.*, small impact magnitude and medium receptor sensitivity) at residential receptors near Mainline Segment 2.

According to Table 3.12-1:

- Mainline Segment 2 construction would intersect Minto Flats State Game Refuge and Tanana Valley State Forest and would occur at 0.03 mile (15 feet) from Denali NPP (a scenic resource);
- Mainline Segment 3 construction would intersect Denali State Park (a scenic resource), and would occur less than 0.5 mile (<2,640 feet) from East Fork Chulitna River Campground;
- Mainline Segment 4 construction would intersect Denali State Park (a scenic resource), Iditarod Trail, Little Susitna Recreation River, Nancy Lake, and Willow Creek SRA, and would occur within 0.05 mile (264 feet) of Montana Creek SRA and Susitna Flats State Game Refuge.

Potential short-term noise impacts along this stretch of the route could result in large increases above ambient sound levels, particularly at the Denali NPP where the natural ambient sound levels are relatively low (approximately 20 dBA; see Section 4.23.3) during the winter months (November 1 through April 30). Denali NPP is a scenic resource with high receptor sensitivity and low natural ambient sound levels; however, because of the short-term construction duration, limited recreational activities during the winter construction season, increased sound attenuation with snow on the ground, and inclusion of the AGDC mitigation measures and BMPs described in Section 4.23.3 (Mitigation Measure No. 1, 2, 3, and 4), impacts on airborne noise and ground-borne vibration on the recreational visitors (if any) and natural soundscape of this park are considered moderate (small impact magnitude and high receptor sensitivity). With regard to the other recreation features, airborne noise and ground-borne vibration impacts on the nearest recreational visitors and natural sound scape would likely range from minor at non-scenic recreational areas (*i.e.*, small impact magnitude and medium receptor sensitivity) to moderate at scenic recreational areas (*i.e.*, small impact magnitude and high receptor sensitivity) (after including the AGDC mitigation measures and BMPs listed in Section 4.23.5 (Mitigation Measure Nos. 1, 2, 3, and 4).

The construction of Mainline Segment 2, 3, and 4 would result in seven HDD crossings (six water body crossings and one non-waterbody crossing). The HDD schedule and equipment specifications are similar to those described for the Yukon River HDD above (Mainline Segment 1b). Table 4.23-7 presents the sensitive noise receptors located within a 1-mile radius of each HDD entry and exit point along Mainline Segments 2, 3, and 4.

Table 4.23-7 Sensitive Noise Receptors within a 1-Mile Radius of HDD Entry & Exit Points along Mainline Segments 2, 3, and 4

HDD Site	Nearest Pipeline Mileposts	Nearest Sensitive Receptors	Distance and Direction of Sensitive Receptors to Drill Site (Miles)
Tanana River Entry	MP 472	S1. Residence	0.60 W
Tanana River Exit	MP 472	S2. Residence	0.12 SSE
Denali NPP Commercial Area Entry	MP 536	Denali Cabins	0.05 NW
Denali NPP Commercial Area Exit	MP 537	Denali Cabins	0.55 ESE
Honolulu Creek Entry	MP 596	N/A	N/A
Honolulu Creek Exit	MP 596	N/A	N/A
Troublesome Creek Entry	MP 638	N/A	N/A
Troublesome Creek Exit	MP 638	N/A	N/A
Chulitna River Entry	MP 639	S1. Residence	0.97 NW
Chulitna River Exit	MP 640	N/A	N/A
Kashwitna River Entry	MP 695	S1. Residence	0.06 W
Kashwitna River Exit	MP 694	S2. Residence	0.19 NW
Willow Creek[a] Entry	MP 706	N/A	N/A
Willow Creek[a] Exit	MP 705	N/A	N/A

N/A = not applicable (there are no sensitive receptors within a mile radius from the HDD site); S1 and S2 represents the closest residence to an HDD entry and exit point, respectively.

[a] Three waterbodies would be crossed with a single HDD.

The closest residential receptors (residence or cabins) to directional drilling (*i.e.*, at entry point where the main noise source occurs) at the Tanana River, Denali NPP Commercial Area, Chulitna River, and Kashwitna River are approximately 0.6, 0.05, 0.97, and 0.06 mile, respectively. The Denali NPP Commercial Area HDD is also less than 0.1 mile from the Denali NPP (a scenic resource). The remaining three HDD sites are not within a mile radius from any residential area or recreation feature.

As indicated earlier, residential receptor sensitivity is considered high during HDD to account for sleep disturbance at nighttime. Airborne noise and ground-borne vibration impacts on residences and cabins near drilling activities at the Denali NPP Commercial Area and Kashwitna River are expected to be major (*i.e.,* medium impact magnitude and high receptor sensitivity), even after inclusion of AGDC-proposed mitigation measures and BMPs described in Section 4.23.5 (Mitigation Measure No. 1). Similarly, airborne noise and ground-borne vibration impacts on recreational visitors near drilling activities at the Denali NPP Commercial Area are also expected to be major (*i.e.,* medium impact magnitude and high receptor sensitivity), even after inclusion of AGDC-proposed mitigation measures and BMPs described in Section 4.23.5 (Mitigation Measure Nos. 1, 2, 3, and 4).

Airborne noise and ground-borne vibration impacts on residences near drilling activities at the Tanana River and Chulitna River are expected to be moderate (*i.e.,* small impact magnitude and high receptor sensitivity), even after inclusion of AGDC-proposed mitigation measures and BMPs described in Section 4.23.5 (Mitigation Measure No. 1).

The remaining three HDD sites are not within a mile radius from any residential area or recreation feature and would have no impact on sensitive receptors (negligible impacts).

4.23.4.1.5. Fairbanks Lateral (Belowground)

Pipeline construction equipment would operate 12 hours per day for 4 summer months on the Fairbanks Lateral construction and associated infrastructure (access roads, a facility pad, and a material site). According to Table 3.19-1, the nearest sensitive receptors to Fairbanks Lateral construction would be the City of Fairbanks and the census area of Goldstream (within the greater Fairbanks area), each located approximately 1 mile (5,280 feet) from the Fairbanks Lateral. Similar to the Mainline construction, the total Lmax levels for Fairbanks Lateral construction is not expected to exceed 92 dBA at 50 feet. The exact value would depend on the number of sources operating at this distance. Based on a typical 6 dB reduction per doubling of distance, projected noise contribution from Fairbanks Lateral construction at the City of Fairbanks and Goldstream census area would be 45.9 and 45.9 dBA, respectively. Existing background noise measurements have not been undertaken at these sensitive receptor locations, so changes to the surrounding noise levels could not be determined. However, considering the long distances to the closest residential receptors (at least a mile away), short-term construction duration (four months), and the AGDC mitigation measures and BMPs listed in Section 4.23.5 (Mitigation Measure No. 1), the airborne noise and ground-borne vibration effects of Fairbanks Lateral construction on the nearest census area is considered negligible (*i.e.,* negligible impact magnitude and medium receptor sensitivity).

Aside from the nearest census areas, the Fairbanks Lateral construction could also affect recreational visitors during activities including but not limited to fishing, camping, hiking, and bird watching at the nearest recreational areas. The Fairbanks Lateral construction would intersect the Tanana Valley State Forest and would occur within 0.02 mile (106 feet) from the Minto Flats State Game Refuge (Table 3.12-1). None of these recreation features is a scenic resource. Considering that Fairbanks Lateral construction would be short-term (4 months), localized, and include the AGDC mitigation measures and BMPs listed in Section 4.23.5 (Mitigation Measure Nos. 1, 3, and 4), airborne and ground-borne vibration impacts on recreational visitors in the Tanana Valley State Forest and the Minto Flats State Game Refuge would likely be minor (*i.e.,* small impact magnitude and medium receptor sensitivity).

There are no HDDs planned for the Fairbanks Lateral construction.

4.23.4.2. Operations and Maintenance

4.23.4.2.1. Channel Dredging and Access Construction on Prudhoe Bay

During the operation and maintenance phase, channel dredging and access construction on Prudhoe Bay would have ceased (completed); therefore, airborne noise and ground-

borne vibration impacts would not occur in this area during this phase (negligible impact). In addition, there are no sensitive noise receptors within a mile from this area.

4.23.4.2.2. Mainline Segment 1a – MP 0 to MP 62 (Belowground)

The only operational noise sources in this segment are the GCF and the 36-inch, 4,200 feet aboveground pipeline with VSM connecting the GCF to the CGF. The GCF would be installed on approximately 90.6 acres and would contain several modular buildings that would house equipment, utilities, workspaces, and personnel. Primary and backup power generation, natural gas compressors, and heating and refrigerant equipment in addition to other ancillary facilities would be located at this facility to drive the natural gas conditioning process. The GCF complex would operate 24-hours a day, 7 days a week. As indicated in the construction phase for this segment, there are no residential or recreational receptors within one mile of the facility. Due to the lack of sensitive receptors in close proximity and because the major noise sources would be enclosed (modular buildings), the airborne noise and ground-borne vibration effects on sensitive receptors would be perceived as insignificant (*i.e.,* negligible impact).

Airborne noise would be radiated from the 36-inch, 4,200 feet aboveground pipeline connecting the GCF to the CGF due to flow of natural gas inside the pipe (assume unlagged pipes). Because there are no residential or recreation features within 1-mile of this aboveground pipeline, airborne noise and ground-borne vibration impacts would be negligible.

With respect to natural gas pipeline operations for the Mainline itself (Mainline Segment 1a), natural gas traveling through a buried pipeline would not emit audible airborne noise above the surface or a perceptible level of ground-borne vibration (*i.e.,* no impact). There are some locations, particularly along the Mainline, where the pipeline would be aboveground: fault crossings, elevated bridge stream crossings, pigging facilities, and block valve locations. However, airborne noise at these aboveground locations would likely be insignificant and impacts to nearest sensitive receptors (*i.e.,* residential and recreational) are expected to be negligible. Occasional pipeline blowdowns[13] associated with pipeline maintenance activities and use of aviation and land-based vehicles for routine patrols of the pipeline corridor could result in perceptible airborne noise level increases in close proximity to these activities. Due to the infrequent pipeline blowdowns and infrequent operation of aircraft (at low altitudes) and land-based vehicles for routine inspections, the airborne noise impact on nearest residential and

[13] A blowdown is the act of releasing natural gas from a section of pipeline so work can be done safely. In general, before work is performed on a section of a gas pipeline (*e.g.,* welding), the pipeline staff or contractor is required to close several valves to isolate that section of the pipeline and then open a special blowdown valve to release any natural gas. The loud noise occurs when natural gas, which is compressed into the pipe at very high pressure, escapes through the opening.

recreational receptors are considered negligible (*i.e.,* negligible impact magnitude and medium receptor sensitivity).

4.23.4.2.3. Mainline Segment 1b – MP 62 to MP 400 (Belowground)

The nearest residential receptors to Mainline Segment 1b would be Coldfoot Camp (0.6 mile [3,168 feet]) and Community of Wiseman (0.7 mile [3,696 feet]). The Mainline Segment 1b is less than 0.2 mile (1,056 feet) from ANWR, Five Mile Campground, and Marion Creek Campground. None of these recreation features is a scenic resource. Similar to Mainline Segment 1a, this segment would also be belowground; therefore, the airborne noise and ground-borne vibration impact of the proposed operations and maintenance on nearest residential and recreational receptors would be negligible (*i.e.,* negligible impact magnitude and medium receptor sensitivity). Additionally, airborne and ground-borne vibration from infrequent pipeline blowdowns and infrequent operation of aircraft (at low altitudes) and land-based vehicles for routine inspections would also be negligible (*i.e.,* negligible impact magnitude and medium receptor sensitivity).

4.23.4.2.4. Mainline Segment 2 (MP400 to MP 535), Segment 3 (MP 535 to MP 634), Segment 4 (MP 634 to MP 733) and Fairbanks Lateral (Belowground)

The nearest residential and recreational receptors to Mainline Segment 2, 3, 4, and Fairbanks Lateral are described in Chapter 2. Mainline Segment 2 and 3 either intersect or are in close proximity to a scenic resource (Denali NPP and Denali State Park), so receptor sensitivity is considered high in these areas (*i.e.,* for recreational visitors). Additionally, airborne and ground-borne vibration from infrequent pipeline blowdowns and infrequent operation of aircraft (at low altitudes) and land-based vehicles for routine, quarterly inspections would result in some noise increases in its immediate vicinity.

Similar to Mainline Segment 1a, Mainline segment 2, 3, 4, and Fairbanks Lateral would also be belowground; therefore, the airborne noise and ground-borne vibration impact of the proposed operations and maintenance on nearest residential receptors would be negligible (*i.e.,* negligible impact magnitude and medium receptor sensitivity). The receptor sensitivity for recreation features near Mainline Segment 4 and Fairbanks Lateral would be considered medium; therefore, the airborne noise and ground-borne vibration impact of the proposed operations and maintenance on nearest recreational receptors in both segments would be infrequent and negligible (*i.e.,* negligible impact magnitude and medium receptor sensitivity). Due to the proximity of Mainline Segment 2 and 3 to scenic resources (Denali NPP and Denali State Park), the airborne noise and ground-borne vibration impact of the proposed operations and maintenance on nearest recreational visitors in both segments would be minor (*i.e.,* negligible impact magnitude and high receptor sensitivity).

4.23.5. Alternative 2 – Denali NPP Route Variation

This section evaluates the potential impact of Alternative 2 - Denali NPP Route Variation (Figure 2.4-1) and associated design measures on airborne noise along the proposed Project corridor. The primary differences (relevant to impacts due to airborne noise) between Alternatives 1 and 2 are as follows:

- The above ground portion of the pipeline for Alternative 2 would take considerably longer to construct, thereby increasing overall noise impacts;
- Between MP 0 and 62 the pipeline would be placed below ground in Alternative 1, but above ground in Alternative 2;
- the Yukon River crossing near MP 356, within Mainline Segment 1b, would be done using HDD for Alternative 1, versus an aerial crossing under Alternative 2 (which involves driving piles for the bridge foundation systems); and
- Between MP 536 and MP 543, approximately seven miles of the pipeline route would insect the Denali NPP.

Results of the impact assessment are summarized in Table 4.23-8, and described in the sections below.

Mainline Segments 2, 3, 4, and the Fairbanks Lateral segments would have the same proposed Project design elements and in turn, the same airborne noise and ground-borne vibration impacts in both Alternatives 1 and 2, and are therefore, not evaluated in detail here. In addition, impacts associated with some modifications to the channel dredging and access construction near MP 0 on Prudhoe Bay were also assessed.

Mitigation Measure Nos. 1 through 5, listed in Section 4.23.5, would help to minimize impacts during construction by minimizing the extent of the airborne noise and ground-borne vibration during construction activities.

4.23.5.1. Construction

4.23.5.1.1. Channel Dredging and Access Construction on Prudhoe Bay

Alternative 2 includes some modifications to the channel dredging and access construction near West Dock on Prudhoe Bay. Specifically, this alternative would require marine dredging at the existing DH2 and vibratory pile driving prior to beginning dredge work. DH2 would need to be widened and deepened to a total depth of -9 feet to accommodate large vessels (creating approximately 750,000 CYs of disposal material). Under this alternative, dredge material would be disposed of in the ocean at the location depicted on Figure 2.2-5. The proposed location under Alternative 2 would be farther from shore than Alternative 1, within Territorial Seas, requiring truck transport of dredge material to the ocean disposal site. The material would be trucked to the ocean disposal site through an ice road, which would be constructed prior to dredging activities.

Similar to Alternative 1, there are no residential or recreation features within a mile from the channel dredging and access construction at DH2. Therefore, airborne noise and ground-borne vibration impacts to the nearest community would be perceived as insignificant, thus creating no airborne noise or ground-borne vibration impact (*i.e.,* negligible impact).

As indicated in Section 4.23.1, Introduction, underwater noise impacts on marine mammals during marine dredging and disposal and in-water vibratory pile driving at the West Dock (Prudhoe Bay) is described in Section 4.12, Marine Mammals.

4.23.5.1.2. Mainline Segment 1a - MP 0 and MP 62 (Aboveground)

Mainline Segment 1, MP 0 to MP 62 of the pipeline (*i.e.,* GCF to TAPS PS2) (Figure 2.2-2 in Chapter 2, Alternatives) would be constructed above ground on VSMs. Similar to Alternative 1, there are no residential or recreation features within a mile from Mainline Segment 1a. Therefore, airborne noise and ground-borne vibration impacts on nearest residents was considered negligible in this segment.

4.23.5.1.3. Yukon Aerial Crossing (Suspension Bridge Construction) near MP 356, within Mainline Segment 1b

The Yukon River HDD would not occur under Alternative 2; rather, a support bridge would be constructed near MP 356 for the Yukon River aerial crossing (see Figure 2.4-3 in Chapter 2, Alternatives). The sensitive receptors along this segment are primarily recreational visitors (on the Dalton Highway and on the Yukon River) and some residents.

While construction of the aerial crossing at the Yukon River would require additional land area, compared to Alternative 1, this disturbance would still occur within a limited area, and the closest receptors would still be exposed to construction noise during sleeping hours (*i.e.*, 24 hours per day). Unlike the 25 weeks of HDD in Alternative 1, the suspension bridge would take substantially longer time (perhaps multiple years) and hundreds of piles would be required to provide foundation support for the towers, main cable anchors, and wind cable anchors. The foundation stage of the bridge construction (when piling would be required) would occur over multiple months and would probably occur over most, if not all of a summer season. Depending on the year, the foundation work may continue late into the fall. Because the bridge construction would take considerably longer than HDD and would include driving hundreds of piles which produce higher noise than the HDD equipment, airborne noise and ground-borne vibration impacts on residential receptors during construction of the suspension bridge is expected to be major (*i.e.,* moderate impact magnitude and high receptor sensitivity). This impact rating accounts for the distance to the closest residential receptor (*i.e.*, 0.55 mile from the camp), noise magnitude of driven-piles, long-term duration (multiple years), small geographic area (*i.e.,* localized), and inclusion of AGDC-proposed mitigation measures and BMPs described in Section 4.23.5 (Mitigation Measure No. 1).

The airborne noise and ground-borne vibration impact on the nearest recreational visitors during construction of the suspension bridge is expected to be negligible (*i.e.*, negligible impact magnitude and high receptor sensitivity). This impact rating accounts for the distance to the closest recreation feature (*i.e.*, 1.73 miles away), noise magnitude of driven-piles, the long-term duration (multiple years), small geographic area (*i.e.*, localized), and inclusion of AGDC-proposed mitigation measures and BMPs described in Section 4.23.3 (Mitigation Measure Nos. 1, 3, and 4).

4.23.5.1.4. Denali NPP Route Variation (Belowground)

The Denali NPP Route Variation would route the pipeline through a corner of Denali NPP (Figure 2.4-1 in Chapter 2 Alternatives), between Mainline (Alternative 1) MPs 535.8 and 543. The route would generally parallel the Parks Highway corridor into Denali NPP on flatter terrain, including through the developed commercial area just north of the northern park's entrance. Receptor sensitivity in Denali NPP is high, given its identity as a scenic resource. This characterization of receptor sensitivity is not necessarily true along the Parks Highway itself. The Parks Highway is one of the state's major transportation routes, and runs adjacent to an active rail line. As a result, evidence of human activity and infrastructure along the Parks Highway is common (*i.e.*, existing ambient noise levels near the Parks Highway is expected to be moderately high due to roadway and railway traffic). The nearest sensitive receptors to this segment are primarily recreational visitors. Pipeline construction within the Denali NPP Route Variation would be scheduled during the winter (12-hour per day for 4 winter months), where possible, when there is little commercial and recreational activity to minimize noise impact on recreational visitors and travelers along the Parks Highway. Work along the highway and through the commercial area would not start until after Labor Day and would occur through late November to avoid the majority of the tourist season around the commercial area and the Denali NPP. Summer work would take place from Nenana crossing at Moody to the Yanert Fork crossing on the east side of the Nenana River, and on the mountainside due to avalanche danger in the winter. No construction work camps are proposed to be located along the Denali NPP Route Variation. The nearest town or community to Denali NPP Route Variation construction would be McKinley Park Village, approximately 1 mile (5,280 feet) from the route. Existing background noise measurements have not been undertaken at these sensitive receptor locations (communities) so changes to the surrounding noise levels could not be determined. However, airborne noise and ground-borne vibration impacts on nearest residents during construction of the Denali NPP Route Variation is expected to be negligible (negligible impact magnitude and medium receptor sensitivity) due to the distance to nearest community/village, short-term duration (few months; segment is short), likely high ambient noise levels in the area from roadway and railway traffic, increased sound attenuation with snow on the ground, and inclusion of the AGDC mitigation measures and BMPs described in Section 4.23.5 (Mitigation Measure Nos. 1).

Aside from McKinley Park Village, the Denali NPP Route Variation construction intersects the Denali NPP and as such, could also affect recreational visitors and the natural soundscape during activities including, but not limited to fishing, camping, hiking, and bird watching. Table 3.12-1 lists the closest recreational features and their distance away from proposed Project components. Though Denali NPP is a scenic resource with high receptor sensitivity and low natural ambient sound levels (approximately 20 dBA; see Section 4.23.3); however, because of the short-term construction duration, limited recreational activities during the winter construction season (when most of the work would occur), increased sound attenuation with snow on the ground, and inclusion of the AGDC mitigation measures and BMPs described in Section 4.23.5 (Mitigation Measure Nos. 1, 2, 3, and 4), impacts on airborne noise and ground-borne vibration are considered moderate (small impact magnitude and high receptor sensitivity).

4.23.5.2. Operations and Maintenance

4.23.5.2.1. Channel Dredging and Access Construction on Prudhoe Bay

The operation and maintenance for Alternative 2 would be the same as Alternative 1 (*i.e.*, channel dredging and access construction would have ceased, hence no impact).

4.23.5.2.2. Mainline Segment 1a – MP0 to MP 62 (Aboveground)

Since this segment of the pipeline would not be buried, airborne noise radiated from aboveground pipeline due to flow of natural gas inside the pipe (assume unlagged pipes) could result in increases in airborne noise levels in its immediate vicinity. Infrequent pipeline blowdowns and infrequent operation of aircraft (at low altitudes) and land-based vehicles for routine inspections could also result to some noise increases in its immediate vicinity. However, such noise increases due to pipeline operations and maintenance would not be out of the ordinary because the area currently experiences both road and air traffic. Considering that there are no residential and recreational areas within a mile of Mainline Segment 1a, long-term impact to airborne noise and ground-borne vibration under Alternative 2 for this segment (*i.e.*, pipe-radiated noise and infrequent pipeline maintenance activities) is considered negligible (*i.e.*, negligible impact magnitude and medium receptor sensitivity).

4.23.5.2.3. Yukon Aerial Crossing near MP 356, within Mainline Segment 1b

The operation and maintenance for Alternative 2 would be the same as Alternative 1 (*i.e.*, most of the segment would be belowground), except for the Yukon Aerial Crossing near MP 356 that would be aboveground. The sensitive receptors near the Yukon Aerial Crossing are primarily recreational visitors (on the Dalton Highway and on the Yukon River) and some residents. The noise increases due to pipeline operation and maintenance would not be out of the ordinary because the Dalton Highway area currently experiences road traffic. Therefore, the long-term airborne noise and ground-borne vibration impact of the pipe-radiated noise from the Yukon Aerial Crossing (assuming unlagged pipes) and

infrequent pipeline maintenance activities on nearest residential and recreational receptors would be negligible (*i.e.,* negligible impact magnitude and medium receptor sensitivity).

4.23.5.2.4. Mainline Segment 2 (MP400 to MP 535), Segment 3 (MP 535 to MP 634), Segment 4 (MP 634 to MP 733) and Fairbanks Lateral (Belowground)

The operation and maintenance for Alternative 2 would be the same as Alternative 1.

4.23.6. Alternative 3 – No Action

Under Alternative 3 (No Action), the proposed Project would not be constructed. As a result, there would be no impact on existing airborne noise and ground-borne vibration in the proposed Project Area.

4.23.7. Conclusions and Comparison of Alternatives

The impacts of Alternatives 1, 2, and 3 are presented in Table 4.23-8. Airborne noise impact on Alternatives 1 and 2 are similar; however, Alternative 2, with the pipeline aboveground for some segments of the route, aerial crossing of Yukon River, and Denali NPP Route Variation would have more impact to airborne noise during the construction phase of the proposed Project. In the No Action alternative (Alternative 3), the proposed Project would not be developed and there would be, therefore, no impacts to airborne noise for construction or operational phases.

Figures 4.23-1 and 4.23-2 illustrate some of the key findings from the impact analysis. The figures intend to provide context for the description of potential impacts of alternatives as described in detail in this section. By illustrating the potential impacts (both positive and negative) on the proposed Project map using a consistent color scheme consistent with the impact summary table (Table 4.23-8), we could begin to draw a few conclusions. Examples are provided below.

- Figure 4.23-1 illustrates negative impacts (negligible, minor, moderate, or major) to airborne noise along the proposed pipeline route. The results indicate construction and operation of the ASAP Mainline and Fairbanks Lateral (excluding HDD crossings) would have negligible to minor negative noise impacts at nearest residential receptors and recreational visitors, except construction of ASAP Mainline MP 400-535 and MP 535-634 where recreational visitors could experience moderate negative impacts on airborne noise. No major negative impact would occur during construction and operation of the ASAP Mainline and Fairbanks Lateral.
- Figure 4.23-2 illustrates negative impacts (negligible, minor, moderate, or major) to airborne noise at the eight HDD crossings along the route. The results indicate three HDD crossings would have major negative impacts on airborne noise at nearest residential receptors (all three crossings) and recreational visitors (one of the crossings), two HDD crossings would have moderate negative impacts on airborne noise at nearest residential receptors only, and the remaining four HDD crossings would have negligible impact on airborne noise.

Table 4.23-8 Airborne Noise and Ground-borne Vibration Impact, Comparison of Impacts of Alternatives Summary

Pipeline Segment and Other Related Activities	Description/ Location	Receptor Type	Receptor Sensitivity	Alternative 1 Impact Rating[a]		Alternative 2 Impact Rating[a]		Alternative 3 Impact Rating[a]	
				Construction	Operation	Construction	Operation	Construction	Operation
Channel Dredging and Access Construction on Prudhoe Bay	Pile driving associated with installation of mooring dolphins at West Dock; no residential or recreational feature within a mile.	*Residential*	*Medium*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*
		Recreational	*Medium*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*
Mainline Segment 1a	MP 0 to MP 62 (GCF to TAPS PS2); includes other infrastructure such as access roads, pads, GCF, aboveground pipeline connecting GCF to existing CGF, etc.	*Residential*	*Medium*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*
		Recreational	*Medium*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*
Mainline Segment 1b	MP 62 to MP 400 (TAPS PS2 to Livengood); includes other infrastructure (access roads, pads, material sites, etc.); excludes Yukon River HDD (Alternative 1) and Suspension Bridge Construction (Alternative 2) which are rated separately below	*Residential*	*Medium*	*Minor*	*Negligible*	*Minor*	*Negligible*	*Negligible*	*Negligible*
		Recreational	*Medium*	*Minor*	*Negligible*	*Minor*	*Negligible*	*Negligible*	*Negligible*
Yukon River HDD	Near MP 356; 24-hour drilling within 0.6 mile from Yukon River Camp; 1.73 miles from Yukon Flats National Wildlife Refuge	*Residential*	*High*	*Moderate*	*N/A*	*N/A*	*N/A*	*Negligible*	*Negligible*
		Recreational	*High*	*Negligible*	*N/A*	*N/A*	*N/A*	*Negligible*	*Negligible*
Yukon Aerial Crossing	Near MP 356; 24-hour bridge construction for	*Residential*	*High*	*N/A*	*N/A*	*Major*	*Negligible*	*Negligible*	*Negligible*

Pipeline Segment and Other Related Activities	Description/ Location	Receptor Type	Receptor Sensitivity	Alternative 1 Impact Rating[a]		Alternative 2 Impact Rating[a]		Alternative 3 Impact Rating[a]	
				Construction	Operation	Construction	Operation	Construction	Operation
(Suspension Bridge Construction)	multiple years (including piling for bridge foundation system); close to some recreational visitors on the Yukon River and some residents	*Recreational*	*High*	*N/A*	*N/A*	*Negligible*	*Negligible*	*Negligible*	*Negligible*
Mainline Segment 2	MP 400 to MP 535 Livengood to Denali NPP; includes other infrastructure (access roads, pads, material sites, etc.); excludes Tanana River HDD which is rated separately below	*Residential*	*Medium*	*Minor*	*Negligible*	*Minor*	*Negligible*	*Negligible*	*Negligible*
		Recreational	*Medium to High*	*Minor to Moderate*	*Negligible to Minor*	*Minor to Moderate*	*Negligible to Minor*	*Negligible*	*Negligible*
Tanana River HDD	Near MP 472; 24-hour drilling within 0.6 mile from nearest residential receptors (residences); not within 1 mile of any recreation feature	*Residential*	*High*	*Moderate*	*N/A*	*Moderate*	*N/A*	*Negligible*	*Negligible*
		Recreational	*Medium*	*Negligible*	*N/A*	*Negligible*	*N/A*	*Negligible*	*Negligible*
Mainline Segment 3	MP 535 to MP 634 Denali NPP to Byers Lake in Denali State Park; includes other infrastructure (access roads, pads, material sites, etc.); excludes Denali NPP Commercial Area HDD and Honolulu Creek HDD which are rated separately below	*Residential*	*Medium*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*
		Recreational	*Medium to High*	*Minor to Moderate*	*Negligible to Minor*	*Minor to Moderate*	*Negligible to Minor*	*Negligible*	*Negligible*
Denali NPP Route Variation	Mainline MP 535.8 to MP 543 (approx. 7 miles); includes other infrastructure (access roads, pads, material sites, etc.)	*Residential*	*Medium*	*N/A*	*N/A*	*Negligible*	*Negligible*	*Negligible*	*Negligible*
		Recreational	*High*	*N/A*	*N/A*	*Moderate*	*Negligible*	*Negligible*	*Negligible*
Denali NPP Commercial Area HDD	Near MP 536 and 537; 24-hour drilling less than 0.1 mile from nearest residential receptors (Denali Cabins); less than 0.1 mile	*Residential*	*High*	*Major*	*N/A*	*Major*	*N/A*	*Negligible*	*Negligible*

Pipeline Segment and Other Related Activities	Description/ Location	Receptor Type	Receptor Sensitivity	Alternative 1 Impact Rating[a]		Alternative 2 Impact Rating[a]		Alternative 3 Impact Rating[a]	
				Construction	Operation	Construction	Operation	Construction	Operation
	from Denali NPP (scenic resource) in Alternative 1 but intersects this scenic recreational feature in Alternative 2	*Recreational*	*High*	*Major*	*N/A*	*Major*	*N/A*	*Negligible*	*Negligible*
Honolulu Creek HDD	Near MP 496; 24-hour drilling but not within 1 mile of any residential area or recreation feature	*Residential*	*High*	*Negligible*	*N/A*	*Negligible*	*N/A*	*Negligible*	*Negligible*
		Recreational	*Medium*	*Negligible*	*N/A*	*Negligible*	*N/A*	*Negligible*	*Negligible*
Mainline Segment 4	MP 634 to End; includes other infrastructure (access roads, pads, material sites, etc.); excludes Troublesome Creek HDD, Chulitna River HDD, Kashwitna River HDD, and Willow Creek HDD which are rated separately below	*Residential*	*Medium*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*
		Recreational	*Medium*	*Minor*	*Negligible*	*Minor*	*Negligible*	*Negligible*	*Negligible*
Troublesome Creek HDD	Near MP 638; 24-hour drilling but not within 1 mile of any residential area or recreation feature	*Residential*	*High*	*Negligible*	*N/A*	*Negligible*	*N/A*	*Negligible*	*Negligible*
		Recreational	*Medium*	*Negligible*	*N/A*	*Negligible*	*N/A*	*Negligible*	*Negligible*
Chulitna River HDD	Near MP 639 and 640; 24-hour drilling at 0.97 mile from nearest residential receptor (residence); not within 1 mile of any recreation feature	*Residential*	*High*	*Negligible*	*N/A*	*Negligible*	*N/A*	*Negligible*	*Negligible*
		Recreational	*Medium*	*Negligible*	*N/A*	*Negligible*	*N/A*	*Negligible*	*Negligible*
Kashwitna River HDD	Near MP 694 and 695; 24-hour drilling less than 0.1 mile from nearest residential receptor (residence); not within 1 mile of any recreation feature	*Residential*	*High*	*Major*	*N/A*	*Major*	*N/A*	*Negligible*	*Negligible*
		Recreational	*Medium*	*Negligible*	*N/A*	*Negligible*	*N/A*	*Negligible*	*Negligible*

Pipeline Segment and Other Related Activities	Description/ Location	Receptor Type	Receptor Sensitivity	Alternative 1 Impact Rating[a]		Alternative 2 Impact Rating[a]		Alternative 3 Impact Rating[a]	
				Construction	Operation	Construction	Operation	Construction	Operation
Willow Creek HDD	Near MP 705 and 706; 24-hour drilling but not within 1 mile of any residential area or recreation feature	*Residential*	*High*	*Negligible*	*N/A*	*Negligible*	*N/A*	*Negligible*	*Negligible*
		Recreational	*Medium*	*Negligible*	*N/A*	*Negligible*	*N/A*	*Negligible*	*Negligible*
Fairbanks Lateral	Along Murphy Dome and Old Murphy Dome Roads; includes other infrastructure (access roads, a facility pad and a material site)	*Residential*	*Medium*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*
		Recreational	*Medium*	*Minor*	*Negligible*	*Minor*	*Negligible*	*Negligible*	*Negligible*

N/A = not applicable
a Impact rating based on the integration of receptor sensitivity and the impact components presented in Table 4.23-1: magnitude/intensity, geographic extent, duration/frequency, and likelihood.

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- City or Village
- Mileposts

Communities and Recreation Features within 1 mile

- ASAP Mainline MP 0 - 62
- ASAP Mainline MP 62 - 400
- ASAP Mainline MP 400 - 535
- ASAP Mainline MP 535 - 634
- ASAP Mainline MP 634 - 733
- FBX v4.1 Lateral (Belowground)

Effect Rating

- Major Positive
- Moderate Positive
- Minor Positive
- Negligible
- Minor Negative
- Moderate Negative
- Major Negative

Effect Indicators

RES: Noise effects (disturbance, stress, and biological) on Residential receptors

REC: Noise effects (disturbance, stress, and biological) on Recreational visitors

Beaufort Sea

MP 0

MP 62

MP 100

MP 200

Wiseman

MP 300

MP 356

Livengood

MP 400

Ester

Four Mile Road

MP 472

Nenana

Anderson

MP 500

Ferry

Healy

MP 535

McKinley Park

Cantwell

MP 600

MP 596

MP 634

MP 700

Willow

Susitna

Big Lake

MP 733

MP 0 to MP 62
Construction: RES, REC
Operations: RES, REC

MP 62 to MP 400
Construction: RES, REC
Operations: RES, REC

Fairbanks Lateral
Construction: RES, REC
Operations: RES, REC

MP 400 to MP 535
Construction: RES, REC
Operations: RES, REC

MP 535 to MP 634
Construction: RES, REC
Operations: RES, REC

MP 634 to MP 733
Construction: RES, REC
Operations: RES, REC

Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

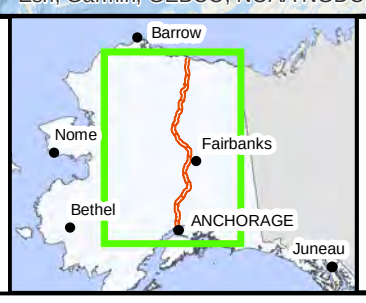
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DATE: MAR 2018
CHKD: K.A.
DRWN: A.V.K.
PROJ. No.: 0416166

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Figure 4.23-1: NOISE IMPACTS ALONG THE PROPOSED PIPELINE ROUTE CONTEXT MAP ALASKA STAND ALONE PIPELINE

0 25 50 100 150 Miles



N

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- City or Village
- Mileposts

Communities and Recreation Features within 1 mile of HDD Crossing

- Yukon River HDD
- Tanana River HDD
- Denali NPP Commercial Area HDD
- Honolulu Creek HDD
- Troublesome Creek HDD
- Chuitna River HDD
- Kashwitna River HDD
- Willow Creek HDD
- ASAP v6.1 Mainline
- FBX v4.1 Lateral (Belowground)

Effect Rating

- Major Positive
- Moderate Positive
- Minor Positive
- Negligible
- Minor Negative
- Moderate Negative
- Major Negative

Effect Indicators

RES: Noise effects (disturbance, stress, and biological) on Residential receptors

REC: Noise effects (disturbance, stress, and biological) on Recreational visitors

MP 300
MP 400
MP 500
MP 535
MP 600
MP 634
MP 700
MP 733

Livengood
Ester
Fairbanks
Four Mile Road
Nenana
Anderson
Ferry
Healy
McKinley Park
Cantwell
Willow
Susitna
Big Lake
Anchorage

Yukon River HDD Construction: RES, REC

Tanana River HDD Construction: RES, REC

Denali NPP Commercial Area HDD Construction: RES, REC

Honolulu Creek HDD Construction: RES, REC

Troublesome Creek HDD Construction: RES, REC

Chulitna River HDD Construction: RES, REC

Kashwitna River HDD Construction: RES, REC

Willow Creek HDD Construction: RES, REC

Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

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DRWN: A.V.K.
PROJ. No.: 0416166

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Figure 4.23-2: NOISE IMPACTS AT HDD CROSSINGS CONTEXT MAP
ALASKA STAND ALONE PIPELINE

0 15 30 60 90 Miles

Barrow
Nome
Fairbanks
Bethel
ANCHORAGE
Juneau

N

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4.24. Navigation Resources

4.24.1. Introduction

This section describes the potential impacts to navigation resources and navigable waterways associated with the construction and operation of the proposed Project, and discusses potential mitigation measures that would avoid or minimize the potential impacts. The information, data, methods, and/or analyses used in this discussion are based on information provided in the 2012 FEIS (USACE, 2012a), as well as new circumstances or information relevant to environmental concerns that have become available since the publication of the 2012 FEIS, including the proposed changes in route and design described in the alternatives. The information provided here often supersedes the information provided in the 2012 FEIS; in some instances, the information is replicated with relatively minor changes and updates, while other material is entirely new or substantially altered.

For this SEIS, the following elements have been added to the assessment of impacts to navigational resources:

- A new section (Section 4.24.2, Methods) was added to explain the procedures used to evaluate the potential impacts associated with the proposed Project and alternatives;
- Mitigation measures incorporated from the 2012 FEIS have been expanded to include recommendations from federal and state agencies; and
- Updates to impacts based on new alternatives and a summary of those results (Section 4.24.5, Alternative 2 – Denali NPP Route Alternative, and Section 4.24.6, Alternative 3 – No Action).

4.24.1.1. Incomplete or Unavailable Information

In compliance with CEQ guidance (see Section 4.3), this section addresses incomplete or unavailable information pertinent to analyzing impacts of the alternatives on navigational resources and waterways. Various information sources have been used to assess impacts to navigation resources potentially affected by the proposed Project. When specific information could not be obtained, a general assessment was made and noted. Assessments for this SEIS are made based on updated and accessible documents. Incomplete or unavailable information for specific waterways or tidal zones, or in general, create uncertainty of impacts. Where data are lacking, professional judgment has been applied based on knowledge, experience of the authors and generally accepted scientific methods.

4.24.2. Methods

Potential impacts for this SEIS were analyzed by assessing the magnitude, extent, duration and likelihood of occurrence as presented in Table 4.24-1, Impact Criteria for Navigational Resources and Waterways. The following sections identify and discuss

potential impacts that could occur in navigable waterways throughout the proposed Project Area. General effects that were assessed include:

- Increased navigational resource use by vessels;
- Displacement of vessels from current routes; and
- Introduction of non-native and invasive species.

4.24.2.1. Description of Effects

The two types of effects to navigational resources that were assessed for the proposed Project are described below.

4.24.2.1.1. Increased Navigational Resource Use by Vessels

The proposed Project would require marine vessel usage during the construction phase. These additional vessels would increase the use of navigational resources at West Dock, the Port of Seward, and on the Yukon River (Alternative 2 only). More vessels equates to more traffic and greater risk of collisions and associated spills.

4.24.2.1.2. Displacement of Vessels from Current Routes

Displacement of vessels from current routes could potentially increase congestion, reduce access for routine vessels, and therefore, have safety implications.

4.24.2.1.3. Introduction of Non-Native and Invasive Species

Non-native and invasive species of plants and animals can adhere themselves to the hulls of vessels and potentially be transported worldwide if not properly mitigated. Ballast water used in the hulls of marine vessels can also transport non-native and invasive organisms from place to place.

4.24.2.2. Impact Criteria

Table 4.24-1 summarizes the criteria used to determine the level of impact based on the magnitude, extent, duration and likelihood of occurrence. Table 4.24-2 defines the types of impacts the proposed Project and alternatives may have on the navigational resources that are assessed in this SEIS. Applicant-proposed design features, mitigation measures and BMPs that may reduce impacts on navigation are presented in Section 4.24.3, Applicant-Proposed Design Features, Mitigation Measures, Best Management Practices, and Project Management Plans. These design elements and mitigation measures have been taken into account in the analysis of alternatives in the following sections.

Table 4.24-1 Impact Criteria for Navigational Resources and Waterways

Impact Component	Impact Level			
	Major	Moderate	Minor	Negligible
Magnitude or Intensity	The effect would permanently restrict access or alter vessel traffic; or would permanently modify the navigability of the waterbody rendering it unusable or unsafe.	The effect would displace vessels temporarily but not affect safety or use of the waterbody.	The effect would be noticeable but would not alter vessel traffic patterns or waterbody use or vessel safety.	No or minimal effect.
Geographic Extent	The effect would have consequences on a statewide or regional basis.	The effect would have consequences at a borough or community level.	The effect would have consequences on a few sites or locations.	The effect would be limited to a specific, isolated location.
Duration or Frequency	The effect would occur for a duration of greater than 3 years or through operations of the proposed Project. Chronic and long-term changes not likely to be reversed over several years or operational life.	The effect would occur intermittently for a duration of 1 to 3 years. Periodic, temporary, or short-term changes could be reversed in an annual or several seasonal cycles.	The effect would occur intermittently for a duration of less than 1 year. Periodic, temporary, or short-term changes could be reversed over one or two seasons.	So intermittent and limited duration that effect dissipates rapidly.
Likelihood	Most likely (Effects are those that have greater than 75% chance of arising from reasonable or demonstrated mechanisms due to the action)	Likely (Effects are those that have 50% to 75% chance of arising from reasonable or demonstrated mechanisms due to the actions)	Somewhat likely (Effects are those that have a 10% to 50% chance of arising from reasonable or demonstrated mechanisms due to the action)	Unlikely (Effects are those that have less than 10% chance of arising from reasonable or demonstrated mechanisms due to the action)

Table 4.24-2 Types of Effects and Impacts on Navigational Resources and Waterways

Type of Effect	Proposed Action Causing Potential Impact	
	Construction	Operations & Maintenance
Increased Vessel Traffic	• Navigability along waterways using OC methods would be temporarily impeded by construction materials and equipment during the pipeline construction process. • Navigability in Prudhoe Bay from dredging, construction, and upgrades at West Dock.	N/A
Displacement of Routine Vessels	• Prudhoe Bay dredging, construction, and upgrades at West Dock. • Transport and delivery of materials into West Dock and Port of Seward.	N/A
Introduction of Non-Native and Invasive Species	• Vessels could introduce non-native and invasive species to the waters they travel.	N/A

4.24.3. Applicant-Proposed Design Features, Mitigation Measures, Best Management Practices, and Project Management Plans

The following design features, mitigation measures and BMPs are proposed by AGDC and have been taken into consideration when evaluating potential impacts on visual resources under Alternatives 1 and 2 during the construction and operations phases. A complete list of mitigation measures and BMPs are also provided in Appendix M.

Proposed measures would include:

1. HDD proposed at major river crossings such as the Yukon River (Alternative 1 only);
2. Use of existing vessel shipping lanes and transit routes;
3. Use of existing bridges for crossing the Nenana and Susitna rivers;
4. Consultation with federal and state regulatory agencies would occur prior to taking gravel from new material sites located along the Sagavanirktok River;
5. Approval from USACE and other federal and state regulatory agencies prior to any work in rivers or streams, as required under Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 403) and Section 404 of the CWA; and
6. Barges entering the proposed Project Area as part of the sealift would be cleaned according to federal and state protocols to mitigate the potential spread of non-native and invasive species.

4.24.4. Alternative 1 – Proposed Action

As described in detail in Chapter 2, Alternative 1 is designated the proposed Action (proposed ASAP Project). The 36-inch, 733-mile-long pipeline and 12-inch, 30-mile lateral pipeline would extend from the North Slope to the existing ENSTAR pipeline system in the Mat-Su Borough. The proposed Action includes the temporary use of two Alaska port sites: West Dock at Prudhoe Bay and the Port of Seward in Resurrection Bay. West Dock would be used over the course of one winter (dredging and dock modifications) and one summer (delivery of modules), while the Port of Seward would be used for approximately 30 months for transport of materials and equipment. Construction of the Yukon and Tanana River crossings in this alternative are proposed to be completed using HDD. The Nenana and Susitna River crossings would use existing infrastructure (Mitigation Measure No. 3, as listed in Section 4.24.3). Alternative 1 would intersect navigation resources in several locations within Alaska, as described in Chapter 3, Section 3.20, Navigation Resources.

The following sections discuss activities that are proposed to occur during the construction, operations, and maintenance phases of the proposed Project with associated potential impacts.

4.24.4.1. Construction

Construction activities for the proposed Project at West Dock, the Port of Seward, and in navigable rivers and streams along the proposed Project ROW could affect navigation resources. Additionally, the use of vessels during construction to transport equipment and modules would increase the navigational resource use by vessels, could displace vessels from the current navigational routes, and could introduce non-native or invasive species to the environment. These potential impacts are discussed below.

4.24.4.1.1. Increased Navigational Resource Use by Vessels

4.24.4.1.1.1. West Dock at Prudhoe Bay

This section describes impacts resulting from modification to the West Dock Causeway and dredging at DH3, which were not assessed in the 2012 FEIS (USACE, 2012a). Alternative 1 would involve winter dredging for creation of a navigation channel and docking stations, modifications to dock infrastructure, and ballasting two temporary barges to support module delivery and transportation across the causeway.

Dredge disposal would result in 247,000 CYs of excavated material being placed in a 100-acre dredge disposal area in nearshore subtidal habitat. Dredge material disposal is discussed in detail in ASAP's West Dock Dredge and Disposal Plan (AGDC, 2016o).

The proposed dredging would occur in the winter. During the summer, 23 barges would be used for the delivery of prefabricated modules for the GCF. Large vessels would be selected to accommodate multiple modules, reducing the total number of vessels needed.

Using the shallow nearshore environment for disposal of dredged material would alleviate most navigational hazards from sediment mounds during the ice-free season because little vessel traffic would be in the shallower waters at this location.

While construction work is completed at West Dock, other vessel traffic would be excluded or re-routed around the area for safety purposes. This exclusion may result in delays and inconveniences for drivers on the road to West Dock and other marine vessels using the area.

The increased navigational resource use for supply shipments could increase the risk of pollution in Prudhoe Bay and other Alaskan waterways. Increased pollution in Alaskan waters from wastewater discharge, ballast water, and potential spills would be minimal, as AGDC would follow all federal and state regulations and standards for discharging wastewater. The risk of spills is discussed in greater detail in Section 4.25, Reliability and Safety.

The impacts to navigation due to proposed work at West Dock DH3 during construction would be minor, as it would result in the temporary increase in vessel traffic, and one winter season of dredging and dredge material placement. Impacts to navigability would be minimized given that any transit through Prudhoe Bay would use existing

shipping lanes (Mitigation Measure No. 2, as listed in Section 4.24.3). The proposed use by 23 barges during one summer season at West Dock would result in exclusion of other vessels during the construction period; however, this effect would be isolated at this single location, and would therefore, be considered minor given this would be a temporary effect. Impacts would be a direct result of the construction and operational period.

4.24.4.1.1.2. Port of Seward at Resurrection Bay

The Port of Seward would be used for delivery of pipeline and other materials needed for construction. No modifications to the existing port would be made, but a marshalling yard would be constructed onshore within the existing rail yard. An estimated 35 shipments would be needed to fulfill pipe delivery, as described in the 2012 FEIS.

The increased navigational resource use for supply shipments could increase the risk of pollution in the Port of Seward and other Alaskan waterways. Increased pollution in Alaskan waters from wastewater discharge, ballast water, and potential spills would be minimal, as AGDC would follow all federal and state regulations and standards for discharging wastewater. The risk of spills is discussed in greater detail in Section 4.25, Reliability and Safety.

Impacts to navigability would be minimized given that any transit through the Port of Seward would use existing shipping lanes (Mitigation Measure No. 2, as listed in Section 4.24.3), and plans would be approved by USACE and other federal and state agencies through the permitting process (Mitigation Measure No. 5, as listed in Section 4.24.3).

Increased vessel activity would occur intermittently for a duration of 2 years; the effects would be temporary and dissipate rapidly without removing the value or integrity of the resource and thus are considered negligible.

4.24.4.1.1.3. Navigable Rivers and Streams

There would be a total of 423 Mainline waterbody crossings, seven Fairbanks Lateral waterbody crossings, 61 access road waterbody crossings, and five in-river material site extraction locations at the Sagavanirktok River; however, not all of these crossed water bodies are navigable waters. River and stream crossings would be completed using the following methods: isolated open cut, open cut, and trenchless HDD. Temporary bridges and culverts may also affect navigation. The three stream crossing methods, bridges, and culverts would affect navigation resources differently and are discussed below.

Consultation with state and federal regulatory agencies would occur prior to taking gravel from material sites located along the Sagavanirktok River (Mitigation Measure No. 4, as listed in Section 4.24.3) and prior to any work in rivers or streams, as required under Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 403) and Section 404 of the CWA (Mitigation Measure No. 5, as listed in Section 4.24.3).

Impacts to navigation could occur if an unintended release of fuel or other construction equipment-related fluids occur where instream work may be necessary for containment of the spill.

4.24.4.1.1.3.1. Open-Cut and Isolated Open-Cut Methods

OC and IOC stream crossing methods involve trenching across a stream channel, laying the pipe, and backfilling. IOC diverts the channel's water temporarily, whereas OC does not divert water. Both of these methods would require temporary exclusion areas around the channels for the purpose of public safety. However, the channels that would be crossed with these methods are the smallest channels crossed, so these channels are likely not navigable waters. Larger streams and rivers would be crossed using HDD or bridges and culverts. The impacts to navigation resources due to proposed work at navigable rivers and streams using the OC or IOC methods during construction would be negligible, as it would result in the temporary exclusion of the public from the construction area and could result in releases of liquid contaminants.

4.24.4.1.1.3.2. HDD Crossings

Yukon and Tanana River crossings and five smaller river and creek crossings (*i.e.*, Honolulu Creek, Troublesome Creek, Chulitna River, Kashwitna River, and Willow Creek) using the HDD method would not have any in-channel impacts or closures. Equipment would be staged on the banks/shore and drilling would go under the entire channel. Impacts to navigation could occur if there is unintended release of drilling fluids (a frac-out) where instream work may be necessary for containment.

The impacts to navigation resources due to proposed work at navigable rivers and streams using HDD methods during construction would be negligible, as no in-channel construction would occur, nor would any structures be installed. A direct but minor impact could occur if there was an unintended release of drilling fluids where instream work would be necessary for containment.

The HDD crossing method is proposed for the Yukon River in Alternative 1. Successful HDD crossing would not affect navigation during construction. Activities would occur on land, on either side of the Yukon River, within the proposed Project's construction ROW (Mitigation Measure No. 1, as listed in Section 4.24.3).

4.24.4.1.1.3.3. Bridges and Culverts

Bridges and culverts used for access road crossings of streams would be removed as part of the abandonment process. Impacts to navigational resources by bridges and culverts would be minimal and temporary for the construction season. Bridges would not have footings in the river or stream channel, all parts would be above the water on banks and span the channel aerially. During construction, the public and landowners would be excluded from the construction area. During the access road abandonment process, bridges and culverts would be removed.

The impacts to navigation resources due to proposed work at navigable rivers and streams using bridges or culverts during construction would be direct but negligible, as it would result in the temporary exclusion of the public from the construction area and could result in releases.

4.24.4.1.2. Displacement of Vessels from Current Routes

Displacement of vessels from current routes could potentially increase congestion, reduce access for routine vessels, and therefore, have safety implications. The proposed Project's vessels would be regulated the same as all other vessels in Prudhoe Bay and the Port of Seward. Vessels would use established shipping lanes (Mitigation Measure No. 2, as listed in Section 4.24.3). Displacement of non-project vessels would therefore not occur or would be negligible.

4.24.4.1.3. Non-native and Invasive Species

Ballast is water taken onboard ships to add weight to maintain the stability of the vessel when cargo is loaded and discharged when cargo is offloaded at the destination port. Ballast water is a major source for introducing non-native and invasive species into aquatic ecosystems and can adversely impact the economy, the environment, or cause harm to human health. Impacts include a reduction in biodiversity of species inhabiting coastal and fresh waters from non-native and invasive species out-competing native species for food and space. AGDC would follow all USCG regulations and permit stipulations for ballast water discharge. All barges entering the proposed Project Area as part of the sealift operations would be cleaned according to federal and state protocols and ballast compartments would be verified clean by a Marine Warranty Surveyor prior to arrival at ports. Assuming BMPs and federal and state regulations are followed; impacts from non-native invasive species on navigable waterways in Alaska are unlikely and negligible. Non-native and invasive plant species are discussed further in Chapter 3, Section 3.4 and Section 4.8 for vegetation resources.

The impacts to navigation resources due to the transmittal of non-native and invasive species transmitted by vessels would be direct but negligible after implementation of BMPs, such as barge cleaning (Mitigation Measure No. 6).

4.24.4.2. Operations and Maintenance

Vessels are not proposed for use during the operations or maintenance of the proposed Project; therefore, no impacts would occur to navigational resources during this phase.

4.24.5. Alternative 2 – Denali NPP Route Variation

Alternative 2 of the proposed Project is described in Chapter 2 in detail. Alternative 2 proposes a new aerial suspension bridge for crossing the Yukon River and would involve the use of West Dock DH2.

This alternative would route the Mainline through approximately 7 miles of Denali NPP. The Denali NPP Route Variation construction impacts would include two crossings of the Nenana River: an HDD crossing south of the McKinley Village and an aboveground crossing using an existing pedestrian/bike bridge at the crossing south of the Canyon commercial area.

Alternative 2 would intersect navigation resources in several locations within Alaska, as described in Chapter 3.

The following sections discuss activities that are proposed to occur during the construction, operations, and maintenance phases of the proposed Project with associated potential impacts.

4.24.5.1. Construction

Construction activities for Alternative 2 that could potentially impact navigation resources include: West Dock DH2 channel dredging and upgrades and increased vessel traffic in Prudhoe Bay, at the Port of Seward, and on the Yukon River. Additionally, the use of vessels during construction to transport equipment and modules would increase navigational resource use by vessels, could displace vessels from current routes, and could introduce non-native or invasive species to the environment. These potential impacts are discussed below.

4.24.5.1.1. Increased Navigational Resource Use by Vessels

4.24.5.1.1.1. West Dock at Prudhoe Bay

In Alternative 2, West Dock DH2 would be utilized for GCF module offloading instead of DH3, as proposed in Alternative 1. DH2 is located in shallower waters and could not accommodate the weight and offloading of the modules without complete retrofitting, including the addition of a third berth. Under Alternative 2, the existing channel from DH2 would need to be widened and deepened to the 10-foot depth to accommodate large vessels delivering the modules. Bathymetric data suggest the depth at DH2 could require more than 750,000 CYs dredging to allow for the barges. The required dredge depths at DH2 would require installing new sheet piling. The infill rate at DH2 would likely be faster than at DH3 due to the location, which in turn may result in the need for summer maintenance dredging following the winter dredging.

Under this alternative, dredge material would be disposed of in the ocean at a 200-acre location depicted on Figure 2.4-3 (Chapter 2). In coordination with EPA and AGDC, USACE would identify and designate a site where materials would be disposed as specified in the conditions under Section 103 of an individual Marine Protection, Research and Sanctuaries Act permit.

While construction work is completed at West Dock, other vessel traffic would be excluded or re-routed around the area for safety purposes. This exclusion may result in

delays and inconveniences for drivers on the road to West Dock and other marine vessels using the area.

The increased navigational resource use for supply shipments could increase the risk of pollution in Prudhoe Bay and other Alaskan waterways. Increased pollution in Alaskan waters from wastewater discharge, ballast water, and potential spills would be minimal, as AGDC would follow all federal and state regulations and standards for discharging wastewater.

More vessel traffic at Prudhoe Bay would result with Alternative 2 because more work would be required to conduct modifications and maintenance at DH2, and additional shipments would be required to transport the VSM pipe and supply. Impacts to navigability would still be minimized given that any transit through Prudhoe Bay would use existing shipping lanes (Mitigation Measure No. 2, as listed in Section 4.24.3).

4.24.5.1.1.2. Port of Seward and Resurrection Bay

Effects to navigational resources at the Port of Seward are the same as those discussed above in Alternative 1.

Impacts to navigability would be minimized given that any transit through the Port of Seward would use existing shipping lanes (Mitigation Measure No. 2, as listed in Section 4.24.3), and plans would be approved by USACE and other federal and state agencies through the permitting process (Mitigation Measure No. 5, as listed in Section 4.24.3).

4.24.5.1.1.3. Navigable Rivers and Streams

Effects to navigational resources at navigable rivers and streams would be the same as those discussed above in Alternative 1, except in the 7 miles of Denali NPP, where two crossings of the Nenana River would occur.

4.24.5.1.1.3.1. HDD Crossings

In the alternate routing through Denali NPP, two crossings of the Nenana River would occur. One of these crossings is proposed as an OC crossing, south of the McKinley Village.

4.24.5.1.1.3.2. Bridges and Culverts

There are two crossings proposed for the Nenana River and one at the Yukon River crossing. One of the Nenana River crossings in Denali NPP is proposed as a suspension bridge crossing.

Alternative 2 includes the aerial crossing of the pipeline across the Yukon River using a new suspension bridge. This option was analyzed in detail in the 2012 FEIS and is carried forward as part of Alternative 2 in the SEIS. No permanent or temporary structures, such as footings, would be installed within the Yukon River under this Alternative. All structures would be sited on uplands on either side if the river within the construction ROW.

Impacts to navigation on the Yukon River could occur during construction because large vessels would likely be required in the river during the construction season until the bridge is fully built. These vessels would likely impede other local vessel traffic during the construction phase of the proposed Project. The potential impacts to navigation resulting from the proposed pipeline suspension bridge would be temporary and negligible.

The impacts to navigation resources due to proposed work at the Yukon River aerial crossing during construction would be direct but negligible, as it could result in the unintended release of drilling fluids where instream work would be necessary for containment.

4.24.5.1.2. Displacement of Vessels from Current Routes

Displacement of vessels in Prudhoe Bay from current routes could potentially increase congestion, reduce access for routine vessels, and therefore, have safety implications. The proposed Project's vessels would be regulated the same as all other vessels in Prudhoe Bay. Vessels would use established shipping lanes (Mitigation Measure No. 2, as listed in Section 4.24.3). Displacement of non-project vessels would therefore not occur or would be negligible.

4.24.5.1.3. Non-Native and Invasive Species

Effects to navigational resources due to the introduction of non-native and invasive species are the same as those discussed above in Alternative 1. Impacts would be negligible during proposed Project construction with the implementation of appropriate BMPs, such as barge cleaning (Mitigation Measure No. 6).

4.24.5.2. Operations and Maintenance

Vessels would not be used for the operations or maintenance of the proposed Project; therefore, no impacts would occur to navigational resources during this phase.

4.24.6. Alternative 3 – No Action

Under Alternative 3 (No Action), the proposed Project would not be developed and there would be no affects to navigation resources.

4.24.7. Conclusions and Comparison of Alternatives

Alternatives 1 and 2 would result in similar impacts to navigational resources during the construction phase of the proposed Project. Construction activities would be the same for both Alternatives 1 and 2 (*e.g.*, use of Port of Seward, crossings of navigable rivers and streams (except at the Yukon River and two Nenana River crossings), and introduction of non-native and invasive species). A summary of the primary differences between Alternative 1 and 2 effects to navigational resources is as follows:

- More impacts to the seafloor in Prudhoe Bay would result with Alternative 2 because a larger area would require dredging. Additionally, summer maintenance dredging may be necessary to offset infill rates.
- A larger dredge placement area would be required with Alternative 2, and it would be in the ocean rather than nearshore.
- More vessel traffic at Prudhoe Bay would result with Alternative 2 because more work would be required to conduct modifications at DH2.
- The aerial suspension of the Yukon River crossing in Alternative 2 would have significantly more impacts to navigational resources than Alternative 1, because the proposed Project work would likely involve large vessels on-river during construction.
- Alternative 2 would result in impacts within Denali NPP, whereas Alternative 1 would avoid the park entirely by going to the east. Two crossings of the Nenana River are proposed along the Denali NPP Route Variation, one OC and one suspension bridge.

Under Alternative 3 (No Action), the proposed Project would not be developed or constructed, and therefore, no impacts to navigational resources would occur.

Table 4.24-3 shows the rankings of effects that proposed Project activities would have on the navigational resources.

Increased navigational resource use by vessels was ranked as minor and having direct impact to navigational resources during the construction phase of both Alternatives 1 and 2. Increased vessel traffic would occur at Prudhoe Bay and at the Port of Seward, during the construction phase of the proposed Project. In Alternative 2, vessel traffic would also increase at the Yukon River because large vessels would be used on-river during construction. The duration would be temporary and effects would be localized to the shipping lanes and the Yukon River crossing directly. During operations, no navigational resources would be impacted.

Displacement of vessels from current routes was ranked as negligible for the construction phase of both Alternatives 1 and 2. During operations, it is not applicable, as no navigational resources would be impacted. The proposed Project's vessels would be under the same regulations as other vessels in the area and would use designated shipping lanes; therefore, displacement would not occur.

Introduction of non-native and invasive species was ranked as negligible and having direct impact to navigational resources during the construction phase of both the Proposed Alternative and Alternative 2. During operations, it is not applicable, as no navigational resources would be utilized after proposed Project construction is complete.

Figure 4.24-1 illustrates some of the key findings from the impact analysis. The figure intends to provide context for the description of potential impacts of alternatives as

described in detail in this section. By illustrating the potential impacts on the proposed Project map using a consistent color scheme consistent with Table 4.24-3, we could begin to draw a few conclusions. Examples are provided below:

- The results indicate the above listed impacts are more strongly perceived in Prudhoe Bay and Resurrection Bay.
- The most significant impacts to navigation would be those associated with increased use of navigational resources.

Table 4.24-3 Comparison of Alternatives for Impacts to Navigational Resources and Waterways (Direct & Indirect)

Resource Effect	Potential Impact Description	Alternative 1		Alternative 2		Alternative 3
		Construction	Operations	Construction	Operations	Construction/Operations
		Impact Rating		Impact Rating		Impact Rating
Increased Navigational Resource Use by Vessels	Vessels used to transport proposed Project materials for construction would add to existing vessel traffic at ports potentially impacting: • Human health • Ecosystems	***Minor***	***Negligible***	***Minor***	***Negligible***	***Negligible***
Displacement of Vessels from Current Route	Displacement of vessels from current routes could potentially increase congestion, reduce access for routine vessels, and therefore, have safety implications	***Negligible***	***Negligible***	***Negligible***	***Negligible***	***Negligible***

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City or Village
Mileposts
ASAP Mainline v6.1
Fairbanks v4.1 Lateral
Navigable Rivers
West Dock Action Area
Port of Seward Action Area

Effect Rating
Major Positive
Moderate Positive
Minor Positive
Negligible
Minor Negative
Moderate Negative
Major Negative

Effect Indicators
USE: Increased navigational resource use by vessels
DISP: Displacement of vessels from current route

Beaufort Sea

MP 0
MP 62
MP 100
MP 200
MP 300
MP 400
MP 500
MP 600
MP 700
MP 733

West Dock in Prudhoe Bay
USE
DISP

Navigable Rivers and Streams
USE
DISP

Port of Seward
USE
DISP

Anaktuvuk Pass
Wiseman
Bettles
Stevens Village
Livengood
Rampart
Minto
Two Rivers
Pleasant Valley
Four Mile Road
Nenana
Fairbanks
Anderson
Ferry
Healy
McKinley Park
Cantwell
Petersville
Talkeetna
Skwentna
Willow
Susitna
Anchorage
Seward

Yukon River
Tanana River
Chatanika River
Nenana River
Susitna River
Little Susitna River

U.S.A.
CANADA

Esri, DeLorme, GEBCO, NOAA NGDC, and other contributors

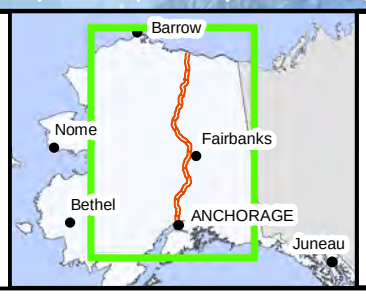
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DATE: MAR 2018
CHKD: K.A.
DRWN: A.V.K.
PROJ. No.: 0416166

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Figure 4.24-1: NAVIGATION IMPACTS CONTEXT MAP ALASKA STAND ALONE PIPELINE

0 30 60 120 180 Miles



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4.25. Reliability and Safety

Sections 4.6 through 4.24 describe potential environmental consequences of the proposed Project and alternatives on a wide range of resources. Each of these sections describes potential effects on the resource and assesses the proposed Project and alternatives based on potential effects and impact level. In contrast, reliability and safety is not a resource, but a characteristic of the proposed Project.

Thus, the organization of this section differs from other sections in that it does not present potential impacts of the proposed Project on a safety and reliability "resource." Rather, current pipeline safety standards are summarized in Section 4.25.2, specific changes to Alternative 1 (proposed Action) relevant to reliability and safety since the 2012 FEIS are described in Section 4.25.3, pipeline accident data are presented in Section 4.25.4, potential impacts to public safety are described in Section 4.25.5, and the evaluation of alternatives is presented relative to those standards and data. Specifically, Section 4.25.12 presents expected significant incident rates for the proposed ASAP pipeline based on U.S. gas pipeline statistics.

4.25.1. Introduction

This section describes the reliability and safety of the proposed Project and alternatives described in Chapter 2. This description is based on information provided in the 2012 FEIS (USACE, 2012a) as well as data presented in the 2016 ASAP EED (AGDC, 2016b). The information used in this section builds on the 2012 FEIS and incorporates new data and information relevant to reliability and safety concerns associated with the alternatives that have become available since the original 2012 FEIS. The proposed changes in route and design described in Alternative 1 are the focus of this assessment. In addition, the gas has changed from containing NGLs to only containing lean natural gas, and the maximum allowable operating pressure for the pipeline decreased from 2,500 psig to 1,480 psig.

In some instances, information from the 2012 FEIS is replicated with relatively minor changes and updates, while other material is entirely new or substantially altered. For this SEIS, the following elements have been added to the assessment of impacts to the reliability and safety of the proposed Project:

- A new methods section (Section 4.25.7) was added to explain the procedures used to evaluate the potential impacts associated with the proposed Project and alternatives;
- Appendix D (Identification and Evaluation of Time-Dependent Route Geohazards) has been added and provides information on the design methodology for addressing potential route threats (specifically, thaw settlement and frost heave) to the pipeline;
- Mitigation measures incorporated from the 2012 FEIS have been expanded to include new proposed Project information; and
- Impacts based on new alternatives hav been updated and a summary of those results has been included.

4.25.2. Pipeline Safety Standards

USDOT is mandated to provide pipeline safety under Title 49, U.S.C. Chapter 601. USDOT's PHMSA oversees the national regulatory program to ensure the safe transportation of natural gas and other hazardous materials by pipeline. It develops safety regulations and other approaches to risk management that help ensure safety in the design, construction, testing, operation, maintenance, and emergency response of pipeline facilities. Several of the regulations are written as performance standards, which set the level of safety to be attained and allow the pipeline operator to use various technologies to achieve safety. PHMSA's mission is to protect people and the environment from the risks of hazardous materials transportation. This work is shared with state agency partners and others at the federal, state, and local level.

The Natural Gas Pipeline Safety Act at 49 U.S.C. 60105 provides for a state agency to assume all aspects of the safety program for intrastate facilities by adopting and enforcing the federal standards, while 49 U.S.C. 60106 permits a state agency that does not qualify under 49 U.S.C. 60105 to perform certain inspection and monitoring functions. A state may also act as USDOT's agent to inspect interstate facilities within its boundaries; however, USDOT is responsible for enforcement actions. The majority of the states have either certifications or agreements with USDOT under the Natural Gas Pipeline Safety Act, while nine states act as interstate agents. The State of Alaska does not have either a certification or an agreement with USDOT under the Natural Gas Pipeline Safety Act.

USDOT pipeline standards are published in 49 CFR 190 to 199. Natural gas pipeline safety issues are specifically addressed in 49 CFR 192. The pipeline and aboveground facilities associated with the proposed Project must be designed, constructed, operated, and maintained in accordance with USDOT Minimum Federal Safety Standards in 49 CFR 192.

The regulations in 49 CFR 192 are intended to ensure adequate protection for the public and the environment and to prevent natural gas facility incidents and failures. Minimum requirements prescribed in 49 CFR 192 are for the:

- Selection and qualification of pipe and components;
- Design of pipe;
- Design and installation of pipeline components and facilities;
- Welding;
- Constructing; and
- Protection from external, internal, and atmospheric corrosion.

The regulation also prescribes minimum standards for leak-testing, strength-testing, operations and maintenance, operator qualifications, and an integrity management program.

Class locations are described in 49 CFR 192.5 and are based on population density near the pipeline. The regulation specifies more rigorous safety requirements for populated areas. The class location unit is an area that extends 220 yards (660 feet) on either side of the centerline of any continuous 1-mile length of pipeline. The four area classifications are defined as follows:

- Class 1: Location with 10 or fewer buildings intended for human occupancy;
- Class 2: Location with more than 10, but less than 46 buildings intended for human occupancy;
- Class 3: Location with 46 or more buildings intended for human occupancy or where the pipeline lies within 100 yards of any building, or small well-defined outside area occupied by 20 or more people on at least 5 days a week for 10 weeks in any 12-month period; and
- Class 4: Location where buildings with four or more stories aboveground are prevalent.

Class locations representing more populated areas require higher safety factors in pipeline design, testing, and operation. Minimum depth of cover is prescribed by 49 CFR 192.327. Pipelines constructed on land in Class 1 locations must be installed with a minimum depth cover of 30 inches in normal soil and 18 inches in consolidated rock. Class 2, 3, and 4 locations, as well as drainage ditches of public roads and railroad crossings, require a minimum cover of 36 inches in normal soil and 24 inches in consolidated rock. All pipelines installed in navigable rivers, streams, and harbors must have a minimum cover of 48 inches in soil and 24 inches in consolidated rock.

Class locations also specify the maximum distance to a sectionalizing block valve. The EED states that block valves would be installed along the proposed Mainline pipeline and the Fairbanks Lateral, spaced in accordance with 49 CFR 192 no greater than 20 miles apart. Block valve spacing regulations are set forth in 49 CFR 192.179, which requires that each point on a pipeline must be within 10.0 miles of a valve in Class 1 locations, within 7.5 miles of a valve in Class 2 locations, within 4.0 miles of a valve in Class 3 locations, and within 2.5 miles of a valve in Class 4 locations, unless the PHMSA Administrator finds that alternative spacing would provide an equivalent level of safety. Pipe wall thickness and pipeline design pressures, hydrostatic test pressures, maximum allowable operating pressure (MAOP), inspection and testing of welds, and frequency of pipeline patrols and leak surveys must also conform to higher standards in more populated areas. Preliminary class locations for Alternative 1 (proposed Action) have been developed based on the relationship of the pipeline centerline to other nearby structures and manmade features. The Class 2 and Class 3 locations have been field verified; field verification was not used for Class 1 locations as aerial photography resolution was sufficient to identify nearby structures and manmade features. Approximate class locations are depicted geographically on Figure 4.25-1. In general, the proposed Project route would be located in Class 1 areas with the following exceptions:

- Class 3 Area: Mainline at McKinley Park MP 534.9 through MP 535.9;
- Class 2 Area: Mainline at Cantwell MP 564.1 through MP 564.7; and
- Class 2 Area: Fairbanks Lateral MP 26 through MP 27.

No Class 4 areas would be encountered along the proposed Project route. The Denali NPP Route Variation (Alternative 2) splits off the proposed Project route just south of the Class 3 Area at McKinley Park. Thus, this Class 3 area would also apply to the Denali NPP Route Variation.

If a subsequent increase in population density adjacent to the ROW indicates a change in class location for the pipeline, AGDC would have to reduce the MAOP or replace the segment with pipe of sufficient grade and wall thickness, if required, to comply with USDOT code of regulations for the new class location.

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Prudhoe Bay
Deadhorse
Beaufort Sea
MP 0
MP 50
MP 100
MP 150
MP 200
MP 250
MP 300
MP 350
MP 400
MP 450
MP 500
MP 550
MP 600
MP 650
MP 700
NATIONAL PETROLEUM RESERVE
Umiat
ARCTIC NATIONAL WILDLIFE REFUGE
U.S.A.
CANADA
GATES OF THE ARCTIC NATIONAL PARK
Wiseman
Bettles
KANUTI NATIONAL WILDLIFE REFUGE
YUKON FLATS NATIONAL WILDLIFE REFUGE
Stevens Village
KOYUKUK NATIONAL WILDLIFE REFUGE
WHITE MOUNTAINS NATIONAL RECREATION AREA
YUKON-CHARLEY RIVERS NATIONAL PRESERVE
Rampart
Class 2
Livengood
Chena Hot Springs
Tanana
Minto
Fox
NOWITNA NATIONAL WILDLIFE REFUGE
MINTO FLATS STATE GAME REFUGE
Fairbanks
Fairbanks Lateral
Anderson
Big Delta
Class 3
Healy
TANANA VALLEY STATE FOREST
McKinley Park
DENALI NATIONAL PARK
Cantwell
Class 2
TETLIN NATIONAL WILDLIFE REFUGE
DENALI NATIONAL PRESERVE
NELCHINA PUBLIC USE AREA
Talkeetna
WRANGELL-ST.ELIAS NATIONAL PRESERVE
Chickaloon
Willow
Big Lake
Susitna
SUSITNA FLATS STATE GAME REFUGE
Anchorage

Location Class
- Class 1
- Class 2
- Class 3
- City or Village
- Mile Post
- International Border
- Roads
- ASAP v6.1 Mainline
- FBX Centerline
- Park/Refuge

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FIGURE 4.25-1: U.S. DEPT OF TRANSPORTATION CLASSIFICATION OF PROPOSED PROJECT ALASKA STAND ALONE GAS PIPELINE

0 50 100 Miles

ALASKA CANADA

N

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4.25.3. Specific Changes to Alternative 1 (Proposed Action) Since the 2012 FEIS Relevant to Reliability and Safety

Since the 2012 FEIS, significant changes have been proposed that have the potential to impact reliability and safety:

- Change from enriched natural gas containing NGL to lean natural gas (89 mole percent methane);
- Reduction in the maximum pipeline pressure from 2,500 psig to 1,480 psig;
- The pipeline is proposed to be buried along the entire route, except at elevated bridge crossings, fault crossings, pigging facilities, and valves;
- Increase in the volume of required fill from 13.1 MCYs to 25 MCYs from gravel sources; and
- Increase in pipeline diameter from 24 inches to 36 inches. The increase in pipe diameter results in deeper, wider trenches and a large increase in the amount of material to be handled.

Applicable regulations (49 CFR 192.5) define pipeline class locations and specify more rigorous safety requirements for populated areas. Changes in pipeline routing have moved sections of the proposed pipeline away from populated areas. Near Nenana, this has allowed a reduction in pipeline class from Class 2 to Class 1. Sections of pipe that were rated as Class 2 and Class 3 between Willow and Trapper Creek have been re-routed, so they are now Class 1.

The transportation of natural gas by pipeline involves some risk to the public in the event of an accident and subsequent release of gas. The greatest hazard is a fire or explosion following a pipeline rupture.

Methane, the primary component of natural gas, is colorless, odorless, and tasteless. It is not toxic but is classified as a simple asphyxiate, possessing a slight inhalation hazard. If breathed in high concentration, oxygen deficiency can result in serious injury or death. Methane has an ignition temperature of 1,000°F and is flammable at concentrations between 5 and 15 percent in air. Unconfined mixtures of methane in air are not explosive. However, a flammable concentration within an enclosed space in the presence of an ignition source can explode. Methane is buoyant at atmospheric temperatures and disperses rapidly in air. If constructed, the proposed Project would be the first major large-diameter natural gas pipeline in the U.S. with a MAOP of 1,480 psig.

The Pipeline Safety Improvement Act of 2002 requires operators to develop and follow a written integrity management program that contains all the elements described in 49 CFR 192.911 and addresses the risks on each transmission pipeline segment. Specifically, the law establishes an integrity management program that identifies all high consequence areas (HCA). The integrity management program is an additional layer of regulatory requirements, beyond the operations, maintenance, and other 49 CFR 192 requirements, for pipelines in an HCA. AGDC has identified an HCA at Denali NPP

(Response to a Request for Information provided in a USACE letter dated November 16, 2015).

USDOT has published rules that define HCAs as locations where a gas pipeline accident could do considerable harm to people and their property and requires an integrity management program to minimize the potential for an accident. This definition satisfies, in part, the Congressional mandate for USDOT to prescribe standards that establish criteria for identifying each gas pipeline facility in a high-density population area.

The HCAs may be classified in one of two ways. In the first method, an HCA includes (49 CFR 192.903):

- Current Class 3 and 4 locations;
- Any area in Class 1 or 2 where the potential impact radius is greater than 660 feet and there are 20 or more buildings intended for human occupancy within the potential impact circle; or
- Any area in Class 1 or 2 where the potential impact circle includes an identified site.

An identified site is an outside area or open structure that is occupied by 20 or more persons on at least 50 days in any 12-month period; a building that is occupied by 20 or more persons on at least 5 days a week for any 10 weeks in any 12-month period; or a facility that is occupied by persons who are confined, are of impaired mobility, or would be difficult to evacuate.

In the second method, an HCA includes any area within a potential impact circle that contains 20 or more buildings intended for human occupancy, or an identified site.

The pipeline operator could choose to use either of the two methods discussed above or may apply one method to individual portions of the pipeline system. Once a pipeline operator has determined the HCAs along its pipeline, it must apply the elements of its integrity management program to those segments of the pipeline within HCAs. USDOT regulations specify the requirements for the integrity management program in 49 CFR 192.911. HCAs are determined based on the relationship of the pipeline centerline to other nearby structures and identified sites.

Details concerning the locations of HCAs are frequently kept confidential from the public in order to maintain a higher level of security. To maintain compliance with the pipeline classification and pipeline integrity management regulations in 49 CFR 192, AGDC would continue to monitor for potential class location changes and HCAs throughout the life of the proposed Project. Monitoring would include AGDC's aerial and ground inspections, review of aerial photography of the route, and surveillance during activities associated with operation. The pipeline integrity management rule for HCAs requires inspection of the entire pipeline for HCAs every 7 years (49 CFR 192.939).

USDOT prescribes the minimum standards for operating and maintaining pipeline facilities, including the requirement to establish written plans governing these activities.

Each pipeline operator is required to establish an emergency plans that includes procedures to minimize the hazards in a natural gas pipeline emergency (49 CFR 192.615). Key elements of the plans include procedures for:

- Receiving, identifying, and classifying emergency events, gas leakage, fires, explosions, and natural disasters;
- Establishing and maintaining communications with local fire, police, and public officials and coordinating emergency response;
- Emergency system shutdown and safe restoration of service;
- Making personnel, equipment, tools, and materials available at the scene of an emergency; and
- Protecting people first and then property, and making them safe from actual or potential hazards.

USDOT requires that each operator establish and maintain liaison with appropriate fire, police, and public officials to learn the resources and responsibilities of each organization that may respond to a natural gas pipeline emergency and to coordinate mutual assistance.

In accordance with 49 CFR 192, AGDC would develop a series of plans to support construction and operations:

- Operations and Maintenance Plan (49 CFR 192.605)
- Emergency Plans (49 CFR 192.615)
- Alarm Management Plan (49 CFR 192.631 (d)(4)(e))
- Baseline Assessment Plan (49 CFR 192.919)
- External Corrosion Direct Assessment (ECDA) plan (49 CFR 192.925)
- Internal Corrosion Direct Assessment (ICDA) plan (49 CFR 192.927)
- Integrity Management Plan (49 CFR 192.1007)
- Since 1982, operators have been required to participate in "One-Call" public utility programs in populated areas to minimize unauthorized excavation activities near pipelines. The "One-Call" program is a service used by public utilities and some private sector companies (*e.g.,* oil pipelines and cable television) to provide preconstruction information to contractors or other maintenance workers on the underground location of pipes, cables, and culverts.

AGDC would conduct a public education program that would include information regarding participation in the "One-Call" program, hazards associated with the unintended release of natural gas, unintended release indicators, and reporting procedures.

4.25.4. Pipeline Accident Data

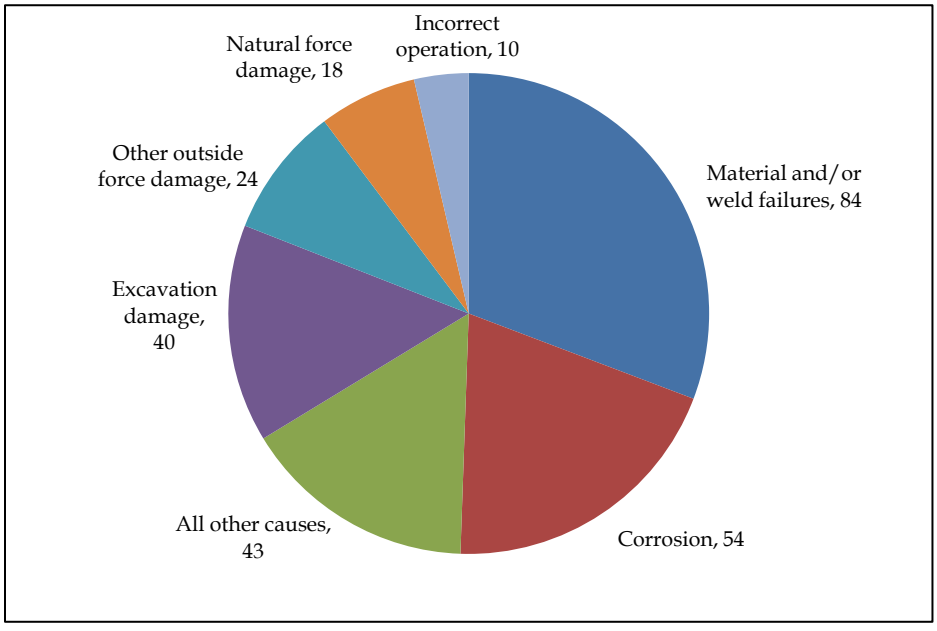
USDOT requires all operators of natural gas transmission pipelines to notify the USDOT of any significant incident and to submit a report within 20 days. Significant incidents include leaks that:

- Caused a death or personal injury requiring hospitalization;
- Involve property damage of more than $50,000, in 1984 dollars;
- Result in release of 50 barrels or more of a liquid that is not a highly volatile liquid; or
- Result in liquid releases resulting in an unintentional fire or explosion.

Note that because the proposed Action no longer uses NGL, there would be no potential for accidental release of highly volatile liquids. Fire first incidents are excluded from the significant incident category. During the 20-year period from 1996 through 2015, a total of 1,016 significant incidents were reported to PHMSA relating to onshore natural gas transmission pipelines nationwide. These incidents are associated with approximately 299,000 miles of pipelines and resulted in 46 fatalities, 181 injuries, and more than $1.3 billion in damage.

Additional insight into the nature of significant incidents may be found by examining the primary factors that caused the failures. The chart below (Figure 4.25-2) is based on the USDOT report *The State of the National Pipeline Infrastructure* (2012).

Figure 4.25-2 Number of Gas Transmission Pipeline Significant Incidents



Source: USDOT, 2012

The dominant incident cause is material or weld failures constituting 31 percent of all significant incidents. Other common causes of significant incidents were corrosion (20 percent), excavation damage (14 percent), other outside force damage (9 percent), natural force damage (6 percent), and incorrect operation (4 percent). The pipelines included in the system vary widely in terms of age, pipe diameter, and level of corrosion control. Each variable influences the incident frequency that may be expected for a specific segment of pipeline.

The frequency of significant incidents is strongly dependent on pipeline age. Older pipelines have a higher frequency of corrosion incidents, since corrosion is a time-dependent process. The use of both an external protective coating and a cathodic protection system, required on all pipelines installed after July 1971, significantly reduces the corrosion rate compared to unprotected or partially protected pipe.

The Proposed pipeline would face geohazards not commonly encountered by pipelines in the 48 contiguous states. These include:

- Mass wasting (avalanches, rock falls, slides, and slumps, solifluction, and gelifluction);
- Geothermal hazards (frost bulb formation, frost heave, thaw bulb formation, and thaw settlement);
- Fluvial processes; and
- Coastal processes.

4.25.5. Impact on Public Safety

PHMSA publishes data on the number of fatalities associated various types of pipelines. Forty-six fatalities were associated with on shore gas transmission lines for the 1996–2015 period, or an average of 2.3 fatalities per year. The number of significant incidents over approximately 299,000 miles of onshore natural gas transmission lines indicates the risk is low for an incident at any given location.

The majority of fatalities from pipelines are due to incidents on local distribution pipelines. Local distribution pipelines distribute natural gas to homes and businesses after transportation through natural gas transmission pipelines. In general, these distribution lines are smaller diameter pipes, plastic pipes, and older pipelines, which are more susceptible to damage. In addition, distribution systems do not have large ROWs and pipeline markers common to the larger natural gas transmission pipelines, such as those under the proposed Project.

4.25.5.1. Terrorism and Security Issues

Following the terrorist attacks of September 11, 2001, terrorism has become a safety and security concern for energy facilities and is an important consideration for the design, construction, and operation of energy facilities. In October 2001, a lone individual shot a

hole in the TAPS oil pipeline with a .338-caliber rifle, demonstrating potential difficulties in securing remote facilities.

Both international and domestic terrorism have changed the way pipeline operators as well as regulators must consider pipeline security, both in approving new projects and in operating existing facilities. The likelihood of future attacks of terrorism or sabotage occurring along the proposed Project is unpredictable and the continuing need to construct facilities to support the development of the natural gas industry in Alaska is not lessened by the threat of any potential future acts.

Design, construction, and operations elements already integrated into the proposed Project provide a level of security from such a threat, including buried construction of the pipeline; locked security fencing surrounding aboveground facilities; regular air and ground inspection of the pipeline route; and regular visitation to aboveground facilities by operations and maintenance crews. Additionally, specialized training in pipeline security awareness for pipeline employees is recommended by the Transportation Security Administration (TSA) (TSA, 2011). Further, specific information including pipeline design and integrity, security risks, and HCAs are frequently kept confidential from the public to maintain a higher level of security.

4.25.5.2. Pipeline Design Approach

The following assessment applies to the proposed Action (Alternative 1), as well as Alternative 2, with regard to safety and reliability standards and design approach. According to 49 CFR 192.317: "The operator must take all practicable steps to protect each transmission line or main from washouts, floods, unstable soil, landslides, or other hazards that may cause the pipeline to move or to sustain abnormal loads." AGDC would complete route investigations to maintain pipeline integrity for potential Arctic hazards caused by thermal interaction of the buried pipeline with the subsurface conditions.

Under Alternative 1, AGDC intends to design and construct a pipeline designed to operate at near ambient-temperatures. The exterior temperature of the pipeline would fluctuate seasonally with ground temperature. The pipeline operating temperature would be governed by the combined influence cooling associated with gas pressure drop and pipe-wall heat transfer from the surrounding soil to the pipeline. As near surface soil temperatures in the northern portion of the pipeline corridor are below freezing for much of the year, the gas would be conditioned to below-freezing temperatures at the GCF. The relatively low mass of hydrocarbon flowing through the pipeline would result in less heat transfer when compared to crude oil pipelines.

The AGDC design approach calls for operation at below-freezing temperatures in predominantly permafrost terrains to protect the thermal stability of the surrounding soils. The pipeline would be located below or in the active layer, which lies above the permafrost, and the active layer tends to thaw each year. When the buried pipeline operates below the freezing temperature in initially thawed soil, frost heave could occur,

with subsequent vertical upward movement of the pipeline. As illustrated in Appendix D, this condition would also result in a frost bulb surrounding the pipeline. Thus, in addition to applying physical forces to the pipeline, frozen soil can impact suprapermafrost groundwater hydraulics and flow paths.

AGDC intends that the pipeline would operate at above-freezing temperatures in predominantly thawed settings, so as not to create frost-bulbs that could lead to frost-heave displacement or adversely impact drainage. When the buried pipeline operates above the freeze point temperature in initially frozen soil, the soil could thaw, with subsequent loss of support and settlement of the pipeline. In both cases, the pipeline could experience stress due to the differential movement of the pipeline.

To keep stress within acceptable limits and compliant with 49 CFR 192 requirements and related industry standards, AGDC proposes employing a design approach to develop limiting curvatures which could be monitored through state-of-art pipeline pigging technology. The limiting curvature criterion is derived from consideration of limiting tensile and compressive strains capacities of the pipe material. The limiting curvature of the pipe is used for design screening of the route terrain units and for developing operational monitoring using pipeline in-line inspection (ILI) tools that detect pipeline movement (*e.g.,* high-resolution geometry pigs). The criteria are used to screen pipe route segments, which do not exceed the criteria limits, after evaluation of the interaction of the pipe material, its operating characteristics, and the segment route subsurface behavior. Segments that are determined to potentially exceed curvature criteria limits are subject to mitigative actions to reduce the pipe response to within acceptable bounds.

The approach would be validated through proposed Project-specific data collection and testing that considers the materials, route alignment and soils, and operational conditions. AGDC would address specific design details such as pipe wall thicknesses, grade, and design factors for road crossings, river crossings, bridge crossings, railroad crossings, TAPS crossings, populated areas, and major geologic fault locations during detailed design. AGDC plans to employ a stress-based design and to include provisions to prevent and mitigate an excessive bending strain. For a discussion of the proposed Project design approach, Appendix D (Identification and Evaluation of Time-Dependent Route Geohazards), and ASAP Design Methodology to Address Frost Heave Potential (MBJ, 2011).

Probabilities and consequences of pipeline failure would be addressed during detailed design and would result in emergency response plans and other proposed Project mitigation features. As with all other aspects of the proposed Project, all plans and features would be reviewed and approved in accordance with the State of Alaska ROW Lease Stipulations.

Under both Alternatives 1 and 2, the pipeline would need to comply with all federal and state pipeline safety regulations in the design, construction, and operation of the pipeline, and in particular, those specified in 49 CFR 191, 192, and 199.

For both Alternatives 1 and 2, portions of the pipeline would be constructed in areas that have historically experienced forest fires. PHMSA safety standards relating to responding to emergencies and natural disasters, including fires, would be applicable to design and construction of the proposed Project. The pipeline would be buried with at least 3 feet of cover for more than 99 percent of the alignment. Due to the depth of cover, a forest fire would have no safety impact on the buried portions of the proposed Project. Block valves, other above ground appurtenances, and facility locations would be maintained to provide adequate buffers and defensible space from potential fires.

Forest fires are not considered an instantaneous threat. Should a facility or valve location be threatened, there would likely be sufficient time to muster resources to protect the pipeline until the fire risk has passed. Under Alternatives 1 and 2, portions of the pipeline would be located near a highway for access to the buried and aboveground facilities.

4.25.6. Incomplete or Unavailable Information

The proposed Action (Alternative 1) envisions a 733-mile long, 36-inch diameter low-pressure natural gas pipeline. This pipeline would cross areas of continuous permafrost, areas of discontinuous permafrost, and areas where permafrost does not occur. The pipeline would be buried along the entire route, except at elevated bridge crossings, fault crossings, pigging facilities, and valves. This approach could be considered as innovative in that no comparable (large scale, large diameter, buried) pipeline crossing large permafrost areas could be identified in North America for comparison purposes. AGDC has cited the Washington Creek Trenching Test Site, which is discussed in Section 4.6, Soils and Geology, as an example of a comparable project. While comparable pipelines that have been identified in Russia have experienced considerable issues with reliability and safety, it is unclear whether or not these issues were solely due to lower environmental and safety standards. Thus, buried Russian pipelines have not been used for comparison. Considering the innovative nature of the proposed Action (Alternative 1), there may be environmental or safety issues that are not fully understood at this time. Safe and reliable design and construction of the proposed Project would require adequate understanding and steps to address a range of potential issues:

- Seasonal fluctuations in soil temperatures which vary with depth, elevation, and latitude;
- The impact of the proposed construction techniques on surface albedo;
- Changes in the thermal and physical properties of soils over a range of geographic scales;
- Continuous changes in thaw depth over the course of each thaw season (both near and further away from the pipeline);
- Potential long-term, regional changes to climate;
- Suprapermafrost groundwater and surface water flow and thermal properties; and

- Positive thermal feedback loops involving hydrologic changes caused by pipeline construction and operation.

To the extent possible, specific Applicant-proposed safety measures and BMPs are cited in this analysis and provide the best available information. Were the pipeline to be constructed, its safety and reliability would depend on a variety of factors that cannot be fully assessed at this time, including:

- The ability of the design team to adequately account for a variety of geomorphic processes that operate at a variety of geographic and temporal scales;
- The impact of economic concerns on the design and construction process; and
- Pipe material and on-site construction quality control.

Under Alternative 2, this SEIS analysis assumes the same methods would be employed for certain portions of the proposed pipeline between MP 62 and the southern terminus. Therefore, the same assumptions regarding reliability and safety apply to Alternative 2 for the portion of the pipeline south of MP 62.

4.25.7. Methods

Evaluation of the reliability and safety of Alternative 1 (proposed Action), as well as Alternative 2 (for the portion of the pipeline south of MP 62), is based on the evaluation of documents provided by AGDC, the resources along the proposed Project corridor, and safety data concerning other pipelines in the U.S. Potential impacts for this SEIS were analyzed by assessing the magnitude, extent, duration and likelihood of occurrence as presented in Table 4.25-1, Impact Criteria for Reliability & Safety. Effects that were assessed include pipeline rupture causing fire or explosion; and other significant accidents and incidents.

Table 4.25-1 summarizes the criteria used to determine the level of impact based on the magnitude, extent, duration and likelihood of occurrence. These criteria have been based, in part, on USDOT standards described above. Table 4.25-2 defines the types of effects the proposed Project and alternatives may have on reliability and safety that are assessed in this SEIS. The potential effects listed in these tables also consider the implementation of the mitigation measures. Potential impacts that remain after mitigation measures have been implemented are described for each alternative in the following sections.

Table 4.25-1 Impact Criteria for Reliability & Safety

Impact Component	Impact Level			
	Major	Moderate	Minor	Negligible
Magnitude or Intensity	Sufficient to cause death; property damage (>$114,000), release of 50 or more barrels of liquid that is not highly volatile[a]; extended service disruption.	Sufficient to cause personal injury requiring hospitalization; property damage (<$114,000), release <50 barrels of liquid that is not highly volatile[a]; short-term service disruption	Sufficient to cause personal injury but does not require hospitalization; no property damage; and no release of liquids[a]; minor service disruption	No or minimal effect
Geographic Extent	Any segment of pipeline	Any segment of pipeline	Any segment of pipeline	Any segment of pipeline
Duration or Frequency	Any	Any	Short-term duration with moderate frequency or moderate duration with low frequency	No lasting impacts
Likelihood	Most likely: Effects are those that have greater than 75% chance of arising from reasonable or demonstrated mechanisms due to the action	Likely: Effects are those that have greater than 50% to 75% chance of arising from reasonable or demonstrated mechanisms due to the actions	Somewhat likely: Effects are those that have a 10% to 50% chance of arising from reasonable or demonstrated mechanisms due to the action	Unlikely: Effects are those that have less than 10% chance of arising from reasonable or demonstrated mechanisms due to the action

a USDOT defines a significant incident as a leak that causes property damage of more than $50,000, in 1984 dollars. Value was converted to 2016 dollars using the U.S. Department of Labor Consumer Price Index Inflation Calculator.

Table 4.25-2 Types of Effects and Impacts Related to Reliability and Safety

Type of Effect	Proposed Project Causing Potential Impact	
	Construction	Operations and Maintenance
Pipeline rupture causing fire or explosion	Not applicable	• Incidents of corrosion, pipeline material/weld/equipment failure, natural force damage, outside force, incorrect operation, or other causes. • Terrorism and security risks increase impacts to public safety. • Potential of pipeline rupture from washouts, floods, unstable soil, landslides, frost heaves, or other hazards. • Potential for extended service disruption.
Other significant accidents and incidents	Construction accidents and incidents could include heavy equipment striking personnel, vehicle accidents and rollovers, cold- or heat-stress injuries, wild animals attacking personnel, excavation cave-ins, or any of numerous other safety risks	Accidents occurring during the operations and maintenance period might include vehicular accidents, cold- or heat-stress injuries, wild animals attacking personnel, or confined space incidents.

Type of Effect	Proposed Project Causing Potential Impact	
	Construction	Operations and Maintenance
	inherent in construction in remote locations.	

4.25.8. Proposed Design Features, Mitigation Measures, Best Management Practices, and Project Management Plans

4.25.8.1. Applicant-Proposed Design Features, Mitigation Measures, Best Management Practices, and Project Management Plans

The following design features, mitigation measures, and BMPs are proposed by AGDC and have been taken into consideration when evaluating potential impacts on reliability and safety under Alternatives 1 and 2 during the construction and operations phases. A complete list of mitigation measures and BMPs is also provided in Appendix M.

Proposed mitigation measures include:

1. Stress-based design;
2. Earthquake mitigation measures and special design considerations at fault crossings;
3. Slope stability monitoring;
4. Seismic/earthquake monitoring;
5. Special techniques proposed for restoration of the trench to prevent alteration of the ice-rich permafrost;
6. Pipeline burial with at least 30 inches of cover in permafrost areas;
7. The proposed HDD crossing of the Yukon River and six other waterbody crossings;
8. Bridge crossings under consideration for the Putuligayuk River, the Susitna River, Montana Creek, and the Nenana River; and
9. Steps to effectively integrate security into supervisory control and data acquisition (SCADA) systems.

4.25.8.2. Agency-Recommended Mitigation Measures

A variety of mitigation measures and best practices have been recommended by the cooperating agencies (Appendix M). Many of these recommendations have been incorporated in the proposed Project and are included in Table 4.25-3 below. The impacts discussed in this chapter are based upon the Applicant-proposed measures. These additional agency recommended measures are not included in the impact analysis.

Table 4.25-3 Reliability and Safety Resources Agency-Recommended Mitigation Measures

Additional Measure Consideration	Agency Proposing Mitigation Measure	Agency Jurisdiction	Authority (*i.e.*, CWA, RHA, ESA)	Affected Resources	Comment Code
A large number of Applicant-proposed design features, mitigation measures, BMPs, and project management plans listed in the Final SEIS contain the language, "In areas where a lease is required from the State Pipeline Coordinator's Section" or "a federal grant of ROW is required from BLM ..." These measures generally represent a best management approach that we recommend using to the maximum extent possible along the entire pipeline route, while acknowledging the outstanding need to complete coordination with private landowners.	EPA	--	--	Numerous	MIT_35

BLM = Bureau of Land Management
ROW = right-of-way
SEIS = Supplemental Environmental Impact Statement

4.25.9. Alternative 1 – Proposed Action

Alternative 1 is designated the proposed Action (proposed ASAP Project). This alternative is detailed in Chapter 2, and includes a number of considerations specific to Alternative 1 that could impact reliability and safety, each of which are described in more detail in the following sub-sections:

- Section 4.25.9.1, Mobilization; and
- Section 4.25.9.2, Buried Pipe and Remote Location.

The pipeline design would have to be sufficient to address the following geohazards:

- Avalanches, rock falls, slides, and slumps;
- Solifluction and gelifluction (including the frozen debris lobe near MP 193),
- Frost heave;
- Thaw settlement;
- Seismic events; and
- Erosion.

Alternative 1 would include features to address seismic events, such as surface fault rupture, seismically-induced slope failure, liquefaction-related hazards, ground shaking, and buoyancy. These earthquake mitigation measures and special design considerations at fault crossings (Mitigation No. 2) are detailed in Section 4.6.4.2 and Table 4.6-4. The pipeline would include seismic/earthquake monitoring (Mitigation No. 4) and would be designed to automatically close block valves in the event of a significant event. In line inspection would be used to assess thaw settlement, frost heave, and pipe strain.

Other pipeline features would include special techniques for the restoration of the trench to minimize alteration of the ice-rich permafrost, slope stability monitoring, and the use of SCADA systems (Mitigation No. 3, 5 and 9). In permafrost settings, additional backfill may be used to account for excess settling if thaw unstable permafrost thaws after pipe installation, ditch plugs (blocks of tundra or other native sod, bentonite, or other appropriate material) may be installed, or re-vegetation may be used to aid in achieving thermal stability of the soil in the trench. In drier areas, the trench backfill may remain above the surrounding grade even after settling. In this case, the backfill may be seeded with upland species.

4.25.9.1. Mobilization

The proposed Project would require three primary sources of materials:

- Pipe would be primarily mobilized through the Port of Seward;
- Modules for the GCF would be mobilized through West Dock; and
- Gravel would be obtained from material sites located along the pipeline corridor.

At Seward and Fairbanks, fenced marshalling yards would be constructed within the existing rail yard or adjacent to the railway. Each yard would be approximately 21 acres and would have the capacity to store 40,000 tons of pipe. From these marshalling yards, the 733 miles of pipe would be transported along the pipeline corridor.

Approximately 23 sealift barges, each loaded with up to 5,500 short tons, would be required to import the prefabricated modules for the GCF. Winter dredging of a navigation and turn basin at West Dock and modification and widening of DH3 berths would prepare the site for delivery.

Approximately 25 MCYs of material (sand and gravel) would be acquired from material sites. The material would be obtained from 89 material sites spread along the pipeline route.

Pipe and material from these sources would be distributed along the length of the pipeline corridor. Moving this volume and mass of material would place significant demands on Alaska's road and railway network. In addition to the work pad along the pipeline corridor, 174.4 miles of new access roads and 22.9 miles of temporary ice roads would supplement the existing transportation network. A highway use agreement between AGDC and ADOT&PF would be developed prior to construction and would document how impact to infrastructure caused by construction would be mitigated. The agreement would also address safety. A project of this size would need to be carefully managed to keep both workers and the general public safe.

4.25.9.2. Buried Pipe and Remote Location

Generally, the pipe would be below ground. Buried pipe (Mitigation Measure No. 6) could affect reliability and safety in a number of ways however, buried pipe is less obtrusive than above ground pipe. At the crossing of the Yukon River and six other water body crossings, HDD would be used; bridge crossings are under consideration for a number of river crossings (Mitigation Nos. 7 and 8).

A buried pipeline would be far less susceptible to vandalism and somewhat less susceptible to terrorism. In addition, because the pipeline would not convey highly volatile liquids, the impacts of a potential terrorist attack would likely be limited to the immediate area of the attack. However, the high-pressure gas would still be sensitive to a terrorist attack. Automated control systems would shut down the GCF and close block valves to stop the flow of gas. AGDC's July 2016 EED states that block valves would be installed along the proposed Mainline pipeline and the Fairbanks Lateral, spaced no greater than 20 miles apart. Block valve spacing regulations are set forth in 49 CFR 192.179, which requires that each point on a pipeline must be within 10.0 miles of a valve in Class 1 locations, within 7.5 miles of a valve in Class 2 locations, within 4.0 miles of a valve in Class 3 locations, and within 2.5 miles of a valve in Class 4 locations. If the system were to function as designed, such a release would only affect gas located between the two nearest block valves.

Buried pipe would be subject to, and would impact, the geomorphic processes described in Chapter 3, Section 3.2 including:

- Mass wasting;
- Permafrost degradation/aggregation;
- Frost and thaw action;
- Seismic activity; and
- Glacial, fluvial, and coastal processes.

The proposed design under Alternative 1 intends to minimize the impact of these processes on the pipeline and to minimize the impact of the pipeline on these processes. This includes route selection and tailoring the design to the requirements in given areas.

The remote location of the proposed route would have both positive and negative impacts on pipeline safety and reliability. Remote locations make accidents like underground utility strikes less likely. They would also hinder intentional acts directed against the pipeline. However, the remote route may hamper activities needed to operate and maintain the pipeline. In particular, significant repair activities, if required, could be more difficult. Repairs requiring heavy or specialized equipment may be delayed depending upon logistical requirements.

4.25.10. Alternative 2 – Denali NPP Route Variation

Alternative 2 includes the Denali NPP Route Variation, use of DH2 at West Dock, ocean disposal of dredge material, pipeline elevated on VSMs from MP 0 to MP 62 in the region of the ACP, pipeline built according to 49 CFR 192 (*i.e.*, stress-based design), and aerial crossing at the Yukon River. For the purposes of this analysis, the same assumptions for Alternative 1 regarding pipeline burial south of MP 62 that are described above also apply to Alternative 2. Features of Alternative 2 that would affect reliability and safety include:

- Mobilization
- Aboveground construction for the first 62 miles
- Remote location
- Stress-based design

Under the proposed Project, the pipe would run through the developed tourist area referred to as either McKinley Park or Denali Park, a Class 3 area and an HCA. Alternative 2 would avoid this area by bringing the pipe further west through Denali NPP.

4.25.10.1. Mobilization

In comparison to the Alternative 1, Alternative 2 would require less gravel material handling. For the first 62 miles, use of VSMs would reduce the amount of gravel

required. This would reduce impacts to Alaska's road network. Given the remote nature of that area, significant interaction between the proposed Project and the public is considered unlikely. Because of the use of VSMs, Alterantive 2 would require that larger volumes pipe and supplies for VSM construction be handled.

4.25.10.2. Aboveground Construction for the First 62 Miles and Remote Location

Use of VSMs for the first 62 miles is not expected to have a significant impact on reliability and safety. During periods of poor visibility due to inclement weather, VSMs and aboveground pipeline could potentially pose a safety hazard to subsistence users traveling by snow machine, potentially resulting in human injury or mortality. Although below ground construction does provide resilience to things like terrorist attacks, the remote location of this section in the pipeline makes such an attack highly unlikely.

AGDC has expressed engineering concerns over the potential for liquid dropout associated with an aboveground pipeline on the North Slope. The phase envelope is a significant consideration in natural gas pipeline mode evaluation on the North Slope because of the potential for the transported gas to transition from a single-phase (gas) to two phases (gas-liquid). In the event of a prolonged shutdown during winter that resulted in a pressure drop, hydrocarbon liquid could accumulate in the pipeline at cold ambient temperatures. This would subsequently lead to substantial pooling of liquids at low spots and could lead to a prolonged shutdown. (AGDC, 2016k)

4.25.11. Alternative 3 – No Action

Under Alternative 3 (No Action), the proposed Project would not be constructed. Safety would not be impacted. Reliability would not be applicable.

4.25.12. Conclusions and Comparison of Alternatives

Alternative 1 would use buried pipe along essentially all of its length. Alternative 2 would place the pipeline on VSMs for the first 62 miles, after which it would be buried. A buried pipeline is considered less susceptible to random acts of violence and somewhat less susceptible to terrorism. A man planning to bomb TAPS in 1999 was arrested by Vancouver police before he was able to carry out the attack (Cloud, 1999). In 2001, TAPS was attacked by vandals with a high-powered rifle, causing a 2-day shutdown of the pipeline resulting in economic and environmental damage. In 2006, federal authorities acknowledged the discovery of a web posting purportedly linked to Al Qaeda that reportedly encouraged attacks on U.S. pipelines, especially TAPS, using weapons or hidden explosives (Congressional Research Service, 2016). With more than 305,000 miles of natural gas pipeline systems in the U.S. (U.S. Energy Information Administration, 2008), the incidence of sabotage or terrorism may be relatively low; however, these threats do exist.

The remote location of the pipeline would have both positive and negative impacts on pipeline safety and reliability. Remote locations make accidents like underground utility

strikes or an inadvertent bullet from a hunter's rifle less likely. However, the remote route may hamper activities needed to operate, maintain, or repair the pipeline. In particular, significant repair activities, if required, would be more difficult. In addition, while the remote location of the portion of the Alternative 2 pipeline on VSMs provides significant protection from intentional damage or sabotage described above, it is still possible that these types of events could occur.

Both Alternatives 1 and 2 would be built based on stress-based design; for Alternative 2 this would start south of MP 62. The use of VSMs for Alternative 2 between MP0 and MP62 would require additional pipe and other steel and support material be transported to the Project site via railroad and trucks.

The long-term safety and reliability of the pipeline would depend on many factors. Primary factors would include the quality of design, construction, and operations and maintenance. Assessment of potential long-term safety and reliability was based on the definition of significant incidents provided in Section 4.25.4. Table 4.25-4 presents USDOT national significant incident for onshore natural gas transmission workers from 1996 to 2015. For comparison incidents reported for TAPS, a large diameter pipeline that crosses much of the same terrain are presented for comparison.

Table 4.25-4 Comparison of Significant Incident Rates

Projections	USDOT National Data 1996 - 2015 [a]	Reported Incidents for TAPS[b]
Time period [years]	20	44
Length of Pipeline(s) [miles]	299,000	800
Fatalities	46	41
Injuries	181	>156
Damage	$1,300,000,000	Not reported

[a] Pipeline and Hazardous Materials Safety Administration, Pipeline Incident 20 Year Trends, Pipeline Incidents (PHMSA, 2016b)
[b] Data from Alyeska Pipeline Service Company, Transalaska Pipeline System, *the facts* dated 2016. Construction occurred from 1974 to 1977, when the pipeline became operational. Thirty two construction fatalities and nine operations-related fatalities were reported. Operations for 2015 were reported as the best safety performance on record, with just four recordable injuries.

It is acknowledged that conditions on the proposed ASAP pipeline would vary significantly from national averages. The differences between ASAP and a typical Lower-48 pipeline are many. The proposed pipeline route is far more remote and less populated. In general, the route would not cross developed areas or farmed land. This suggests that risks posed to residents are lower than national averages. The risk posed to residents is also considerably less than those posted to construction and operational workers.

The proposed pipeline would be far less likely to experience third-party damage because of the remote route and because it would be mostly on government land with restricted ROWs. At least initially, the proposed pipeline would have fewer corrosion failures because it would be several decades younger than the average pipeline included in the USDOT National Data. On the other hand, the remoteness and difficult climatic conditions likely pose greater risks to worker health and safety. The proposed pipeline would have a different pattern of risks and failures because it would be constructed with techniques and materials that are different and are improved over old pipelines.

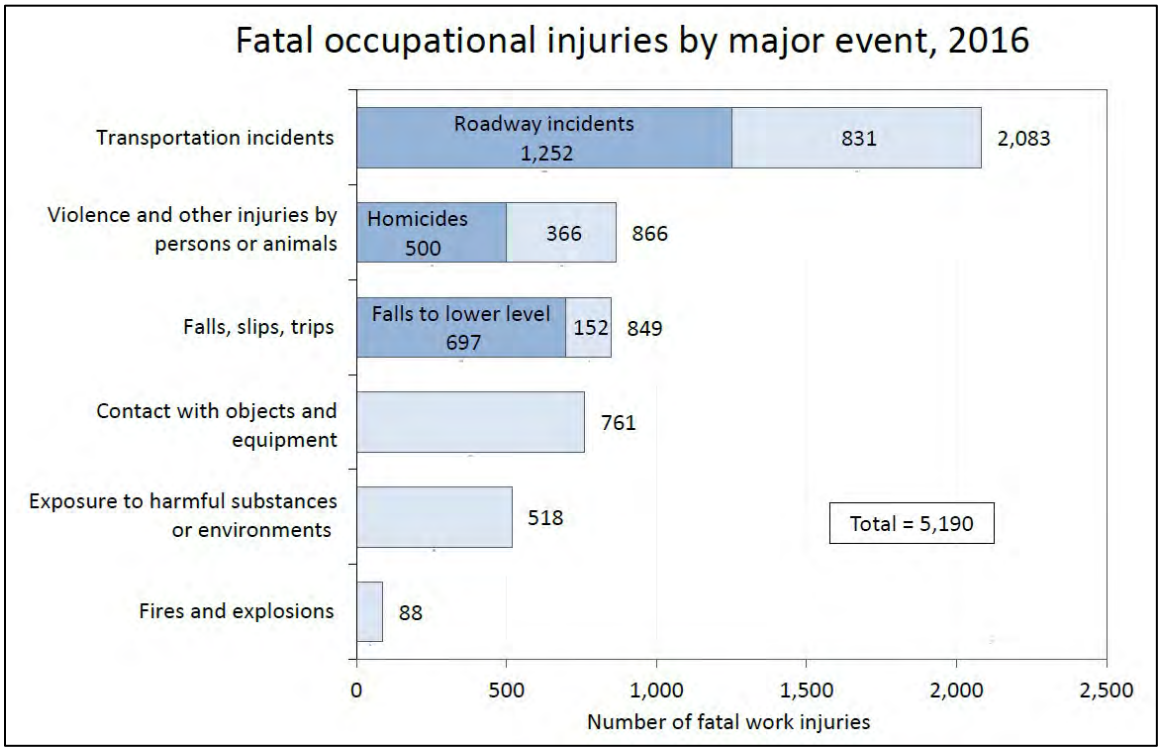
Although there are many similarities between ASAP and TAPS, the safety of the construction industry has improved markedly since TAPS was built. The higher incident rate for TAPS (when compared to typical U.S. pipelines) is likely related to the very remote location, harsh environment, lack of infrastructure or nearby medical facilities, or other similar factors that contributed to the number of incidents. Due largely to the scale of the Project, incidents involving property damage or requiring hospitalization, or possibly worker loss of life, could occur during construction, operations, or maintenance. Due to the remote location of most of the proposed pipeline, the possibility of injury to the public from construction and operation accidents is considered low.

As detailed in Table 4.25-4, 41 fatality incidents have been reported for TAPS since 1974; 32 of which occurred during the construction phase of the project, from 1974 to 1977. After operation, this number decreased to 8 fatality incidents (between 1977 and 2016); almost all of these incidents resulted from heavy equipment or vehicle accidents (Alyeska, 2016). Incident rates under either Alternative 1 or Alternative 2 would be lower than those reported for TAPS given the significant improvements in safety protocols, roadways, access to medical care, and AGDC's proposed measures to minimize safety risks during construction and operations. For example, in the early-to-mid 1990s, Alaska had the highest workplace fatality rates in the nation. In 2015, however, Alaska recorded its lowest workplace fatality since records started being captured in 1992 – a direct relation not only to the reduction in size of high-fatality industries (e.g. fishing and logging), but also as a result of regulation changes and the development and availability of technology to make some dangerous activities safer (Kreiger, 2017). In 2016, the agriculture, forestry, fishing, and hunting industry had the highest rate of fatal work related injuries in the country (23.3 per 100,000 full-time workers) and the private construction industry had the highest count of total fatal injuries (991 incidents). Comparatively, the combined mining, quarrying, and oil and gas extraction industry reported a total of 89 fatal work incidents, or 10.1 per 100,000 full-time workers (BLS, 2017a).

As described in section 4.25.10.1, under Alternative 2 the use of VSMs for the first 62 miles would require that larger volumes of pipe and supplies for VSM construction be transported and handled. These additional activities could result in a greater number of injuries and vehicles accidents, compared to Alternative 1. According to the U.S. BLS, of the 4,836 fatal occupational injuries reported in 2015, 2,054 (approximately 42 percent)

of these were related to transportation incidents; 1,264 of which were roadway incidents. All 2015 reported fatal occupational injuries are presented in Figure 4.25-3.

Figure 4.25-3 Fatal Occupational Injuries by Major Event, 2016



Source: BLS, 2017a

Since construction of TAPS, state and federal pipeline safety programs as well as national occupational safety culture have evolved notably. Since 2003, the number of non-fatality occupational injuries has steadily declined according to the BLS, from approximately 5 injuries per 100 full-time workers, to 2.9 per 100 full-time workers in 2016 (BLS, 2017b). As a result of this, the number of incidents involving injury, hospitalization, and death are expected to be considerably less than they were during construction of TAPS. For comparison, the Canadian Inuvik Gas Pipeline, constructed over two winters between 1998 and 1999 experienced only seven safety incidents, including two loss of time accidents and one near miss, all of which were related to vehicle/transportation accidents (McDougall, 2004). Additionally, design, construction, and operational safety regulations designated in the CFR (49 CFR 191, 192, and 199) along with OSHA regulations, and individual contractor health and safety programs would reduce health and safety concerns to workers during all phases of the Project.

Public awareness and community education would reduce the potential for injury to the general public from construction and operation of the proposed Project. Any portion of the buried pipeline would be required to be marked accordingly with caution signs. Beginning January 1, 2016 PHMSA took over responsibility of enforcing excavation standards near natural gas pipelines. These enforcement standard programs are put in

place to protect the public from the risk of pipeline rupture during excavation. According to PHMSA, excavation damage is one of the leading causes of serious pipeline accidents, and estimates that damage to an underground utility occurs every six minutes as a result of digging prior to location existing underground utilities (PHMSA, 2017). Compliance with national utility locate requirements ("One Call" or "Call before you dig" programs) would reduce the risk of public and private contractor injury risk associated with encountering a buried natural gas pipeline during excavating activities. Failure to properly attempt to locate buried gas pipelines is a violation of Alaska state statute and federal regulations. Security measures (e.g. fencing, gates, and security personnel) set in place to prevent the general public from interacting with construction activities and during operation would additionally reduce the likelihood of injury or fatality to the public. The potential for injury to the public both during construction and operation is considered similar for both Alternative 1 and Alternative 2.

Short-term service disruptions could occur during the life of the project. However, the Cook Inlet Natural Gas Storage Alaska (CINGSA) facility located in Kenai, Alaska would serve to buffer any service disruptions. The facility has an underground storage reservoir with a capacity of 11 billion cubic feet. Given that the Mainline would be expected to operate near its MAOP and would transport approximately 500 MMscfd, when full, CINGSA could store approximately 22 days of production.

The reliability and safety of Alternatives 1 and 2 would be similar, although each alternative would face different challenges (see Table 4.25-5). In many ways, the most challenging part of the Project would be located not on the North Slope (where Alternatives 1 and 2 take different approaches), but in areas of discontinuous permafrost, and particularly in areas of warm permafrost (frozen soil near the melting point). In these areas, Alternatives 1 and 2 use the same approach as described in Chapter 2.

Table 4.25-5 Comparison of Alternatives for Reliability and Safety Impacts

Resource Effect	Alternative 1		Alternative 2		Alternative 3
	Construction	Operations	Construction	Operations	Construction/Operations
	Impact Rating		Impact Rating		Impact Rating
Fatalities[a]	*Minor (-)*	*Minor (-)*	*Moderate (-)*	*Minor (-)*	*Negligible*
Injuries or Property Damage (>$114,000)	*Moderate (-)*	*Minor (-)*	*Moderate (-)*	*Minor (-)*	*Negligible*
Gas Supply Interruptions	*N/A*	*Moderate (-)*	*N/A*	*Moderate (-)*	*N/A*

a While any fatality would be consider a major adverse event, this impact rating relates to the potential risk of fatalities based on recent pipeline construction projects and in comparison to other industry national averages as described in this section. Potential safety impacts to the public would be similar, but likely less than those to workers, both during construction and operation, and for both Alternative 1 and Alternative 2.

ADGC thermal modeling suggests that over a 30-year period, up to 1.1 to 1.5 m (3.6 to 4.9 feet) of thaw settlement could occur based on the modeled thaw depth below the undisturbed active layer in discontinuous permafrost terrain (Appendix A and Appendix D). Good engineering principles call for pilot testing to be performed when innovative approaches are proposed. Pilot testing allows for experience gained at small scales to be applied to larger projects. The available pilot test data for excavation in continuous permafrost (MS3) and discontinuous permafrost (Washington Creek) raise some concerns about pipeline burial in permafrost and discontinuous permafrost areas. As detailed in Sections 4.6.4, similar pipelines have sunk in thawing permafrost and some have broken or otherwise failed. Those pipelines that have been successful have either used a flexible approach to design and construction or did not allow the thaw bulb generated by the pipe to penetrate into thaw unstable permafrost.

To protect thermal stability of the surrounding soil, AGDC would operate the pipeline at below-freezing temperatures in predominately permafrost terrains and at above-freezing temperatures in predominately thawed settings. In areas predicted during design to have thaw settlement or frost heave in excess of 0.5 percent strain for standard wall thickness pipe, the Project would add heavier wall thickness pipe and/or utilize other means to stabilize the pipe and prevent ground movement (such as thermal siphons); these areas would be identified for curvature surveillance during operations utilizing digital pigging analysis. AGDC has also proposed to reduce potential impacts through trench restoration to prevent alteration of ice-rich permafrost and burial of the pipeline with at least 30 inches of cover in permafrost areas. AGDC's geothermal subsurface modeling methodology, geothermal analysis, and discussion of buried pipeline structural mechanics is included in Appendix D. Under both Alternatives 1 and 2, the pipeline would need to comply with all federal and state pipeline safety regulations in the design, construction, and operation of the pipeline, and in particular, those specified in 49 CFR 191, 192, and 199.

4.26. Cumulative Impact Assessment

Cumulative impacts could result from individually minor, but collectively significant, actions taking place over a period of time (adapted from U.S. CEQ, 1997). The goal of this assessment is to concentrate on the accumulation of meaningful impacts of greatest concern that may be associated with the proposed Action (Alternative 1) or Alternatives 2 or 3. Given the large geographic scope of the proposed Project Area and the number of physical, biological, and socioeconomic resources within that area, there are varying degrees on the level of detailed data for each resource. A brief description of incomplete or unavailable information is provided specific to each resource in Sections 4.6 through 4.25.

The following subsections describe the methodology (steps) for the cumulative impacts assessment, proposed Project Area and scope, a summary of direct and indirect effects for each resource, an overview of past, present, and RFFAs included in the assessment, and results.

4.26.1. Steps for Identifying Cumulative Impacts

The CEQ guidelines (Section 4.3) for evaluating cumulative effects state that the greatest environmental effects may result not from the direct effects of a particular action, but from the combination of individually minor effects of multiple actions over time (CEQ, 1997). The CEQ regulations for implementing NEPA define cumulative effects as follows:

> *The impact on the environment which 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 effects can result from individually minor but collectively significant actions taking place over a period of time (40 CFR 1508.7).*

For this SEIS, assessment of cumulative effects requires an analysis of the direct and indirect effects of Alternative 1 (proposed Action) and the alternatives, in combination with other past, present, and RFFAs potentially affecting biological, physical, and socioeconomic resources within the proposed Project Area described in Section 4.1, Project Area and Scope for Analysis. The intent of this analysis is to capture the total effects of several actions over time that would be missed by evaluating each action individually.

This is especially important given the dynamic nature of natural ecosystems and the processes that go on within them and act upon them. It is also important to note that if the results of the analysis of direct or indirect effects of the proposed Action are negligible, the contribution of the proposed Action to a cumulative effect would not occur, and thus, an analysis of cumulative effects would not be presented. For example, benthic reproductive health would not be directly or indirectly affected by the proposed Action, and is therefore, not carried forward for a cumulative analysis (see Section 4.13, Benthic). Therefore, resources that would have negligible, direct, or indirect effects of alternatives (*i.e.*, marine water quality and environmental justice), do not have a detailed analysis of potential cumulative effects per CEQ guidance. Exceptions to this may include certain topics of particular concern raised during the public comment period once the draft SEIS is published.

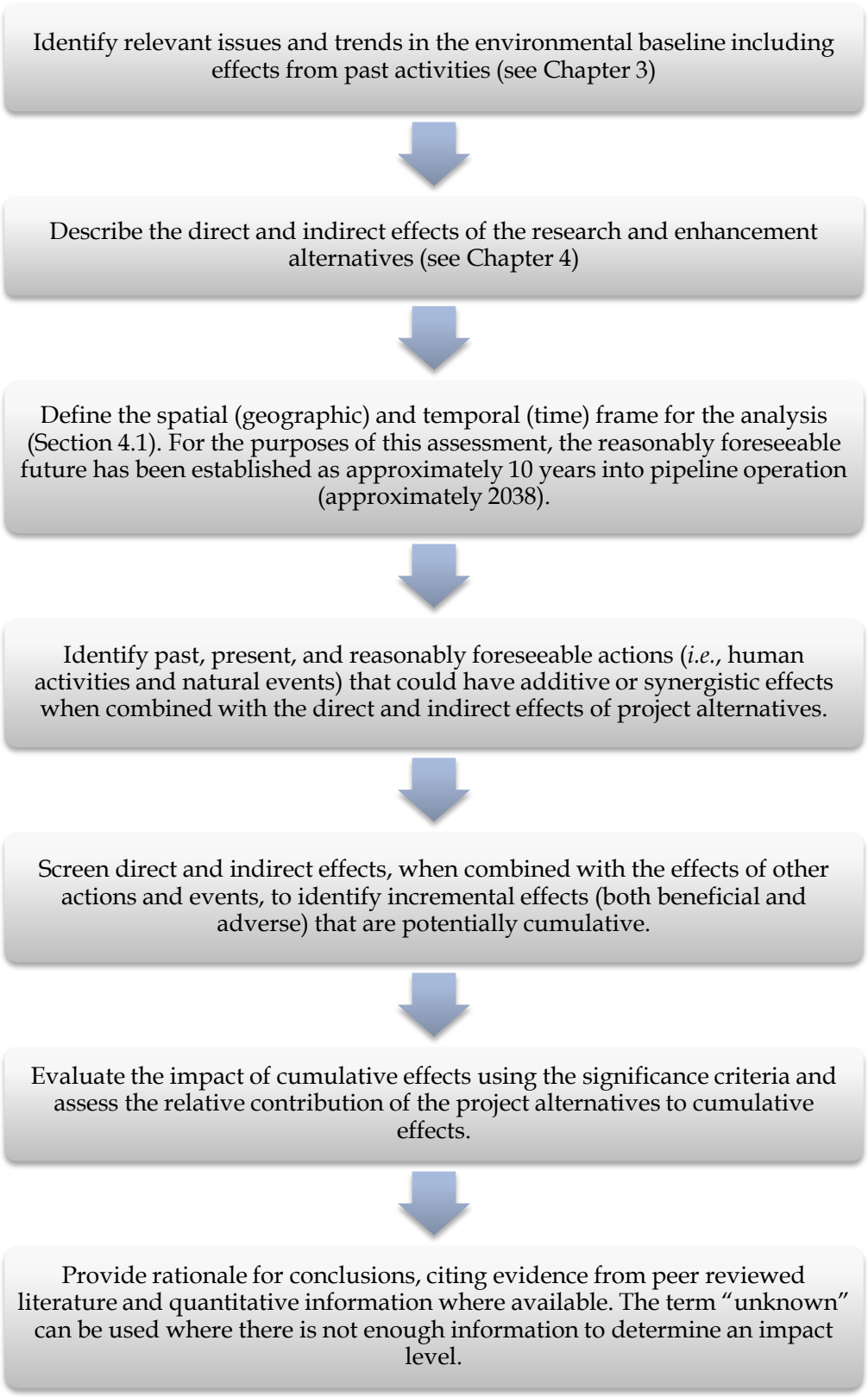
Another purpose of this analysis is to assess the relative contribution the proposed Action and its alternatives have on cumulative effects. The cumulative effects assessment then describes the additive or synergistic result of the proposed Action and alternatives, as they are reasonably likely to interact with other external actions (*i.e.*, other development projects or climate change). The ultimate goal of identifying cumulative effects is to provide for informed decisions that consider the total effects (*i.e.*, direct, indirect, and cumulative) of the alternatives.

The methodology used for cumulative effects analysis includes the steps outlined in Table 4.26-1. The advantage of this approach is that it closely follows 1997 CEQ

guidance, employs an orderly and explicit procedure, and provides the reader with the information necessary to make an informed and independent judgment concerning the validity of the conclusions.

Steps in the cumulative impact assessment are shown on Figure 4.26-1.

Figure 4.26-1 Steps in the Cumulative Impact Assessment



4.26.2. Project Area and Scope for Cumulative Impacts Analysis

The geographic scope of the cumulative impacts analysis is defined generally as the 733-mile pipeline corridor encompassing the proposed Project ROW between Prudhoe Bay and the existing ENSTAR pipeline system at MP 39 southwest of Big Lake, Alaska. Also included is a 30-mile-long lateral pipeline that would connect to the natural gas distribution system in Fairbanks, referred to as the Fairbanks Lateral (see Figures 2.2-1 and 2.2-2). The areas around proposed infrastructure, including access roads, material sites, and facilities (*i.e.*, GCF and camps), and the West Dock and Port of Seward action areas depicted on Figures 4.26-2 and 4.26-3, are included in the scope as well. Around Denali NPP, the assessment encompasses the proposed Alternative 1 corridor along the Parks Highway, east of the Denali NPP boundary, as well as the pipeline segment proposed under Alternative 2 between approximately MP 535 and MP 543, which runs through Denali NPP, as shown on Figure 2.4-1.

This broad geographic scope was necessitated by the route alignment and in consideration of the transboundary movements of several resources evaluated in previous sections of this chapter. Likewise, when events outside the overall geographic scope have strongly influenced the baseline conditions for a given resource, an extended scope for analysis is applied, if appropriate. For example, while the majority of certain NWRs (such as ANWR, Kanuti NWR, or Yukon Flats NWR) fall outside the proposed Project Area, they provide important habitat for species evaluated in this SEIS. The proposed Project Area and scope are described in more detail in Section 4.1.

In addition to establishing the geographic scope, it is important to describe the timeframe (temporal scope) within which potential cumulative impacts are evaluated. The EPA's 1999 guidance on cumulative impacts analysis recommends establishing a chronological reference point to mark the beginning of a historical review (*i.e.*, past effects analysis) depending on available data and with consideration of trends within the area that have contributed to the baseline condition. As described in a 2003 NRC Report on Cumulative Environmental Effects of Oil and Gas Activities on Alaska's North Slope, the 1968 discovery of oil at Prudhoe Bay catalyzed change for several physical, biological, and socioeconomic resources in the region and across Alaska. Prior to this period, much of the proposed Project Area was undeveloped. Construction of the 800-mile TAPS pipeline began in 1974 and was completed in 1977, when Prudhoe Bay came on line delivering oil from the North Slope to the Valdez Marine Terminal. This effort involved some 70,000 workers. For this reason, a logical starting point for this analysis is the mid-1970s. A reasonable future endpoint for this assessment is 10 years into pipeline operations (approximately 2038), as described in Section 4.1.

Figure 4.26-2 West Dock Action Area

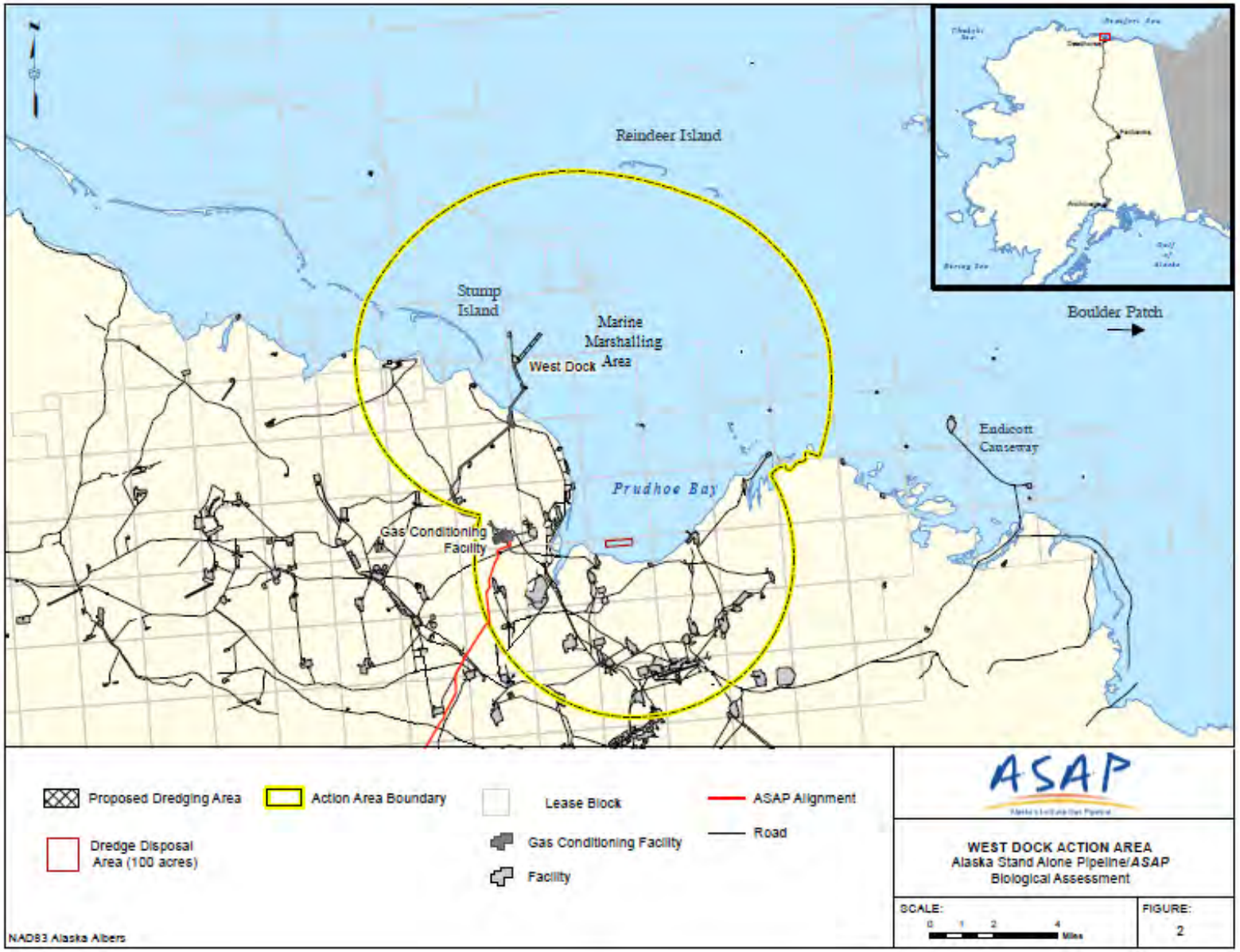


Figure 4.26-3 Port of Seward Action Area



4.26.3. Cumulative Impact Criteria

As described in Section 4.1, Project Area and Scope for Analysis, CEQ regulations implementing NEPA state that significance is determined by considering both the context in which the action would occur, and the intensity of the action (40 CFR 1508.27). Context and intensity are often further broken down into components for impact evaluation. The context considers the extent of the effect (*i.e.*, geographic extent or extent within a species, ecosystem, or region) and any special conditions, such as endangered species status or other legal ramifications. The intensity of an impact is the result of its magnitude and duration. Actions may have both adverse and beneficial effects on a particular resource. A component of both the context and the intensity of an impact is the likelihood of its occurrence.

The impact analysis must be conducted in a consistent manner based on standardized impact definitions. For each resource selected for detailed cumulative impact analysis, direct, indirect, and cumulative impacts are described. Impacts identified for each issue brought forward are based on the duration, extent, and intensity of the impact. Impact levels are characterized as negligible, minor, moderate, or major, as defined in Table 4.26-1, following the same terms and approach used to identify direct and indirect impacts described in Sections 4.6 to 4.25. As with the evaluation of direct and indirect effects, the sensitivity of a resource to a type of impact is considered during the analysis. For example, juvenile wildlife species might be more sensitive to an impact than adults of the same species. Therefore, the impact assessment would consider the life stage of the species and the timing of proposed activities when ranking an impact.

Table 4.26-1 Resource Assessment Impact Levels

Impact Component	Major	Moderate	Minor	Negligible
Magnitude or Intensity	Substantial impact or change would occur that is easily defined and highly noticeable, and that measurably alters the condition or appearance of the resource.	Noticeable change would occur which would alter the condition or appearance of the resource, but the integrity of the resource would remain.	Change would occur, but no substantial resource impact would result. The change in the resource would be perceptible but would not alter the condition of the resource.	Little or no impact would occur; any change that might occur may be perceptible but difficult to measure.
Geographic Extent	Impact would affect the resource on a state level, extending well across several regions.	Impact would affect the resource on a regional level or in the region as a whole, extending well beyond the immediate alternative site.	Localized – Impact would occur only at this alternative site or its immediate surroundings, and would not extend into the region.	None

Impact Component	Major	Moderate	Minor	Negligible
Duration or Frequency	Long-term – Effect would likely last more than 3 years and may continue beyond the lifetime of the proposed Project.	Short-term – Effect would extend beyond the time of construction, but would not last more than 3 years.	Temporary – Effect would only last about 1 year. After 1 year, the resource conditions would return to pre-construction conditions.	None
Likelihood	Most likely (Impacts that have greater than 75% chance of arising from the action).	Likely (Impacts that have a 50% to 75% chance of arising from the action).	Somewhat likely (Impacts that have a 10% to 50% chance of arising from the action).	Unlikely (Impacts that have less than 10% chance of arising from the action).

4.26.4. How Mitigation and Monitoring Have Been Considered in the Cumulative Impact Assessment

EPA guidance on mitigation and monitoring (1999) states, "At a minimum, the mitigation should address the proposed project's contribution to the cumulative impacts." As summarized in Section 4.5, Mitigation Measures, Applicant-proposed design features, mitigation measures, and BMPs that are currently drafted are listed in each resource section and considered in the analysis of direct and indirect effects. In addition, any plans that would be required by state or federal agencies in order to permit the proposed Action are cited and considered in the analysis of direct and indirect effects. Therefore, the analysis of cumulative effects is based on the results of the direct and indirect effects assessment summarized in Section 4.26.6, and the assumption that the design features, mitigation measures, and BMPs listed in Sections 4.6 to 4.25 and Appendix M would be implemented to address the proposed Project's contribution to a potential cumulative impact.

4.26.5. Incomplete and Unavailable Information

The direct and indirect effects analyses (Sections 4.6 to 4.25) identify where information is unavailable to support the evaluation of environmental consequences of the alternatives. Data may be limited for other activities occurring within the proposed Project Area. Due to some of these data limitations, the assessment of cumulative impacts relies on data from existing reports, literature, and internet websites (*i.e.*, company websites) as well as qualitative information gathered during the scoping period August 1 – October 14, 2014. An example of existing data gaps includes the variability of the proposed Susitna-Watana Hydro Project. Because the Susitna–Watana Hydro Project has undergone several stop/start phases and is still in the preliminary design phase, activities and specifications related to the location of a proposed dam, as well as details on supporting infrastructure, are considered unknown in this assessment. Therefore, potential impacts associated with the proposed Susitna-Watana Project are qualitative in nature.

Please note that due to the limited information on the specific location and spatial extent of RFFAs, analysts have included several RFFAs in this assessment for which a specific location could not be determined. This conservative approach allowed analysts to evaluate these RFFAs at a high level in terms of their potential to result in a cumulative effect on a regional scale between the North Slope and southcentral Alaska.

4.26.5.1. Key Assumptions

Several key assumptions were used in the preparation of likely cumulative impacts from the proposed Project. This section has been updated from the list of assumptions identified in the 2012 FEIS (USACE, 2012a).

The cumulative impact analyses presented in this report are based on the direct and indirect impacts of the proposed Action (Alternative 1), Alternative 2 (Denali NPP Route Variation), and Alternative 3 (No Action) identified in Sections 4.6 to 4.25. As described for certain resource categories analyzed in Sections 4.6 to 4.25, in some cases, the lack of complete or readily available data has limited the extent to which impacts can be characterized.

The key assumptions represent projected local, regional, and statewide trends that might affect the proposed Project Area in several important categories. The proposed Project is not connected to other energy projects. The proposed ASAP Project would result in access to natural gas for the state, which currently includes up to five offtake locations. These offtake locations would be comprised of a valve that could be connected to additional distribution lines that are not currently part of the proposed Action. However, potential future distribution of natural gas to communities within the proposed Project Area is included in this cumulative impact assessment.

Key assumptions used for this cumulative effects analysis include:

- There would be purchasers for the estimated quantities of utility grade natural gas for the Fairbanks and Cook Inlet areas served by FNG, Golden Valley Electric Association (GVEA), ENSTAR, Matanuska Electric Association (MEA), Chugach Electric Association (CEA), Homer Electric Association (HEA), Municipal Light & Power (ML&P), and Seward Electrical Department;
- Existing North Slope natural gas reserves would be adequate to support proposed Project operations. No new mining or extraction operations would be necessary for the proposed Project to proceed, and overall North Slope oil and gas operations would be limited to transportation activities for purposes of this cumulative effects analysis;
- Past federal, state, and local authorizations (including the relatively recent 30-year ROW renewal) to operate TAPS are effective in avoiding and minimizing adverse cumulative impacts from that project; however, impacts from TAPS likely contribute to cumulative effects on certain resources that may also be impacted by the proposed Project. These permit requirements cover a wide range of resource protections

including restoring vegetative cover, preventing soil erosion, and maintaining water quality, timing windows for crossing of fish-bearing streams, water withdrawal limits from lakes with fish, work in sensitive habitat areas, employee training, public safety, and minimizing impacts to subsistence users. Prior permit requirements would be updated to meet current standards and applied to the location, design, construction and operation of this proposed Project;

- PHMSA, the SPCS, and the operator of the proposed Project would use a risk-based compliance monitoring program that emphasizes public safety and health, protection of the environment, and pipeline integrity (BLM, 2002);
- Final decisions for constructing the proposed Project could be affected by decisions associated with the proposed Alaska LNG project. As described in Chapter 1, Section 1.5, the Alaska LNG project is self-defined as an LNG export project with very different objectives. Although the Alaska LNG project contains provisions for at least five offtakes within the state, the responsibility to represent, manage and distribute this offtake gas to residents does not reside with the Alaska LNG project. Given the magnitude of both projects to deliver natural gas from the North Slope to Southcentral Alaska, it is unlikely both would be built;
- The interconnected electrical generation and transmission (G&T) systems serving the rail belt (populations served by the ARRC and typically the Kenai Peninsula south of Seward to Homer, Alaska) would continue to rely on a combination of energy sources including natural gas, diesel, hydropower, and coal as sources of fuel;
- Electricity would not be an economical energy source for home and business heating;
- Using depleted natural gas reservoirs for temporary storage of natural gas from existing or new Cook Inlet gas fields for use during winter peak demand and increasing energy conservation measures would provide short-term relief from the projected shortfall of proven natural gas reserves in Cook Inlet;
- Existing ROWs for major electrical transmission lines may be widened to accommodate new parallel transmission lines required to meet existing and projected electrical demands in the rail belt area;
- Discovery of economic natural gas reserves from one or more large natural gas fields in the Cook Inlet area capable of meeting existing and future demand for natural gas is uncertain;
- Propane for heating and cooking in remote Alaskan communities is likely restricted to coastal communities with regular, year-round barge service and would be more economical than fuel oil;
- The relative cost of energy to rail belt consumers produced by new or developing technologies, such as the use of municipal waste to generate power, or the generation of power from tidal or geothermal sources are noted as "speculative"

projects within the temporal scope of this analysis (2038) given the recent attempts and subsequent abandonment of such efforts (for example, please see RFFA 62 in Table 4.26-3);

- Renewal of the proposed Project ROW for potential a second 30-year period would require an EIS as renewal similar to the EIS required for the TAPS ROW; and
- An IHA or LOA would be required for proposed Project activities that may result in the incidental "taking"[14] by harassment of marine mammals protected under the MMPA. IHAs are authorized annually and LOAs for up to 5 years from NMFS and USFWS.[15] It is assumed that an IHA and/or LOA would be required for any activities that could incidentally take marine mammals species occurring within the proposed Project Area.

4.26.6. Summary of Direct and Indirect Effects

The summary of direct and indirect effects of Alternatives 1 through 3 presented in Table 4.26-2 provide the context to understand how these effects, in combination with other activities and events external to the proposed Project, may result in the cumulative effects described in Section 4.26.9. Past, present, and RFFAs are summarized in the following section followed by a summary of overall cumulative effects.

[14] Defined by regulation (50 CFR 216.3) as "to harass, hunt, capture, collect, or kill, or attempt to harass, hunt, capture, collect, or kill any marine mammal."

[15] USFWS recently issued Incidental Take Regulations in August 2016 (81 FR 52276) authorizing incidental take of polar bears associated with oil and gas activities in the Beaufort Sea. Under these regulations, USFWS may issue individual LOAs for multi-year activities involving take of polar bears, effective for up to 5 years. It is assumed the proposed Project would involve incidental take of polar bears for each year of construction activities occurring in the proposed Project Area, as specified in Chapter 2, Table 2.2-7, ASAP Construction Spread Plan (Schedule).

Table 4.26-2 Summary of Direct and Indirect Effects of Alternatives 1, 2, and 3

	Alternative 1		Alternative 2		Alternative 3	
Types of Effects	**Construction**	**Operation**	**Construction**	**Operation**	**Construction**	**Operation**
Soils & Geology						
Effects to local topography, soil, and geology	*Major (-)*	*Major (-)*	*Major (-)*	*Major (-)*	*Negligible*	*Negligible*
Effects to permafrost and geology	*Major (-)*	*Major (-)*	*Major (-)*	*Major (-)*	*Negligible*	*Negligible*
Water						
Altered Surface Water Quality	*Moderate (-)*	*Minor (-)*	*Moderate (-)*	*Minor (-)*	*Negligible*	*Negligible*
Altered Groundwater	*Major (-)*	*Moderate (-)*	*Major (-)*	*Moderate (-)*	*Negligible*	*Negligible*
Stream Bank Stabilization and Geomorphology	*Moderate (-)*	*Minor (-)*	*Moderate (-)*	*Minor (-)*	*Negligible*	*Negligible*
Flooding	*Moderate (-)*	*Moderate (-)*	*Moderate (-)*	*Moderate (-)*	*Negligible*	*Negligible*
Altered Water Availability	*Moderate (-)*	*Moderate (-)*	*Moderate (-)*	*Moderate (-)*	*Negligible*	*Negligible*
Vegetation					*Negligible*	*Negligible*
Vegetation Loss/Disturbance	*Moderate (-)*	*Minor (-)*	*Moderate (-)*	*Minor (-)*	*Negligible*	*Negligible*
Non-native, Invasive, and Noxious Plants	*Moderate (-)*	*Moderate (-)*	*Moderate (-)*	*Moderate (-)*	*Negligible*	*Negligible*
Habitat Fragmentation	*Major (-)*	*Minor (-)*	*Major (-)*	*Minor (-), Negligible on the Beaufort Coastal Plain*	*Negligible*	*Negligible*
Soil Compaction and Erosion	*Moderate (-)*	*Minor (-)*	*Moderate (-)*	*Minor (-)*	*Negligible*	*Negligible*
Wetlands						
Loss of Wetlands	*Moderate (-)*	*Minor (-)*	*Moderate (-)*	*Minor (-)*	*Negligible*	*Negligible*
Wetland Fragmentation	*Major (-)*	*Minor (-)*	*Major (-), Moderate (-) on the Beaufort Coastal Plain*	*Minor (-), Negligible on the Beaufort Coastal Plain*	*Negligible*	*Negligible*
Change in Function, Value or Water Type Code	*Ranging from Minor to Moderate (-)*	*Minor (-)*	*Ranging from Minor to Moderate (-)*	*Minor (-)*	*Negligible*	*Negligible*
Wildlife						
Mortality	*Minor (-)*	*Minor (-)*	*Minor (-)*	*Minor (-)*	*Negligible*	*Negligible*
Reproductive Effects / Function / Health / Resilience	*Moderate (-)*	*Moderate (-)*	*Moderate (-)*	*Moderate (-)*	*Negligible*	*Negligible*
Fish						
Mortality	*Minor (-)*	*Negligible*	*Minor (-)*	*Negligible*	*Negligible*	*Negligible*
Reproductive Effects/Growth/Health/ Distribution	*Minor (-)*	*Negligible*	*Minor (-)*	*Negligible*	*Negligible*	*Negligible*

	Alternative 1		Alternative 2		Alternative 3	
Types of Effects	**Construction**	**Operation**	**Construction**	**Operation**	**Construction**	**Operation**
Effects to habitat	*Minor (-)*	*Negligible*	*Minor (-)*	*Negligible*	*Negligible*	*Negligible*
Marine Mammals						
Mortality	*Minor (-)*	*Negligible*	*Minor (-)*	*Negligible*	*Negligible*	*Negligible*
Displacement, Disturbance, Diminished Reproduction	*Ranging from Minor to Moderate (-)*	*Negligible*	*Ranging from Minor to Moderate (-)*	*Negligible*	*Negligible*	*Negligible*
Disease, Invasives, Predation, Exposure to Toxins	*Negligible*	*Negligible*	*Minor (-)*	*Negligible*	*Negligible*	*Negligible*
Benthic						
Mortality	*Negligible*	*Negligible*	*Minor (-)*	*Negligible*	*Negligible*	*Negligible*
Reproductive Effects / Function / Health / Resilience	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*
Threatened & Endangered Species						
Injury or Mortality	*Moderate (-) if injury or mortality, Minor if disturbance*	*Moderate (-) if injury or mortality, Minor if disturbance*	*Moderate (-) if injury or mortality, Minor if disturbance*	*Moderate (-) if injury or mortality, Minor if disturbance*	*Negligible*	*Negligible*
Physical habitat loss, alteration, and fragmentation	*Minor (-)*	*Minor (-)*	*Minor (-)*	*Minor (-)*	*Negligible*	*Negligible*
Biological and behavioral responses to disturbance, including changes to distributions	*Minor (-)*	*Minor (-)*	*Minor (-)*	*Minor (-)*	*Negligible*	*Negligible*
Changes to predator distributions and increased predation	*Minor (-)*	*Minor (-)*	*Minor (-)*	*Minor (-)*	*Negligible*	*Negligible*
Introduced non-native, invasive and parasitic species	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*
Turbidity	*Minor (-)*	*Minor (-)*	*Minor (-)*	*Minor (-)*	*Negligible*	*Negligible*
Spills and Contaminants	*Minor (-)*	*Minor (-)*	*Minor (-)*	*Minor (-)*	*Negligible*	*Negligible*
Land Use						
Effects to Land Use Planning and Conservation	*Minor (-)*	*Minor (-)*	*Minor (-)*	*Minor (-)*	*Negligible*	*Negligible*
Effects to Existing Transportation and Utilities; Easements/ ROW Rights	*Minor (-)*	*Minor (-)*	*Minor (-)*	*Minor (-)*	*Negligible*	*Negligible*
Effects to Forestlands; Agriculture; Important Farmlands; Developed Areas	*Moderate (-)*	*Moderate (-)*	*Moderate (-)*	*Moderate (-)*	*Negligible*	*Negligible*
Waste Generation	*Minor (-)*	*Minor (-)*	*Minor (-)*	*Minor (-)*	*Negligible*	*Negligible*
Land Ownership and Zoning	*Minor (-)*	*Minor (-)*	*Minor (-)*	*Minor (-)*	*Negligible*	*Negligible*

	Alternative 1		Alternative 2		Alternative 3	
Types of Effects	**Construction**	**Operation**	**Construction**	**Operation**	**Construction**	**Operation**
Recreation						
Changes to Recreational Quality	*Moderate (-)*	*Minor (-)*	*Moderate (-)*	*Minor (-)*	*Negligible*	*Negligible*
Changes to Recreational Access	*Moderate (-)*	*Minor (-)*	*Moderate (-)*	*Minor (-)*	*Negligible*	*Negligible*
Visual						
MP 0 to MP 62 (GCF to TAPS PS2)	*Moderate (-)*	*Minor (-)*	*Moderate (-)*	*Moderate (-)*	*Negligible*	*Negligible*
MP 62 to MP 400 (TAPS PS2 to Livengood)	*Moderate (-)*	*Minor (-)*	*Moderate (-)*	*Moderate (-)*	*Negligible*	*Negligible*
MP 400 to MP 535 Livengood to Denali NPP	*Moderate (-)*	*Minor (-)*	*Moderate (-)*	*Moderate (-)*	*Negligible*	*Negligible*
MP 535 to MP 634 Denali NPP to Byers Lake in Denali State Park	*Moderate (-)*	*Moderate (-)*	*Moderate (-)*	*Moderate (-)*	*Negligible*	*Negligible*
MP 634 to End	*Moderate (-)*	*Moderate (-)*	*Moderate (-)*	*Moderate (-)*	*Negligible*	*Negligible*
Fairbanks Lateral: Along Murphy Dome and Old Murphy Dome Roads	*Minor (-)*	*Minor (-)*	*Minor (-)*	*Minor (-)*	*Negligible*	*Negligible*
Denali NPP Route Variation: Mainline MP 536 to MP 543	*N/A*	*N/A*	*Moderate (-)*	*Minor (-)*	*Negligible*	*Negligible*
Socioeconomics						
Population Trends and Projections	*Moderate (-)*	*Moderate (-)*	*Moderate (-)*	*Moderate (-)*	*Negligible*	*Negligible*
Employment	*Major (+)*	*Moderate (+)*	*Major (+)*	*Moderate (+)*	*Negligible*	*Negligible*
Housing and Property Values	*Moderate (-)*	*Moderate (-)*	*Moderate (-)*	*Moderate (-)*	*Negligible*	*Negligible*
Government Revenue and Expenditures	*Major (-)*	*Major (+)*	*Major (-)*	*Moderate (+)*	*Negligible*	*Negligible*
Infrastructure and Services	*Moderate (-)*	*Major (-)*	*Moderate (-)*	*Major (-)*	*Negligible*	*Negligible*
Increased Energy Supply	*Negligible*	*Major (+)*	*Negligible*	*Major (+)*	*Negligible*	*Negligible*
Cultural Resources[a]						
Cultural Resource Effects – Direct Impact Area	*Major (-) (26)*		*Major (-) (25)*		*Negligible*	
Cultural Resource Effects – Direct Impact Area	*Moderate (-) (11)*		*Moderate (-) (10)*		*Negligible*	
Cultural Resource Effects – Direct Impact Area	*Minor (-) (21)*		*Minor (-) (21)*		*Negligible*	
Cultural Resource Effects – Direct Impact Area	*Negligible (14)*		*Negligible (14)*		*Negligible*	
Subsistence[b]						
Communities with Impact Ranking: 15-18	*Major (-) (3)*	*Major (-) (2)*	*Major (-) (3)*	*Major (-) (2)*	*Negligible*	*Negligible*
Communities with Impact Ranking: 10-14	*Moderate (-) (10)*	*Moderate (-) (11)*	*Moderate (-) (10)*	*Moderate (-) (11)*	*Negligible*	*Negligible*
Communities with Impact Ranking: 5-9	*Minor (-) (16)*	*Minor (-) (7)*	*Minor (-) (16)*	*Minor (-) (7)*	*Negligible*	*Negligible*
Communities with Impact Ranking: 0-4	*Negligible (22)*	*Negligible (31)*	*Negligible (22)*	*Negligible (31)*	*Negligible*	*Negligible*

	Alternative 1		Alternative 2		Alternative 3	
Types of Effects	**Construction**	**Operation**	**Construction**	**Operation**	**Construction**	**Operation**
Public Health						
Social Determinants of Health	*Moderate (-)*	*Moderate (-)*	*Moderate (-)*	*Moderate (-)*	*Negligible*	*Negligible*
Accidents and Injuries	*Moderate (-)*	*Moderate (-)*	*Moderate (-)*	*Moderate (-)*	*Negligible*	*Negligible*
Exposure to Hazardous Materials	*Moderate (-)*	*Minor (-)*	*Moderate (-)*	*Minor (-)*	*Negligible*	*Negligible*
Food, Nutrition, and Subsistence Activity	*Moderate (-)*	*Moderate (-)*	*Moderate (-)*	*Moderate (-)*	*Negligible*	*Negligible*
Infectious Disease	*Moderate (-)*	*Moderate (-)*	*Moderate (-)*	*Moderate (-)*	*Negligible*	*Negligible*
Water and Sanitation	*Minor (-)*	*Negligible*	*Minor (-)*	*Negligible*	*Negligible*	*Negligible*
Non-Communicable and Chronic Disease	*Moderate (-)*	*Minor (+)*	*Moderate (-)*	*Minor (+)*	*Negligible*	*Minor (-)*
Health Services Infrastructure and Capacity	*Minor (-)*	*Negligible*	*Minor (-)*	*Negligible*	*Negligible*	*Negligible*
Air Quality, Climate Change, and Greenhouse Gas Emissions						
Increased levels of air contaminant concentrations (criteria pollutants and HAPs)	*Moderate (-)*	*Minor (-)*	*Moderate (-)*	*Minor (-)*	*Negligible*	*Negligible*
Increased Fugitive Dust emissions	*Moderate (-)*	*Minor (-)*	*Moderate (-)*	*Minor (-)*	*Negligible*	*Negligible*
Decreased emissions as a result of improved access to natural gas	*Negligible*	*Minor (+)*	*Negligible*	*Minor (+)*	*Negligible*	*Negligible*
Noise[c]						
Channel Dredging and Access Construction on Prudhoe Bay	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*
Mainline Segment 1a	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*
Mainline Segment 1b	*Minor (-)*	*Negligible*	*Minor (-)*	*Negligible*	*Negligible*	*Negligible*
Yukon River HDD Residential	*Moderate (-)*	*N/A*	*N/A*	*N/A*	*Negligible*	*Negligible*
Recreational	*Negligible*	*N/A*	*N/A*	*N/A*	*Negligible*	*Negligible*
Yukon Aerial Crossing (Suspension Bridge Construction) Residential	*N/A*	*N/A*	*Major (-)*	*Negligible*	*Negligible*	*Negligible*
Recreational	*N/A*	*N/A*	*Negligible*	*Negligible*	*Negligible*	*Negligible*
Mainline Segment 2 Residential	*Minor (-)*	*Negligible*	*Minor (-)*	*Negligible*	*Negligible*	*Negligible*
Recreational	*Ranging from Minor to Moderate (-)*	*Ranging from Negligible to Minor (-)*	*Ranging from Minor to Moderate (-)*	*Ranging from Negligible to Minor (-)*	*Negligible*	*Negligible*
Tanana River HDD Residential	*Moderate (-)*	*N/A*	*Moderate (-)*	*N/A*	*Negligible*	*Negligible*
Recreational	*Negligible*	*N/A*	*Negligible*	*N/A*	*Negligible*	*Negligible*
Mainline Segment 3 Residential	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*

		Alternative 1		Alternative 2		Alternative 3	
Types of Effects		**Construction**	**Operation**	**Construction**	**Operation**	**Construction**	**Operation**
	Recreational	*Ranging from Minor to Moderate (-)*	*Ranging from Negligible to Minor (-)*	*Ranging from Minor to Moderate (-)*	*Ranging from Negligible to Minor (-)*	*Negligible*	*Negligible*
Denali NPP Route Variation	Residential	*N/A*	*N/A*	*Negligible*	*Negligible*	*Negligible*	*Negligible*
	Recreational	*N/A*	*N/A*	*Moderate (-)*	*Negligible*	*Negligible*	*Negligible*
Denali NPP Commercial Area HDD		*Major (-)*	*N/A*	*Major (-)*	*N/A*	*Negligible*	*Negligible*
	Recreational	*Major (-)*	*N/A*	*Major (-)*	*N/A*	*Negligible*	*Negligible*
Honolulu Creek HDD		*Negligible*	*N/A*	*Negligible*	*N/A*	*Negligible*	*Negligible*
Mainline Segment 4	Residential	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*
	Recreational	*Minor (-)*	*Negligible*	*Minor (-)*	*Negligible*	*Negligible*	*Negligible*
Troublesome Creek HDD		*Negligible*	*N/A*	*Negligible*	*N/A*	*Negligible*	*Negligible*
Chulitna River HDD		*Negligible*	*N/A*	*Negligible*	*N/A*	*Negligible*	*Negligible*
Kashwitna River HDD	Residential	*Major (-)*	*N/A*	*Major (-)*	*N/A*	*Negligible*	*Negligible*
	Recreational	*Negligible*	*N/A*	*Negligible*	*N/A*	*Negligible*	*Negligible*
Willow Creek HDD		*Negligible*	*N/A*	*Negligible*	*N/A*	*Negligible*	*Negligible*
Fairbanks Lateral	Residential	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*
	Recreational	*Minor (-)*	*Negligible*	*Minor (-)*	*Negligible*	*Negligible*	*Negligible*
Navigation							
Increased Navigational Resource Use by Vessels		*Minor (-)*	*Negligible*	*Minor (-)*	*Negligible*	*Negligible*	*Negligible*
Displacement of Vessels from Current Route		*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*
Non-native and Invasive Species		*Negligible*	*N/A*	*Negligible*	*N/A*	*Negligible*	*Negligible*
Reliability and Safety							
Fatalities		*Minor (-)*	*Minor (-)*	*Moderate (-)*	*Minor (-)*	*Negligible*	*Negligible*
Injuries or Property Damage (>$114,000)		*Moderate (-)*	*Minor (-)*	*Moderate (-)*	*Minor (-)*	*Negligible*	*Negligible*
Gas Supply Interruptions		*N/A*	*Moderate (-)*	*N/A*	*Moderate (-)*	*N/A*	*N/A*

a For cultural resources, the effect categories are not mutually exclusive, and certain effects (*e.g.*, introduction of vibration, noise, or atmospheric elements) could occur from construction activities, operational activities, and/or proposed Project infrastructure. For this reason, the construction and operational impacts are expected to be similar. Additionally, cultural resources are categorized by the number of sites at each impact ranking rather than type of impact. The number in parenthesis indicates how many communities/cultural resource sites may be affected.
b The number in parenthesis for subsistence indicates how many communities may be affected.
c Impact ratings for noise are the same for residential and recreational in rows that are not divided.

4.26.7. Past, Present and Reasonably Foreseeable Future Actions and Natural Events within the Project Area

The purpose of this analysis is to determine the overall potential effect to each resource as a result of the proposed Project in combination with past, present, and RFFAs and natural events. As such, this section provides historical context for the proposed Project Area in terms of human development projects and major natural events that have influenced the current environmental and social baseline. It is also critical to understand what RFFAs are likely to occur within the proposed Project Area based on available data. These actions include activities or natural events that may occur in a broader geographic area than the proposed Project Area (*i.e.*, Parks and Dalton Highway corridors) and include projects that may be in varying stages of development. The following criteria were considered to identify these actions and events:

- **Past Actions** includes activities that may have been initiated in the, past but also could involve present operations such as infrastructure development and non-oil related actions, and oil industry facilities and present transportation of product from those facilities. Past actions are considered part of the existing environment reflected in Chapter 3, Affected Environment.
- **Present Actions and Transport** includes oil and gas transportation projects and related activities that may just have come on-line, are currently under way, or are planned for the near future. This may also include other non-oil-related development that is presently under development.
- **Reasonably Foreseeable Future Actions** includes oil and gas transport or other projects that are clearly identified and are expected to initiate transport-related activities (site surveys, permitting, or construction) within the next 60 years. In addition to oil and gas transport, other RFFAs were identified. They include continued human activities such as sport and subsistence hunting and fishing, commercial fishing, sport harvest, tourism, recreational activities, land use planning, and military projects.
- **Natural Events** includes both past and potential future natural phenomena, such as major storm events, earthquakes, fires, flooding, etc. that have occurred or, based on literature, could reasonably occur within the timeframe of this analysis.

It is critical to focus the assessment on meaningful cumulative impact issues, rather than on all conceivable impact relationships. This is especially important given the dynamic nature of development projects and natural ecosystems. It is also necessary to eliminate RFFAs that are merely speculative in nature. For example, a proposed project that is only listed in planning documents but has not been funded or analyzed, as described below.

A screening process of RFFAs was undertaken to determine which are likely to interact in time or space with the proposed ASAP Project, or impact the same resources. This step involved the following considerations:

- Proximity of external actions and events (RFFAs and natural events) to the proposed Project (*i.e.*, do they overlap spatially and/or in time);
- Whether external actions or events affect the same resources as the proposed Project; and
- Whether proposed activities are truly reasonably foreseeable versus merely speculative.

Determining whether an action is reasonably foreseeable can be challenging, but not impossible. To do this, the following criteria are applied:

- Is the activity part of a formal development plan?
- Is the activity funded?
- Does the activity have required permits and authorizations?
- What is the likely timeframe for the proposed activity?

Based on available information, only projects with dedicated funding, government support (*i.e.*, regulations or significant planning), and a medium to high probability of occurring have been included in the cumulative impacts analysis for this proposed Project.

For the purposes of this cumulative impact assessment, the list of past, present, and RFFAs and natural events presented in Table 4.26-3 was developed based on the best available information and are considered herein. Where possible, the general location of these activities has been mapped, as shown on Figures 4.26-4 and 4.26-5. In some cases, where data regarding the specific location or extent of an activity could not be confirmed, the activity is not labeled on the map. As a conservative approach for the assessment, however, analysts considered a more inclusive list of activities to evaluate potential cumulative impacts on a regional scale. The items listed in Table 4.26-3 are identified by an "Identification (ID) No." that corresponds to the numbers shown on Figures 4.26-4 and 4.26-5 and intends to provide the geographic context of the actions in proximity to the proposed ASAP Project. A critical component of the evaluation process involved a spatial assessment to spatially illustrate potential interaction between proposed alternatives and the RFFAs. GIS was used for this process and enabled analysts to visually depict critical spatial linkages between resources and the actions considered in the analysis.

The subsections following Table 4.26-3 and Figures 4.26-4 and 4.26-5 provide brief descriptions of the major actions and natural events considered in the cumulative effects analysis.

Table 4.26-3 Past, Present, and RFFAs Occurring Within or Near the Project Area

ID No.	Activity/ Event Type	Action / Natural Event	Name of Company	Time of Initial Activity / Event	Location	Land Area / Concession	Additional Description	Current Status	Included in Cumulative Effects Analysis? (Y/N)	Website
3	Gold Mining	Donlin Gold Mine	Donlin Gold, LLC (NovaGold Resources and Barrick Gold Corporation 50:50 partnership)	2001	140 miles NW of Bethel, 200 miles west of Willow. 10 miles north of Crooked Creek (village)	See description	Large, proposed open-pit gold mine located approximately 10 miles north of Crooked Creek, Alaska, 1.5 miles across and 1,200 feet deep. Included would be a 2,300-acre tailings facility, a 315-mile, 14-inch diameter natural gas pipeline, and a 30-mile road connecting the mine with the Kuskokwim River. The probable reserve is estimated at 33.8 million ounces of gold, with an estimated production rate of 1.3 million ounces annually.	Draft EIS published 2015, Final EIS expected 2017. Transitioned into final stage of EIS project, final EIS still expected 2017 (6/27/16).	Y	http://www.donlingold.com/our-plan#137
4	Gold Mining	Livengood Gold	International Tower Hill Mines	1914 - Ongoing	70 miles northwest of Fairbanks	48,000 acres	The Livengood area has been placer mined since 1914. The mine is located in the Tolovana mining district within the Tintina Gold Belt. International Tower Hill acquired the rights to the core Livengood property from AngloGold Ashanti in 2006 and has expanded the land position and gold resource since that time. 577,600 ounces of gold annually, 8.1 million ounces over the estimated 14-year life of the mine. The company controls 100% of its 75 mi^2 land package, which is made up of Alaska State mining claims, fee simple land, federal placer claims, mineral lands leased from the Alaska Mental Health Land Trust, and leases with private holders federal patented and unpatented lode and placer claims.	The Feasibility Study Summary NI 43-101 was published September 4, 2013. Pre-Feasibility Study results published 9/8/16.	Y	http://www.ithmines.com/project/livengood_alaska/
5	Gold Mining	True North	Fairbanks Gold Mining, Inc. (Kinross Gold Corporation)	2001	Approximately 25 highway miles northeast of Fairbanks, Alaska	615 acres of existing facility disturbance	Mining activities ceased in 2009, and reclamation of the site began in 2010. As of 2014, the site was almost fully revegetated and prescribed for monitoring over the next several years.	No longer operational. Final phases of site reclamation.	N	
6	Gold Mining	Fort Knox	Fairbanks Gold Mining, Inc. (Kinross Gold Corporation)	1994	Approximately 25 highway miles northeast of Fairbanks, Alaska	The open pit is projected to cover ~0.4 square miles at mine closure. The tailings dam and pond would cover ~1.75 square miles.	On primarily State of Alaska and private lands within the FNSB. Active, open-pit, truck and shovel gold mining operation, using carbon-in-pulp, heap leach and gravity processes, located approximately 25-miles northeast of Fairbanks, Alaska. Production to date is around 1.100 ounces-per-day	Operating, estimated current life-of-mine out to 2020.	Y	
7	Gold Mining	Ryan Lode Project	Gold Run Ltd (San Antonio, TX)	1911 - Ongoing	9 miles northwest of Fairbanks (population 75,000) and 2 miles from unincorporated village of Ester. Access: State maintained Parks Hwy to Gold Hill Road and Henderson Road	Not available	The site is road accessible, intrusive-related gold deposit, approximately 9 miles from Fairbanks, Alaska. Recent estimates put the total load deposit at 676,000 ounces. The proposed project as gone through multiple ownerships.	Possible future development. Looking for investors for further exploration and development. Proximity of subdivisions in the area, possibility of drinking water well impacts, and noise/dust pollution have been points of concern in past public meetings relating to possible surface mining at Ryan Lode.	N	http://mrdata.usgs.gov/ardf/show-ardf.php?ardf_num=FB065
8	Land Use	Central Yukon Resource Management	BLM	2010	Northwest Arctic Borough, NSB, Denali	59 million acres in CY planning area;	The Plan would provide future management strategies for approximately 13.1 million acres of BLM-managed land including the Dalton Hwy and the Central Yukon.	Scoping. Analysis of management situation plan published April 2016. Comment	Y	https://eplanning.blm.gov/epl-front-office/eplanning/planAndProjectSite.do

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		Plan and Environmental Impact Statement			Borough, and FNSB	16 million managed by BLM		period on the Preliminary Alternative Concepts open from 1/17/2017 to 3/17/2017.		?methodName=dispatchToPatternPage&currentPageId=45824
9	Land Use	NSB Comprehensive Plan	NSB	2005	Seven villages including Atqasuk, Utqiagvik, Kaktovik, Nuiqsut, Point Hope, Point Lay, Wainwright	60 million acres	The plan would provide support in preservation of Inupiat values and traditions, direction for managing boroughs future development and declining revenues, guide land use, regulation, and resource and village development. It would also help manage borough funds, employees, and facilities; assist in obtaining grants, identify and set priorities for the borough and villages, and incorporate values of elders and visions for youth.	The plan guide decisions affecting land use and the revisions of the borough land use regulations, transportation, fire protection, public facilities, and economy. The major goal is to support development of the villages and natural resources that preserves Inupiat ways of life.	Y	http://www.north-slope.org/your-government/comprehensive-plan
10	Land Use	North Slope Management Plan	ADNR	2015	North Slope, Alaska including offshore areas out to 3 nautical miles	12 million acres of state land	This plan is currently under development and a draft Plan is scoped for completion by Winter 2016. The plan would increase permitting efficiency and predictability for the public, ADNR, and the oil and gas industry and facilitate municipal entitlement conveyance decisions to the NSB.	Scoping was completed July 31, 2015. The draft plan is currently in production.	Y	http://dnr.alaska.gov/mlw/planning/mgtplans/nsmp/
11	Land Use	Mat-Su Borough Comprehensive Community Plans	Mat-Su Borough	Varies depending on plan	Includes 31 communities	16 million acres	The plans help guide decisions affecting land use, transportation, fire protection, public facilities, and economy.	Ongoing	Y	http://www.matsugov.us/plans
12	Land Use	Denali National Park and Preserve Management Plans	National Park Service	1986 - Ongoing	Located along George Parks Hwy, ~240 miles north of Anchorage, 125 miles south of Fairbanks, and 12 miles south of Healy	6 million acres	Comprehensive park plans that guide the long-term management of resources, visitor use, and general development at the park.	Ongoing	Y	https://www.nps.gov/dena/getinvolved/planning-portfolio.htm
12a	Land Use	Eastern Interior Resource Management Plan	BLM	2012	Includes 12 communities bounded by the Elliot and Dalton Hwy on the west, Alaska Hwy on the South	31 million acres	The Plan provides direction for managing public lands under the jurisdiction of BLM's Eastern Interior and Central Yukon Field Offices in Interior Alaska. The plan is a tool for use in managing resources and designating public land uses.	Draft, BLM website states the Notification and Publication of Proposed RMP/Final EIS step in the NEPA processes has been completed.	Y	https://www.blm.gov/ak/st/en/prog/planning/east_int_rmp.html
13	Land Use	ANWR	USFWS, National Wildlife Refuge System	1960	Far north-east corner of Alaska, bordering Canada and the Beaufort Sea	19.64 million acres	In January 2015, USFWS released the Final Comprehensive Conservation plan for the ANWR, designed to guide all aspects of refuge management. 1.5 Million acres inside the refuge was designated under ANILCA, as a study area for oil and gas development. In 2015, the Federal Government called for the full wilderness designation of ANWR. However in 2017 Congress voted to open ANWR to oil and gas exploration.	In April 2018, a Notice of Intent was published to the Federal Register that BLM intended to prepare a leasing Environmental Impact Statement to implement an oil and gas leasing program within a designated area of the wildlife refuge.	Y	https://www.fws.gov/refuge/arctic/ https://www.eenews.net/assets/2018/04/19/document_gw_03.pdf

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14	Land Use	Doyon Limited Conveyed Lands	Private landowners	2016	Central Alaska north of Evansville, and near Minto, Manley Hot Springs, Rampart and Nenana	N/A	Doyon encourages shareholders to apply for non-commercial use of Doyon conveyed fee lands so long as there is no conflicting land use in place and no negative impact to cultural resources. Fish and trap line camps, cabin sites, and the cutting of house logs or firewood are all authorized uses of Doyon lands, although shareholders must apply before using the land in these ways. While Doyon does not issue hunting permits, subsistence hunting, fishing and trapping on Doyon land is authorized for all Doyon shareholders.	Ongoing	Y	http://www.doyon.com/our-corporation/our-lands-2/permits/
15	Land Use	Yukon Flats National Wildlife Refuge and Kanuti National Wildlife Refuge	USFWS, National Wildlife Refuge System	1980	Located in Central Alaska at the confluence of the Yukon, Porcupine, and Chandalar Rivers (Yukon); Located in central Alaska, west of the Dalton Hwy, bisected by the Arctic Circle (Kanuti)	8.6 million acres	The Yukon Flat refuge is a large wetland complex important for breeding birds. It is the 3rd largest NWR in the U.S. The Kanuti Refuge straddles the Arctic Circle, with approximately 1/3 of it located above the Arctic Circle. The Yukon Flats NWR and Kanuti NWR are bisected by the Dalton Hwy.	In the past, Doyon Limited negotiated with USFWS to swap NWR land with nearby Doyon-owned acreage. Negotiations have since been dropped. An alternative route for the Ambler Mining District access road has been proposed by Alaska Industrial Development and Export Authority (AIDEA) that would cross the Kanuti NWF.	Y	https://www.fws.gov/refuge/yukon_flats/; https://en.wikipedia.org/wiki/Kanuti_National_Wildlife_Refuge
16	Land Use	Denali National Park and Preserve	National Park Service	1917	Central Alaska, 240 miles north of Anchorage, and 125 miles south of Fairbanks	6 million acres	Denali NPP is managed in three units, the Denali Wilderness, the Denali National Park, and the Denali National Preserve. 400,000 people visit the park annually.	N/A	Y	https://www.nps.gov/dena/index.htm
17	Land Use	Gates of the Arctic National Park and Preserve	National Park Service	1980	West of the Dalton Hwy, centered in the Brooks Mountain Range	8.4 million acres	Northernmost and second largest national park in the country. The park currently has no roads within its boundaries. In 2013, only 11,000 people visited the park.	A 220 mile industrial access road has been proposed to join the Ambler Mining District with the Dalton Highway. The route would cross 22 miles of NPS lands in Gates of the Arctic National Park and Preserve.	Y	https://www.nps.gov/gaar/index.htm
18	Military	Army 2020 Force Structure Realignment	U.S. Department of the Army	2014	Statewide	N/A	Reduction of 73 personnel at Fort Wainwright resulting from the Army 2020 Force Structure Realignment.	Ongoing	Y	https://www.wainwright.army.mil/env/NEPA/Completed%20EIS-EA/EA/SPEA%20Army%202020%20Force%20Structure%20Realignment_Final%20EA_Chapters%201-7.pdf
19	Military	Clear Air Force Base - Long Range Discrimination Radar	U.S. Air Force	2016	110 miles west of Fort Greely, and 78 miles south-west of Fairbanks	11,438-acre installation, most of which is undeveloped Developed portion is roughly 350 acres	Clear Air Force Base - $175 million dollar Congressional approval for the construction of a fire station and Phase 1 construction of a Long Range Discrimination Radar.	Funded for FY 2017. Final Environmental Assessment released June 30, 2016.	Y	https://www.mda.mil/global/documents/pdf/env_LRDR_finalEA_FONSI_CAFS_2016_07_08.pdf

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20	Military	Eielson Air Force Base - Construction Projects	U.S. Air Force	2016	Approximately 26 miles southeast of Fairbanks Alaska	19,790-acre installation, approximately 15,754 of which are forested	Eielson Air Force Base - Over $200 million approval from Congress for six construction projects preparing for the arrival of 54, F-35s, including construction of a 16-bay Weather Shelter, Earth Covered Magazines, 4-bay Maintenance/Corrosion Control Facility, an, a 4-bay Squadron Operations Center, and a Missile Maintenance Facility. The increase is planned to add over 1,500 personnel to the base, requiring additional buildings and updates to existing infrastructure.	Funded for FY 2017. Construction planned for 2017, with F-35 arrival planned for 2020.	Y	http://donyoung.house.gov/news/documentsingle.aspx?DocumentID=398736
21	Military	Eielson Air Force Base U.S. Air Force's F-35A Operational Beddown - Pacific	U.S. Air Force	2016	Approximately 26 miles southeast of Fairbanks Alaska	19,790-acre installation, approximately 15,754 of which are forested	Basing the F-35As at Eielson would bring an estimated 2,765 individuals to our community, including 1,563 military and civilian jobs and 1,202 military dependents. The proposed Action would have positive impacts on the FNSB School District by adding an estimated 385 students that would fill current excess capacity. 314 new households would seek housing in the community. Full-time operations associated with basing the F-35As at Eielson are expected to begin in FY2020. At that time, an estimated 2,321 jobs, $176.1 million in labor income, and $275.4 million in economic output would be generated by F-35A operations and maintenance activities. The draft EIS found potential significant impacts for on- and off-base noise impacts. Off base, an increased number of residences in Moose Creek would be exposed to noise levels.	The first set of over nearly 40 associated projects would begin in 2017.	Y	http://www.alaskaf35s.com/eis/
22	Military	Joint Base Elmendorf-Richardson - $35 million funding for upgrades to AWAC aircraft hangars and the construction of a Fuel Offload Facility	U.S. Air Force	2016	Anchorage, Alaska	64,213-acre installation	Construct a truck off-load facility at Joint Base Elmendorf-Richardson (JBER), Alaska, adjacent to the existing Bulk Fuel Facility north of Airlifter Drive. The truck off-load facility would be the secondary means of aviation fuel resupply, designed to meet the average daily demand and contingency requirements of 1,300,000 gallons per day. JBER bulk storage tank farm receives Jet A-1-Additized (F-24) fuel from the North Jet Pipeline that originates from the Crowley Terminal located at the Port of Anchorage. The truck off-load facility would become the secondary means of resupply, designed to meet the average daily demand and contingency requirements of 1,300,000 gallons per day. The new truck off-load facility would provide an alternative means of fuel resupply that is not dependent on the North Jet Pipeline. The project would include a four-position truck off-load rack, allowing simultaneous off-load of four commercial tanker trucks by gravity into a 20,000 gallon, double wall steel underground (direct-buried) drop tank. Three vertical turbine distribution pumps in the drop tank would transfer the fuel via aboveground piping through the Bulk Fuels Facility's existing receipt filtration system to the bulk storage tanks. The pumps and electrical equipment associated with the facility, as well as the off-load rack's containment pad would be covered by an open-air canopy. The offload rack would include a secondary containment pad and spill prevention measures. Other site amenities include access driveways, security fencing and gates, emergency generator connection and LED site lighting.	Funded for FY 2017.	Y	http://donyoung.house.gov/news/documentsingle.aspx?DocumentID=398736; https://govtribe.com/project/jbe030-construct-truck-off-load-facility-at-joint-base-elmendorf-richardson-jber-alaska

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23	Military	Proposal To Improve F-22 Operational Efficiency at Joint Base Elmendorf-Richardson, Alaska	U.S. Air Force	2015	Anchorage, Alaska	64,213-acre installation	Six alternatives have initially identified changes in runway use or airfield infrastructure and maintenance.	Notice of Intent published on September 22, 2015.	Y	
24	Military	Army Testing, Infrastructure Improvement and Enhanced Environmental Procedures	Department of the Army U.S. Army Cold Regions Test Center	2012	Donnelly Training Area Fort Wainwright, Alaska and Fort Greely, Alaska	N/A	A total of 22 site-specific projects that are either new construction (8) or upgrades to existing facilities and ranges (14). Construction of new buildings within Donnelly Training Area to replace outdated or unsafe facilities, installation of additional fiber optic lines, power line extensions, and associated infrastructure upgrades are planned. Consolidation of facilities from Main Post Fort Greely to the training ranges near the Bolio Test Complex and the Mobility Test Complex.	Finding of No Significant Impact published February 20, 2012.	Y	https://www.wainwright.army.mil/env/NEPA/Completed%20EIS-EA/EA/CRTC%20PEA%20&%20FNSI%20Feb%202012.pdf
25	Military	Fort Greely - Funding for construction of a Missile Defense Switchgear Facility	U.S. Department of Defense and multiple civilian contractors	2016	Approximately 5 miles south of Delta Junction, Alaska	Approximately 108 acres	N/A	Funded for FY 2017.	Y	http://donyoung.house.gov/news/documentsingle.aspx?DocumentID=398736
26	Military	Infrastructure and operational support for Company D of the 25th Aviation Regiment Gray Eagle in Interior Alaska	U.S. Department of the Army	2015		Approximately 7 acres	Construction of a 1.3-acre permanent hangar with an integrated Company Operations Facility, an approximately 3.3-acre organizational vehicle parking area, and a 1.3-acre privately owned vehicle parking area with 123 parking spaces.	Funded for FY 2017.	Y	https://www.wainwright.army.mil/env/NEPA/Current/Gray%20Eagle/EA_Gray%20Eagle%20UAS%20EA%20and%20FNSI_FWA.pdf
28	Oil & Gas	Liberty Development Project	Hilcorp Alaska, LLC	2014 - 2019	Foggy Island Bay in Beaufort Sea, Alaska approximately 15 miles east of Prudhoe Bay	9.3 acre offshore island and associated onshore support infrastructure	Liberty Island would be built about 5 miles offshore in Foggy Island Bay of the Beaufort Sea OCS. A nominal 12-inch sales oil pipeline inside 16-inch outer pipe would transport crude oil to the Badami Sales Oil Pipeline. The offshore portion of the pipeline would be approximately 5.6 miles long, and the overland portion would be approximately 1.5 miles long to the Badami pipeline tie-in point. Associated onshore facilities to support the project would include use of permitted water sources, construction of gravel pads to support the pipeline tie-in location and Badami ice road crossing, ice roads and ice pad construction, hovercraft shelter, small boat dock, and development of a gravel mine site west of the Kadleroshilik River. In addition, existing North Slope infrastructure would be used to support the proposed Project.	Anticipated for release May 2018	Y	http://libertyprojectak.com/
29	Oil & Gas	LNG Transport by Tanker Truck to Fairbanks	Fairbanks Natural Gas and the Alaska Railroad	2016	Point MacKenzie to Fairbanks		FNG in 2016 increased tanker volumes to 13,000-gallon capacity, a 30% increase from current volume. Increased volume capacity of LNG tanker trucks and pilot project by ARRC to move LNG to Fairbanks by train are anticipated to increase efficiency and volume of LNG delivered to Interior Alaska, as well as driving volume demands.	Completed pilot program 2016.	Y	http://www.frontiersman.com/news/shipping-lng-by-rail-sets-milestones/article_e1df5c5a-82d1-11e6-ac06-ef44d27f017d.html

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30	Oil & Gas	Construction of Point MacKenzie Liquefaction Plant and 32-mile Port MacKenzie rail extension – Would increase volume of LNG processed from Cook Inlet as well as volume available for transport	AIDEA, construction by Salix Inc.	Pending state funding	Near Point MacKenzie rail extension	32-mile rail extension, and potentially lease 114 acres of port property	100,000 gallon production/day	Proposed	N	http://www.adn.com/energy/article/top-pick-named-interior-energy-project/2016/03/05/
31	Oil & Gas	Point Thomson Sales Gas Pipeline	ExxonMobil Production Company (ExxonMobil)	2012 - 2016	60 miles east of Prudhoe Bay	N/A	8 trillion cubic feet of natural gas and 200 million barrels of natural gas condensate. Expected to produce 10,000 barrels NG condensate per day	Initially proposed to be operational 2016, however, as of November 2017, a gas pipeline had not yet been constructed. Plans approved by Alaska Department of Natural Resources will have Exxon Mobil increasing production of condensate to 50,000 barrels per day by converting two injection wells to production wells. This plan would also increase gas production from the field. The final decision to constuct the gas expansion project would take place in 2019 after further planning, engineering and negotiating commercial agreements with Prudhoe Bay operators.	Y	http://corporate.exxonmobil.com/en/company/worldwide-operations/locations/united-states/alaska/point-thomson?parentId=d372df1b-de85-4609-9e9d-37f08b9fefe6
32	Oil & Gas	Cook Inlet Area wide Oil & Gas Lease Sales	ADNR DIV O&G	Ongoing	Cook Inlet, Alaska	N/A	AIDEA estimated 1,183 billion cubic feet of oil and gas reserves in Cook Inlet in 2014. Total of 16 platforms with approximately 6 operators as of 2016. Aurora Gas plans to explore two wells in Susitna Flats State Refuge and six other prospects in Cook Inlet. Hilcorp Alaska acquired Middle Ground, Beluga River, and Ninilchik Units. BlueCrest Energy constructed offshore faculties at Cosmopolitan Unit. Cook Inlet Energy relinquished 14 leases set to expire in 2023. Furie Operating Alaska operating Kitchen Lights Unit (working with Homer Electric under purchase agreement). SAExploration is also exploring in Cook Inlet.	2015 - Ongoing	Y	http://dog.dnr.alaska.gov/GIS/Data/ActivityMaps/CookInlet/CookInletOilAndGasActivityMap-201511.pdf

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33	Oil & Gas	Alaska LNG Project	AGDC	2012	Prudhoe Bay to Nikiski, Alaska/	806-mile-long pipeline	3.3 Billion cubic per day	FERC began the 20-month EIS process in March 2018 with an EIS decision due by December 2019.	Y	http://ak-lng.com/
34	Oil & Gas	Kenai LNG Plant	ConocoPhillips Alaska	1969	Nikiski	N/A	The facility shipped five cargoes between May and September 2014, and six cargoes between May and October 2015. Cook Inlet production in 2016 has instead been sold to local markets. The Cook Inlet Unit produced 3.58 billion cubic feet in the first 6 months of 2016. In July 2017, it was announced that the facility would be "mouthballed" in the Fall 2017, while ConocoPhillips looks for a buyer for the facility.	2-year export license was approved by U.S. Department of Energy (DOE) through February 2018, allowing export of up to 40 billion cubic feet. CP is currently in the process of selling its Cook Inlet gas field but plans to retain the Nikiski LNG plant.	Y	https://www.alaskapublic.org/2017/07/13/facing-global-gas-glut-conocophillips-to-mothball-kenai-lng-plant/
35	Oil & Gas	Trans Alaska Pipeline System	Alyeska Pipeline Service Company	1975	North slope to tidewater in Valdez	800-mile-long pipeline	At peak production the pipeline moved over 2.1 million barrels of oil a day. TAPS is owned by BP Pipeline, ConocoPhillips Transportation, ExxonMobil, and Unocal Pipeline companies. Currently only four of the 12 pump stations are required to move daily production volumes.	In 2015, TAPs transported an average of 508,446 barrels of oil a day and a total of 17.2 billion barrels of oil in 2015.	Y	http://www.alyeska-pipe.com/TAPS/PipelineOperations/PumpStations
36	Oil & Gas	Donlin Creek Mine Pipeline	Donlin Gold LLC (NovaGold Resources and Barrick Gold Corporation 50:50 partnership)	2001	Carrier Pipelines in the Fairbanks and surrounding areas and in the Cook Inlet area (FNG and ENSTAR) to power mine development	312 miles long	A 312-mile-long buried pipeline is being considered to carry natural gas from the Cook Inlet region to the mine site, an alternative from barging diesel fuel in from Bethel, AK.	The EIS was issued in April 2018.	Y	http://www.donlingold.com/our-plan
37	Oil & Gas	Fairbanks Gas Distribution System	Interior Energy Project (AIDEA, AEA, ADOCCED ADOR and ADNR),	2013	Greater Fairbanks	N/A	Joint project: AIDEA, AEA, the Department of Commerce, Community, and Economic Development, the Department of Revenue, and ADNR to find a solution to poor air quality and high energy costs common to Interior Alaska. Development of the Interior Gas Utility distribution system and expansion of the Fairbanks Natural Gas distribution system. Projects add up to an additional ~140 miles of installed natural gas distribution pipe within the FNSB by fall 2015. Two tanker trucks a day transport LNG from the Titan facility to the Fairbanks Natural Gas storage facility using smaller truck trailers. See also RFFA # 26.	AIDEA is evaluating both railroad and road alternatives to transport the LNG. AIDEA is currently negotiating with the FNSB Interior Gas Utility (IGU) company to form a combined utility. The combined utility would then proceed with procurement of Cook Inlet gas liquefaction capacity and increased LNG storage. IGU is also preparing to purchase the Titan LNG liquefaction plant near Point McKenzie.	Y	http://www.interiorenergyproject.com/Project%20Overview/distribution.html

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38	Oil & Gas	ARRC (shipping oil and gas) & Fairbanks Natural Gas	Alaska Railroad	Ongoing	Anchorage to Fairbanks	N/A	First railroad company in the U.S. to ship LNG. As of October 14, 2016, tanks would carry 7,000 gallons of natural gas, chilled to negative 250 °F. According to the railroad, plans call for the containers to be trucked from Anchorage to the Titan LNG facility at Point MacKenzie, where they would be filled and returned to Anchorage. Starting Sept. 27, containers would be loaded onto a railroad flatcar for the 350-mile trip to Fairbanks. The railroad plans eight LNG round trips to Fairbanks over four weeks. In October 2015, FRA granted Alaska Railroad a 2-year permit to send a dozen LNG cars per train on trips across the state. After this fall's pilot run, the railroad would make a decision about whether it is worth pursuing LNG shipments as a new line of business. Once in Fairbanks, a flatbed truck would transport the containers 4 ½ miles to the Fairbanks Natural Gas storage facility. See also RFFA #25. The month long demonstration was completed in October 2016.	Demonstration complete.	Y	http://www.desmogblog.com/2016/10/13/lng-rail-alaska-risks-secrecy; http://www.naturalgasintel.com/articles/107881-alaska-railroad-to-begin-containerized-lng-shipping-demonstration
39	Oil & Gas	Houston-Willow Basin Exploration License (Gas-only)	Samuel Case and Daniel Donkel	2007	Houston-Willow area, north/east side of Parks Hwy	Initial 21,240 acre exploration license	In April 2007, LAPP Resources Inc. requested a 10-year natural gas exploration license covering around 21,240 acres near Houston and Willow, north and east of the Parks Hwy. The proposal included an initial $500,000 work commitment. The plan was to explore for conventional natural gas and possibly shallow gas deposits, if encountered. Case and Donkel assumed control of the proposal after the initial principal passed away. The state re-solicited public comments in early 2016.	Comment period reopened, closes February 26, 2016. Application pending.	Y	http://www.petroleumnews.com/pntruncate/207612333.shtml
40	Oil & Gas	Tolsona No. 1 - Ahtna Gas Exploration	Ahtna Inc.	2016	Glenn Hwy MP 175, near Glenn Allen.	43,492 acre lease	No. 1 is expected to be drilled to a target depth of 4,000 feet. 40-miles of 2-D seismic exploration was performed by the company in 2014.	Initial drilling began on September 29, 2016.	Y	https://www.adn.com/business-economy/energy/2016/10/12/ahtna-drills-cautious-well-as-native-companies-step-into-oil-and-gas-exploration/
41	Oil & Gas	Toghotthele No.1 - Nenana Basin Oil and Gas Exploration	Cook Inlet Regional Corporation / Doyon Limited JV	2009 (initial exploration activities)	Nenana Basin/Minto Flats	Approximately 400,000 acres of leased State of Alaska land	Unknown	Exploration drilling began on June 1, 2016. Additional wells and 2-D seismic testing planned for 2017.	N	http://www.newsminer.com/news/local_news/doyon-plans-more-oil-gas-exploration-in-the-nenana-basin/article_3ea88abe-6d8f-11e5-8ea3-e31e011e1fb7.html
42	Oil & Gas	Nanushuk Project Exploration and Development	Oil Search Alaska, LLC	2011 - initial drilling	North Slope, between the Kuparuk and Alpine Units	Unit coverage: 63,304 acres	Oil Search Alaska, LLC is proposing development of hydrocarbon deposits in the Pikka Unit. An EIS has been submitted that includes construction of the Nanushuk Pad comprised of Drill Site 1 and a Central Processing Facility, Drill Site 2, Drill Site 3, an operations center pad, infield pipelines, the export/import Nanushuk Pipeline, infield roads, an access road, a tie-in pad, and a potable water system.	Final EIS should be released in August 2018 with a record of decision in November 2018.	Y	http://www.nanushukeis.com/projectdescription.html
43	Oil & Gas	Smith Bay Development	Caelus Energy, LLC	2016	North Slope, south east of Utqiagvik, Alaska	Submarine complex fan spread of over 300 square miles	Based on two exploration wells, Caelus Energy announces in October 2016 the discovery of an estimated 6 billion barrels of oil at the current lease. Predicted production is up to 200,000 barrels per day.	Initial planning phases of Appraisal Program.	Y	http://caelusenergy.com/caelus-confirms-large-scale-discovery-on-the-north-slope-of-alaska/

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43a	Oil & Gas	Northstar Unit, Endicott, & Milne Point	Hilcorp Alaska, LLC	2000	Beaufort Sea 12 miles northwest of Prudhoe Bay	North Slope and Beaufort Sea	On April 22, 2014, BPXA sold interests in four BP-operated oilfields on the North Slope of Alaska to Hilcorp Alaska. The agreement includes associated pipelines in the Milne, Northstar, and Endicott fields.	Operating	Y	https://www.boem.gov/About-BOEM/BOEM-Regions/Alaska-Region/Leasing-and-Plans/Plans/BP-North-Star.aspx
43b	Oil & Gas	Alpine & Greater Mooses Tooth Units	ConocoPhillips Alaska	2006	North Slope, near Kuparuk River Field and Nuiqsut	North Slope, NPR-A	Alpine: 97-acre surface development with 1-day peak production record of 139,000 barrels in 2007. First North Slope project to use directional drilling. Greater Mooses Tooth	Construction has begun at Greater Mooses Tooth (GMT) -1, and the EIS process has been initiated for GMT-2. A supplemental EIS for GMT-2 should be completed in 2018.	Y	http://alaska.conocophillips.com/who-we-are/Pages/projects.aspx
44	Oil & Gas	Moose Pad Development	Hilcorp	2016	North Slope, Prudhoe Bay Unit	Unknown	Milne Point Expansion would include the addition of 24 horizontal production and 16 injection wells at the Milne Point Unit. 10,000 barrels per day production.	Rig onsite, Operator currently filing state and federal permit applications. Pad development planned for 2017.	Y	https://www.adn.com/business-economy/energy/2016/10/13/hilcorp-delivers-new-rig-to-north-slope-moose-pad-expansion/
45	Oil & Gas	Icewine Oil Prospect	Accumulate Energy, a subsidiary of 88 Energy Ltd.	2015	Continuous 271,000-acre lease, 35 miles south of Deadhorse, Alaska	Unknown	88 Energy Ltd has completed one exploration well and 2 years of seismic studies 25-miles south of Deadhorse. Predictions released Oct. 18, 2016, estimate a total recoverable oil reservoir of 758 million barrels	Completed first exploration drilling in 2015, currently reviewing seismic studies conducted in 2015-2016. A second exploration well is planned for completion in 2017.	Y	http://www.alaskajournal.com/2016-10-20/oil-prospect-gets-even-bigger#.WCzZeE27qos
46	Oil & Gas	Cook Inlet Redevelopment Project	Hilcorp Alaska	2015	Cook Inlet, Alaska	Unknown	Hilcorp is currently processing Cook Inlet 3-D seismic data from 2015 and purchased two operating platforms in offshore Middle Ground Shoal.	Planning, exploration. Future drilling activities in the Shoal would be dependent economics of the drilling projects.	Y	http://www.petroleumnews.com/pntruncate/638722831.shtml
47	Oil & Gas	Ninilchik Plant Development	Hilcorp Alaska	November 2016, beginning with clearing of vegetation	Ninilchik, Alaska	1.78 acre pad	Plan proposes building a 1.78-acre pad (Kalotsa Pad), and drill wells directionally to target natural gas offshore.	Pending applicable permit and authorization receipt, the gravel pad, access road, and flow line are planned for completion by mid-November 2016. Well drilling, exploration zones, and expected development zones would continue through April 2017, followed by well testing in May 2017.	Y	http://peninsulaclarion.com/news/2016-10-03/hilcorp-plans-new-gas-wells-near-ninilchik
48	Transportation & Infrastructure	Dalton Hwy Improvements	ADOT&PF	2016-2017	Dalton Hwy MP 379 to 414	N/A	Reconstruction to have sturdier embankment, as well as new culverts and fish passages. Also working to raise grade to mitigate future potential flood damage, replace culverts, and resurface the roadway.	The remaining portion of the improvements between MP 362 and MP 379 are expected to be completed by September 2018.	Y	http://www.alaskanavigator.org/parks-highway
49	Transportation & Infrastructure	Elliott Hwy Improvements	ADOT&PF	2016-2017	Elliott Hwy MP 107.7 to 120.5	N/A	Realign 5 miles of the roadway improving sight distances. Drainage improvements would include culvert replacement, grade raises and establishing ditch lines to reduce icing and overflow problems.	This project is expected to be complete in October 2017.	Y	http://www.alaskanavigator.org/parks-highway
50	Transportation & Infrastructure	Parks Hwy Improvements	ADOT&PF	2016	Parks Hwy MP 239 to 242	N/A	Rock slope mitigation (*i.e.*, blasting and removal of unstable rock).	November 2016	Y	http://www.alaskanavigator.org/parks-highway

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51	Transportation & Infrastructure	Parks Hwy Improvements	ADOT&PF	2016	Parks Hwy MP 91.2 to 92 and 100 to 100.8	N/A	Improvements to existing at-grade railroad crossings on the Parks Hwy at MP 91.6 and MP 100.4 with new overpasses over the railroad crossing.	October 2016	Y	http://www.alaskanavigator.org/parks-highway
52	Transportation & Infrastructure	Mat-Su Borough Glenn Hwy Rail Crossing Improvements	ARRC	2012 - Ongoing	Glenn Hwy between Inner Springer Loop and Outer Springer Loop	N/A	N/A	Currently exploring options to improve gravel transport and reducing impacts to vehicle traffic.	N	https://www.alaskarailroad.com/corporate/projects
53	Transportation & Infrastructure	Port MacKenzie Rail Extension	ARRC	2012 - Ongoing	Port MacKenzie to existing rail facilities near the Parks Hwy intersection northeast of Big Lake, Alaska	N/A	The Port Mackenzie Rail Extension involves 32 miles of new rail line from Port MacKenzie to the ARRC Mainline just south of Houston, Alaska. The line would ultimately provide improved rail transportation between the Port and Interior Alaska, expanding the regional transportation network.	Segments 1-6 funded; Segment 4 under construction in 2015. Funding still required for Segments 7 and 8.	Y	http://www.portmacrail.com/
55	Transportation & Infrastructure	Ambler Mining District Access Project	AIDEA	2010	Gates of the Arctic National Park and Preserve	200-mile road, connecting the Mining District with the Dalton Hwy	According to AIDEA, the district has extensive mineral resources, including silver, gold, lead, and zinc and has been characterized as one of the largest undeveloped copper-zinc belts in the world.	ROW application has been submitted and AIDEA is currently studying potential transport corridor construction. At this time two potential corridors have been identified. The public comment period for the scoping process of this project will continue through January 31, 2018. The draft EIS is expected in 2018 and the final EIS is expected in 2019, pending funding decisions by AIDEA. NPS is also working on an Economic and Environmental Assessment parallel with the EIS.	Y	https://www.nps.gov/gaar/learn/management/ambler-mining-district-current-status.htm
56	Transportation & Infrastructure	Tanana Access Road Project	ADOT&PF	2012	Manley to Tanana	20-mil-long single lane road extension, from the Tofty Road near Manley	Funding for the project was received in FY2012, construction started in 2014, and the 20-mile extension to Tanana completed in 2016. The new road is hoped to increase mineral development in the area.	Completed	Y	https://www.adn.com/opinions/2016/08/30/a-fourth-road-now-connects-the-alaska-highway-system-to-the-yukon-river/
57	Transportation & Infrastructure	Alaska Intertie Project - Rail Belt Power Pool Project.	AEA	1998	170-mile transmission line running between Willow and Healy	N/A	The 345 kV transmission line includes several high voltage transformers, and three facilities placed in the Rail belt Grid. The Regulatory Commission of Alaska is currently investigating the effectiveness of unifying the management of the grid, currently owned and operated by five independent utilities. Also proposed is the development of additional intertie lies, as there is currently only one, connecting Homer to Fairbanks, eliminating single-point failure problems.	Chugach Electric Association and Municipal Light and Power plan to begin combining power generation facilities by 4th Quarter 2016 or 1st Quarter 2017. Matanuska Electric Association is expected to join the pool shortly after.	Y	http://www.alaskajournal.com/business-and-finance/2015-07-08/rca-report-recommends-realignment-railbelt-utilities#.WCon9027qos

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58	Transpor-tation & Infrastruc-ture	Anchorage/Mat-Su Borough Regional Transit Authority Plan	Municipality of Anchorage and Mat-Su Borough	2011	Municipality of Anchorage and Mat-Su Borough	N/A		Plan examined the feasibility of establishing a Regional Transit Authority and serves as a guide for the management and organizational structure for current and future regional public transportation services in Southcentral Alaska.	Y	https://www.alaskarailroad.com/sites/default/files/akrr_pdfs/RTA_Final_Report_2011_1231.pdf
59	Transpor-tation & Infrastruc-ture	Seward Marine Terminal Expansion Planning Project	USDOT and Maritime Administrat-ion	2015 - Ongoing	Port of Seward	N/A	Once studies are complete, engineered design alternatives would be assembled for presentation at a public meeting in Seward in August of 2016.	Master Plan to address improvements or additions to existing and future marine and land-based infrastructure, Mainline and/or yard rail configuration, road connectivity, and real estate utilization.	Y	https://www.alaskarailroad.com/sites/default/files/akrr_pdfs/Railport_Seward_Project_Fact_Sheet.pdf
59a	Transpor-tation & Infrastruc-ture	Marine Shipping & Other Vessel Traffic	Various	Ongoing	Beaufort Sea and Port of Seward	N/A	USCG District 17 reported that for 2008 to 2012, total annual vessel traffic in the Arctic region grew from 120 to 250, a more than 100% increase. The growth rate was particularly high for tank vessels; tugs and other cargo vessels were the second and third largest categories of movements. Annually, more than 130,000 people and more than 2 million tons of cargo enter or exit Seward via the ARRC dock facilities.	Ongoing	Y	http://www.cmts.gov/downloads/CMTS_Draft_Arctic_MTS_Overview_and_Priorities_Paper_for_Public_Comment-Feb2013.pdf; https://www.alaskarailroad.com/sites/default/files/akrr_pdfs/2014_04_25_ARRC_Swd_MasterPlan_PROJ.pdf
60	Oil & Gas	Rural Alaska Village Grant Program	USDA	2016	Rural Alaskan communities including Bethel, Unalakleet, Golovin, Anvik, Kivalina, Mountain Village, Marshall, and others	N/A	US Department of Agriculture Rural Development program grant to improve rural sanitization. State of Alaska is required to match 1/3 of the $27M federal grant. Grant money would be used to improve water and sanitation services and preliminary engineering review and environmental reports.	27 million of federal money going to the Yukon Kuskokwim Delta for water and sewer systems (8/31/16)	Y	http://www.knom.org/wp/blog/2016/09/01/usda-awards-27-million-to-address-rural-sanitation/
61	Energy	Susitna-Watana Hydro	AEA	Initial construct-ion proposed for 2017; however, veto of funding for the project has put future develop-ment plans on hold	184 river miles from Cook Inlet on the Susitna River, 87 river miles from Talkeetna	The 705-foot tall dam would create a 42-mile long, 1-mile wide reservoir	2,800,000 megawatt-hours annual energy production.	On Hold	N	http://www.susitna-watanahydro.org/project/project-description/

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62	Energy	Cook Inlet Tidal Energy Project	Ocean Renewable Power Company	2011 - Granted FERC preliminary permit for a feasibility study.	Cook Inlet, Alaska	Unknown	Proposed Tidal Energy Project consisting of a network of sites intended to generate clean, renewable energy for utilities between Fairbanks, Alaska and the Kenai Peninsula. Pilot project near Nikiski, Alaska could potentially produce up to 5 megawatts of energy.	Ocean Renewable Power Company surrendered preliminary FERC license for the proposed East Foreland tidal energy project due to non-competitive costs with conventional energy resources.	N	http://tidalenergytoday.com/2016/03/29/orpc-drops-cook-inlet-tidal-project-license/
63	Energy Policy	Energy Policy Modernization Act of 2016 (S. 2012)	114th U.S. Congress 2D Session	2016	Denali National Park and Preserve, Alaska	N/A	Section 3109(d). Denali National Park and Preserve Natural Gas Pipeline. "A high-pressure gas transmission pipeline (including appurtenances) in a non-wilderness are within the boundary of the park, shall not be subject to title XI of the ANILCA (16 U.S.C. 3161 et seq.).	December 14, 2016 bill did not pass through the U.S. Congressional Conference Committee.	N	https://www.congress.gov/bill/114th-congress/senate-bill/2012/text
64	Natural Event	Wildfire	Natural Event	Historical - Present	Statewide	Statewide	The 2015 Alaska wildfire season burned 5.1 million acres, resulting in the second largest burn area since 1940 (Partain, J. L. *et al.*, 2016). The combined total acres burned for the top three worst fire years in the state equals 16 million. Wildfires are common in Interior Alaska during the summer months, and are a result of both natural events (lightning strikes) and man-made events. The magnitude and frequency of wildfire may increase as a result of climate change.	N/A	Y	
65	Natural Event	Flooding	Natural Event	Historical - Present	Statewide	Statewide	Flooding may occur any time of the year across the state however is most common in the spring during winter break up and in the fall, when precipitation is most frequent. Ice jams frequently dam thawing rivers and streams, restricting flow and resulting in flooding upstream. Recently, flooding of the Sag river in Prudhoe Bay has resulted in inundation of the Dalton Hwy, the only land access point to North Slope oil fields. Heavy rains in 1967 resulted in Fairbanks "Great Flood," resulting in four deaths and millions of dollars in damage. The town of Galena, AK flooded in 2013, when an ice jam resulted in damming of the Yukon River. Over 90% of buildings were destroyed during the flood.	N/A	Y	http://www.crh.noaa.gov/Image/dvn/downloads/backgrounder_DVN_Ice_Jams.pdf
66	Natural Event	Earthquakes	Natural Event	Historical - Present	Statewide	Statewide	Alaska sits in an area of high seismic activity, with an average of one earthquake reported by the UAF Alaska Earthquake Center every 15 minutes. The second and either largest earthquake ever reported occurred in Alaska (1964 Good Friday quake [9.2] and the 1965 Rat Island quake [8.7]). More than 40,000 earthquakes were recorded in Alaska in 2014.	N/A	Y	https://earthquake.alaska.edu/earthquakes/about
67	Natural Event	Climate Change	Natural Event	Historical - Present	Statewide	Statewide	Average temperatures have risen in Alaska 3°F over the past 60 years. Increases in temperatures have resulted in earlier breakup of river ice, increases in precipitation, potential increases in permafrost thaw, and changes in ecosystem composition. Potential climate change impacts to the state also include increases in wildlife's, loss of sea ice, and increased ocean elevations and coastal erosion.	N/A	Y	https://www.epa.gov/climate-impacts/climate-impacts-alaska

ID No.	Activity/ Event Type	Action / Natural Event	Name of Company	Time of Initial Activity / Event	Location	Land Area / Concession	Additional Description	Current Status	Included in Cumulative Effects Analysis? (Y/N)	Website
68	Poaching	Illegal hunting or fishing of species outside of regulated hunting seasons, without proper permits, in areas not permitted for hunting, or the take of species not permitted for hunting.	Unknown	SPCS	SPCS	SPCS	Big game species allowed for permitted take in Alaska include bison, caribou, elk, muskox, wolves, black and brown bear, Dall sheep, moose, deer, and mountain goat. Other small game and birds are also available. Poaching (illegal hunting) already occurs in the state. Increased access to undeveloped areas and increases in seasonal worker populations has the potential to increase the occurrence of illegal hunting along the proposed corridor.	N/A	Y	http://www.adfg.alaska.gov/index.cfm?adfg=hunting.main
69	Tourism and Recreation	Tourism and recreation activities	Various	Statewide	Statewide	Statewide	Recreation and tourism occurs statewide and may involve land-based activities as well as activities on lakes, rivers and oceans within the proposed Project Area. Tourism is the second-largest private sector employer, and accounts for one in eight Alaskan jobs. The most recent available data indicates that the tourism industry generates more than 47,000 jobs, $187.8 million in taxes and revenues, $1.94 million in visitor spending and $1.39 million in labor income from a total of approximately 2.07 million visitors (ADCCED, 2015).		Y	https://www.commerce.alaska.gov/web/ded/DEV/TourismDevelopment/TourismResearch.aspx
70	Transportation and Infrastructure	Subsea cable installation	Quintillion	Summer/ Fall 2016	Chukchi and Beaufort Seas	N/A	Installation of subsea cable. In 2016, cable-laying ships C/V Ile de Sein and C/V Ile de Brehat spent the summer and fall installing Phase 1 of the Quintillion Subsea Cable System off the northern coast of Alaska. Phase 1 connects the Alaska communities of Nome, Kotzebue, Point Hope, Wainwright, Utqiagvik and Prudhoe Bay to the main subsea cable trunk running between Nome and Prudhoe Bay. Phase 1 – Alaska is a 1,200-mile submarine fiber optic cable main trunk line between Nome and Prudhoe Bay, Alaska. Additional branches are installed into the Alaskan communities of Kotzebue, Point Hope, Wainwright and Utqiagvik. Concurrently, new terrestrial fiber between Fairbanks and Prudhoe Bay, Alaska, installed along the Dalton Hwy, is nearing completion. At Fairbanks, the new fiber would connect to existing networks reaching Anchorage, Alaska, Portland, Oregon, and Seattle, Washington, providing fiber link between the Continental United States and the Arctic. The Dalton Hwy system is scheduled to be in-service Q1 2017, with the subsea system turning up service later in 2017.	Ongoing	Y	http://qexpressnet.com/

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71	Transport -ation and Infrastruc -ture	Spill Prevention and Response Exercises and Training	Alaska Clean Seas, Clean Water Services, Cook Inlet Spill Prevention and Response, Inc., and Alaska Chadux	Ongoing	Beaufort Sea and Cook Inlet	Statewide	Spill Prevention and Response Exercises and Training	Ongoing	Y	http://www.alaskacleanseas.org/upcoming-training/ http://www.cispri.org/contacts.htm https://www.chadux.com/

N/A - Not Applicable

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RFFA ID	Label
4	Livengood Gold Mine
5	True North Mine
6	Fort Knox Mine
13	Arctic National Wildlife Refuge
14	Kanuti National Wildlife Refuge
15	Yukon Flats National Wildlife Refuge
17	Gates of the Arctic National Park and Preserve
28	Liberty Unit
31	Point Thompson Pipeline
35	TAPS
41	Toghotthele No. 1, Nenana Basin Exploration Lease
42	Nanushuk Exploration
43	Smith Bay Development
44	Moose Pad Development
45	Icewine
48	Dalton Highway Improvements MP 379-414
49	Elliot Highway Improvements MP 107-120
70	Quintillion Subsea Cable System
71a	Badami Unit
71b	Colville River Unit
71c	Duck Island Unit
71d	Greater Mooses Tooth
71e	Kuparuk River Unit
71f	Liberty Unit
71g	Milne Point Unit
71h	Nikaichuq Unit
71i	Northstar Unit
71j	Oooguruk Unit
71k	Point Thompson Unit
71l	Prudhoe Bay Unit

ERM

DATE: FEB. 2017
CHKD: K.J.
DRWN: A.V.K.
PROJ. No.: 0255086

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FIGURE 4.26-4: PAST, PRESENT AND REASONABLY FORESEEABLE FUTURE ACTIONS (RFFAS) WITHIN THE NORTH PROJECT AREA ALASKA STAND ALONE PIPELINE

0 15 30 60 90 Miles

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RFFA ID	Label
1	Chuitna Coal Project
2	Usibelli Coal Mine
5	True North Mine
6	Fort Knox Mine
7	Ryan Lode Project
16	Denali National Park and Preserve
19	Clear Air Force Base
20	Eielson Air Force Base
22	Joint Base Elmendorf-Richardson
23	Joint Base Elmendorf-Richardson
24	Fort Wainwright
25	Fort Greely
30	Point MacKenzie Liquifaction Plant
32	Cook Inlet Oil and Gas Units
34	Kenai LNG Plant
35	TAPS
37	Fairbanks Gas Distribution System
40	Tolsona Exploration
41	Toghotthele No. 1, Nenana Basin Exploration Lease
47	Ninilchik Plant Development
49	Elliot Highway Improvements MP 107-120
50	Parks Highway Improvements MP 239-242
51	Parks Highway Improvements MP 91-101
52	Mat-Su Borough Glenn Hwy Rail Xing Improvements
59	Seward Marine Terminal Expansion Planning
61	Susitna-Watana Proposed Dam
62	Cook Inlet Tidal Energy Project
71a	Cispri
71b	Chadux

ASAP v6.1 Mainline
FBX v4.1 Lateral
Populated Places
RFFA Activity/Event Type
Energy
Coal Mining
Gold Mining
Oil and Gas
Transportation & Infrastructure
Oil and Gas Pipelines
Military
Oil and Gas
Land Use

Service Layer Credits: Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN,

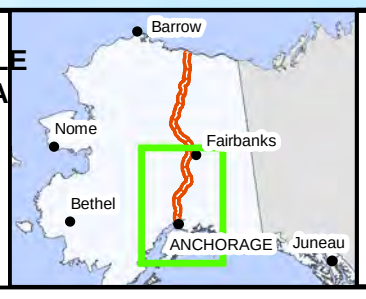
ERM

DATE: FEB. 2017
CHKD: K.J.
DRWN: A.V.K.
PROJ. No.: 0255086

825 W. 8th Ave., Anchorage, AK 99501, (907) 258-4880

FIGURE 4.26-5: PAST, PRESENT AND REASONABLY FORESEEABLE FUTURE ACTIONS (RFFAS) WITHIN THE SOUTH PROJECT AREA ALASKA STAND ALONE PIPELINE

0 15 30 60 90 Miles



N

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4.26.7.1. Oil and Gas and Energy Generation Activities

Oil and gas activities have been occurring on Alaska's North Slope since the 1960s and 1970s. Oil production on the North Slope has grown from a single operational oil field at Prudhoe Bay to a complex network of producing oil fields, interconnecting roads, pipelines, and power lines, extending from the Colville River to the near border of the Arctic NWR. A 2014 article by Raynolds *et al*. discusses the cumulative effects of infrastructure and climate change on ice-rich permafrost around Prudhoe Bay. According to Raynolds *et al*., as of 2011, there were 127 production pads, 25 facility pads, 145 support pads (power stations, camps staging areas, etc.), 103 exploration sites, 13 offshore exploration islands, 7 offshore production islands, 9 airstrips, 4 exploration airstrips, 2,037 culverts, 27 bridges, 50 caribou crossings, 1 active landfill, 931 km (579 m) of roads and 790 km (491 m) of pipelines. Total oil and gas development infrastructure covered 18,357 acres as of 2011, mainly consisting of gravel pads (5,795 acres), gravel mines (6,763 acres), and 3,101 acres of gravel roads and causeways. Raynolds *et al*. (2014) states that most of the direct effects of these developments occurred between 1968 and 1988 and by 2010, indirect effects of development included 1,732 acres of flooding, 907 acres infrastructure-related thermokarst (*i.e*., land-surface that results from thawing ground ice in a permafrost region), 820 acres of roadside gravel and debris, 719 acres of off-road vehicle tracks, and 84 acres of road dust.[16] Figure 4.26-6 presents the locations of several developments along the North Slope, some of which may spatially overlap with the proposed Project. Figure 4.26-6 depicts most of the major development units that exist on the North Slope. While more recent projects, such as the ConocoPhillips Greater Mooses Tooth 2 Development Project, are not pictured, the figure is representative of the current development units relative to the proposed ASAP Project.

It is widely documented that the North Slope contains vast natural gas reserves (DOE, 2009). In 2005, USGS estimated that approximately 37.5 trillion cubic feet of natural gas and 478 million barrels of natural gas liquids were in reserve at the North Slope (USGS, 2005). Current oil extraction operations on the North Slope utilize the byproduct of natural gas to pressurize the resource basin so that oil flows to gathering facilities at the surface. Therefore, while natural gas resources on the North Slope are available, there are presently no natural gas transportation facilities.

The cumulative effects of oil development were first studied at Prudhoe Bay in the 1980s with mapping that quantified the extent of direct and indirect landscape effects of oilfield infrastructure (Walker and Everett, 1987). Potential effects from oil and gas exploration and development activities include the structural footprint impacts as well as the effects to hydrologic processes, vegetation, and animal populations from operations. Disturbance of the insulative vegetation and surface layer over ice wedges or the introduction of heat to the ice wedges (*e.g*., standing or flowing water), can cause

[16] According to Raynolds *et al.* (2014), the extent of road dust is underrepresented due to the scale of mapping used for the assessment.

thawing of the ice, settling of the surface and creation of thermokarst terrain (Van Everdingen, 1998 as reported in Raynolds *et al*., 2014). Other potential impacts include:

- Contamination from on- and offshore oil spills;
- Socioeconomic, aesthetic, and cultural changes to surrounding communities;
- Air pollution from the combustion of fossil fuels;
- Long-term effects to sensitive vegetation from off-road travel; and
- Changes to ecosystems resulting from water withdrawal (NRC, 2003a).

Since the 1960s, new technologies (such as closer spacing of the well heads, directional drilling to reach deposits, and reinjection of drilling fluids into the geological formations to eliminate the need for reserve pits), have reduced the size of gravel pads for drill sites in newer oilfields considerably. Modern oil fields also use ice-roads during winter, which further reduced their footprint (Gilders and Cronin, 2000; AMAP, 2010; Streever *et al*., 2011 as reported in Raynolds *et al*., 2014).

Changes have also occurred in the Prudhoe Bay area that are not attributed to oil and gas infrastructure such as lakeshore erosion, thermokarst in areas located far from facilities, and revegetation of riverbanks along the Putuligayuk and Sagavanirktok rivers; a total of approximately 1,698 acres was documented by Raynolds *et al*. (2014) as of 2011. Of these changes, thermokarst was the most significant; with the most rapid changes (1.8-fold) occurring between 1990 and 2010 (Raynolds *et al*., 2014). Other infrastructure projects constructed in permafrost or discontinuous permafrost areas in Alaska including highways, railroads, or airports are described in Section 4.26.8, Non-Oil and Gas Activities.

Figure 4.26-7 shows the types of landforms affected by thermokarst as documented in the study. Non-infrastructure-related thermokarst was documented on approximately 19.1 percent of areas unaffected by development by 2010. Raynolds *et al.* (2014) attribute the regional increase in thermokarst to a likely long-term increase in summer temperature, and exceptionally warm temperatures in 1989 and 1998.

Other concerns raised about oil and gas exploration and production on the North Slope include cumulative effects of infrastructure on fish and wildlife migration (especially bowhead whales, Arctic cisco, and caribou), collision (eiders), contamination of subsistence resources, Alaska Native community health and wellbeing, and wilderness values (NRC, 2003a). The following sections provide more detailed information on specific North Slope oil and gas facilities near the proposed Project Area, while Section 4.26.9 provides an assessment of potential cumulative effects on physical, biological, and socioeconomic resources in the proposed Project Area.

North Slope Oil and Gas Activity

State of Alaska, Department of Natural Resources, Division of Oil and Gas, as of May 2018

BOEM
Calling for information and nominations for proposed 2019 Beaufort Sea lease sale.

Oil Search
Plan to drill on Pikka-Horseshoe trend next winter. Evaluating potential targets within Pikka Unit and on NPRA acreage north of Stony Hill well. Development at unit expected to come online by 2022-2023 and may produce up to 120K BOPD.

Eni
Drilling extended reach well into Nikaitchuq North OCS prospect from Spy Island.

Hilcorp
Expecting first oil from Moose Pad in late 2018. Planning expansion of other drillsites to accommodate additional wells.

BSEE
Deferring expiration of ASRC's Beaufort Sea leases that they acquired from Shell in 2016. ASRC must file an exploration plan with BOEM in 2023.

AOGCC
Approved pool rules for Northstar-Kuparuk oil pool at Northstar Unit.

ConocoPhillips
Well CD5-25 set a North American record for longest horizontal lateral drilled in a land-based well: 21,748 feet in the Alpine A sand. With a true vertical depth of 7,900 feet and a second lateral of 12,463 feet, the well reached a combined total footage of 42,993 feet.

ExxonMobil
Division of Oil and Gas approved plan to engineer Point Thomson expansion for gas sales to Alaska LNG project and increased condensation production.

ConocoPhillips
Drilled three wells to explore the Pikka-Horseshoe Nanushuk and Alpine targets (Putu 2 & 2A and Stony Hill 1) plus four wells to delineate the Willow area Nanushuk trend (Tinmiaq 7-9 and West Willow 1). Successfully flow tested oil in Putu 2/2A, Stony Hill 1, and Tinmiaq 6-8.

Started GMT-1 development drilling from MT6 pad targeting Lookout Alpine C reservoir. Planning to drill nine horizontal wells, four producers and five injectors.

BLM
Released draft EIS for ConocoPhillips' proposed GMT-2 development targeting Rendezvous Alpine reservoir.

Brooks Range Petroleum
Tested North Tarn 1A well in November 2017. Average peak flow rate was 1,292 barrels of 24 API oil per day. Continuing to work towards first oil production. Application to expand Southern Miluveach Unit denied by Division of Oil and Gas.

ConocoPhillips
Improving gravel roads in Kuparuk River Unit to ensure safety and engineering standards are met.

BP Exploration
Prudhoe Bay oil production held flat at 280K BOPD for third straight year. Reached new maximum number of 33 wells online for Sag Rich Gas Program and new peak production of 12K BOPD. Expanding Q pad in western area of PBU to allow safe maneuvering of larger drilling rigs to access existing wells.

Glacier Oil and Gas
Spudded exploratory B1-07 Starfish well at Badami. Well targets are the Badami and Killian sands (Canning Fm).

BLM
Beginning EIS for oil and gas leasing program within 1002 area of ANWR.

ConocoPhillips
Completed 250 sq-mi Bear 3D seismic survey on their state leases south of Horseshoe and east of Colville River.

88 Energy
Completed 175 sq-mi Icewine 3D survey to refine prospects identified from 2D seismic. Permitted Bravo and Charlie wells in acquisition area. Also acquired 37 sq-mi Yukon 3D survey on Yukon Gold acreage west of ANWR.

Accumulate Energy Alaska
Planning to reopen Icewine 2 for flow testing this spring/summer.

Bureau of Land Management
Under recent appropriation bill, will receive $10 million to complete legacy well cleanup in NPRA.

Division of Oil and Gas
Released final best interest finding for North Slope Areawide oil and gas lease sale, tentatively scheduled for fall 2018.

Division of Oil and Gas
Released North Shore 3D, reprocessing of Pike Bottom Hole Planning 2D survey, Cross Island Ocean Bottom Geotechnical Study, and North Slope Geological Field Program data sets through Geologic Materials Center.

Smith Bay
CT-1 & CT-2
Teshekpuk Lake
Alaska Seaward Boundary
Beaufort Sea
Nikaitchuq
NIKAITCHUQ NORTH 01
Oooguruk
Pikka
PLACER 3
Placer
Colville River
Bear Tooth
TINMIAQ 9
WEST WILLOW 1
TINMIAQ 6
TINMIAQ 7
TINMIAQ 2
TINMIAQ 8
Greater Mooses Tooth
PUTU 2 & 2A
STONY HILL 1
HORSESHOE 1 & 1A
S. Miluveach
Kuparuk River
Milne Point
Dewline
Beechey Point
Northstar
Duck Island
Liberty
Prudhoe Bay
Guitar
Trans-Alaska Pipeline
Dalton Hwy
Deadhorse
Prudhoe Bay
Badami
BADAMI B1-07
Point Thomson
ICEWINE 2
National Petroleum Reserve - Alaska
Umiat

Exploratory Wells Spud

- 2018
- 2017
- 2016
- Oil & Gas Unit Boundary

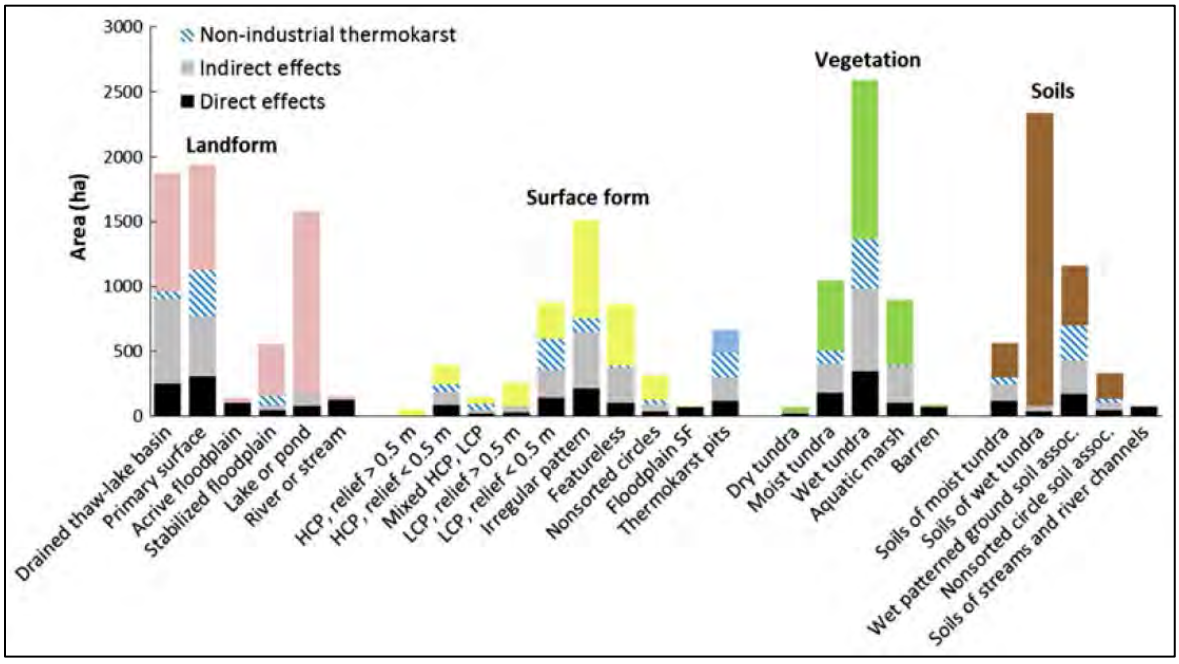
0 5 10 15 20 25 Miles

Map Location

The accuracy of this map is subject to pending decisions currently on appeal and other administrative actions. Please visit www.dog.dnr.alaska.gov/Information/MapsandGIS to see our most current maps.

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Figure 4.26-7 Land Forms Affected by Thermokarst in Prudhoe Bay



Note: Total areas of geoecological units >50 ha within maps A, B, and C, area of each unit with direct (black) and indirect (gray) industrial impacts, with nonindustrial thermokarst (blue diagonal stripes) and remaining unchanged portion (includes area of floodplain gravel erosion and deposition). Thermokarst pits include areas mapped with this code as dominant or secondary surface form.
HCP = high-centered polygons; LCP = low-centered polygons; SF = surface form.

4.26.7.1.1. North Slope Facilities

Oil and gas facilities currently operating on the North Slope include, but are not limited to, Alpine, Badami, Endicott, Kuparuk, Milne Point, Northstar, Point McIntyre / Lisburne, Point Thomson, Prudhoe Bay, Oooguruk, Greater Mooses Tooth Units, and Nikaitchuq. The location of these primary North Slope operating areas are presented on Figure 4.26-6. Additional information on certain facilities is provided below. In general, these facilities are currently capable of and include infrastructure for oil/gas/water separation, gas dehydration/compression/reinjection, and water treatment/reinjection (Petrotechnical Resources of Alaska, 2004). Facilities on the North Slope compete for space and resources, but could also participate in resource and facility sharing that benefit multiple parties, increase production, improve resource conservation, reduce waste, and reduce financial and operation risks. Some examples of facility and resource sharing include: mobile and non-mobile equipment, emergency fire response, spill response, waste management (including solid oily waste), camp services, and materials. Sharing agreements may also include fee-based operatorship by existing North Slope producers for new producers on the North Slope (Petrotechnical Resources of Alaska, 2004).

4.26.7.1.2. Trans-Alaska Pipeline System

Initial construction of the 48-inch, 800-mile-long TAPS pipeline began in 1974 and concluded in 1977. In 2002, the oil pipeline ROW was renewed for 30 years. Infrastructure to support TAPS includes 78,000 VSMs, 790 miles of work pads, and 225 access roads. There are approximately 579 animal crossings, 34 major stream crossings, and 500 smaller waterbody crossings. Approximately 800 employees and 1,000 contractors currently work for APSC responsible for operating and maintaining the pipeline (APSC, 2016).

The proposed Project parallels the TAPS route between Prudhoe Bay and Livengood. Actions associated with continued operations and maintenance of TAPS facilities are considered reasonably foreseeable.

4.26.7.1.3. Liberty Development Project

Liberty Island is proposed for construction about 5 miles offshore in Foggy Island Bay of the Beaufort Sea Outer Continental Shelf. A nominal 12-inch sales oil pipeline inside 16-inch outer pipe would transport crude oil to the Badami Sales Oil Pipeline. The offshore portion of the pipeline would be approximately 5.6 miles, and the overland portion would be approximately 1.5 miles to the Badami pipeline tie-in point. Associated onshore facilities to support the project would include use of permitted water sources, construction of gravel pads to support the pipeline tie-in location and Badami ice road crossing, ice roads and ice pad construction, hovercraft shelter, small boat dock, and development of a gravel mine site west of the Kadleroshilik River. In addition, existing North Slope infrastructure would be used to support this project. The proposed Project may utilize similar transit corridors offshore in the Beaufort Sea and existing road systems including the Dalton Highway to transport materials. The same airports (*i.e.*, Deadhorse or Fairbanks) may also be used by both projects. The Liberty Project is currently undergoing NEPA review by BOEM. BOEM anticipates releasing a final EIS for the Liberty Project in May 2018 and a record of decision in June 2018.

4.26.7.1.4. Point Thomson Project

In April 2016, ExxonMobil announced that initial operations began at the production and pipeline system at Point Thomson on the North Slope. The Point Thompson facility includes a central gravel pad for wells and facilities, two satellite gravel pads for wells, an airstrip, a service dock, a sealift facility and barge mooring dolphins (this involved dredging and screeding of around 3,900 CYs), a gravel mine site, infield gravel roads, and infield gathering pipelines (USACE, 2012c). A 22-mile-long export pipeline has been constructed to transport hydrocarbon liquids from Point Thomson to existing common carrier pipelines at the Badami Development. The Point Thompson facility may also include infrastructure such as a waste injection well, communications towers and staging facilities at Badami, Prudhoe Bay, or Deadhorse (USACE, 2011). The Point Thomson facilities are located 60 miles east of Prudhoe Bay, where proposed ASAP Project activities are proposed. Plans approved by ADNR will have Exxon Mobil

increasing production of condensate to 50,000 barrels per day by converting two injection wells to production wells. This plan would also increase gas production from the field. The final decision to constuct the gas expansion project would take place in 2019 after further planning, engineering, and negotiating commercial agreements with Prudhoe Bay operators.

4.26.7.1.5. Northstar, Endicott and Milne Point Units

Northstar is a joint federal and state unit located in the Beaufort Sea about 12 miles northwest of Prudhoe Bay. BPXA was the original lessee and operator of Northstar. On April 22, 2014, BPXA announced that it has agreed to sell interests in four BPXA-operated oilfields on the North Slope of Alaska to Hilcorp Alaska, LLC (Hilcorp). On November 18, 2014, Hilcorp took over and accepted the duties and responsibilities of Operatorship of the Northstar Unit (100-percent ownership), and Liberty Unit (Hilcorp received 50-percent ownership and became the designated operator). BPXA also sold interest in prospects in State of Alaska waters to Hilcorp, notably the Duck Island (Endicott) Unit (100-percent interest), and onshore at the Milne Point Unit (50-percent interest). The agreement includes associated pipelines in the Milne, Northstar, and Endicott fields. The six producing federal wells fall under Bureau of Safety and Environmental Enforcement regulatory authority; the state wells fall under the State of Alaska regulatory oversight (BOEM, 2017).

4.26.7.1.6. Alpine and Greater Mooses Tooth Units

The Colville River Unit (commonly referred to as Alpine) is located in the Colville River Delta on Alaska's western North Slope, 34 miles west of the Kuparuk River Field (Kuparuk) and 8 miles north of the Inupiat village of Nuiqsut.

Alpine was the first North Slope field developed exclusively with horizontal well technology to access greater than 50 square miles of subsurface from a single drilling pad. The original Alpine facility was planned as a 97-acre surface development that included stand-alone processing facilities (CD1), a second drilling pad (CD2), and an airstrip/3-mile gravel road connecting the two pads. That original development accessed about 40,000 acres of subsurface area from the original two drill sites. With additional satellites, the total surface development now encompasses about 165 acres. Alpine has no permanent road connecting it to other North Slope infrastructure; therefore, in the winter, an ice road is built connecting Kuparuk to Alpine to move in supplies for the rest of the operating year. In any given winter season, more than 1,500 truckloads of modules, pipeline, and equipment are moved to Alpine over the ice road (ConocoPhillips, 2017).

The Greater Mooses Tooth Unit is located about 28 miles west of ConocoPhillips' central Alpine field facilities. ConocoPhillips' Greater Mooses Tooth-1 and -2 projects are now underway and are projected to add about 30,000 barrels per day each at peak production. Greater Mooses Tooth-1 is currently under construction with first oil expected in late 2018 while Greater Mooses Tooth-2 is in permitting.

The Preliminary Final SEIS for the GMT-2 project was released in March 2018, and a final SEIS is anticipated in late 2018.

4.26.7.1.7. Alaska LNG

The proposed ASAP Project is differentiated from the Alaska LNG project in that the Alaska Legislature intended ASAP to address in-state gas needs as the primary project objective (AS 31.25.005). Alaska Statute also placed in AGDC the responsibility to:

> *…endeavor to develop natural gas pipelines and other transportation mechanisms to deliver natural gas, including propane and other hydrocarbons associated with natural gas other than oil, to public utility and industrial customers in areas of the state to which the natural gas, including propane and other hydrocarbons associated with natural gas other than oil, may be delivered at commercially reasonable rates… (AS 31.25.005(6)).*

The Alaska LNG pipeline project is under the jurisdiction of the Federal Energy Regulatory Commission (FERC). Under the Alaska LNG Project, BPXA, ConocoPhillips, ExxonMobil, and the State of Alaska (AGDC) partnered to study the feasibility of a NGL plant and storage facilities and an export terminal at Nikiski on the Kenai Peninsula, an 800-mile gas pipeline from southcentral Alaska to the North Slope largely along the same route as the proposed ASAP Project, a gas treatment plant on the North Slope and transmission lines connecting the project to gas producing fields. The project is expected to produce and export up to 20 million metric tons of LNG per year for foreign commerce. Based on the findings documented in the August 2016 Alaska LNG Competitiveness Study, conducted by Wood Mackenzie, AGDC's three producing partners announced intentions to defer continued investment in project. The study reported the Alaska LNG project lacked competitiveness with the global LNG market, which was already oversupplied with LNG projects (Wood Mackenzie, 2016). As of November 2016, AGDC was in the process of negotiating taking leadership over of the Alaska LNG project. In a letter dated September 19, 2016 to Alaska Governor Bill Walker, BP Alaska LNG LLC and ConocoPhillips Alaska LNG Company stated they would continue to work with AGDC to enable a state-led project for commercialization of North Slope natural gas resources. The two companies would provide completed work to date on the Alaska LNG project and work with AGDC on structural and commercial concepts to lower the proposed Project's cost of supply and enhance competitiveness in the current market.

The Alaska LNG project is self-defined as an LNG export project with very different objectives. Although the Alaska LNG project contains provisions for at least five off-takes within the state, the responsibility to represent, manage and distribute this offtake gas to residents does not reside with the Alaska LNG project. Given the magnitude of both projects to deliver natural gas from the North Slope to Southcentral Alaska, it is unlikely both AK LNG and ASAP Project would be built. FERC began the 20-month EIS process in March 2018, with an EIS decision due by December 2019.

4.26.7.1.8. Energy for Utilities

The majority of natural gas that would be transported by the proposed Project from the North Slope would be consumed in population centers (*i.e.*, Fairbanks, Anchorage, Mat-Su and Kenai Peninsula Boroughs) and would be used to generate electricity and provide building heating. However, there are other energy generation projects that could have a cumulative effect on energy supply and consumption in the region. This cumulative effects analysis assumes that natural gas for heating would not be replaced by electrical energy for heating during the time the proposed Project would be operational. The estimated volumes of product would be expected to change as renewable energy generation supplements the long-term demand for electrical generation using natural gas.

4.26.7.1.9. Electrical Power Generation within the Project Area

The proposed Project would provide utility grade natural gas to ENSTAR, displacing or supplementing natural gas supplies currently obtained from Cook Inlet gas fields. The ENSTAR distribution system delivers natural gas to approximately 140,000 residential, commercial, and industrial customers in and around the Anchorage and Cook Inlet area, including Anchor Point, Big Lake, Bird Creek, Butte, Chugiak, Eagle River, Eklutna, Girdwood, Homer, Houston, Indian, Kachemak, Kasilof, Kenai, Knik, Nikiski, Nikolaevsk, Ninilchik, Palmer, Peters Creek, Portage, Sterling, Soldotna, Wasilla and Whittier. ENSTAR's service area encompasses more than 57 percent of the Alaska population (ENSTAR, 2016).

In April 2015, ENSTAR, APSC, and Cook Inlet Energy, LLC filed a gas sales agreement with the RCA (RCA 2015). The gas sales agreement contemplates continued production out of the North Fork Unit, which if approved, would deliver 2.5 MMscfd of natural gas on a firm basis to ENSTAR at a price of $6.03 per million cubic feet for approximately 7 months. The ENSTAR pipeline system delivers natural gas to CEA, ML&P, HEA, and MEA. The electrical generation facilities of these associations are summarized below.

There are five regional electrical service areas that could benefit from the natural gas supplied to ENSTAR by the proposed Project:

- **CEA Service Area**: CEA provides service to 83,000 metered retail locations that extend from Anchorage to the Kenai Peninsula to Whittier, Alaska on Prince William Sound, to Tyonek on the west side of Cook Inlet via several production facilities with a 531.2 MW of installed commissioned capacity from Chugach-owned facilities (which includes Chugach's share of the jointly owned Southcentral Power Project and Eklutna Power Plant). Chugach uses various generation resources to support reliable power generation including the state-owned Bradley Lake Hydroelectric Project near Homer and from the Fire Island wind project. In 2015, 86 percent of the kilowatt-hours Chugach sold came from natural gas units, 11 percent from hydroelectric resources, and 3 percent from wind. CEA operates 2,113 miles of energized line comprised of 407 miles of transmission line that includes the jointly

owned Eklutna transmission line, 897 miles of overhead distribution line and 809 miles of underground distribution line (CEA, 2016).

- **HEA Service Area**: HEA is connected to the rail belt G&T system and serves 22,892 customers with a system totaling 2,407 miles of transmission line. The Nikiski power plant generates about 80 MW of electrical energy that serves its customers (HEA, 2016).
- **MEA Service Area**: MEA purchases the electricity distributed over more than 4,300 miles of transmission line to its 50,000 customers in the Mat-Su Borough. The new Eklutna 171 MW plant is now serving homes and businesses from Eagle River to South Denali Princess Lodge (MEA, 2016).
- **ML&P Service Area**: ML&P serves an average of 24,439 residential customers and 6,328 commercial customers in the Anchorage area. ML&P also provides all requirements for power to the Joint Base Elmendorf-Richardson, with 83 percent of its revenue from the electrical energy provided to the military. ML&P owns two power plants with a total of eight turbines (two could use No. 2 fuel oil as an alternate and one operates on waste heat, otherwise the plants run on natural gas). A new plant expansion project at Plant 2 was completed and began operation in 2016, providing 120 MW. ML&P also partnered with Chugach Electric on the Southcentral Power Project, a 183-MW facility that went on line in 2013 in Anchorage. ML&P also has a 53.33 percent interest in the Eklutna Lake hydroelectric facility and is required to purchase 25.9 percent of the electricity produced at the Bradley Lake Hydroelectric Project near Homer. Total generating capacity is 379.2 MW with electricity (ML&P, 2015).
- **Seward Electrical Department**: Seward Electrical Department is part of the City of Seward municipality. It does not directly use ENSTAR gas, but purchases power from CEA and has six diesel-powered backup generators.
- There is potential to produce electrical generation by wind farms that would connect to the existing electrical transmission systems. These are the Eva Creek Wind Farm near Healy (24.6 MW), the Fire Island Wind Farm at Anchorage (17.6 MW), Delta Wind Farm near Delta Junction (2 MW), and a wind farm at Nikiski (15 MW) (AEA, 2013). In 2015, three-quarters of Alaska's non-hydroelectric renewable electricity (more than 60 MWs) was supplied by wind (EIA, 2016d). The Healy Clean Coal Project would contribute 50 MW of electrical energy to the utilities connected to the rail belt transmission system. The GVEA purchased the Healy Unit 2 Power Plant in 2013, and in 2016, the plant passed commissioning tests and met availability, environmental, and economic metrics (GVEA, 2016). These projects could reduce, but not eliminate, the demand for natural gas, and would contribute to the state's energy goal of providing 50 percent of rail belt power from renewable resources by 2025.

4.26.7.1.10. Hydroelectric Power

If a large hydroelectric project, such as the downsized Susitna Hydropower Project (600 MW) (Watana Project) (Office of Governor Sean Parnell, 2011) or the Chackachamna hydroelectric project, were to displace electricity currently generated by natural gas, up to approximately 50 MMscfd of natural gas would be conserved. Therefore, the Susitna Hydropower Project could reduce natural gas demand by approximately 10 percent, but would not supplant the 500 MMscfd that would be transported by the proposed Project. In a letter to FERC, dated August 4, 2016, Alaska Governor Bill Walker notified the Commissioner of the State of Alaska that the state would be closing down the project due to the current fiscal situation; however, the state intended to preserve all work conducted up to that point. Existing appropriations were used to advance the project to the stage of an updated Commission Study Plan Determination, and requested such from FERC (AEA, 2016b). Energy conservation projects, such as home and business weatherization and upgrading current electrical generating facilities, has the potential to reduce demand for natural gas now used to generate electricity and for heating.

4.26.7.1.11. Transmission Line Upgrades

The Knik-Willow Line, as well as other high-voltage transmission lines throughout the rail belt, would be upgraded and additional parallel lines constructed to enhance the long-term reliability of the entire system to deliver the quantities of electricity where and when needed. The AEA proposes to upgrade the existing Anchorage-to-Fairbanks Intertie (Intertie) with a 25-mile 230-kV transmission line running from the Teeland substation to the Willow substation. In 2011, five of the six utility companies operating between Kenai and Fairbanks created the Alaska Railbelt Cooperative Transmission and Energy Company to manage the needs of the rail belt. Currently, the utility companies are evaluating the creation of a power pool and unified system operator for the rail belt. The proposed unified system would result in a more efficient and effective regional transmission system (Alaska Power Authority, 2016). Other new, as yet conceptual transmission lines would be required when new energy projects, such as the Watana Hydroelectric Project or wind farms, are added to the mix of energy supplied to the rail belt transmission systems.

4.26.7.1.12. Long-term Planning

In February 2010, a Regional Integrated Resource Plan (RIRP) set out a 50-year plan that identified combinations of G&T facilities in the rail belt. RIRP was funded by the Alaska Legislature and led by the AEA. It addressed the energy needs in the combined service areas of the ML&P, CEA, SES, GVEA, HEA, and MEA. The plan was not considered a state or regional energy plan. It is also not viewed as a state energy plan, nor does it set state policy since both are the purview of the Governor and the Alaska Legislature. Current challenges for the short- and long-term production of electrical energy considered in the RIRP are: limited redundancy, small economies of scale, dependency

on fossil fuels, declining supply of natural gas from Cook Inlet fields to meet long-term demands for reliable deliverability and storage, aging G&T facilities, ability to finance improvements, and lack of full integration. The RIRP recommends a series of short- and long-term actions to address improved integration of the six regulated utilities, resource and regulatory uncertainties, enhanced G&T capability, and the need to pursue a large hydroelectric facility (Black & Veatch, 2010). The elements of this RIRP are evaluated in this cumulative effects analysis.

4.26.8. Non-Oil and Gas Activities

4.26.8.1. Highway, Air, Rail, and Marine Transportation

As described in Chapter 3, Section 3.11.6, Transportation and Utilities Crossed by the Proposed Project, the proposed Project ROW would cross railroads, utilities (including TAPS), trails, driveways, and local and arterial roads. Certain portions of the proposed Project, however, do not have existing transportation or utility systems including the portion of the proposed Project between MP 00 and 28 on the North Slope, the Minto Flats State Game Refuge (MP 405-MP 458), and south of Willow (MP 709 – MP 727).

Some amount of habitat fragmentation has occurred in Alaska as a result of these types of linear projects. The effects of terrestrial habitat fragmentation depend primarily on how much of a barrier is created by the road, utility or railroad as well as how large the integral land area is. The land area is not only reduced by the road or railroad itself but also by the disturbance that occurs on either side. For example, fugitive dust, noise, emissions, trash, the risk of collision, hazardous materials spills, changes in accessibility (*i.e.*, reduced movement for wildlife but increased access for humans) could all result from these types of linear projects. These types of effects undoubtedly have occurred in portions of the proposed Project Area as a result of major road and railroad systems including but not limited to the Dalton, Elliot, and Parks highways and the ARRC. The magnitude of these impacts depends on these factors described and can vary across ecoregion depending on how sensitive the local resources are to these changes. The sections below provide a summary of the major road and railroad infrastructure projects within the proposed Project Area.

Marine traffic and associated support facilities may also affect resources within the proposed Project Area. Vessel traffic could result in many different types of impacts including but not limited to increased underwater noise, release of antifouling chemicals, fuels or other hazardous materials, vessel strike, introduction of non-native species, emissions, turbidity, physical impacts to marine habitats, or disturbance due to vessel presence. Other indirect or cumulative effects may also be caused by activities in the port area associated with construction, dredging, or land use changes (OSPAR Commission, 2009).

Although some categories of habitat impacts resulting from activities related to port and marina construction and maintenance and vessel operations may be minimal and site specific, the cumulative effects of these activities over time could have substantial

impacts on habitat. In January 2015, the International Council on Clean Transportation published a report titled "10-Year Projection of Maritime Activity in the U.S. Arctic Region" (Azzara, Wang, and Rutherford, 2015). According to the report, vessel traffic in the U.S. Arctic (including the Beaufort, Chukchi, and northern Bering seas and Bering Strait) increased 108 percent (from 120 to 250 vessels) between 2008 and 2012 (see Section 4.26.8.1.3).

4.26.8.1.1. Highways

Highways are continually being repaired, replaced, or upgraded in accordance with schedules published by the ADOT&PF. Actual implementation depends on appropriations by the Alaska Legislature. Table 4.26-4 shows planned actions on the Dalton and Elliott highways associated with the proposed Project and associated facilities between the North Slope and the Fairbanks area. Table 4.26-5 provides a list of planned actions for the Parks Highway corridor associated with the proposed Mainline and Fairbanks Lateral.

Table 4.26-4 Dalton and Elliott Highway Projects Considered in Cumulative Effects Analysis

Dalton and Elliott Highway Projects Considered in Cumulative Effects Analysis
Dalton Highway MP 362 to 379 Reconstruction
Dalton Highway MP 18 to 37 Reconstruction (Hess Creek area)
Dalton Highway MP 109 to 144 Reconstruction (Old Man Camp to Jim River Bridge #3)
Dalton Highway MP 0 to 9 Reconstruction (Livengood to 9 Mile Hill)
Dalton Highway MP 305 to 335 Reconstruction (Sag Camp to Happy Valley)
Dalton Highway MP 209 to 235 Reconstruction (Dietrich to Chandalar Shelf)
Dalton Highway MP 289 to 305 Rehabilitation (Kuparuk to Sag Camp)
Dalton Highway MP 362 to 414 Reconstruction (Pump 2 to Deadhorse)
Dalton Highway MP 265 Roche Moutonnee Creek Bridge Replacement
Dalton Highway MP 120 to 135 Reconstruction (Pung Creek to Prospect Creek)
Dalton Highway MP 109 to 120 Reconstruction
Dalton Highway MP 209 to 222 Reconstruction (Owen Creek to Chandalar Shelf)
Dalton Highway MP 305 to 315 Reconstruction
Dalton Highway MP 315 to 325 Reconstruction
Dalton Highway MP 18 to 25 Reconstruction
Dalton Highway MP 222 to 235 Reconstruction
Elliot Highway MP 73 to 107 Rehabilitation
Elliot Highway MP 37 Globe Creek Bridge Replacement
Elliot Highway MP 0 to 12 Rehabilitation (Fox to Haystack)

Source: ADOT&PF, 2016

Table 4.26-5 Parks Highway Projects Considered in Cumulative Effects Analysis

Parks Highway Projects Considered in Cumulative Effects Analysis
Parks Highway MP 239 to MP 242 Rock Slope Mitigation
Parks Highway Church Road to Pittman Road Construction
Parks Highway Talkeetna Spur Road Pedestrian Improvements
Parks Highway Rehabilitation MP 90 to 123.5
Parks Highway MP 123.5 to MP 163 Drainage and Culvert Improvements
Parks Highway MP 48.8 to MP 52.3 Pittman Road to Big Lake Road Reconstruction
Parks Highway MP 43.5 to 52.3 Reconstruction Lucus Road to Big Lake Cutoff
Parks Highway Bridge Replacement Montana Creek and Sheep Creek
Parks Highway Denali Park Area Rail Realignment
Parks Highway to Chena River University Ave Rehabilitation
Parks Highway MP 305 to 325 Reconstruction
Parks Highway Rehabilitation MP 163-183
Parks Highway MP 239 to 263 Reconstruction
Parks Highway MP 231 Enhancements
Parks Highway MP 183 to 192 Reconstruction
Parks Highway Bridge Deck Rehabilitation
Parks Highway MP 163 to 168.5 and 169.5 to 174 Rehabilitation (excluding railroad crossing at MP 169)
Parks Highway MP 174 to 183 Rehabilitation

Source: ADOT&PF, 2016

4.26.8.1.2. Airports

The proposed Project does not include building, improving, or expanding any airports. Existing airports would be used to support construction and operations.

The Applicant has identified 14 existing airports and airstrips that would be used to support construction. The Anchorage, Deadhorse, and Fairbanks airports would be hubs while Galbraith Lake, Healy River Strip, Prospect Creek, and Talkeetna would be primary airports. The state owns 11 of the 14 airports; the exceptions are Cantwell (private), Five Mile (BLM), and Nenana Municipal (Nenana). As with highways, the state schedules airport improvements to meet existing and projected demand. The Applicant believes the selected 14 airports generally are adequate but some may require upgrades to improve runways, lighting, communications, or navigational aids. Airport improvements are subject to the availability of federal and state funding and state priorities. The hub and primary airports provide scheduled passenger and freight service as well as serving private and charter air operations. Nine of the airports (Anchorage, Deadhorse, Fairbanks, Galbraith Lake, Prospect Creek, Chandalar Shelf, Coldfoot, Five Mile, and Livengood Camp) could also be used for the AK LNG Project. Upgrades to airport facilities at Anchorage, Talkeetna, and Deadhorse are in the current State of Alaska Airport Improvement Plan schedule.

4.26.8.1.3. Rail

The ARRC is state-owned but operates as a private enterprise that is funded by the services provided and from leases of its real estate holdings. The proposed Project would not require improvements to the ARRC system. The ARRC provides both passenger and freight service between Seward, Whittier, Anchorage, Fairbanks, and freight only services to Fort Wainwright, and Eielson Air Force Base. Passenger service between Anchorage and Fairbanks is scheduled year-around. During the summer, there is daily service between Seward, Whittier, Anchorage, and Fairbanks, with flag-stop service to rural residents and recreationists along the rail system in areas not readily accessible by road. Current and proposed ARRC projects include the Healy Canyon Safety and Reliability Program, Fairbanks Area Rail Line Relocation, Nenana Rail Line Relocation, the Northern Rail Extension, considerations for Glen Highway MP 34-42 improvements, South Wasilla Rail Line Relocation (MP 154-156), and a Port MacKenzie Rail Extension (ARRC, 2016). There is regular freight service transporting refined fuel products and gravel. Coal from the mine at Healy is shipped to the Port of Seward for export. Other freight is scheduled on an as need basis. Both Seward and Whittier are designed to receive freight by hydrotrain (barges equipped to transport large items on rail cars).

AGDC selected Seward as the primary delivery point for all pipe and most construction equipment and bulk supplies due to the existing ARRC facilities. Construction equipment and bulk supplies would be delivered by rail to Fairbanks and the laydown/construction camps.

4.26.8.1.4. Marine

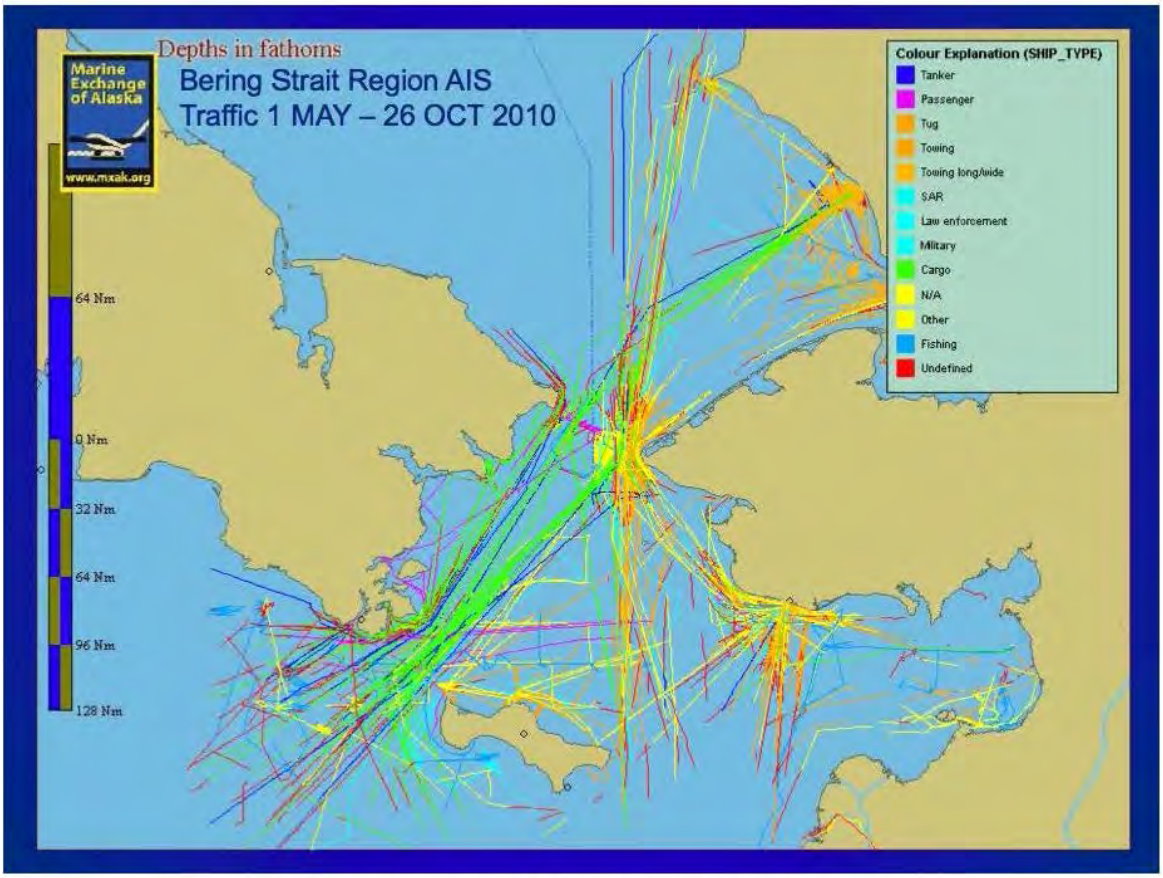
Alaska ports capable of receiving large vessels are located in Seward, Whittier, Homer, and Anchorage. Docks capable of receiving ocean-going vessels are located at Nikiski, Port MacKenzie, and the West Dock causeway on the North Slope. Dock facilities at Seward and West Dock would be used for the proposed Project. Seward would be the primary point for marine deliveries for the proposed Project, while the West Dock Causeway would be the point of delivery for the GCF modules.

Between 2008 and 2012, USCG District 17 reported that total annual vessel traffic in the Arctic region grew from 120 to 250, a 108 percent increase. Tank vessel traffic was particularly high while tugs and other cargo vessels were the second and third largest categories of movements (see Figure 4.26-8). Vessel traffic at Seward includes a range of large passenger ships during the summer, vessels transporting coal for export and a variety of private boats, commercial fishing vessels and charter vessels for sightseeing and fishing. More than 130,000 people and more than 2 million tons of cargo enter or exit the Port of Seward via the ARRC dock facilities.

The Alaska Marine Highway System provides daily scheduled passenger and vehicle transportation in the Southcentral part of Alaska by ferries between Whittier, Valdez, and Cordova during the summer and weekly service during the winter. Seward is not a

port of call for the Alaska Marine Highway System; therefore, there would be no interaction between proposed Project activities and ferry service.

Figure 4.26-8 Arctic Shipping Traffic



Source: John Adams, Marine Exchange of Alaska as reported in Pawlowski 2015

4.26.8.1.5. Land Use and Planning

The proposed Project would cross land under the jurisdiction of numerous authorities, including the NSB, YKCA, Denali Borough, Mat-Su Borough, FNSB; state areas managed by ADNR, ADF&G, ARRC, ADOT&PF; and, federal lands managed by the military, BLM, and NPS. The Eastern Interior Proposed Regional Management Plan and Environmental Impact Statement (BLM, 2016) were finalized in 2016 and replace the White Mountain National Recreation Area Regional Management Plan (BLM, 2016) and Steese National Conservation Area Regional Management Plan (BLM, 2016). The proposed Project is also proximate to conveyed Doyon Limited lands, particularly near Rampart, Minto, and Manley Hot Springs. Any development of these private lands may require a modification of the Yukon Flats National Wildlife Refuge Comprehensive Land Use Plan or the Minto Flats State Game Refuge Plan. Additional Land Use Management Plans proposed or currently under construction include the North Slope Borough Comprehensive Plan, Central Yukon Resource Management Plan and

Environmental Impact Statement, the Eastern Interior Resource Management Plan, and the North Slope Management Plan, as listed in Table 4.26-3. These plans assist in the establishment of community and resource management goals and policies, management intent, and set guidelines for the use of resources protected under the plan for the public and industry. These plans may also include recommendations for retention or selling of land, opening or closing areas to resource development, selection of priority or special use land designations, and recommendations of legislative designations (ADNR, 2017).

4.26.8.1.6. Subsistence

As defined in AS (16.05.940[32]):

> *Direct personal or family consumption as food, shelter, fuel, clothing, tools, or transportation, for the making and selling of handicraft articles out of nonedible by-products of fish and wildlife resources taken for personal or family consumption, and for the customary trade, barter, or sharing for personal or family consumption.*

ADF&G maintains the Community Subsistence Information System and provides access to data collected (1964 through 2012) on subsistence harvest by region, community, and several other categories. These data are available on line at: http://www.adfg.alaska.gov/sb/CSIS/. Access to and use of subsistence resources (*i.e.*, hunting, fishing, foraging, trapping, whaling, sealing, traveling) occurs within the general area of the proposed Project. Cumulative impacts on subsistence resources are discussed in Section 4.26.9.15.

4.26.8.1.7. Tourism and Recreation

The proposed Project either crosses or occurs in proximity to state recreation areas and parks (*i.e.*, Nancy Lake, Willow Creek, Denali State Park), national parks or wildlife refuges (Denali NPP, Arctic NWR, Gates of the Arctic NPP, Yukon Flats NWR, Minto Flats Wildlife Refuge, White Mountains National Recreation Area), and trails and recreation access points such as the Iditarod Trail and the Dalton Highway Recreation Area. Numerous recreational and tourism activities are offered within these areas (with lodging to support them ranging from small bed and breakfast businesses to the large complex at the entrance to Denali NPP), boating, hiking, flight seeing, camping, fishing and hunting. ARRC also provides service to tourists traveling to Denali NPP. These recreational opportunities are therefore considered in the cumulative effects analysis (see Section 4.26.9.11).

4.26.8.1.8. Military Projects

The proposed Project would be constructed near Fort Wainwright and Joint Base Elmendorf-Richardson. These military bases are currently proposing to perform infrastructure improvements (*i.e.*, infrastructure upgrades, facility improvements) and base upkeep activities that could coincide with construction of the proposed Project.

4.26.8.1.9. Mining

The Donlin Gold project is undergoing evaluation under NEPA at this point in time; therefore, the final aspects of these proposed Projects may change. The Donlin Mine EIS is anticipated to be released in July 2018. The Livengood Gold project recently completed pre-feasibility studies and given the early stage of evaluation may also change key aspects of their proposed activities as International Tower Hill moves through additional stages of evaluation. Each of these projects are geographically distant from the proposed location for the project, and would not physically overlap with the proposed Project Area. However, given their size and potential impacts to resources including but not limited to infrastructure (*i.e.*, transportation), employment, regional air and water quality, regional habitat, wetlands, gravel, and vegetation, cumulative impacts may result as discussed for certain resources later in this section.

4.26.8.2. Foreseeable Projects if the Proposed ASAP Project is Built

4.26.8.2.1. Fairbanks Natural Gas Distribution System

The proposed Project would provide a long-term reliable supply of utility grade natural gas in the Fairbanks area as a fuel source for electrical power generation, home and institutional heating. Distribution from the terminus of the Fairbanks Lateral would most likely involve a pipeline distribution system and possibly new facilities that compress natural gas for distribution by storage tanks. Conversion or retrofit of power generation and heating facilities could also take place to allow for burning of natural gas.

FNG estimated the cost of converting a resident to use natural gas would be $1,000 to $1,500 (State of Alaska, 2011). According to ENSTAR, it would cost about $1,000 for the initial hookup to Mainline pipeline and $17 a foot for each section of pipe between the home or business and the Mainline system (WebCenter11.com, 2011). Recent analysis indicates that the cost to convert a residence to natural gas ranges from the low estimate provided by FNG ($1,000 to $1,500) to as high as $12,000 to $20,000 for a boiler replacement, chimney upgrade (or replacement), and other hydronic (or forced air) connections and there are options in between that range of prices for conversion (Northern Economics, 2012). Northern Economics (2012) also estimates that the annual cost savings on fuel by switching to natural gas is significant for the region at approximately $315 million saved during the first full year of operation in 2021, a savings of 60 percent over the status quo. This distribution system and any additional facilities are considered reasonably foreseeable actions related to the proposed Project.

Northern Economics (2012) further stated that construction and operation of a piped natural gas distribution system in the mid- and high-density areas of the FNSB and a propane distribution system in the lower-density areas of the borough have the potential to substantially reduce fuel costs for heating of residential and commercial buildings. Based on the 2012 analysis, for the estimated first full year of operation, the proposed distribution system has the potential to reduce heating costs by approximately

60 percent. This cost reduction was derived by estimating heating costs from the use of wood and fuel oil in 2021 at approximately $524 million and costs from the use of the natural gas and propane distribution system of approximately $210 million.

FNG currently owns and operates a 70 plus mile long pipeline distribution system delivering natural gas to more than 1,100 homes and businesses for heating, cooking and other applications. FNG presently produces LNG from Cook Inlet natural gas transported by the ENSTAR pipeline system to an FNG facility adjacent to the MP 39 of the Beluga Pipeline (Figure 4.26-4) and trucked via the Parks Highway to a FNG 91,200 gallon facility in Fairbanks where it is stored until distribution; FNG also transports LNG from Cook Inlet to the Talkeetna Alaskan Lodge owned by the Cook Inlet Regional Corporation.

In 2013, legislation passed authorizing AIDEA to partner with the private sector to explore providing "affordable, clean-burning natural gas to Interior Alaska." Identified as the Interior Energy Project, it is a joint venture between AIDEA, the Alaska Energy Authority, the Department of Commerce, Community, and Economic Development, the Department of Revenue, and ADNR to explore solutions to poor air quality and high energy costs in Interior Alaska (AIDEA, 2015). In 2015, AIDEA purchased FNG, and in 2016, the company ordered three additional LNG trailers to haul natural gas via the road system. The new trailers (13,000-gallon capacity) would have a 20 percent greater LNG capacity than the current fleet (Brehmer, 2016). AIDEA is currently finalizing discussions with the FNSB Interior Gas Utility company to form a consolidated gas utility for the area. The combined utility would have expanded Cook Inlet gas liquefaction capacity as well as increased liquefied natural gas storage in the FNSB.

GVEA operates and maintains 3,216 miles of transmission and distribution lines, 35 substations, eight generating facilities, and covers 5,973-square-miles of service territory. The GVEA system is interconnected with electrical generation facilities at Fort Wainwright, Eielson Air Force Base, Fort Greeley, UAF, and all electrical utilities in the rail belt that extend from Homer to Fairbanks. Peak load in 2009 was 200.5 MW with a peak of 223 MW in December 2007. In 2015, the capacity was measured at 356 MW. GVEA serves more than 44,000 m in Fairbanks, Delta Junction, Nenana, Healy, and Cantwell. Eight GVEA owned generating facilities have a combined capacity of 381 MW with 188 MW produced from diesel fuel, 88 MW from coal, 60 MW from naphtha, 25 MW from wind, and 20 MW as hydroelectric power (GVEA, 2016).

The proposed Project's Fairbanks Lateral segment would eliminate the need to truck LNG to Fairbanks, or to continue production of LNG at the existing plant near MP 39 of the Beluga Pipeline and truck that product to Fairbanks.

4.26.8.2.2. Future Gas Development Scenarios

4.26.8.2.2.1. LNG Export Scenario

One reasonable foreseeable conceptual usage for future natural gas from the proposed Project is development of an LNG export terminal. Based on existing information, the most probable location for such a facility would be in Cook Inlet at the existing LNG terminal within the Nikiski Industrial Area. This facility has been in operation since 1969 and is currently operated by ConocoPhillips. Existing pipelines and pipeline capacity are adequate to service this facility with the proposed Project's natural gas. The Nikiski LNG terminal has a storage capacity of 105,000 cubic meters (m^3) of LNG and an annual throughput capacity of approximately 6.8 million m^3 of LNG. On November 17, 2016, ConocoPhillips announced it was in the initial stages to try to sell the Nikiski plant. The proposed plant sale followed the company's release of its Beluga River Gas field stake in Cook Inlet (Municipality of Anchorage, 2016). It is possible the existing liquefaction facility and terminal facilities could be used to their capacity under new ownership. If additional capacity is required, there is sufficient land available at the existing site for construction of a second LNG liquefaction train.

Based on throughput, the existing pier at Nikiski might require reinforcement or the pier and cargo handling system would be expanded to berth 135,000 m^3 LNG cargo ships (the most common LNG cargo vessel size today) or larger vessels. The current dock face (ship's berth) at the Nikiski LNG terminal is approximately 320 m long. The Alaska LNG project purchased roughly 630 acres of land in Nikiski with the intent to build a LNG liquefaction plant and marine terminal. The proposed marine terminal may include a 3,300-foot-long trestle to twin loading berths. The terminal could service 21 LNG carriers a month (Kenai Peninsula Borough, 2016). As of November 2016, future ownership of this property is uncertain, as the State of Alaska prepares to take lead of the project. Specific details of the Alaska LNG project are likely to change if, and when the project continues to be evaluated.

4.26.8.2.2.2. Anchor Industrial Users

Another potential future gas use scenario is the transport and sale of substantial quantities of natural gas to an anchor industrial user located in Southcentral Alaska. The proposed Accelergy/Tyonek Coal to Liquids (CTL) Project is a potential future anchor industrial user. Such a facility could utilize up to 200 MMscfd of natural gas from the proposed Project. In October 2010, the Tyonek Native Corporation announced that they had signed an agreement with Accelergy, a technology company, to develop a CTL plant on Tyonek land. This facility would produce 60,000 barrels per day of aviation fuel, as well as gasoline and diesel for military and industrial use, and would generate 200 MW to 400 MW of electricity with waste heat. This early planning stage project would use a new technology called "integrated coal biomass-to-liquids," which captures some of the carbon dioxide for use in the plant itself, and uses the rest to grow algae, which is then combusted in the plant for energy generation. The combination of

recycling carbon dioxide and the use of biomass could improve the efficiency of the CTL process while simultaneously reducing GHG emissions. Accelergy has stated that 90 percent of the energy present in the coal is used in final products.

To transport up to 200 MMscfd of natural gas from the proposed Project to Tyonek for use in the CTL process, the existing pipelines in the area would likely need to be supplemented with a new pipeline. A 12-inch-diameter, 320-mile long buried steel pipeline from the end of the proposed Project pipeline at MP 39 of the Beluga Pipeline (ASAP MP 736.4), to the Tyonek area would be required.

Other potential future industrial gas users include the Donlin Creek Mine Project, which proposes to draw an additional 25 MMscfd of natural gas from unspecified sources at Cook Inlet by 2017 (Donlin Gold, 2016), and a natural gas to liquids facility in the Cook Inlet area that would produce synthetic diesel and gasoline fuels from natural gas.

4.26.8.3. Natural Events Including Climate Change, Wildfire and Flooding

Climate change, wildfire, and flooding are likely to occur within the proposed Project Area within scope of this assessment (approximately 10 years into pipeline operations). This section provides a broad overview of the potential effects of these natural events on the resources evaluated in the following sections.

4.26.8.3.1. Climate Change

According to the EPA, the average temperature in Alaska has increased approximately 3°F over the past 60 years; an increase twice that observed across the rest of the country. Temperatures are expected to continue to increase statewide by an additional 2 to 4°F by the middle of this century (Chapin *et al.*, 2014). With increasing temperatures, annual precipitation is also expected to increase during all seasons. According to the NOAA 2016 Arctic Report Card, new record high air temperatures were reported in January, February, October, and November in 2016 and North American spring snow cover extent was the lowest it has been since satellite reporting began in 1967. Warming conditions promote permafrost thaw and microbial conversion of permafrost carbon to GHGs (carbon dioxide and methane) into the atmosphere, further accelerating climate change (NOAA, 2016). This combination is expected to result in greater evaporation, longer growing seasons, and an overall drier state (EPA, 2016e).

Potential impacts to ecosystems in Alaska as a result of climate change include an increase in glacial retreat; a reduction in sea ice and increasing sea levels; an increase in drought and drying of lakes and wetlands; shifts in plant communities and migration patterns of wildlife; increases in wildfires, flooding, landslides, and avalanches; and increasing damage from insect infestation (EPA, 2016e). The 733-mile long proposed Project corridor would intersect a wide range of ecosystems sensitive to climatic changes including marine, boreal forests, tundra, and peatlands.

As described in Chapter 3, Section 3.2.4.3, regular frost and thaw action occurs throughout the proposed Project Area due to temperature changes across Alaska.

Thermokarst features are formed in the active layer by the repeated freezing and thawing of ice within a given soil. Freezing of ice wedges causes them to expand. The negative consequences of thermokarst to infrastructure are well-known and extensively documented (U.S. Arctic Research Commission, 2003; Streletskiy *et al*., 2012). However, thermokarst thaw could have significant negative consequences to infrastructure. According to Larsen *et al*. (2008) as reported in Raynolds *et al*. (2014), the effects of climate change are estimated to result in approximately $3.6 - $6.1 billion of additional maintenance and replacement costs on public infrastructure in Alaska through 2030, but it is difficult to isolate the projected costs of thermokarst from other climate change effects. Rehabilitation has been very costly in areas affected by thermokarst where gravel has been removed and trenches where cables and pipelines are buried has resulted in subsidence (Streever, 2012 as reported in Raynolds *et al*., 2014).

AGDC conducted thermal modelling to assess long-term thaw depths associated with the proposed ASAP pipeline (Appendix D). Modeling focused on an area of warm permafrost near Fairbanks, with a mean annual ground temperature just below freezing. Warm permafrost is more susceptible to thaw than soils surrounding the pipeline in colder areas, such as the North Slope. The AGDC model used climate data from the Fairbanks area. Under conditions of an assumed climate warming rate of 0.08°F per year (AGDC, 2017f), additional long-term thaw depth would occur beneath the ROW and climate warming could cause long-term permafrost thaw in undisturbed terrain. The model predicted thaw depths of up to 18 feet for cleared terrain off of the ROW that was allowed to revegetate over time. The predicted thaw depth beneath the gravel pad would be up to 22 feet after 30 years. Predicted thaw depths under the gravel pad were deeper than under the proposed gas pipeline. The following figures present the ASAP ROW long-term thaw depths with (Figure 4.26-9) and without (Figure 4.26-10) the surface layer below the gravel pad.

Figure 4.26-9 ROW Thaw Depths for Case with Buried Organic Soil Below Gravel Pad

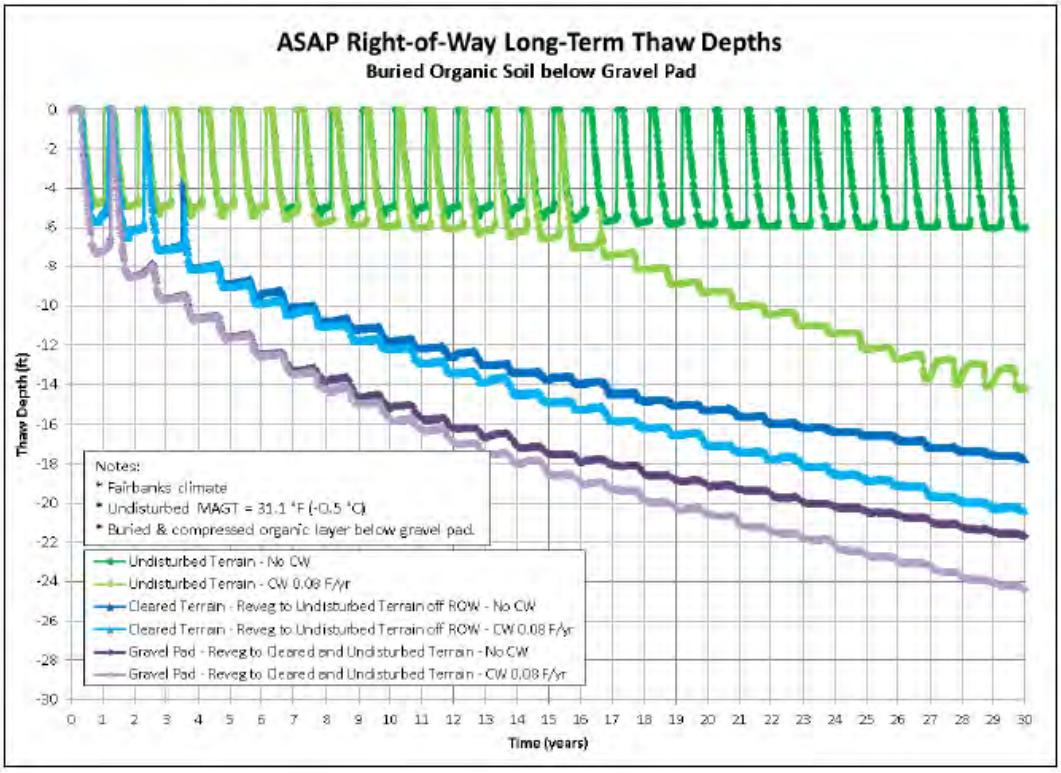


Figure 4.26-10 ROW Thaw Depths for Case without Buried Organic Soil Below Gravel Pad

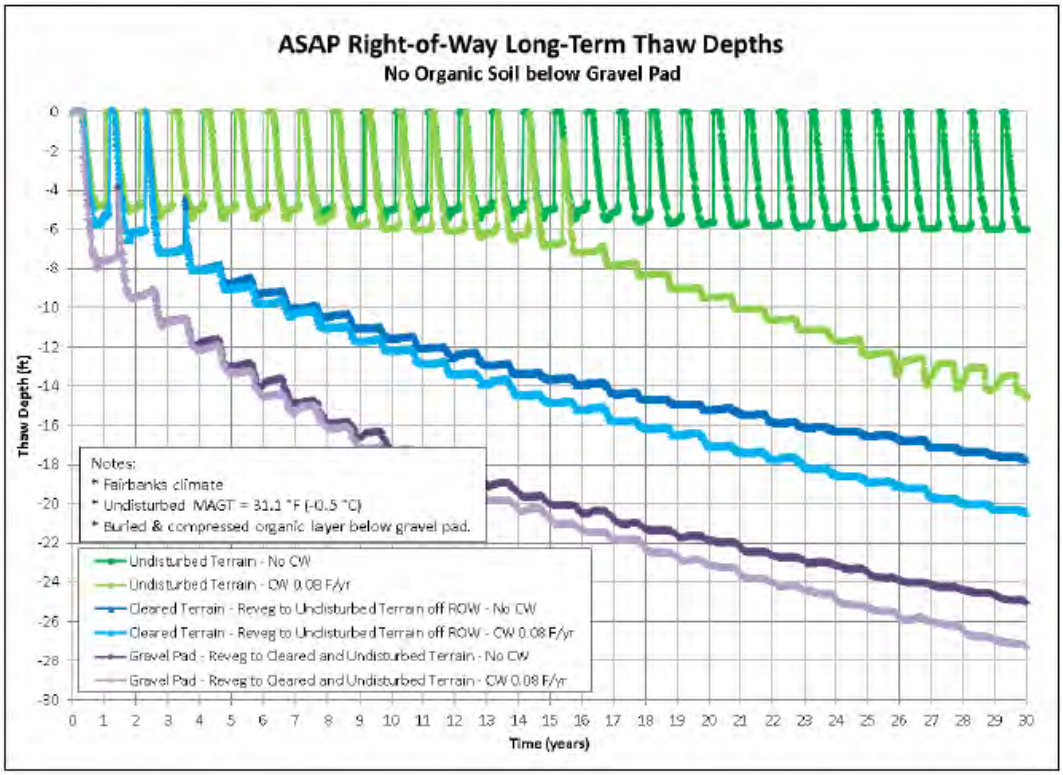
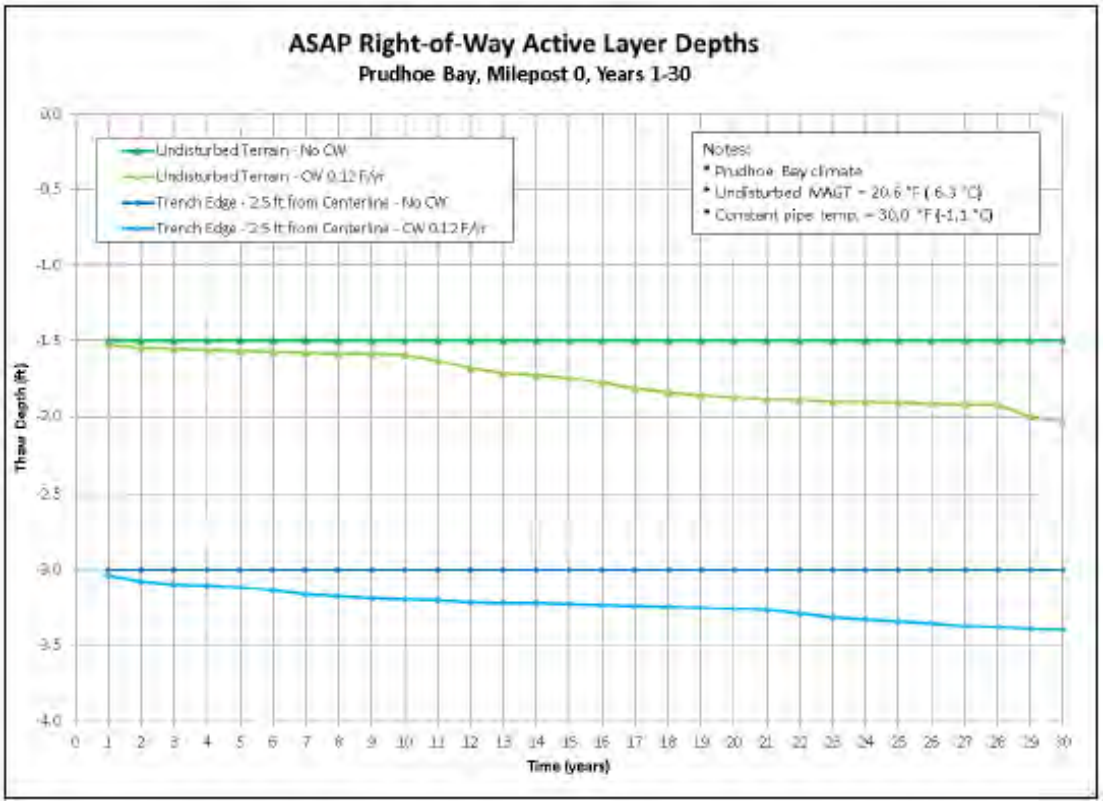


Figure 4.26-11 summarizes the two geothermal modeling cases (with and without climate warming) in continuous permafrost at Prudhoe Bay by showing the change in the active layer depth in undisturbed terrain and above the pipe over 30 years. An assumed climate warming rate of 0.12°F per year (AGDC, 2017f) was applied to assess the effect of a constant buried pipe temperature of 30°F at MP 0 of the ASAP pipeline at Prudhoe Bay (AGDC, 2017f). It is noted that the active layer becomes slightly deeper each year, and no long-term progressive thaw is triggered by climate warming.

Figure 4.26-11 Comparison of ROW Active Layer Depths with and without Climate Warming



With the assumed climate warming, throughout the 30-year model run, the thaw depth continued to increase from year to year. The model was run with stable climate input data, thus the thaw depth of undisturbed terrain remained constant over the 30-year model run. Warming climate would be expected to result in greater thaw depths. Thaw depth is important because the pipeline and gravel pad rely on the underlying permafrost for support. AGDC concluded "long-term thaw in warm permafrost caused by surface disturbance, may not reach periodic steady-state within typical pipeline design lifetimes on the order of 30 years." Permafrost thaw could reduce ground surface elevations, which in turn could change surface water flow paths and result in additional heat addition.

Climate change is discussed, where applicable, as a RFFA in Sections 4.26.9.1 through 4.26.9.20.

4.26.8.3.2. Wildfire

Wildfires occur naturally through lightning strikes throughout Alaska and are an important factor in tundra and boreal forest ecosystem. Regular wildfires help maintain the health of these ecosystems by rejuvenating habitats and releasing stored nutrients to soils. Cyclical wildfires clear excess debris and ultimately reduce the risk of more extensive and dangerous wildfires (EPA, 2016e). While wildfires can be destructive to man-made structures and activities, they play a very important part in sustaining ecological health of many systems in Alaska. Wildfires are especially important to forest succession in Interior Alaska, and are responsible for the cyclical transition of spruce forest to grass and herb-dominated areas, which succeed to scrub-shrub habitats, then to deciduous tree stands, and finally back to spruce forests. Typical uneven wildfire burns, due to moisture, vegetation, weather, and terrain, produce the diverse open and forested wetland and forest landscape mosaic that dominates Interior Alaska (UAF, 2013). It is predicted the likelihood of sever fire seasons in Alaska has increased to 34 to 60 percent as a result of climate change (Partain *et al.*, 2016). Wildfires pose a risk to the proposed Project as well as other present, and RFFAs within the proposed Project corridor. Wildfires are discussed as a RFFA possibly contributing to cumulative impacts in the sections below.

4.26.8.3.3. Flooding

Alaska's numerous streams and rivers are prone to flooding most times of the year. Heavy rainfall causing rivers and streams to overbank is a common cause for flooding, as well as melting snow and ice, and the inadvertent damming of waterways. Ice jams are also a common, destructive cause of flooding in Alaska. This type of flood occurs when frozen waterbodies (lakes, rivers, and streams) begin to thaw and broken pieces of ice collect to form a dam of water. Once the ice dam breaks, the pooled water could be released in one large, flash flood-type surge. The community of Galena, Alaska was flooded by the Yukon River in 2013 after an ice jam dammed up portions of the Yukon River. It was estimated 90 percent of the buildings in the community were destroyed and damages were estimated at more than $10 million (FEMA, 2013). An ice jam in the Sagavanirktok River resulted in the flooding of the Dalton Highway 20 miles south of Deadhorse, Alaska in 2015. The flood destroyed stretches of the highway and prevented hundreds of supply and fuel trucks from accessing the North Slope oil field (ADN, 2015). In the sections below, flooding has been included as a RFFA (where applicable) that may have cumulative affects to the proposed Project resources.

4.26.9. Cumulative Impact Assessment Results

The potential cumulative effects associated with the proposed Project and RFFAs, as well as natural events, such as climate change or wildfire, are discussed by resource

below. Federal, state, and local agencies must review most of the future projects (RFFAs) included in Table 4.26-3 for compliance with requirements for construction of facilities in areas where a governmental license or permit may be required. The expansion or construction of inter- or intra-state pipelines, highways, and major water development projects would require state or federal permits and approvals to comply with Section 7 of the ESA; Sections 401, 402, and 404 of the CWA; the CAA; and Section 106 of the NHPA among other regulations as described in Chapter 1. Issuance of the necessary permits and approvals would require specific conditions (mitigations) intended to reduce or avoid significant effects to wetlands and waterbodies, vegetation and wildlife (including threatened and endangered species), cultural resources, and air quality and noise. For the purposes of the cumulative effects analysis, it is assumed that any agency-required mitigation and monitoring would be implemented for RFFAs that would require agency approval.

4.26.9.1. Soils and Geology

As discussed in Section 4.6 (Soils and Geology), the proposed Project would likely result in major direct and indirect impacts to soil and geology during construction and operation and maintenance. Proposed activities would affect local topography, soil, geology, and permafrost and may result in the following impacts:

- Alternation to drainage patterns and topography;
- Increased erosion and loss of vegetation;
- Creation of landscape scars, ponding, and siltation;
- Thaw settlement resulting in ground depressions and topographic changes; and
- Development of frost heaves and thaw bulbs.

The proposed Action would cross a wide range of landscapes, including arctic tundra, alpine areas, low lands, forests, and wetlands. This includes areas of continuous permafrost, discontinuous permafrost, and sporadic permafrost, as well as areas that are free of permafrost. Past, present, and RFFAs are presented in Table 4.26-3 and Figures 4.26-4 and 4.26-5. A summary of potential past, present, and RFFAs and events that may contribute to cumulative effects on soil and geology is presented in Table 4.26-6. These activities and events have been ranked using the impact criteria defined in Table 4.26-1 based on the magnitude or intensity of the impact, the geographic extent, the duration, and the likelihood of occurrence.

The majority of impacts to soil and geology from past, present, and RFFAs are associated with effects to local topography, soil, and geology (increased erosion and loss of vegetation, alterations to drainage patterns and topography) and effects to permafrost and geology (changes in thaw/settle regimes and creation of landscape scars, ponding, and siltation). These impacts could arise from both man-made events (current and future resource exploration activities and highway improvements) and natural events

(flooding, wildfires, and earthquakes). See Sections 4.26.7.1, Oil and Gas and Energy Generation Activities and 4.26.8.3.1, Climate Change.

The RFFAs discussed here have the potential to cause cumulative effects on soil and geology resources within the proposed Project Area. Past and present activities along the Project ROW such as TAPS (RFFA 35), Prudhoe Bay oil and gas operations, and existing highway infrastructure (RFFA 48-51), and coal mining operations (RFFA 2) have required the removal of topsoil and other alterations of ground surface. Although these impacts are localized for each project, when combined with the proposed Action, cumulatively, these activities would contribute to increases in disturbed areas, potential erosion, as well as alterations in historic drainage patterns.

RFFAs, including new highway and access road construction and improvements (RFFAs 48-51, 54, and 55) would also contribute to cumulative erosion, alteration to topography, and changes in drainage patterns. Exploration and development activities associated with the Icewine Oil Prospect (RFFA 45) and future gold mining operations (RFFAs 4 and 7) would have similar impacts to soil and geology.

Additionally, alterations to topography associated with construction activities would contribute to changes in surface and subsurface temperatures and annual freeze/thaw cycles. As a result, topographic changes from past and current RFFAs would contribute to the impacts associated with the proposed Action. Thermal erosion due to the proposed Project construction may have major effects that could degrade the value, integrity, and function of soil and geologic resources in areas where permafrost is present. This is true for other RFFAs occurring in areas where permafrost is present and that involve construction of temporary ice roads and pads and permanent gravel roads and pads. Expected changes to the thermal balance as a result of these activities are reasonably expected for activities associated with gold mining operations near Fairbanks (RFFAs 4 and 7), Icewine Prospect exploration and development (RFFA 45), and highway and access road construction (RFFAs 48-51, 54, and 55).

The Alaska LNG project (RFFA 33) would result in similar impacts to soil and geology resources as those resulting from the proposed Project, given the common purpose of both projects to deliver natural gas from the North Slope to Southcentral Alaska. As mentioned in Section 4.26.7, it is assumed that the State of Alaska would require only one LNG pipeline and either the proposed Project or the Alaska LNG Project would be executed.

A significant potential future impact noted during the review of RFFAs were those associated with natural events. Wildfires (RFFA 64) occur regularly across the state of Alaska, specifically in the interior of the state and in areas corresponding to the proposed ROW. The loss of vegetation, root decay, and alterations to soil integrity followed by a wildfire may result in post-fire landslides. Post-fire landslides result in additional loss of vegetation, block waterways and drainages, damage structures, and endanger human lives. Wildfires also may destabilize pre-existing, deep-seated landslides (USGS, 2016). Wildfires indirectly thaw frozen soils and permafrost by

burning organic cover, blackening the soil surface, and reducing active layer insulation. Soils are then heated through increases absorptions of heat from the sun (USFWS, 2007).

Wildfires also have a direct effect on soil properties, which include increasing biodegradation rates of decomposable soil organic matter; enhancing plant nitrogen update (through the contribution of charcoal to the soil); decreasing the availability of nitrogen through the formation of aromatic forms of nitrogen; and physically altering soil structure, texture, porosity, wettability, infiltration rates, and water holding capacities (Encyclopedia of Southern Fire Science, 2017). Wildfires also result in the natural succession of plant communities and process dead and dying vegetation and reestablish soil nutrients. The impacts resulting from wildfires could be both positive and negative in relation to the proposed Project.

Additional impacts to alterations in drainage patterns, topography, and soil and geology composition could result from seasonal flooding (RFFA 65). Flooding in Alaska could occur during normal spring melt of snow and ice, as a result of unseasonably warm periods, or during high precipitation events. Flooding may also result in changes to topography, existing drainage patters, and vegetative cover. Major flooding occurred along the Sag River in both 2015 and 2016 which significantly impacted North Slope oil and gas operations. The flooding was attributed to early and rapid spring thaw and was reported to be worst in the area over the past 40 years. It is unclear whether these two flood events anomalies or due to climate change.

Climate change (RFFA 67) could exacerbate the impacts of all the RFFAs, which include activities on permafrost. Alterations in seasonal temperatures and annual precipitation could alter freeze/thaw cycles and cause changes to surrounding topography and drainage patters as a result of permafrost alterations. Thawing permafrost could drive the active zone deeper and destabilize existing or proposed roads, buildings, and pipelines, requiring rebuilding, maintenance, and additional investment. The construction of future infrastructure may require the development of new technologies to address changing soil and geologic conditions. (ACIA, 2004). Changes in temperature and precipitation could alter or reduce vegetative communities, resulting in a decrease in protective ground cover and increase in erosion. Along the proposed pipeline route, this is particularly true in areas where permafrost is subject to degradation. In general, climate change could reduce a system's natural ability to mitigate extreme weather events (flooding, wildfires, etc.) as well as the impact minor stressors (highway improvements, access road development) have on the environment (EPA, 2016e). However, in areas of non-thaw susceptible soil in cold regions, a warming climate would result in an extended growing season and higher primary productivity. The impact rating for the effects to local topography, soil, and geology and the effects to permafrost and geology from the proposed Action (Alternative 1) were summarized as major, based on the impact component criteria in Table 4.6-1. The cumulative impacts of the proposed Project in combination with the RFFAs described here would result in moderate impacts to soils considering the amount of area affected by these activities

compared to the amount of undisturbed land that would still exist within the proposed Project Area.

Alternative 2 includes crossing the Yukon River on a suspension bridge, dredging associated with use of DH2, ocean disposal of dredge material, use of VSM from MP 0 to MP 62, and routing a section of the pipeline through Denali NPP. The direct and indirect impact rating of Alternative 2 is major, but less than Alternative 1 (see Section 4.6, Table 4.6-5). Similar to Alternative 1, the cumulative impacts of the proposed Project in combination with the RFFAs described here would result in moderate impacts to soils considering the amount of area affected by these activities compared to the amount of undisturbed land that would still exist within the proposed Project Area.

Overall, past, present and future development projects including but not limited to oil and gas exploration and development, roadway construction, operations and maintenance, flooding, and wildfires would contribute to cumulative effects on soil and geology within the proposed Project Area. Certain environments may be more sensitive to impacts than others depending on the magnitude, extent and severity of the cumulative effect. Considered collectively, past, present and RFFAs within the proposed Project Area would likely result in moderate negative cumulative effects on soil and geology.

Table 4.26-6 Past, Present, and RFFAs with Potential to Affect Soils and Geology

RFFA or Natural Event	Past, Present, RFFA ID Number[a]	Net Effect	Types of Effects
Donlin Gold Mine, Livengood Gold, True North, Fort Knox, Ryan Lode Project	3, 4, 5, 6, 7, 36	Minor – Major Negative	• Thaw settlement resulting in ground depressions and topographic changes • Creation of landscape scars, ponding, and siltation • Increased erosion and loss of vegetation • Alternations to drainage patterns and topography
Resource Management Plans, Conveyances and Refuges	8 - 17	Major Positive	• Protection and conservation of land areas
TAPS, Nanushuk, Smith Bay, Alpine and Greater Mooses Tooth, Icewine Oil	35, 43a, 43b, 44, 45, 46	Minor Negative	• Increased erosion and loss of vegetation • Alternations to drainage patterns and topography • Thaw settlement resulting in ground depressions and topographic changes
Highway Improvements	48 – 51	Minor Negative	• Increased erosion and loss of vegetation • Alternations to drainage patterns and topography • Thaw settlement resulting in ground depressions and topographic changes
Ambler Mining District Access Road	55	Minor Negative	• Increased erosion and loss of vegetation • Alternations to drainage patterns and topography

RFFA or Natural Event	Past, Present, RFFA ID Number[a]	Net Effect	Types of Effects
			• Thaw settlement resulting in ground depressions and topographic changes
Susitna-Watana Hydro	61	Minor Negative	• Alternations to drainage patterns and topography
Alaska LNG Project	33	Moderate Negative	• Increased erosion and loss of vegetation • Alternations to drainage patterns and topography • Thaw settlement resulting in ground depressions and topographic changes
Wildfire	64	Moderate Negative/ Moderate Positive	• Thaw settlement resulting in ground depressions and topographic changes • Creation of landscape scars, ponding, and siltation • Increased erosion and loss of vegetation • Alternations to drainage patterns and topography • Development of frost heaves and thaw bulbs • Nutrient cycling (positive effect) • Ecosystem succession (positive effect)
Flooding	65	Major Negative	• Thaw settlement resulting in ground depressions and topographic changes • Creation of landscape scars, ponding, and siltation • Increased erosion and loss of vegetation • Alternations to drainage patterns and topography
Earthquakes	66	Major Negative	• Thaw settlement resulting in ground depressions and topographic changes • Alternations to drainage patterns and topography
Climate Change	67	Major Negative	• Thaw settlement resulting in ground depressions and topographic changes • Creation of landscape scars, ponding, and siltation • Increased erosion and loss of vegetation • Alternations to drainage patterns and topography • Development of frost heaves and thaw bulbs

a The RFFA number corresponds to the number listed in Table 4.26-3.

4.26.9.2. Water Resources

As discussed in Section 4.7 (Water) and summarized in Table 4.26-3 (Past, Present, and RFFAs Occurring Within or Near the Project Area), the proposed Project would likely result in negligible to major direct and indirect impacts to water resources during construction and operations. The following activities associated with the proposed ASAP Project could affect water resources:

- Water discharge, excavation and disturbance of ground cover, stream crossing activities, use of chemicals and regular vehicle and construction equipment use, and dredge and disposal activities could alter surface water quality;
- Contamination due to heavy construction equipment leaks or fueling activities and pipeline construction in areas of continuous and discontinuous permafrost could affect groundwater flow and quality;
- Excavation activities including utilization of gravel from streams, waterbody crossings, and pipeline operation temperature could impact stream bank stability and geomorphology;
- Excavation activities taking place in permafrost and ice road construction and thawing, sand and gravel storage, and pipe temperature, could affect flooding and floodplains; and
- GCF construction, hydrostatic testing, HDD, ice work pads, ice access roads and earth work would require water withdrawal activities that could alter water availability.

A summary of potential past, present and RFFAs that may contribute to cumulative effects on water resources is presented in Table 4.26-7. These activities and events have been ranked using the impact criteria defined in Table 4.26-1 based on the magnitude or intensity of the impact, the geographic extent, the duration and the likelihood of occurrence. The majority of impacts on water resources arising from RFFAs are associated with surface water quality, altered water availability, and stream bank stability.

4.26.9.2.1. Climate Change and Natural Occurrences

Climate change and natural occurrences are also expected to result in effects to water resources that are also affected by the proposed Project. Increases in climate change (RFFA No. 67) could result in earlier breakup of river ice, increases in precipitation, coastal erosion, increased ocean elevations, potential increases in permafrost thaw, droughts, warmer or cooler temperatures, and more frequent occurrence of extreme weather conditions in the same areas that are affected by the proposed Project. Notable impacts to water resources as a result of climate change and as described in Arctic Climate Impact Assessment (ACIA) Impacts of a Warming Arctic (2004) include the following:

> *Air temperature, snow cover, and vegetation, all of which are affected by climate change, affect the temperature of frozen ground and depth of seasonal thawing. Permafrost temperatures over most of the sub-arctic land areas have increased by several tenths of a degree Celsius up to 2°C over the past few decades, and the depth of the active layer is increasing in many areas. Over the next 100 years, these changes are projected to continue and their rate to increase, with permafrost degradation projected to occur over 10-20% of the present permafrost area.*

> *Projected increases in permafrost temperatures and in the depth of the active layer are very likely to cause settling, and to present significant engineering challenges to infrastructure such as roads, buildings, and industrial facilities.*
>
> *The potential for many shallow streams, ponds, and wetlands in the Arctic to dry out under a warming climate is increased by the loss of permafrost. As permafrost thaws, ponds connect with the groundwater system. They are thus likely to drain if losses due to downward percolation and evaporation are greater than re-supply by spring snowmelt and summer precipitation.*

Climate change in projected to increase the frequency of natural occurrences including changes in precipitation which contributes to flooding (ACIA, 2004) which could result in cumulative impacts to stream bank stability and surface water quality. Heavy precipitation could also contribute to mudslide Flooding is most common in the spring during winter break up and in the fall, when precipitation is most frequent. Ice jams frequently dam thawing rivers and streams, restricting flow and resulting in flooding upstream, an impact that could be increased by ice roads associated with the proposed Project that have not yet melted in the spring. Stream bank stability could be affected if flooding occurred concurrently with stream crossings, especially where trench crossing modes are used.

Naturally occurring and anthropogenic wildfires have the potential to impact water resources within the proposed Project Area. Specifically, water runoff from burned areas could transport chemicals associated with the fire to lakes, streams, and rivers, and could result in serious and immediate water quality problems. A loss of protective vegetative cover could increase surface water runoff as well as runoff sediment yield, resulting in increased stream, river, and lake turbidity as well as temperature (Tecle and Neary, 2015). Long-term impacts form wildfires, however, could be beneficial to water quality in a number of ways. Wildfires play an integral role in the creation and persistence of wetland species and ecosystems. In turn, wetlands benefit water resources by enhancing water quality, managing peak flood attenuation, and reducing erosion and sediment transportation (USDA, 2005).

The impacts to water resources described above are expected to occur regardless of construction of the proposed Project. While all permafrost areas that are susceptible to soil instability as a result of thawing permafrost could be impacted by climate change, the impacts are expected to be most notable in areas characterized as discontinuous permafrost. Under Alternative 3 (No Action), ACIA (ACIA, 2004) predicts that the likelihood of increases in permafrost temperatures and in the depth of the active layer are very likely to cause settling within this century. Under this SEIS, the duration of impact considered is over the next 10 years, so while the impacts resulting from permafrost thawing would be permanent, they are considered only somewhat t likely to occur in the next 10 years. Using the criteria outlined in Table 4.7-1, Impact Criteria for Water Resources, as described above, the overall impact to water resources as a result of permafrost degradation is expected to be moderate. The likelihood of increased flooding

causing changes to surface and groundwater flow over the next 10 years is considered somewhat likely to occur in the next 10 years; the geographic extent of flooding would be localized in a few isolated locations; the effect of flooding is expected to occur over one season; and the magnitude of the impact is expected to be major as it would have potential to degrade the value and function of a water resource. The overall impact of flooding as a result of climate change is expected to be moderate.

Other oil and gas development projects including the Alaska LNG project, North Slope oil and gas exploration and development projects, and interior Alaska oil and gas exploration and development projects, could cumulatively impact water resources potentially affected by the proposed Project. Development projects near Houston and Willow (RFFA No. 39) would be likely to have the most notable cumulative impacts to water resources as they are in close proximity to the proposed Project. In April 2007, LAPP Resources, Inc. requested a 10-year natural gas exploration license in this area covering around 21,240 acres near Houston and Willow, north and east of the Parks Highway. Exploration activities associated with this project may impact water availability and ground and surface water quality related to their water use needs and use of hazardous chemicals in exploratory drilling. Activities associated with the Liberty development project on the North Slope are not expected to result in cumulative impacts to surface water quality as the activities would take place at Foggy Island Bay in Beaufort Sea, Alaska approximately 15 miles east of Prudhoe Bay, where dredge and disposal activities would take place. Under Alternative 2, disposal activities would take place several miles north of West Dock. Although the Alaska LNG project could result in similar impacts to water resources as those resulting from the proposed Project, ranging in magnitude from minor to major, given the common purpose of both projects to deliver natural gas from the North Slope to Southcentral Alaska it is unlikely both would be constructed. While impacts to surface water quality and water availability would likely result from these projects alone (Alternative 3 – No Action), the overlap between these projects and the proposed Project are limited to a specific, isolated location; and the duration of the impact is expected to be seasonal. As a result, impacts to water quality and water availability within the proposed Project Area are expected to be moderate.

Impacts to water quality and water availability resulting from Alternative 1, the proposed Action, are considered moderate during construction and minor to moderate during operations as described in Section 4.7, Water. When combined with the potential impacts of the projects described above, the likelihood of the impacts would increase, but would be limited to one or more specific isolated locations and the duration of the activities are not likely to overlap. Based on these criteria, it is expected that the cumulative effects to water quality as a result of the RFFAs described above would remain moderate during construction and minor during operations and that the cumulative effects to water availability as a result of the RFFAs described above would remain moderate during both construction and operations. As described in Section 4.7, Water, the impacts of the project changes considered under Alternative 2 are not

expected to significantly impact water availability or water quality. As a result, the cumulative impacts when combined with the projects described above are expected to be consistent with those described under Alternative 1.

Area management plans such as RFFAs No. 8-11 and the Rural Alaska Village Program include provisions to manage or preserve water resources, which may result in a positive impact to water resources or impact the same water resources that would be potentially impacted by the proposed Project in a positive way. At this time specific project detail necessary to evaluate the impact rating of these plans on water resources is not available.

4.26.9.2.2. Relevant Past/Present Actions, RFFAs and Natural Events Affecting Water Resources

Table 4.26-7 summarizes the relevant past and present actions, RFFAs, and natural events that have already or may continue to impact water resources within the proposed Project Area.

Table 4.26-7 Past, Present, and RFFAs with Potential to Affect Water Resources

RFFA or Natural Event	Past, Present, RFFA ID Number[a]	Net Effect	Types of Effects
Donlin Gold Mine, Livengood Gold, True North, Fort Knox, Ryan Lode Project	3, 4, 5, 6, 7, 36	Minor Negative	• Surface Water Quality • Groundwater • Altered Water Availability
Resource Management Plans, Conveyances and Refuges	8 - 17	Major Positive	• Protection of surface water and groundwater quality and quantity
North Slope Oil & Gas Facilities: Liberty, Point Thomson Pipeline, TAPS, Nanushuk, Smith Bay, Alpine & Greater Mooses Tooth, Icewine Oil,	28, 31, 35, 43a, 43b, 44, 45, 46	Minor Negative	• Altered Water Availability • Surface Water Quality
North Slope Oil & Gas Development Project	42 – 45	Minor Negative	• Surface Water Quality • Altered Water Availability
Highway Improvement Projects	48 – 53	Minor Negative	• Surface Water Quality
Ambler Mining District Road Access	55	Minor Negative	• Floodplains • Surface Water Quality • Streambank Stability
Seward Marine Terminal Expansion Planning Project	59	Minor Negative	• Surface Water Quality
Susitna-Watana Hydro	61	Moderate Negative	• Altered Water Availability • Surface Water Quality • Floodplains • Streambank Stability
Wildfire	64	Moderate Negative / Moderate Positive	• Surface Water Quality • Ecosystem regeneration, nutrient cycling, and habitat succession

RFFA or Natural Event	Past, Present, RFFA ID Number[a]	Net Effect	Types of Effects
Earthquakes	66	Moderate Negative	• Surface Water Quality • Stream bank stability
Cook Inlet Tidal Energy Project	62	Minor Negative	• Surface Water Quality
Natural Gas Exploration near Houston and Willow	39	Moderate	• Surface Water Quality • Water Availability
Alaska LNG Project	33	Moderate Negative	• Altered Water Availability • Surface Water Quality • Floodplains • Streambank Stability • Groundwater
Flooding	65	Moderate Negative	• Surface Water Quality • Streambank Stability • Floodplains
Management Plans	8 – 11	Major Positive	• Altered Water Availability • Surface Water Quality
Rural Alaska Village Grant Program	60	Moderate Positive	• Altered Water Availability • Surface Water Quality
Climate Change	67	Major Negative	• Altered Water Availability • Surface Water Quality • Streambank Stability • Floodplains

a The RFFA number corresponds to the number listed in Table 4.26-3.

4.26.9.3. Vegetation

As discussed in Section 4.8 (Vegetation) and summarized in Table 4.26-3 (Past, Present, and RFFAs Occurring Within or Near the Project Area), the proposed Project would likely result in minor and moderate direct and indirect impacts to vegetation during construction and operation and maintenance. A summary of potential past, present, and RFFAs that may contribute to cumulative effects on vegetation is presented in Table 4.26-8. These activities and events have been ranked using the impact criteria defined in Table 4.26-1 based on the magnitude or intensity of the impact, the geographic extent, the duration, and the likelihood of occurrence.

The proposed Project would cross three distinct ecoregions: the Arctic Tundra, the Intermontane Boreal, and the Alaska Range Transition. Ecoregions are discussed in more detail in Chapter 3, Section 3.2.3, and described on Figure 3.2-1. With the exception of the first 62 miles of the proposed Project, the magnitude of impacts to vegetation is similar for the majority of the proposed Project. Vegetation impacts are visualized on Figure 4.8-1, Vegetation Impacts Context Map. In general, impacts to the Arctic Tundra would be more substantial to vegetation as a result of the short growing season, the cold temperatures, and the sensitive shallow permafrost underlying the ecoregion. The growing season in the Intermontane Boreal and Alaska Range Transition are longer, warmer, and seasonality in these ecoregions less extreme than the arctic, which, in part, could contribute to quicker recovery from development impacts. As described on Figure

4.8-1, the only vegetation effect indicator associated with the Arctic Tundra with an impact rating lower than those assigned for the Intermontane Boreal or Alaska Range Transition is "clearing, grubbing, and grading."

Net effects identified in Table 4.26-3 include vegetation loss, introduction of invasive, non-native, and noxious plant species, and habitat fragmentation (see Section 4.26.7.1). These impacts would arise from the placement of gravel; damage to rootstocks from clearing, grubbing, grading, and mowing; removal or disturbance to sensitive plant species; removal or disturbance of forest vegetation; reduction or alteration of plant species diversity; disturbance or damage from dust deposition; and crushing, covering, or compaction. Also included in Table 4.26-3 are positive net effects associated with implementation of management plans and impacts from natural events/disasters.

Vegetation loss and/or disturbance would be widespread along the pipeline ROW and impacts would be long-term and cross three distinct ecoregions (Arctic Tundra, Intermontaine Boreal, and the Alaska Range Transition).

Ecoregions are discussed in more detail in Chapter 3, Section 3.2.3. Impacts from trenching and backfilling and soil compaction would be major for the first 62 miles of the proposed Project due to the sensitive nature of the vegetation comprising this ecoregion. The impact rating for these effect indicators for the remainder of the proposed Project are considered moderate. As described on Figure 4.8-1, the only effect indicator that show greater impact in the Intermontaine Boreal and the Alaska Range Transition ecoregions are effects from clearing, grubbing, and grading. These are considered moderate outside of the first 62 miles of the proposed Project and negligible for the first 62 miles. This is a result of the proposed elevation of that portion of the pipeline.

Oil and gas exploration projects (RFFAs 39-41, and 42-45), proposed mining projects (RFFA 2), and highway improvements (RFFA 48-51) would result in similar direct losses of plant cover due to access road construction, facility development, and vehicle and equipment use. These are expected to have a small but unknown effect on forest vegetation since the principal construction activity would be placing roads and utilities between the facility and the nearest existing access point.

Surface disturbance and habitat alteration by the proposed Project and nearby RFFA activities could provide habitats favoring the establishment of invasive plant species. This may occur through the introduction of new species by equipment, supplies, or workers associated with the proposed Project or by neighboring operations. The introduction of invasive species would result in a negative cumulative effect on efforts to reestablish native communities. The sensitive nature of the Arctic Tundra ecoregion also makes habitat fragmentation impacts more substantial than those in the Intermontaine Boreal and Alaska Range Transition (due to short growing seasons, cold temperatures, and generally more extreme climatic conditions). AGDC mitigation controls for preventing the establishment and proliferation of non-native, invasive, and noxious plants would be limited by the management efforts of neighboring RFFAs.

Section 4.8, Vegetation, indicates a number of rare and sensitive plants could be adversely affected by the proposed Project. Other future projects (highway improvements [RFFA 48-51], the Alaska LNG project [RFFA 33], access road installations [RFFA 54, 55], oil and gas exploration [39-41 and 42-45]) could have a similar potential effect on rare and sensitive plants. Rare or sensitive species may be impacted through direct loss or disturbance of vegetation, by habitat fragmentation, or by competition with invasive or non-native species.

Natural events such as flooding and wildfires are a common occurrence in Alaska. Wildfires have an important, beneficial effect to both the boreal forest and tundra ecosystems in Alaska. Wildfires positively impact vegetation resources by releasing trapped nutrients back into the ecosystem as well promoting natural succession of species (USFWS, 2007). Wildfire suppression for the protection of structural components of the proposed Project, its associated workers, and other nearby RFFAs would cumulatively reduce the number of important small-scale wildfires and lead to unnatural accumulations of fuel. Cyclical wildfires clear excess debris and ultimately reduce the risk of more extensive and dangerous wildfires (EPA, 2016e).

Effects of climate change on vegetation within the proposed Project ROW may result in alterations to community composition as a result of changing temperatures and annual precipitation. These potential climatic changes may increase the effect of project- and RFFA-related impacts on already stressed vegetation resources. Changing climate conditions could result in more frequent and destructive wildfire and flood events. Vegetation already stressed by anthropogenic sources may have a more difficult time recovering from these natural events. Finally, rising temperatures could lead to an increase in accessibility of natural resources, increases in tourism and transit populations, and potentially alterations in land use, including increases in agricultural use (EPA, 2016e).

4.26.9.3.1. Relevant Past/Present Actions, RFFAs and Natural Events Affecting Vegetation

Table 4.26-8 summarizes the relevant past and present actions, RFFAs, and natural events that have already or may continue to impact vegetation within the proposed Project Area.

Table 4.26-8 Past, Present, and RFFAs with Potential to Affect Vegetation

RFFA or Natural Event	Past, Present, RFFA ID Number[a]	Net Effect	Types of Effects
Donlin Gold Mine, Livengood Gold, True North, Fort Knox, Ryan Lode Project	3, 4, 5, 6, 7, 36	Minor Negative	• Vegetation Loss • Non-Native, Invasive, and Noxious Plants • Habitat Defragmentation
Resource Management Plans, Conveyances and Refuges	8 - 17	Major Positive	• Protection and conservation of land areas
ARRC (shipping oil and gas) & Fairbanks Natural Gas	38	Minor Negative	• Non-Native, Invasive, and Noxious Plants
Highway Improvements	48 – 51	Minor Negative	• Vegetation Loss • Non-Native, Invasive, and Noxious Plants
Ambler Mining District and Tanana Access Roads	55, 56	Minor Negative	• Vegetation Loss • Non-Native, Invasive, and Noxious Plants
TAPS	35	Moderate Negative	• Non-Native, Invasive, and Noxious Plants
Interior Alaska Oil & Gas Exploration	39 – 41	Moderate Negative	• Vegetation Loss • Non-Native, Invasive, and Noxious Plants
North Slope Oil & Gas Exploration	28, 31, 42 – 46	Moderate Negative	• Vegetation Loss • Non-Native, Invasive, and Noxious Plants
Management Plans	8 – 12	Major Positive	• Vegetation Loss • Non-Native, Invasive, and Noxious Plants • Habitat Defragmentation
Denali National Park and Preserve	16	Major Negative	• Vegetation Loss • Non-Native, Invasive, and Noxious Plants • Habitat Defragmentation
Alaska LNG Project	33	Major Negative	• Vegetation Loss • Non-Native, Invasive, and Noxious Plants • Habitat Defragmentation
Wildfire	64	Major Negative	• Vegetation Loss • Non-Native, Invasive, and Noxious Plants • Habitat Defragmentation
Flooding	65	Major Negative	• Vegetation Loss • Habitat Defragmentation
Climate Change	67	Major Negative	• Vegetation Loss • Non-Native, Invasive, and Noxious Plants • Habitat Defragmentation

a The RFFA number corresponds to the number listed in Table 4.26-3.

4.26.9.4. Wetlands

As discussed in Section 4.9 (Wetlands) and summarized in Table 4.26-3 (Past, Present, and RFFAs Occurring Within or Near the Project Area), the proposed Project would likely result in minor and moderate direct and indirect impacts to wetlands during construction and operation and maintenance. Gravel fill placement, clearing/mowing, grading/trenching/blasting/backfilling, fragmentation, soil compaction, dust deposition, alteration of physical and chemical processes, potential noxious plant species introduction, and rehabilitation activities would all impact wetlands during construction and operation phases of the proposed Project.

A summary of potential past, present, and RFFAs that may contribute to cumulative effects on wetlands is presented in Table 4.26-9. These activities and events have been ranked using the impact criteria defined in Table 4.26-1 based on the magnitude or intensity of the impact, the geographic extent, the duration and the likelihood of occurrence. The majority of impacts on wetlands arising from RFFAs are associated with loss/disturbance, defragmentation, and changes to functional value (see Section 4.26.7.1).

Construction impacts associated with other resource development RFFAs near the proposed ROW are expected to be similar to those described for the proposed Project. Access road and temporary and permanent facility construction may result in the loss, disturbance, or fragmentation of wetlands similar to those found in the proposed Project ROW. Evaluated RFFAs potentially contributing to cumulative wetland impacts included an access road to the Ambler Mining District (RFFA 55), highway improvement projects (RFFA 48-51), the Alaska LNG project, and oil, gas, and mining exploration and development projects (RFFAs 39-41, 42-45, and 48-51).

As with the proposed Project, it is assumed other resource development and exploration RFFAs would restore some wetland habitat following construction. Similar to the proposed Project ROW, other natural resource development RFFAs may need to clear and maintain what were forested wetlands as emergent or scrub-shrub habitats. This could result in a change in the wetlands' value and would change its functionality.

It is assumed that some wetland fragmentation has occurred from existing RFFAs within the proposed Project ROW. For example, construction of TAPS (RFFA 35), highway construction, and current North Slope oil and gas operations have fragmented wetlands. Additional fragmentation would occur if similar RFFAs were executed. Changes to surface water flow as a result of fragmentation would result in degradation of wetlands as well as increase the recovery time of wetlands.

Climate change could impact wetland resources as a result of changing temperatures and precipitation. Direct and indirect changes in temperature may result in alteration of wetland system water quality and quantity. Extreme climate events that could impact wetlands and increase the cumulative impact of the proposed Project (and RFFAs) include altered hydrology; increased heat stress; increased flooding, wildfires,

landslides, avalanche, and mudslides; increased erosion; and decreased flood plain recharge (Erwin, 2009). Changes to potential land use as a result of climate change may also make wetlands and surrounding areas more accessible and valuable to other developers. These could include, but are not limited to, increases in resource exploration, commercial development, tourism, and potential agricultural use.

Management plans have been included in Table 4.26-9 as a positive cumulative net effect to wetland resources and would aid in the proper evaluation and management of these resource in relation to the proposed Project. These plans (RFFAs 8-12) include the Central Yukon Resource Management Plan and Environmental Impact Statement, North Slope Borough Comprehensive Plan, North Slope Management plan, and the Denali National Park and Preserve Management Plan.

4.26.9.4.1. Relevant Past/Present Actions, RFFAs and Natural Events Affecting Wetlands

Table 4.26-9 summarizes the relevant past and present actions, RFFAs, and natural events that have already or may continue to impact wetlands within the proposed Project Area.

Table 4.26-9 Past, Present, and RFFAs with Potential to Affect Wetlands

RFFA or Natural Event	Past, Present, RFFA ID Number[a]	Net Effect	Types of Effects
TAPS	35	Minor Negative	• Loss of Wetlands • Wetland Fragmentation • Changed Function, Value • Impacts to other Resources
Ambler Mining District Access Road	55	Minor Negative	• Loss of Wetlands • Wetland Fragmentation • Changed Function, Value • Impacts to other Resources
Flooding	65	Minor Negative	• Changed Function, Value
Interior Alaska Oil & Gas Exploration Projects	39 – 41	Moderate Negative	• Loss of Wetlands • Wetland Fragmentation • Changed Function, Value • Impacts to other Resources
North Slope Oil & Gas Exploration Projects	42 – 45	Moderate Negative	• Loss of Wetlands • Wetland Fragmentation • Changed Function, Value • Impacts to other Resources
Highway Improvements	48 – 51	Moderate Negative	• Loss of Wetlands • Wetland Fragmentation • Changed Function, Value • Impacts to other Resources
Management Plans	8 – 12	Major Positive	• Loss of Wetlands • Wetland Fragmentation • Changed Function, Value • Impacts to other Resources
Alaska LNG Project	33	Major Negative	• Loss of Wetlands

RFFA or Natural Event	Past, Present, RFFA ID Number[a]	Net Effect	Types of Effects
			• Wetland Fragmentation • Changed Function, Value • Impacts to other Resources
Wildfires	64	Major Negative	• Loss of Wetlands • Wetland Fragmentation • Changed Function, Value • Impacts to other Resources
Climate Change	67	Major Negative	• Loss of Wetlands • Wetland Fragmentation • Changed Function, Value • Impacts to other Resources

a The RFFA number corresponds to the number listed in Table 4.26-3.

4.26.9.5. Wildlife

Habitats crossed by the proposed Project support a diversity of wildlife, including big game animals, small game animals and furbearers, waterfowl and game birds, and many other nongame animals (see Chapter 3, Section 3.6). Wildlife habitats within the proposed Project Area include arctic tundra, alpine tundra, boreal forests, and coastal forests. Much of the proposed Project route crosses through wetland and riparian habitats. Vegetation communities provide forage, cover, and breeding habitats for wildlife. This section addresses common big game animals, small and unclassified game animals and fur animals, waterfowl and game birds, and other common nongame animals in the proposed Project Area. As described in Section 4.10.2.1, direct and indirect effects of the proposed Project are expected to be minor for mortality and disturbance (*i.e.*, due to human presence or noise) during construction. During operations, moderate negative direct and indirect effects on wildlife reproductive health primarily would be associated with disturbance, and habitat alteration or fragmentation under Alternatives 1 and 2. The potential direct and indirect effects of Alternative 2 during operations would likely be greater than Alternative 1 given that an aboveground pipeline may alter wildlife movement through the area or could be a collision hazard for certain bird species. However, the overall direct and indirect effect of Alternative 2 are still considered moderate adverse.

Table 4.26-10 lists the past, present, and RFFAs within the proposed Project Area that have and/or are would likely contribute to cumulative effects on wildlife. Past actions in the region between the North Slope and MP 533.5 associated with the construction, operation, and maintenance of TAPS, Prudhoe Bay, Point Thomson, and the Dalton, Elliott and Parks Highways, and the ARRC have resulted in extensive studies providing inventories of the various wildlife habitats, wildlife populations, and sensitive periods in their lifecycles in the region. Linear projects including roadways and pipelines have resulted in minor to moderate cumulative effects associated with habitat fragmentation or loss in the area as well as infrastructure that may alter animal movements (see Section 4.26.7.1). Some of these impacts to wildlife have been mitigated, several of which were

examined as part of the TAPS ROW Renewal EIS in 2002. Large construction projects associated with TAPS, highways, Point Thomson, Prudhoe Bay, and several other developments shown on Figure 4.26-4 have resulted in disturbance to wildlife species although these projects did not occur over the same timeframe which may have helped minimize disturbance to wildlife. However, given the extent of developments across the proposed Project Area, in combination with Alternative 1 or 2, cumulative adverse effects from construction in terms of habitat alteration, loss and fragmentation, and human presence and noise, is considered moderate. Mortality associated with construction is likely to result in minor adverse cumulative effects given that most projects include mitigation to reduce vehicle collision, major spills of contaminants, prohibition of hunting from construction camps or removal of nests that may have young.

Truck transport or other vehicular traffic along ice roads associated with existing development, the Parks, Dalton, or Elliot Highways could contribute to mortality or serious injury as well as behavioral disturbance from noise. Under Alternative 3, mortality associated with existing activities such as highway or ice road traffic would likely result in minor adverse cumulative effects on wildlife given mitigation measures to reduce potential for collisions. The extent of these impacts under Alternative 1 or 2 covers a broad region when considered along with the proposed 733-mile proposed ASAP pipeline. These cumulative negative effects are considered moderate given that mortality results in loss of life. However, the number of animals killed each year as a result of these cumulative effects is not likely to cause declines on a population level for any species occurring within the proposed Project Area. Access to wildlife species that may be hunted could increase due to new roads associated with development projects and could increase under Alternative 1 or 2. Hunting would result in either serious injury or mortality and could contribute to a negative cumulative effect on wildlife populations although these effects are likely to be minor across the proposed Project Area. Under Alternative 3, access provided by existing highways would also result in minor adverse cumulative effects to hunted species within the proposed Project Area. Illegal hunting (poaching) could result in moderate to major adverse cumulative effects to local populations if left unmitigated for long periods of time.

Under all the Alternatives, natural events, including wildfires and flooding, could contribute to cumulative effects depending on the extent and frequency of occurrence. While many species may be able to flee areas subject to fires or floods, several (including young) may not. The impacts of such events could be quite variable and to some degree, could be considered part of the natural ecosystem cycle. Therefore, the potential contribution of fires and floods to cumulative impacts on wildlife is considered minor to moderate under all three Alternatives and could be positive or negative depending on whether changes associated with such events result in beneficial or adverse changes to habitats or prey availability.

As described in Clark *et al.* (2010), climate change may contribute to negative or positive cumulative effects on wildlife due to changes in species distribution and behavior,

habitat changes or loss, temperature changes and associated timing of snowmelt, flooding, fire, changes in vegetation, erosion and other factors. Many Arctic fish and wildlife species depend on specific elements of the ecosystem and characteristically migrate great distances during certain times of the year. Depending on the timing or the lifestage of a species when exposed to a stress (*i.e.*, habitat changes or disturbance due to human presence) certain individuals may be more susceptible to impacts. For example, certain waterbirds, caribou, anadromous fish, and polar bears, which are in search of food, denning or overwintering areas, molting areas, calving grounds, or breeding areas, could be especially vulnerable. Many of the species found in the proposed Project Area have evolved to be dependent on the areas of the Beaufort coastline (USACE, 1980).

Given the variability of factors associated with climate change and the difficultly in attributing them to changes in wildlife species, it is difficult to determine the overall cumulative effects of climate change on wildlife. Each variable associated may result in individually minor effects on wildlife but when considered collectively and then combined with other stressors such as habitat fragmentation from development, human disturbance or direct mortality from hunting, collisions or contamination, the potential cumulative effects could range from minor to major. Alternatives 1 and 2 may contribute additional adverse effects on habitat when combined with climate change given the potential for habitat alteration due to changes in soils and vegetation within the pipeline ROW. ACIA (ACIA, 2004) predicts that the likelihood of increases in permafrost temperatures and in the depth of the active layer are very likely to cause settling within this century. Under this SEIS, the duration of impact considered 10 years into pipeline operations. So, while the impacts resulting from permafrost thawing would be permanent, they are considered only somewhat likely to occur in the next 10 years. Cumulative impacts to habitat associated with changes in permafrost and vegetation would vary from minor to major for Alternatives 1 and 2.

Overall, past, present and future development projects including but not limited to oil and gas, roadway construction, operations and maintenance, hunting, flooding, and wildfires would contribute to cumulative effects on wildlife within the proposed Project Area. Under Alternatives 1 and 2, cumulative impacts to habitat in particular are expected to be moderate adverse. Under Alternative 3, No Action, minor adverse cumulative effects are anticipated due to the contribution of existing human disturbance, habitat fragmentation, climate change, and wildfires to wildlife and their habitats. Certain species and even certain populations may be more sensitive to impacts than others depending on the magnitude, extent and severity of the cumulative effect.

4.26.9.5.1. Relevant Past/Present Actions, RFFAs and Natural Events Affecting Wildlife

Table 4.26-10 summarizes the relevant past and present actions, RFFAs, and natural events that have already or may continue to impact wildlife within the proposed Project Area.

Table 4.26-10 Past, Present, and RFFAs with Potential to Affect Wildlife

RFFA or Natural Event	Past, Present, RFFA ID Number[a]	Net Effect	Types of Effects
Donlin Gold Mine, Livengood Gold, True North, Fort Knox, Ryan Lode Project	3, 4, 5, 6, 7, 36	Minor – Major Negative	• Direct mortality during construction and operation • Physical habitat loss, alteration, and fragmentation • Biological and behavioral responses to disturbance resulting from construction and operational activities • Changes to distributions resulting from anthropogenic practices • Introduction of non-native, invasive and parasitic species • Contaminants
Military Installation Upgrades/ Development	18 – 26	Minor Negative	• Direct mortality during construction and operation • Physical habitat loss, alteration, and fragmentation • Biological and behavioral responses to disturbance resulting from construction and operational activities • Changes to distributions resulting from anthropogenic practices • Introduction of non-native, invasive and parasitic species • Contaminants
LNG Transport by Tanker Truck to Fairbanks	29	Minor Negative	• Direct mortality during construction and operation • Biological and behavioral responses to disturbance resulting from construction and operational activities • Changes to distributions resulting from anthropogenic practices
TAPS	35	Minor Negative	• Direct mortality during operation • Biological and behavioral responses to disturbance resulting from operational activities • Changes to distributions resulting from anthropogenic practices • Introduction of non-native, invasive and parasitic species • Contaminants
Highway Improvements, Ambler Mining District Access Road	48 – 51, 55	Minor Positive/ Negative	• Direct mortality during construction and operation • Physical habitat loss, alteration, and fragmentation • Biological and behavioral responses to disturbance resulting from construction and operational activities • Changes to distributions resulting from anthropogenic practices • Introduction of non-native, invasive and parasitic species
Wildfire	64	Minor Negative	• Direct mortality • Physical habitat loss, alteration, and fragmentation • Biological and behavioral responses to disturbance
Flooding	65	Minor Negative	• Direct mortality • Physical habitat loss, alteration, and fragmentation • Biological and behavioral responses to disturbance • Contaminants

RFFA or Natural Event	Past, Present, RFFA ID Number[a]	Net Effect	Types of Effects
Interior Alaska Oil & Gas Development and Exploration	39 – 41	Moderate Negative	• Direct mortality during construction and operation • Physical habitat loss, alteration, and fragmentation • Biological and behavioral responses to disturbance resulting from construction and operational activities • Changes to distributions resulting from anthropogenic practices • Introduction of non-native, invasive and parasitic species • Contaminants
North Slope Oil & Gas Development and Exploration	28, 31, 35, 42 – 46	Moderate Negative	• Direct mortality during construction and operation • Physical habitat loss, alteration, and fragmentation • Biological and behavioral responses to disturbance resulting from construction and operational activities • Changes to distributions resulting from anthropogenic practices • Introduction of non-native, invasive and parasitic species • Contaminants
Resource Management Plans, Conveyances and Refuges	8-17	Major Positive	• Mitigates direct mortality during construction and operation • Controls habitat loss, alteration, and fragmentation • Considers biological and behavioral responses to disturbance resulting from construction and operational activities • Mitigates changes to distributions resulting from anthropogenic practices • Manages increase hunting pressure resulting from changes to access • Addresses the introduction of non-native, invasive and parasitic species • Contaminant management
Alaska LNG Project		Major Negative	• Direct mortality during construction and operation • Physical habitat loss, alteration, and fragmentation • Biological and behavioral responses to disturbance resulting from construction and operational activities • Changes to distributions resulting from anthropogenic practices • Increase hunting pressure resulting from changes to access • Introduction of non-native, invasive and parasitic species • Contaminants
Climate Change	67	Major Negative	• Physical habitat loss, alteration, and fragmentation • Introduction of non-native, invasive and parasitic species
Poaching	68	Moderate to Major Negative	• Direct mortality during construction and operation • Increase hunting pressure resulting from changes to access • Changes to distributions resulting from anthropogenic practices

a The RFFA number corresponds to the number listed in Table 4.26-3.

4.26.9.6. Fisheries

As described in detail in Section 4.11, Fish, the proposed Project construction activities at West Dock would be designed and scheduled to minimize impacts to fish species and habitats. Dredging of the channel and turning basin would occur in winter when fish are not likely to be encountered. A breach would remain during construction of temporary barge bridge to allow for fish passage through the causeway. Once module offload is complete, the barge bridge would be removed and the fish passage breach returned to its original size. Minor direct and indirect effects due to the proposed Project would likely have negative effects on fish mortality, reproduction and health, and fish habitat.

A total of 186 locations were identified as impacting fish-bearing waterbodies. Most (181) of these waterbody impact locations are crossing locations of the Mainline, Fairbanks Lateral, or access roads. An additional five locations are in-river material extraction sites within the Sagavanirktok River. For a complete list of each waterbody crossed by the Mainline, Fairbanks Lateral, and access roads, see the ASAP Fish Stream List (Appendix J).

Site-specific conditions for any project that involves a stream crossings could influence the potential for effects on fish and fish habitat. For example, permanent alteration of riparian and fish stream habitat in new ROW alignments and access roads could cause sub-population level changes to growth and survival rates, productivity, and range due to anthropogenic and natural hydrological changes (ADF&G, 2010). Likewise, the proposed timing for construction could be adjusted to help minimize effects on fish and enhance habitat protection. Other factors including minimum flow requirements and structure designs providing for fish passage, blasting methods and timing, processes for disposal of water used for hydrostatic testing, procedures for fueling construction equipment, proximity of fuel storage to a water body and equipment used are all important considerations for addressing impacts to fish and could result in cumulative effects to water quality and temperature regime.

Past and current construction and routine maintenance of the ARRC, TAPS and highways show that incorporating these factors avoids direct, indirect, and cumulative negative impacts to fish habitats and fish populations in the areas that would be crossed by the proposed Project. Overwintering has been identified as an especially sensitive period for fish inhabiting the Arctic and subarctic freshwater environments (Power, 1997; Reynolds, 1997; Moulton and George, 2000). Fish are susceptible to decreased oxygen levels from water withdrawals during winter months, when lakes are covered by ice. Water withdrawals from fresh water lakes during construction of development projects could alter fish habitat. Applications to ADF&G under Title 16 (fish habitat) and to ADNR for temporary water use permits typically require that data on the volume of water in the lake to be used and the bottom profile of the lake be known to estimate the likely effects of the proposed water withdrawal on fish habitats. This is especially true for any lakes that provide habitat for overwintering fish. It is unlikely that both ADF&G

and ADNR would approve water withdrawals that would adversely impact any fish populations in the lake proposed for water withdrawal.

RFFAs listed in Table 4.26-11 may result in minor to major cumulative impacts to fish and fish habitats. The contribution of the proposed ASAP Project to cumulative effects is considered minor. On the North Slope, potential minor negative cumulative effects on fish and fish habitat could result from the combination of ASAP dredging activities and annual maintenance activities at West Dock that may disturb habitat. Impacts to fish habitat on the North Slope would also be likely due to Dalton Highway maintenance or ice road construction (water withdrawal). Changes in water quality due to runoff from construction activities could alter fish habitat or affect fish health though these cumulative impacts are expected to be minor given the mitigation requirements associated with ADF&G or ADNR permits under all Alternatives. While both Alternatives 1 and 2 would likely contribute minor adverse effects to fish or fish habitat, these effects are not likely to be greater than the minor adverse effects to fish under Alternative 3 given the existing and proposed activities likely to occur within the proposed Project Area.

Portions of the proposed Project that parallel the Parks Highway and other road crossings could cause cumulative effects to fish habitats due to potential runoff, erosion, oil or fuel spills or gravel placement. However, as stated above, these negative cumulative effects are likely to be minor given permitting requirements. Climate change and flooding could contribute to positive or negative cumulative effects on fish and fish habitats within the proposed Project Area. Climate change is likely to cause changes to freshwater quantity and quality in Alaska, which may contribute to cumulative impacts on fish and fish habitats, as well as species distributions and timing of fish runs (ADF&G, 2010). According to Wrona *et al*. (2006) as reported in Clark *et al.* (2010), freshwater quantity and quality is projected to change as a result of changes in climate. Freshwater storage in the form of snowpack and glacial ice is likely to decrease and precipitation would likely increase. Increased precipitation could result in changes to many Alaska drainage system hydrographs such that flooding becomes more likely. Fish distributions could shift resulting in some beneficial and some adverse changes depending on the species. As stated in Clark *et al.* (2010), while these significant changes may occur, only moderate effects to fish species and habitats are anticipated given the variability of stocks responses or populations to such changes. Under Alternative 3, No Action, these effects could vary from minor to major and could be positive or negative. Given the challenges with predicting the magnitude, extent and intensity of climate change on fish, the combined effects of Alternatives 1 and 2 could also range from minor to major and could be positive or negative depending on the circumstances or species affected.

4.26.9.6.1. Relevant Past/Present Actions, RFFAs and Natural Events Affecting Fish

Table 4.26-11 summarizes the relevant past and present actions, RFFAs, and natural events that have already or may continue to impact fish within the proposed Project Area.

Table 4.26-11 Past, Present, and RFFAs with Potential to Affect Fisheries

RFFA or Natural Event	Past, Present, RFFA ID Number[a]	Net Effect	Types of Effects
TAPS	35	Minor Negative	• Direct and indirect mortality during construction and operation
Susitna-Watana Hydro	61	Minor Negative	• Direct and indirect mortality during construction and operation • Effects to habitat resulting in indirect impacts to fish
Cook Inlet Tidal Energy Project	62	Minor Negative	• Direct and indirect mortality during construction and operation • Effects to habitat resulting in indirect impacts to fish
Cook Inlet Area-wide Oil & Gas Lease Sales	32	Minor Negative	• Direct and indirect mortality during construction and operation • Reproductive, growth, health, and distribution effects from construction and operation activities • Effects to habitat resulting in indirect impacts to fish
Liberty Development Project	28	Minor Negative	• Direct and indirect mortality during construction and operation • Reproductive, growth, health, and distribution effects from construction and operation activities • Effects to habitat resulting in indirect impacts to fish
Seward Marine Terminal Expansion Planning Project	59	Moderate Negative	• Direct and indirect mortality during construction and operation • Reproductive, growth, health, and distribution effects from construction and operation activities • Effects to habitat resulting in indirect impacts to fish
Alaska LNG Project	33	Moderate Negative	• Direct and indirect mortality during construction and operation • Reproductive, growth, health, and distribution effects from construction and operation activities • Effects to habitat resulting in indirect impacts to fish

RFFA or Natural Event	Past, Present, RFFA ID Number[a]	Net Effect	Types of Effects
Interior Alaska Oil & Gas Exploration and Development Projects	39 - 41	Moderate Negative	• Direct and indirect mortality during construction and operation • Reproductive, growth, health, and distribution effects from construction and operation activities • Effects to habitat resulting in indirect impacts to fish
North Slope Oil & Gas Exploration Projects	42 - 45	Moderate Negative	• Direct and indirect mortality during construction and operation • Reproductive, growth, health, and distribution effects from construction and operation activities • Effects to habitat resulting in indirect impacts to fish
Ninilchik Plant Development	47	Moderate Negative	• Direct and indirect mortality during construction and operation • Reproductive, growth, health, and distribution effects from construction and operation activities • Effects to habitat resulting in indirect impacts to fish
Climate Change	67	Moderate Positive/Negative	• Effects to habitat resulting in indirect impacts to fish
Resource Management Plans, Conveyances and Refuges	8 - 17	Major Positive	• Direct and indirect mortality during construction and operation • Reproductive, growth, health, and distribution effects from construction and operation activities • Effects to habitat resulting in indirect impacts to fish
Flooding	65	Major Negative	• Effects to habitat resulting in indirect impacts to fish

a The RFFA number corresponds to the number listed in Table 4.26-3.
The symbol + indicates a positive effect.

4.26.9.7. Marine Mammals

As discussed in Section 4.12 (Direct and Indirect Effects of the Alternatives on Marine Mammals) and summarized in Table 4.26-3 (Past, Present, and RFFAs Occurring Within or Near the Project Area), the proposed Project would likely result in minor adverse direct and indirect effects to marine mammals during construction associated with a very low risk of mortality due to vessel strike or crushing during construction of ice roads (ringed seals). Upgrades and maintenance at West Dock under Alternative 1 would occur during winter months and would cause disturbance due to noise, turbidity, and vessel traffic though these are expected to be minor. Delivery of construction equipment and supplies for the proposed Project would be delivered by ocean going ships to the Port of Seward over 24 months which may result in minor adverse effects due to disturbance from underwater noise and vessel presence. GCF modules would be delivered to West Dock over one summer between August and September. The

associated direct and indirect effects of West Dock barge traffic would be short-term, lasting only one winter and one summer season.

A summary of potential past, present and RFFAs that may contribute to cumulative effects on marine mammals is presented in Table 4.26-12. These activities and events have been ranked using the impact criteria defined in Table 4.26-1 based on the magnitude or intensity of the effect, the geographic extent, the duration and the likelihood of occurrence. The majority of impacts on marine mammals arising from RFFAs are associated with disturbance (including vessel or human presence and underwater noise), habitat alteration (*i.e.*, placement of materials in water), and potential exposure to contaminants (*i.e.*, due to spills). These impacts arise from vessel activities, construction in water (including pile driving or placement of material), or seismic surveys or sonar that are anticipated to occur due to other actions proposed to occur within or near the proposed Project Area.

Marine mammals may be significantly affected by continued North Slope development, particularly offshore. Increased vessel traffic to and from the development area might have a brief disruptive effect on whale migrations, but the probability of encounters detrimental to even individual whales is judged to be low. Species that shun areas of intense human activity or accidental discharge of toxic materials would suffer a loss of habitat due to behavioral responses. The maximum spill that could result from barge activities under Alternative 1 or 2 would be from fuel handling or accidental rupture of a towing vessel fuel tank. Such spills would not be likely to have long-term impacts on any marine populations. Spatial shifts in populations would adversely affect subsistence hunters (USACE, 1980).

At West Dock (see Figure 4.26-2), proposed Project winter construction activities are not likely to intersect with many RFFAs. If proposed ASAP winter dock modifications and dredging activities occur during the same timeframe as the proposed Liberty Project, minor disturbance on a regional scale could occur. However, the potential cumulative effects would likely be minor given the distance between project sites and considering most marine mammals are not likely to be in the area during winter months making exposure to underwater noise or vessel traffic low.

During summer months, barge traffic to deliver GCF modules under Alternative 1 or 2 has the potential to contribute to minor adverse cumulative effects if those activities overlap with existing marine shipping traffic as well as any potential oil and gas exploration at Smith Bay. Existing traffic routes are depicted on Figure 4.26-8 and contribute minor to moderate adverse cumulative effects on marine mammals due to mortality from vessel strikes and underwater noise, which could cause behavioral disturbance or in some cases, physiological changes due to stress (*i.e.*, related to chronic exposure). The Smith Bay Development Project is a new discovery and plans for seismic surveys, vessel activities or other scientific studies associated with exploration are currently unknown. Therefore, while the potential for disturbance due to vessel presence or underwater noise or mortality associated with vessel strike is possible, the

likelihood of this occurring is quite low. Cumulative effects associated with the proposed Project and the Smith Bay Development are therefore considered minor due to the distance between the two projects and the fact that plans for exploration at Smith Bay are unknown. Under all Alternatives, marine shipping is likely to increase due to increased access. The 2009 Arctic Marine Shipping Assessment (AMSA) reported that:

> *Climate change as indicated by Arctic sea ice retreat is a facilitator of marine access. It is highly plausible there will be greater marine access and longer seasons of navigation, except perhaps during winter, but not necessarily less difficult ice conditions for marine operations.*

At this time, it is difficult to predict marine vessel traffic volumes near Prudhoe Bay. For this reason, cumulative impacts on marine mammals due to increase vessel traffic are difficult to measure Potential vessel strikes and acoustic harassment or harassment of marine mammals due to the presence of vessels would continue to increase in the future and may result in minor to major adverse impacts on marine mammals due to the potential for increased mortality or behavioral disturbance.

Marine mammals may be affected by petroleum development in the Beaufort Sea primarily through potential oil spills, noise, and disturbance effects. Bowhead whales would be affected primarily in deeper waters (greater than at least 3.7 m, 12 feet) where their primary migrations occur. Ringed and bearded seals may be particularly sensitive to disturbance by human presence and industrial activity. Undisturbed areas available to polar bears for foraging and denning is decreasing due to existing and projected development in the region along the Beaufort Sea coast (including Canada). Because the proposed activities under Alternatives 1 and 2 would be almost wholly within areas affected by existing development, the contribution to cumulative impacts would be minor (USACE, 1980).

For the southern portion of the proposed Project near the Port of Seward, several activities may contribute to cumulative effects to marine mammals including mortality due to vessel strike, disturbance (*i.e.*, underwater noise and vessel presence), potential spills and turbidity associated with construction. Regularly scheduled vessel traffic at the Port of Seward would contribute minor to major adverse cumulative effects from disturbance due to noise and the potential for vessel strike. In January 2016, the City of Seward reported that the number of ships that visit Seward each season varies significantly and historically has ranged between less than 20 to more than 100. Vessel speed lower than about 10 knots has been shown to reduce the likelihood of a strike (Jensen and Silber, 2003). It is assumed that in close proximity to the Port of Seward vessel speeds would be low thereby reducing the potential for strikes. However, ships transiting in the open ocean to and from the Port would operate at higher speeds, increasing the potential for strikes.

As described in Section 4.12.3.1.1 West Dock: Dock Head 3 Upgrades, NMFS is actively working with sectors of the maritime industry on vessel strike avoidance and awareness programs (81 FR 62259). While the proposed Project would only contribute a minor

negative effect due to vessel disturbance around the Port of Seward, the overall cumulative effects of potential vessel strikes are considered a moderate negative effect when considering RFFAs including regular Port traffic including tourist charters, fishing boats, recreational vessels and shipping traffic in the area. Under Alternatives 1 and 2, the proposed vessel traffic in and out of the Port of Seward over 24 months would contribute minor adverse effects to overall minor to moderate cumulative effects on marine mammals due to noise, vessel presence or potential spills. Similarly, under Alternatives 3, potential adverse cumulative effects are anticipated around the Port of Seward due to existing vessel traffic and the Port of Seward Terminal Expansion which could cause disturbance (noise or vessel presence) or mortality (ship strike).

Vessels do have the potential to introduce invasive species to marine mammal habitat in Prudhoe Bay and Seward. Ballast-water discharge, fouled vessel hulls, or equipment placed overboard (*e.g.*, anchors, piles, etc.), are vectors for introducing invasive species. In Alaska, vessels are subject to USCG regulations (33 CFR 151 Subpart D) intended to reduce the transfer of invasive species by "removal of fouling organisms from hull, piping, and tanks on a regular basis and dispose of any removed substances in accordance with local, state, and federal regulations." The Arctic Council reported that "progress is being made to prevent the transfer of invasive species through both ballast water exchange and biofouling, to mitigate the impact of underwater noise from ships on marine mammals, and to manage black carbon emissions" (Arctic Council, 2015). The potential for vessels in and out of the Port of Seward or West Dock to result in a negative cumulative effect is considered minor under all the Alternatives based on regulations imposed by the USCG to minimize infestation.

Cook Inlet oil and gas lease sales may involve increased vessel traffic and seismic surveys associated with exploration or development. The Bureau of Ocean Energy Management (BOEM) sold 14 tracts (roughly 76,615 acres) of leases in Cook Inlet in June 2017, which resulted in $3 million in bids. The potential for impacts to marine mammals evaluated in the BOEM 2016 EIS for the Cook Inlet oil and gas leases include seafloor disturbance and habitat alteration, drilling discharge, anthropogenic noise, physical presence, trash and debris, vessel and air traffic, and accidental oil spills and gas releases. BOEM determined most potential impacts from routine lease sale activities were expected to have negligible to minor levels of effects on marine mammals, resulting primarily from noise and vessel traffic. Small spills were expected to have a negligible level of effect due to their limited size and ease of management and cleanup. Large spills were also expected to have a negligible effect on all marine mammals in the area of investigation, with the exception of sea otters. BOEM determined a large spill in Cook Inlet could have a moderate level of impact to sea otter populations (BOEM, 2016). Should development occur, the potential cumulative effects of those activities could be considered moderate negative impacts on marine mammals in the area depending on timing, specific activities proposed, and the number of developments.

The Kenai LNG plant, owned by ConocoPhillips, is in the process of being shut down. The last export from the plant was fall of 2015 and the plant has been idle since then.

Anchorage Municipal Light & Power and Chugach Electric Association jointly purchased ConocoPhillips' Cook Inlet gas field in early 2016, providing gas to local markets instead of buyers in Japan. The Cook Inlet Unit produced 3.58 billion cubic feet in the first 6 months of 2016. Considering the relatively low number of shipments that have occurred, the risk of vessel strike or spills is low; however, the consequences of a strike could involve serious injury or mortality for marine mammals in the area. The Kenai LNG project and the proposed ASAP Project are not within close proximity. Therefore, the cumulative effects of these activities is considered negative minor under Alternatives 1 and 2 given the distance between the projects, and the fact that the proposed ASAP Project shipments to the Port of Seward would be during one summer under both Alternatives 1 and 2. Under Alternative 3, the Kenai LNG project could contribute adverse effects to overall cumulative effects to marine mammals in the area however, the magnitude, extent, and duration of such impacts cannot be determined at this time.

Illegal hunting or poaching results in direct the mortality of marine mammal species. While there is no doubt that marine mammals within the proposed Project Area are likely hunted illegally each year, the statistics about these activities is not readily available. Therefore, while the potential effects of illegal hunting could contribute major negative cumulative effects, it is not possible to further evaluate this issue given the lack of data.

The cumulative effects of climate change on marine mammals result in changes in sea temperature, prey availability, changes in the frequency of major storm events and changes in habitat. Some marine mammal species would likely have greater ability than others to adapt to major climate shifts and ecosystem disturbances (Huntington and Moore, 2008; Moore and Huntington, 2008; O'Corry-Crowe, 2008). It is difficult to predict how cumulative effects may impact specific marine mammal species in any given location however, the contribution of climate change to cumulative effects could range from minor to major depending on the specific species and the context of their exposure to other stressors such as the proposed ASAP Project. The combined effects of climate change and the proposed Project on marine mammals potentially affected by ASAP activities is considered minor to major adverse under Alternatives 1 and 2 considering the relatively short duration of proposed Project activities within the context of a much greater ecosystem change that may be caused by climate change. Similarly, under Alternative 3, No Action, effects of climate change may range from minor to major adverse within the temporal scope of this assessment (approximately 10 years into pipeline operations) given how variable these effects could be.

4.26.9.7.1. Relevant Past/Present Actions, RFFAs and Natural Events Affecting Marine Mammals

Table 4.26-12 summarizes the relevant past and present actions, RFFAs, and natural events that have already or may continue to impact marine mammals within the proposed Project Area.

Table 4.26-12 Past, Present, and RFFAs with Potential to Affect Marine Mammals

RFFA or Natural Event	Past, Present, RFFA ID Number[a]	Net Effect	Types of Effects
Seward Marine Terminal Expansion	61	Minor Negative	• Disturbance • Turbidity • Potential exposure to contaminants
Port of Seward Vessel Traffic	61	Minor Negative	• Disturbance • Potential exposure to contaminants
West Dock Vessel Traffic	35	Minor Negative	• Disturbance • Potential exposure to contaminants
Cook Inlet Oil & Gas Lease Sales	32	Moderate	• Disturbance • Habitat alteration • Potential exposure to contaminants
Kenai LNG Plan	34	Moderate Negative	• Disturbance • Habitat alteration • Potential exposure to contaminants
North Slope Offshore Developments	28, 31, 33, 43, 43a, 43b,	Moderate Negative	• Disturbance • Habitat alteration • Potential exposure to contaminants
Marine Shipping & Other Vessel Traffic	59a	Moderate Negative	• Disturbance • Habitat alteration • Potential exposure to contaminants
Illegal hunting/killing	69	Major Negative	• Mortality
Climate Change	68	Minor to Major Positive and Negative	• Mortality • Habitat alteration • Introduced non-native species • Changes in prey availability (*i.e.*, increase or decrease)

a The RFFA number corresponds to the number listed in Table 4.26-3.

4.26.9.8. Benthic

The direct and indirect effects of the proposed Project on the benthic organisms are considered minor negative, as described in detail in Section 4.13, Direct and Indirect Effects of the Alternatives on the Benthic Environment (see Table 4.26-2). There would be mortality of a relatively small number of benthic organisms due to dredging activities at West Dock in Prudhoe Bay. This effect would be localized and benthic organisms are expected to recolonize the area within a short amount of time (*i.e.*, possibly less than 1 year). Alternatives 1 and 2 would result in a negligible effect on reproductive health of benthic organisms on a population level. Therefore, cumulative impacts to benthic reproductive health are not considered further for those alternatives.

A summary of potential past, present and RFFAs that may contribute to cumulative effects on benthic organisms is presented in Table 4.26-13. These activities and events have been ranked using the impact criteria defined in Table 4.26-1 based on the magnitude or intensity of the effect, the geographic extent, the duration and the likelihood of occurrence. Potential impacts to benthic organisms would be associated with mortality from smothering or disturbance of the substrate, water quality impacts,

or contaminants due to spills. Flooding could occur during ice break up or major storm events resulting in substantial flow across rivers and streams. Storm events in the nearshore marine environment could result in displacement or mortality of benthic invertebrates. The nearshore environment around West Dock is subject to ice scour every year and therefore, many benthic organisms have adapted to that environment.

Construction that would result in placement of large amounts of fill or significant dredging from projects such as Liberty Development or the Seward Marine Terminal Expansion would cause direct mortality to benthic organisms. The extent of the impacts would depend on the amount of fill and dredging. Considering many benthic organisms along the Beaufort Sea coast are adapted to ice scour and significant storm events, their ability to re-populate areas that have been disturbed is high. The Liberty Project would involve placement of fill to create a permanent offshore gravel island that would cause mortality of benthic organisms in the area. While this would be a permanent negative effect, the effects are not likely to result in population level changes to benthic organisms in the Beaufort Sea. Other oil and gas related activities in Prudhoe Bay or Smith Bay could include placement of fill or dredging although specific details of these activities are not currently known. The contribution of Alternative 1 to cumulative negative effects on benthic organisms is minor while collectively, if each of the projects listed in Table 4.26-13 were to occur simultaneously and involved a large geographic extent, the potential cumulative impacts to benthic organisms could be moderate negative. However, as previously stated, the number of unknowns regarding potential Smith Bay exploration or development, or Prudhoe Bay activities that could include dredging, make it difficult to predict cumulative effects with any certainty at this time. The contribution of Alternative 2 to potential mortality of benthic organisms is moderate adverse given the increased dredging and disposal required. A moderate adverse cumulative effect is expected with Alternative 2 considering the proposed activities described above.

Climate change could alter areas of open water and ice cover influencing storms and severe weather. According to a 2007-2008 report prepared by the Inter Polar Year (IPY) organization associated with the Canadian government, the severity and frequency of Arctic storms appear to be increasing. Rising sea level and storms produce high waves that could disturb nearshore benthic organisms. Storm frequency and severity, sea level, sea ice and rates of coastal erosion are all expected to increase due to climate change (Environment Canada, 2013). The magnitude and extent of climate change effects cannot be determined with certainty at this time however could range from minor to major depending on the severity of storms, storm frequency, extent or erosion or substrate disturbance among other factors. The contribution of climate change under all alternatives could range from minor to moderate within the scope of this analysis (*i.e.*, approximately 10 years into pipeline operations).

The proposed Project is not likely to result in direct or indirect effects at the Port of Seward. So while there are RFFAs that may contribute to negative minor cumulative effects on benthic organisms in the Port area (*i.e.*, the Seward Marine Terminal

Expansion Project), these are not considered further for Alternatives 1 and 2 given the anticipated negligible effects of those alternatives on benthic. Under Alternative 3, No Action, the proposed Seward Terminal Expansion project, along with other vessel traffic, which could stir up bottom sediments during vessel movement, could contribute minor to moderate adverse cumulative effects to benthic organisms within that localized area. However, since specific details of the Seward Expansion project may change, the potential impacts cannot be determined at this time.

4.26.9.8.1. Relevant Past/Present Actions, RFFAs and Natural Events Affecting Benthic

Table 4.26-13 summarizes the relevant past and present actions, RFFAs, and natural events that have already or may continue to impact benthic within the proposed Project Area.

Table 4.26-13 Past, Present, and RFFAs with Potential to Affect Benthic

RFFA or Natural Event	Past, Present, RFFA ID Number[a]	Net Effect	Types of Effects
Interior Alaska Oil & Gas Exploration and Development	39 – 41	Minor Negative	• Direct mortality during construction and operation • Physical habitat loss, alteration, and fragmentation • Introduced non-native, invasive and parasitic species • Contaminants
Cook Inlet Area wide Oil & Gas Lease Sales	32	Minor Negative	• Direct mortality during construction and operation • Physical habitat loss, alteration, and fragmentation • Introduced non-native, invasive and parasitic species • Contaminants
Marine Shipping & Other Vessel Traffic	59a	Minor Negative	• Disturbance • Habitat alteration • Potential exposure to contaminants
Seward Marine Terminal Expansion Planning Project	59	Moderate Negative	• Direct mortality during construction and operation • Physical habitat loss, alteration, and fragmentation • Introduced non-native, invasive and parasitic species • Contaminants
North Slope Offshore Developments	28, 31, 33, 43, 43a, 43b,	Minor Negative	• Direct mortality during construction and operation • Physical habitat loss, alteration, and fragmentation • Introduced non-native, invasive and parasitic species • Contaminants

RFFA or Natural Event	Past, Present, RFFA ID Number[a]	Net Effect	Types of Effects
Flooding	65	Moderate Negative	• Physical habitat loss, alteration, and fragmentation • Introduced non-native, invasive and parasitic species • Contaminants
Alaska LNG Project	33	Moderate Negative	• Direct mortality during construction and operation • Physical habitat loss, alteration, and fragmentation • Introduced non-native, invasive and parasitic species • Contaminants
Susitna-Watana Hydro	61	Major Negative	• Direct mortality during construction and operation • Physical habitat loss, alteration, and fragmentation • Introduced non-native, invasive and parasitic species • Contaminants
Climate Change	67	Major Negative	• Physical habitat loss, alteration, and fragmentation • Introduced non-native, invasive and parasitic species

a The RFFA number corresponds to the number listed in Table 4.26-3.

4.26.9.9. Threatened and Endangered Species

The threatened, endangered, and candidate species that could occur in the proposed Project Area include seven marine mammals and two avian species (Table 4.26-14). No federal- or state-listed plants are found to occur in the proposed Project Area based on inventories conducted to date. Polar bear terrestrial denning and sea ice critical habitat areas would be impacted by proposed Project features near Prudhoe Bay. Approximately the first 5 miles (8 km) of the proposed Project would fall within the polar bear terrestrial denning critical habitat area. The proposed work at West Dock would fall within the polar bear sea ice critical habitat. The GCF, a material source, approximately the first 2 miles of the Mainline, and several access road segments near Prudhoe Bay would fall within the "no disturbance zone" of the polar bear barrier islands and denning critical habitat area. No other critical habitat would be intersected by proposed Project activities.

Table 4.26-14 Threatened and Endangered Species that Could Occur in the Proposed Project Area

Common Name	Scientific Name	Federal Status	Where Found in Relation to Proposed Project Area
Bearded seal (Beringia DPS)	*Erignathus barbatus*	Threatened	Prudhoe Bay
Bowhead whale	*Balaena mysticetus*	Endangered	Prudhoe Bay
Fin whale	*Balaenoptera physalus*	Endangered	Resurrection Bay
Humpback whale[a] • WNP DPS • Hawaii DPS • Mexico DPS	*Megaptera novaeangliae*	Endangered Not Listed Threatened	Resurrection Bay and Prudhoe Bay
Polar bear	*Ursus maritimus*	Threatened	Prudhoe Bay and ACP (Beaufort)
Ringed seal (Arctic DPS)[b]	*Phoca hispida*	Threatened	Prudhoe Bay
Steller sea lion (Western DPS)	*Umatopias jubatus*	Threatened	Resurrection Bay
Spectacled eider	*Somateria fischeri*	Threatened	Prudhoe Bay and ACP (Beaufort)
Steller's eider	*Polysticta stelleri*	Threatened	Prudhoe Bay and ACP (Beaufort), and Resurrection Bay
Eskimo curlew	*Numenius borealis*	Endangered	No Affect (Considered Extinct)

a Note that one of the three humpback whale DPSs that occur in the Gulf of Alaska and Resurrection Bay was delisted in September 2016 as a result of NOAA's 2015 Status Review the species (NOAA, 2015b). The Hawaii DPS was delisted, but the WNP DPS remains endangered and the Mexico DPS remains threatened.
b The ringed seal is discussed in greater detail in Section 4.12, Marine Mammals.

Threatened, endangered, or candidate species of marine mammals that may occur near the proposed Project West Dock Action Area (Figure 4.26-2) include bearded seals, bowhead whales, humpback whale, and polar bears although the likelihood of encountering humpback whale is very low. Spectacled eiders and Steller's eiders also occur within the proposed Project Area on the North Slope. Near Seward, the species of concern include fin whales, humpback whales, Steller sea lions, and Steller's eider. Results of the direct and indirect effects analysis are summarized in Section 4.14 and Table 4.26-3. Overall, injury or mortality as well as habitat loss, alteration, and fragmentation, behavioral disturbance, and predation during proposed ASAP construction and operation under Alternatives 1 or 2 would likely result in minor negative cumulative effects. The potential direct and indirect effects of the proposed Project under Alternatives 1 or 2 due to turbidity are expected to be minor.

RFFAs of main concern listed in Table 4.26-15 that may contribute to moderate or major negative cumulative effects on ESA-listed species include past, present, and future oil and gas exploration and development projects such as TAPS, Prudhoe Bay, and several others as shown on Figure 4.26-4. A 2003 National Research Council Report (NRC) suggests that Alaska's oil and gas development, primarily beginning in the 1970s, has resulted in displacement of ESA-listed species, loss or alteration of habitat, disturbance due to noise or human presence, vessel traffic, road construction or aircraft movements. There have been oil spills on the North Slope; however, they have not been frequent or

large enough in terms of extent or volume to result in population-level effects on ESA-listed species.

Summer vessel traffic under Alternatives 1 and 2 would contribute to the potential for vessel strikes in and out of the West Dock and marine marshalling areas. Bowhead whales are commonly found offshore of the barrier islands during their spring and fall migrations. Therefore, the combination of vessel traffic from the proposed Project as well as any vessels associated with Prudhoe Bay operations, Point Thomson, Liberty Development or Smith Bay exploration or development could collectively increase the likelihood of strikes leading to serious injury or mortality. Threatened bearded seals and threatened polar bears are present year-round inshore of the barrier islands near Point Thomson, and thus, are likely to be impacted by Point Thomson activities (USACE, 2012c).

Considering bowhead whale migration patterns, the timing of proposed activities is an important consideration when evaluating potential cumulative effects, with spring and fall months having the highest potential for collisions in the proposed Project Area. A 2012 article by Neilson *et al.* reported that in Alaska, most strikes (n = 98, 91 percent) occurred in May through September, with no reports from December or January. The majority of strikes (n = 82, 76 percent) were reported in southeastern Alaska, where the number of humpback whale collisions increased 5.8 percent annually from 1978 to 2011 (Neilson *et al.*, 2012). Vessel strikes due to regular shipping traffic in combination with the proposed Project could result in serious injury or mortality of fin and humpback whales near the Port of Seward. Vessel strikes of bearded seals and Steller sea lions are expected to be low as it is assumed these species may be able to avoid strikes given their smaller size and agility in the water. Overall, the potential negative cumulative effect of mortality due to vessel strikes is considered moderate.

Behavioral responses to disturbance including vessel and human presence and underwater noise would contribute to cumulative effects on listed species within the proposed Project Area. As described in more detail in Section 4.14.2.1.3 (Biological and Behavioral Responses to Disturbance), disturbance during critical periods such as calving, migration, or feeding, could impact species productivity. Many marine mammals are accustomed to a turbid environment and utilize sophisticated sonar systems to sense the environment around them (Au *et al.*, 2000).

Noise could affect communication by masking; mortality may also increase when species are unable to detect predators by sound. Baleen whales are low-frequency cetaceans with a generalized hearing range of 7 Hz to 35 kHz, while bowhead and fin whales have a mid-frequency hearing range of 150 Hz to 160 kHz. Underwater noise associated with dredging, pile driving and vessel traffic around West Dock would contribute to cumulative disturbance in the Prudhoe Bay area. Other primary noise-producing activities (RFFAs) in the area could include regular vessel traffic in the Beaufort Sea nearshore area as well as in and out of West Dock, seismic exploration of Smith Bay, and island construction for the Liberty Development. Given that the Smith

Bay Development and Liberty Development are in very early stages of evaluation and have not yet been permitted, the extent of underwater noise impacts from these activities cannot be determined at this time to predict cumulative effects under any of the alternatives.

The most likely source of cumulative underwater noise would therefore be associated with the proposed ASAP Project and regular vessel traffic (for both Alternatives 1 and 2). Considering that modifications to West Dock for ASAP would occur during winter months when bowhead whales are not in the area and bearded seals are likely to be farther from shore on pack ice, the potential cumulative effects of underwater noise from the proposed Project and regular vessel traffic is likely to be minor for Alternatives 1 and 2. During summer months, however, the combination of 23-barge deliveries (Alternatives 1 and 2) and regular vessel traffic would result in increased noise levels in the local West Dock area. Assuming barge thrusters are not used while transiting, but only during berthing and close-in maneuvering, they are not expected to contribute substantially to underwater noise. The overall negative cumulative effect of underwater noise could cause behavioral disturbance during the summer when GCF delivery is planned under Alternatives 1 and 2. The overall negative cumulative effect is considered moderate when combined with other vessel traffic that could contribute underwater noise in the area. Arctic marine vessel traffic would continue and is likely to increase near the proposed Project Area. As stated earlier, between 2008 and 2012, USCG District 17 reported that total annual vessel traffic in the Arctic region grew from 120 to 250, a more than 100 percent increase. Tank vessel traffic was particularly high while tugs and other cargo vessels were the second and third largest categories of movements (see Figure 4.26-6). Potential cumulative effects associated Liberty and Smith Bay oil and gas activities cannot be determined at this time. Therefore, disturbance to marine mammals would primarily be associated with increased shipping.

The 2003 NRC report suggests that reduced productivity is the most substantial cumulative impact to bird populations due to oil and gas development activities on Alaska's North Slope. Localized effects on the distribution or density of some bird species may result in cumulative habitat loss due to exploration, development and operation of Alaska North Slope oilfields (BLM, 1998). Human activities that contribute to cumulative negative effects on eiders include temporary displacement by human presence, subsistence hunting and egg collecting, sport hunting, and disturbance during nesting and migration. Ice road construction associated with Alternatives 1 or 2 when combined with other RFFAs and existing roads would alter habitat or contribute to habitat loss. Trenching, gravel mining or overland transport also contribute to negative effects to listed eiders, in particular, given potential habitat fragmentation and loss. Facilities could present collision hazards, especially for spring and fall migrating Steller's eiders depending on whether such facilities are located within their migration corridor. Unprotected eggs or young may be susceptible to predation or mortality due to human presence near nests. Under Alternative 3, No Action, habitat fragmentation and

loss as well as mortality due to collisions with facilities are contributing to adverse cumulative impacts on listed eiders within the proposed Project Area.

Threatened spectacled eiders occur in the Point Thomson study area and could have minor negative effects from infrastructure near the Point Thomson West Pad and gravel access roads (USACE, 2012c). Steller's eiders also occur in the region and are likely affected by the Point Thomson project. Changes in moisture regime around ice roads could cause changes in eider habitat during snowmelt. Water withdrawals from North Slope lakes would reduce open-water habitat. Pre-construction activity such as on-the-ground surveys, use of helicopter and fixed wing aircraft, use of construction camps and equipment/pipe storage sites could disturb nesting eiders depending on the timing of the activities. The combination of Alternative 1 or 2 with other developments in the area would likely result in minor to moderate adverse cumulative effects on listed eiders due to mortality (collision with facilities), disturbance due to human presence (although to some degree this is mitigated by avoiding sensitive breeding periods) and habitat loss or fragmentation.

Polar bears could experience negative cumulative impacts from on- and offshore construction and operation activities for the proposed ASAP Project, TAPS, Point Thomson Project, Dalton Highway, Liberty Development, or Smith Bay Development as well as all other existing operations (see Figure 4.26-4). Although polar bears tend to be associated with the coastal area, single individuals have been reported as far inland as TAPS PS4 and more recently near Fort Yukon, south of the Brooks Range.

Generally, the topographic settings for the proposed Project Area is not favorable for denning habitat which may reduce the likelihood of interaction with bears in the area. Additionally, USFWS authorizes harassment of bears away from development facilities to minimize the chances of interactions. Intentional killing of polar bears that threaten people is authorized, if necessary, by USFWS, which does occur. Companies operating on the North Slope have developed approved management processes for human-polar bear encounters to minimize the potential for impacts to the species. Such measures include pre-activity surveys to identify dens, harassment of bears away from people and specific design aspects for facilities to reduce potential for drifting snow that could be used for denning. Winter activities such as ice road construction would require pre-activity surveys to identify topography favorable to forming snowdrifts that could be used for polar bear denning as required by USFWS. Amstrup (1993) and Richardson *et al.* (1995) have reported that for most of the year, polar bears do not appear to be very sensitive to noise or other human disturbances. Pregnant females and those in dens with newborn cubs may be more sensitive to noise and vehicular traffic (Amstrup and Gardner, 1994). Cumulative impacts due to noise disturbance are expected to be negligible to minor given that adult bears do not appear sensitive to noise.

Polar bears may be drawn to developed areas due to garbage, which could then result in higher potential for encounters with humans. Measures to contain garbage are required for any North Slope project and would help minimize the need to intentionally harass

bears away from sites, or kill animals that may become problematic. It is expected that the proposed Project (Alternatives 1 and 2) and other non-related oil and gas activities would incorporate USFWS-approved management measures during construction and operations to help reduce potential cumulative effects to bears.

Cumulative impacts to Steller sea lions could occur near the Port of Seward. For Steller sea lions, the primary impact of concern would include disturbance from vessel presence, as these species are known to be sensitive to underwater noise from vessels. Disturbance could also result from the Marine Terminal Expansion Project if construction activities occurred at the same time ASAP vessels were delivering equipment and supplies to the Port (under both Alternatives 1 and 2). The extent and duration of these cumulative effects is likely to be localized and short-term and therefore considered minor for Alternatives 1 and 2. Vessel presence, vessel and construction noise, turbidity associated with dredging or other Port of Seward activities could result in cumulative impacts on Steller sea lions under Alternative 3 (No Action) but the magnitude, extent or duration of these impacts is currently unknown.

Approximately 20 to 30 percent of the world's plant and animal species assessed as of 2006 are likely to be at increasingly high risk of extinction as global mean temperatures exceed a warming of 2 to 3°C above preindustrial levels (Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report (IPCC, 2008). Evidence of climate-related changes in Alaska is growing and includes increasing temperature, permafrost thaw, coastal erosion, wetland drying, glacial and sea ice recession, and an increase in fire frequency and intensity. If recent warming trends continue, as many projections indicate they wou, cumulative effects could alter the extent and timing of sea ice, affect the distribution and abundance of marine and terrestrial plants and animals, and affect permafrost (NRC, 2003a). Climate change has the potential to affect all designated species within the proposed Project Area. Habitat loss and alteration, changes in prey availability, frequency of storms, changes in vegetation, frequency of flooding and other fluctuations associated with climate change complicate the assessment and isolation of the effects of development activities on the North Slope. Under Alternative 1, 2, or 3, the extent of cumulative impacts associated with climate change on ESA-designated species is difficult to predict and could vary depending on the specific characteristics of each species and the environmental changes occurring.

Implementation of appropriate conservation measures as determined through consultations with federal, state, and local agencies for state-protected sensitive species and federally protected threatened, endangered, or candidate species for Alternative 1 or 2 and for future projects would include habitat restoration, impact avoidance, and impact minimization, which would likely mitigate long-term cumulative impacts. There could be short-term negative direct and indirect impacts to a designated species that could also have cumulative negative effects as a result of the frequency of disturbance, or the extent that other nearby activities such as proposed Liberty Development, Smith Bay exploration, Point Thomson operations or maintenance activities on TAPS could occur during the same general period. Coordinating the period of activity for the

proposed Project with other RFFAs could minimize the level of cumulative disturbances to designated species under Alternatives 1, 2 or 3.

4.26.9.9.1. Relevant Past/Present Actions, RFFAs and Natural Events Affecting Threatened and Endangered Species

Table 4.26-15 summarizes the relevant past and present actions, RFFAs, and natural events that have already or may continue to impact threatened and endangered species within the proposed Project Area.

Table 4.26-15 Past, Present, and RFFAs with Potential to Affect Threatened and Endangered Species

RFFA or Natural Event	Past, Present, RFFA ID Number[a]	Net Effect	Types of Effects
Cook Inlet Tidal Energy Project	62	Minor Negative	• Direct mortality during construction and operation • Changes to predator distributions due to anthropogenic practices • Introduced non-native, invasive and parasitic species • Turbidity • Spills and contaminants
Cook Inlet Area-wide Oil & Gas Lease Sales	32	Moderate Negative	• Direct mortality during construction and operation • Physical habitat loss, alteration, and fragmentation • Biological and behavioral responses to disturbance, • Changes to predator distributions due to anthropogenic practices • Introduced non-native, invasive and parasitic species
North Slope Borough Comprehensive Plan and North Slope Management Plan	9, 10	Major Positive	• Direct mortality during construction and operation • Physical habitat loss, alteration, and fragmentation • Biological and behavioral responses to disturbance, • Changes to predator distributions due to anthropogenic practices • Introduced non-native, invasive and parasitic species • Turbidity • Spills and contaminants
ANWR and Gates of the Arctic National Park and Preserve	13, 17	Major Positive	• Physical habitat loss, alteration, and fragmentation • Biological and behavioral responses to disturbance, • Changes to predator distributions due to anthropogenic practices • Introduced non-native, invasive and parasitic species
North Slope Oil & Gas Exploration (Past, Present, Future)	28, 31, 33, 35, 42 – 45, 47	Major Negative	• Direct mortality during construction and operation • Physical habitat loss, alteration, and fragmentation • Biological and behavioral responses to disturbance, • Changes to predator distributions due to anthropogenic practices • Introduced non-native, invasive and parasitic species • Turbidity

RFFA or Natural Event	Past, Present, RFFA ID Number[a]	Net Effect	Types of Effects
			• Spills and contaminants
Climate Change	67	Major Negative	• Physical habitat loss, alteration, and fragmentation • Introduced non-native, invasive and parasitic species
Poaching/Illegal Hunting	68	Major Negative	• Direct mortality during construction and operation • Biological and behavioral responses to disturbance • Introduced non-native, invasive and parasitic species

a The RFFA number corresponds to the number listed in Table 4.26-3.
The symbol + indicates a positive effect.

4.26.9.10. Land Use

As discussed in Section 4.15 (Land Use) and summarized in Table 4.26-3 (Past, Present, and RFFAs Occurring Within or Near the Project Area), the proposed Project would likely result in minor and moderate direct and indirect impacts to land use during construction, operation, and maintenance. Actions predicted to cause potential impacts include: temporary land use during construction and permanent land use during operations, alterations in transportation infrastructure and utility usage, clearing of forestlands, waste generation, and changes in land ownership.

A summary of potential past, present, and RFFAs that may contribute to cumulative effects to land use are presented in Table 4.26-16. These activities and events have been ranked using the impact criteria defined in Table 4.26-1 based on the magnitude or intensity of the impact, the geographic extent, the duration and the likelihood of occurrence. The majority of impacts on land use arising from RFFAs are associated with affects to land use planning, affects to transportation and utilities, and effects to land cover. Also discussed here are cumulative effects natural disasters /events may have on the proposed Project. The RFFAs discussed here present direct and indirect impacts to land use resources within the proposed Project Area, independent of which alternative is selected. These RFFAs would therefore represent the only cumulative impacts associated with the No Action alternative (Alternative 3).

Natural events, disasters, and wildfires would potentially impact land use and contribute to cumulative effects of the proposed Action in a number of ways. Wildfires, flooding, and earthquakes (RFFAs 64-66, respectively) may alter land use planning and availability, access to infrastructure and utilities, and total acreage of land cover types. Similarly, climate change (RFFA 67) could have similar effects to land use. Changes in temperature and precipitation may alter the functionality of some land cover types in the proposed Project ROW. This could result in an increase in acreage of one land type and a decrease in another. Depending on the land types' economic, cultural, or environmental importance, these changes may have either a positive or negative cumulative effect on the proposed Action. Potential changes in land type due to climate change that could impact the proposed Project Area include decreases in wetland

acreage, changes to vegetation community species composition, increases in productive agricultural lands (*e.g.,* warmer temperatures and lengthened growing season), and conversion of tundra to scrub/shrub-type lands (EPA, 2016e).

The proposed Project and many of the RFFAs in Table 4.26-16 would intersect lands managed according to federal, state, borough, and local management plans resulting in impacts throughout the proposed ROW and adjacent areas. A summary of relevant land use plans and documents for the proposed Project are included in Chapter 4, Table 4.15-3. These projects that could impact land use planning include current and future North Slope and interior Alaska oil and gas exploration projects (RFFAs 39-45), U.S. Department of Defense development projects (RFFA 18-26), TAPS (RFFA 35), and highway improvement projects (RFFA 48-51). Table 4.26-16 also includes management plans (RFFAs 8-12) associated with boroughs, municipalities, and regions intersected by the proposed Project, included here as positive cumulative RFFA impacts. These include the Central Yukon Resource Management Plan and Environmental Impact Statement, North Slope Borough Comprehensive Plan, North Slope Management plan, the Eastern Interior Regional Management Plant, and the Denali National Park and Preserve Management Plan.

Proposed natural resource development and exploration projects as well as infrastructure improvement projects would also impact existing transportation, utilities, easements, and ROWs. Similar to the proposed Action, many of these RFFAs would cross railroads, utilities, trails, driveways, and local and arterial roads during construction. These activities could result in disruption to traffic flow and utility services. For example, multiple military installation improvement and construction projects (RFFAs 18 and 21) are planned for the near future in and around Fairbanks, Alaska. The cumulative effect of these projects in addition to the proposed Action could impact local infrastructure and utilizes.

Clearing of forest and other land cover types, as required for construction and development RFFAs listed in Table 4.26-16, would contribute to cumulative land cover effects associated with the proposed Project. Forestlands are present throughout the proposed ROW, with the exception of lands north of the Brooks Range. It is assumed that clearing of forestlands would be required for some RFFA permanent facilities and access routes, and therefore would contribute to the cumulative loss of this land type in the proposed Project Area. As with the proposed Action, some of these areas would be allowed to revegetate following construction activities. However, long-term conversion of forestland acreage to shorter vegetation or gravel roads is most likely necessary for these RFFAs to successfully meet operation and maintenance goals. Farmlands of Local Importance have been identified in Fairbanks and in the Mat-Su Borough, which would be impacted by the proposed Action. It is possible that other RFFAs occurring near these communities could also impact these land use resources.

As described in Section 4.15.7 and in Table 4.15-5, the proposed Alternatives 1 and 2 would result in similar impacts to land use resources during both construction and

operation phases of the proposed Project. Construction and operations activities associated with RFFAs would be similar to both Alternatives 1 and 2 (*e.g.,* vegetation clearing, dust deposition, soil compaction, potential noxious plant species introduction, etc.).

4.26.9.10.1. Relevant Past/Present Actions, RFFAs and Natural Events Affecting Land Use

Table 4.26-16 summarizes the relevant past and present actions, RFFAs, and natural events that have already or may continue to impact land use within the proposed Project Area.

Table 4.26-16 Past, Present, and RFFAs with Potential to Affect Land Use

RFFA or Natural Event	Past, Present, RFFA ID Number[a]	Net Effect	Types of Effects
Donlin Gold Mine, Livengood Gold, True North, Fort Knox, Ryan Lode Project	3, 4, 5, 6, 7, 36	Moderate Negative	• Changes in land use • Affects to existing transportation and utilities, easements/ROW rights • Affects to forestlands, agriculture, important farmlands, or developed areas
North Slope Oil & Gas Developments	28, 31, 33, 35, 43a, 43b, 44, 45, 46	Minor Negative	• Affects to existing transportation and utilities, easements/ROW rights
Highway Improvements	48 – 51	Minor Positive/ Negative	• Affects to existing transportation and utilities, easements/ROW rights
Ambler Mining District Access Road	55	Minor Negative	• Affects to existing transportation and utilities, easements/ROW rights
Military Installation Development Projects	18 – 26	Minor Positive/ Negative	• Changes in land use • Affects to existing transportation and utilities, easements/ROW rights • Affects to forestlands, agriculture, important farmlands, or developed areas
Interior Alaska Oil & Gas Exploration and Development	39 – 41	Moderate Negative	• Changes in land use • Affects to existing transportation and utilities, easements/ROW rights • Affects to forestlands, agriculture, important farmlands, or developed areas
North Slope Oil & Gas Development and Exploration	42 – 45	Moderate Negative	• Changes in land use • Affects to existing transportation and utilities, easements/ROW rights • Affects to forestlands, agriculture, important farmlands, or developed areas
Port MacKenzie Rail Extension	53	Moderate Negative	• Affects to existing transportation and utilities, easements/ROW rights
Wildfire	64	Moderate Negative	• Affects to land use planning • Affects to existing transportation and utilities, easements/ROW rights • Affects to forestlands, agriculture, important farmlands, or developed areas

RFFA or Natural Event	Past, Present, RFFA ID Number[a]	Net Effect	Types of Effects
Flooding	65	Moderate Negative	• Changes in land use • Affects to existing transportation and utilities, easements/ROW rights • Affects to forestlands, agriculture, important farmlands, or developed areas
Earthquakes	66	Moderate Negative	• Changes in land use • Affects to existing transportation and utilities, easements/ROW rights • Affects to forestlands, agriculture, important farmlands, or developed areas
Management Plans	8 – 12	Major Positive	• Changes in land use • Affects to existing transportation and utilities, easements/ROW rights • Affects to forestlands, agriculture, important farmlands, or developed areas
Denali National Park and Preserve Management Plans	16	Major Positive	• Changes in land use • Affects to forestlands, agriculture, important farmlands, or developed areas
Climate Change	67	Major Positive/ Negative	• Changes in land use • Affects to existing transportation and utilities, easements/ROW rights • Affects to forestlands, agriculture, important farmlands, or developed areas

a The RFFA number corresponds to the number listed in Table 4.26-3.
The symbol + indicates a positive effect.

4.26.9.11. Recreation

As discussed in Section 4.16 (Recreation) and summarized in Table 4.26-3 (Past, Present, and RFFAs), the proposed Project would likely result in minor direct and indirect impacts to recreation during construction, operation, and maintenance. Actions predicted to cause potential impacts to recreation include use of public roads and ports, recreational disturbance by construction activities at key recreation features (such as designated wilderness areas, water bodies, and interpretative sites), influx of construction workers, and the presence of temporary and permanent facilities.

A summary of potential past, present and RFFAs that may contribute to cumulative effects on recreation are presented in Table 4.26-17. These activities and events have been ranked using the impact criteria defined in Table 4.26-1 based on the magnitude or intensity of the impact, the geographic extent, the duration and the likelihood of occurrence. The majority of impacts to recreation arising from RFFAs are associated with changes to recreational quality and changes to recreational access. These would include impacts to recreational experience as a result of construction activities, traffic congestion, the generation of noise and visual detractants, changes to water quality, competition for recreational facilities, and temporary restrictions and delays to access recreation areas. These RFFAs present direct and indirect impacts to recreation resources within the proposed Project Area, independent of which alternative is selected. These RFFAs

would therefore represent the only cumulative impacts associated with the No Action alternative (Alternative 3).

The proposed Project as well as certain RFFAs included in Table 4.26-17 could potentially result in an increase in competition between construction workers, tourists, and Alaskan residents. Potentially impacted activities include sport fishing, hunting, sightseeing, and lodging in back-country lodges, small public campgrounds and hotels along the Dalton, Elliott and Parks Highways, and charter air services due to the personnel involved in construction of the proposed Project and the other RFFAs. These RFFAs include highway improvement projects (RFFA 48-51), construction of other natural resource exploration access roads (54-56), oil and gas exploration projects (RFFA 33, and 39-41), military installation development projects (RFFA 18-26), and the Seward Marine Terminal expansion project (RFFA 59). Competition for these resources could result in an economic gain for businesses however would limit the availability of resources for tourists.

Temporary delays and restrictions, traffic congestion, and noise as a result of construction activities may diminish the recreational experience for some participants. These impacts could apply to all RFFAs occurring along public roads. In locations with limited recreation facilities/resources, the competition is likely to increase as construction workers would have more disposable income to spend in Alaska and more time to participate in these activities if they work a typical 2-week on/2-week off schedule. This competition would be repeated when other large RFFA projects results in an influx of construction workers and other support personnel.

Alternative 1 and Alternative 2 would result in similar impacts to recreation during both construction and operations phases of the proposed Project. The RFFA impacts construction and operations activities would be the same for both Alternatives 1 and 2 (*e.g.,* restriction to recreation areas, construction noise, etc.). Table 4.16-3 assigned an impact rating of moderate to all potential recreation impacts from construction for Alternative 1 and Alternative 2 and minor for operation and maintenance. Cumulative effects resulting from RFFAs are considered minor, as they would be localized, temporary, and have no substantial resource impact. The likelihood of each RFFA occurring simultaneously with the proposed Project is also low, limiting the cumulative impact of the multiple actions with the proposed Project. Changes to recreation would be perceptible and temporary, but would not alter the condition of recreation resources.

4.26.9.11.1. Relevant Past/Present Actions, RFFAs and Natural Events Affecting Recreation

Table 4.26-17 summarizes the relevant past and present actions, RFFAs, and natural events that have already or may continue to impact recreation within the proposed Project Area.

Table 4.26-17 Past, Present, and RFFAs with Potential to Affect Recreation

RFFA or Natural Event	Past, Present, RFFA ID Number[a]	Net Effect	Types of Effects
Ambler Mining District and Tanana Access Roads	55, 56	Minor Positive/ Negative	• Changes to Recreation Quality • Changes to Recreation Access
Highway Improvements	48 – 51	Minor Positive/ Negative	• Changes to Recreation Access
Interior Alaska Oil & Gas Exploration and Development Projects	39 – 41	Moderate Negative	• Changes to Recreation Quality • Changes to Recreation Access
Livengood and Ryan Lode Projects	4, 7	Moderate Negative	• Changes to Recreation Quality • Changes to Recreation Access
Flooding	65	Moderate Negative	• Changes to Recreation Quality • Changes to Recreation Access
Military Installation Development Projects	18 – 26	Moderate Negative	• Changes to Recreation Quality • Changes to Recreation Access
Earthquakes	66	Moderate Negative	• Changes to Recreation Quality • Changes to Recreation Access
Management Plans	8 – 12	Major Positive	• Changes to Recreation Quality • Changes to Recreation Access
National Wildlife Refuges and National Parks	13 – 17	Major Positive/ Negative	• Changes to Recreation Quality • Changes to Recreation Access
Alaska LNG Project	33	Major Negative	• Changes to Recreation Quality • Changes to Recreation Access
Seward Marine Terminal Expansion Planning Project	59	Major Positive/ Negative	• Changes to Recreation Quality • Changes to Recreation Access
Wildfire	64	Major Negative	• Changes to Recreation Quality • Changes to Recreation Access
Climate Change	67	Major Positive/ Negative	• Changes to Recreation Quality
Poaching	68	Major Negative	• Changes to Recreation Quality

a The RFFA number corresponds to the number listed in Table 4.26-3.

4.26.9.12. Visual

As discussed in Section 4.17 (Visual Resources) and summarized in Table 4.26-3 (Past, Present, and RFFAs), the proposed Project would likely result in direct and indirect impacts to visual resources. The impacts would range from minor to moderate and scenic quality and viewer sensitivity ratings would range from moderate to high during construction and operations. Construction activities including pipeline Mainline ROW construction, facility construction, and solid waste storage and disposal may negatively affect visual resources by increasing visual contrast with the existing landscape and reducing scenic quality. Additionally, the permanent pipeline infrastructure, facilities, and temporary recurring presence of maintenance activities could contribute to impacts to visual resources.

A summary of potential past, present and RFFAs that may contribute to an increase in visual contrast with existing landscape and reduction in scenic quality is presented in

Table 4.26-18. These activities and events have been ranked using the impact criteria defined in Table 4.26-1 based on the magnitude or intensity of the impact, the geographic extent, the duration and the likelihood of occurrence. The following activities are expected to result in the most notable cumulative noise impacts:

- Management plans (RFFAs No. 8-12) employ a range of management strategies that provide framework to guide management of public lands and interests on a local level. These may include guidelines for assessing the visual quality of existing landscapes, views of natural landscapes and unique areas with high visual quality. Consideration of these guidelines during proposed Project planning could result in a positive impact to visual resources, which would offset the potential negative impacts to visual resources resulting from proposed Project construction and operations.
- Natural occurrences such as wildfires and flooding could degrade the visual quality of existing landscapes. Although the likelihood of a natural occurrence in the areas of high visual quality that are impacted by the proposed Project is low, the magnitude of the impacts could be major.
- Interior mining projects (RFFAs No. 2 – 7 and 36) located in the Fairbanks area and along the proposed Project Mainline near Healy would result in the most notable cumulative impacts to visual resources. These impacts would occur as a result of mining activities in close proximity to the proposed Project Area. The impacts would be long-term and are likely to occur.
- The Alaska LNG project could result in similar visual resource impacts to those impacts resulting from the proposed Project; however, given the common purpose of both projects to deliver natural gas from the North Slope to Southcentral Alaska, it is unlikely both would be constructed.

The combined impact of RFFAs and natural occurrences described above on increased visual contrast with the existing landscape and reduction in scenic quality as a result of the No Action alternative (Alternative 3) are expected to be moderately negative based on the following criteria:

- The effect would indisputably alter a visual resource in terms of its value, quantity, quality, and uses, but would allow the resource to be used without removing, degrading, destroying its value resulting in a moderate intensity.
- The effects would be site-specific or would occur in a few isolated locations, resulting in a minor geographic extent
- The effect would be permanent, resulting in a major duration
- While the likelihood of all of the events mentioned above occurring within to 10-year evaluation period for this SEIS is unlikely, it is most likely that the effects of at least some of these projects would occur, resulting in an overall likely effect.

Under Alternative 1 (the proposed Action), the effects described above would be combined with the effects of the proposed Action described in Section 4.17, Visual Resources. The cumulative effects of this project combined with the projects above are likely to noticeably or measurably alter a visual resource in terms of its value, quantity, quality, and uses but are not likely to degrade the scenic quality, resulting in a minor impact. Natural occurrences such as a forest fire in an area of high scenic quality could result in a major visual impact, with or without the presence of the proposed Project. The proposed Project's contributions to such major visual impacts would be incremental. In general, the geographic extent of the combined impact of the pipeline, RFFAs, and natural occurrences would affect site-specific locations along the pipeline. As a result, the cumulative impacts to visual resources are expected to be negligible to moderate as shown in Table 4.26-26.

Alternative 2 would result in slightly higher impacts during pipeline operation than Alternative 1 from milepost 0 to 535, and from milepost 536 to 543 due to aboveground features or due to clearing of the ROW in visible areas along the Parks Highway as described in Section 4.17, Visual Resources. Although visual impacts would be slightly greater under Alternative 2, the cumulative impacts are not expected to significantly alter the impact findings resulting from the construction of Alternative 2 for the same reasons described above, under Alternative 1.

4.26.9.12.1. Relevant Past/Present Actions, RFFAs and Natural Events Affecting Visual Resources

Table 4.26-18 summarizes the relevant past and present actions, RFFAs, and natural events that have already or may continue to impact visual resources within the proposed Project Area.

Table 4.26-18 Past, Present, and RFFAs with Potential to Affect Visual Resources

RFFA or Natural Event	Past, Present, RFFA ID Number[a]	Net Effect	Types of Effects
Interior Alaska Oil & Gas Exploration and Development Projects	39, 40	Minor Negative	• Increase in visual contrast with existing landscape and reduction in scenic quality
Icewine Oil Prospect	45	Minor Negative	• Increase in visual contrast with existing landscape and reduction in scenic quality
Donlin Gold Mine, Livengood Gold, True North, Fort Knox, Ryan Lode Project	3, 4, 5, 6, 7, 36	Moderate Negative	• Increase in visual contrast with existing landscape and reduction in scenic quality
Flooding	65	Moderate Negative	• Increase in visual contrast with existing landscape and reduction in scenic quality
Management Plans	8 – 12	Major Positive	• Increase in visual contrast with existing landscape and reduction in scenic quality

RFFA or Natural Event	Past, Present, RFFA ID Number[a]	Net Effect	Types of Effects
Denali National Park and Preserve	16	Major Negative	• Increase in visual contrast with existing landscape and reduction in scenic quality
Alaska LNG Project	33	Major Negative	• Increase in visual contrast with existing landscape and reduction in scenic quality
Wildfire	64	Major Negative	• Increase in visual contrast with existing landscape and reduction in scenic quality

a The RFFA number corresponds to the number listed in Table 4.26-3.
The symbol + indicates a positive effect.

4.26.9.13. Socioeconomics

As discussed in Section 4.18 (Socioeconomics) and summarized in Table 4.26-3 (Past, Present, and RFFAs), the proposed Project would likely result in direct and indirect impacts ranging from major positive to major negative during construction and operations. Several activities associated with the proposed ASAP Project could affect socioeconomics. The influx of non-permanent workers during construction phase and employees associated with operations and maintenance of facilities could potentially impact population trends and projections as well as housing availability. Additional temporary workers needed for the duration of the construction and operation and maintenance phases of the proposed Project would result in employment opportunities. Local and statewide government revenues and expenditures could increase as a result of the costs associated with infrastructure development and revenues collected in the form of state and local taxes. Increased activity and influx of construction employees could result in increased stress on existing infrastructure. Finally, access to energy supply could improve through access to natural gas via new and existing infrastructure.

A summary of potential past, present and RFFAs that may contribute to cumulative effects on socioeconomics is presented in Table 4.26-19. These activities and events have been ranked using the impact criteria defined in Table 4.26-1 based on the magnitude or intensity of the impact, the geographic extent, the duration and the likelihood of occurrence. The majority of impacts on socioeconomics arising from RFFAs are associated with employment, revenue and expenditures, and energy supply and demand.

The following activities are expected to result in the most notable cumulative effects to socioeconomic indicators:

- Management plans (RFFA No. 9-12) manage local development and revenues, increase permitting efficiency for the oil and gas industry, and help guide decisions about public facilities and local economies in the same areas that would be affected by the proposed Project. The combined impacts of the proposed Project and the Management plans are likely to result in cumulative economic effects of varying

magnitude in areas where the Management Plans intersect the proposed Project Area.

- Existing and proposed oil and gas development projects would impact socioeconomic indicators in the proposed Project Area. The Houston-Willow Basin gas exploration license (RFFA No. 39) could result in impacts to all socioeconomic resource indicators described in Section 4.18, in the same geographic area as the proposed Project, although likely on a smaller scale. The combined impacts of this project with the proposed Project could result in further improved access to natural gas near Houston and Willow as well as greater local government revenues. Although North Slope oil and gas development projects (RFFAs No. 28, 31, 42-45) and other in state oil and gas development activities (RFFAs No. 40, 41) would not directly affect the communities in the proposed Project Area on the local level, these proposed projects could have a major positive socioeconomic effect statewide. The proposed upgrades to the Fairbanks natural gas distribution system, combined with the improved natural gas supply via the proposed Project could result in major positive impacts to the natural gas supply in the community of Fairbanks. The Alaska LNG project could result in similar impacts to all socioeconomics indicators described in this section of magnitudes from major negative to major positive. However, given the common purpose of both projects to deliver natural gas from the North Slope to Southcentral Alaska, it is unlikely both would be constructed.
- Natural occurrences such as wildfires, flooding, and earthquakes could result in effects to all socioeconomic indicators, most notable infrastructure and services as well as government expenditures. Constructing infrastructure that can withstand unexpected natural occurrences, and re-construction of damaged infrastructure as a result of natural occurrences during the same time that project construction is taking place, would place additional strain on government funding and infrastructure needs. Although it is unlikely that these natural occurrences would occur during construction activities and within the areas directly impacts by the proposed Project, the magnitude of the combined effects could be major and negative.
- The proposed Project would have a positive, short-term economic effect on revenue to the Port of Seward (RFFA No. 59) and the positive effect would be amplified by other large projects in the state that use the Port of Seward for delivery of construction equipment and supplies.
- Modifications to military installments, including infrastructure improvements at Clear Airforce Base and Eielson Air force Base Fairbanks, Joint Base Elmendorf-Richardson in Anchorage, and Fort Greely near Delta Junction, cumulatively impact all of the socioeconomic indicators potentially affected by the proposed Project. Most notably, the combined expansions at Eielson Air Force Base are expected to require up to 3,000 military and civilian jobs and greater than 1,200 military dependents. This increase in population could result in increased opportunities for employment and government revenues in Fairbanks, however, the increase in population would

place stress on housing, schools, and existing infrastructure and government services.

- While most of these impacts combined impact of RFFAs and natural occurrences described above would result in moderate to major positive impacts statewide as a result of employment opportunities and state revenues, many would also result in moderate to major localized impacts to population, housing, and demand on government infrastructure and services, where especially the modifications to military installments within the FNSB. Construction of the proposed oil and gas development projects above, which are somewhat likely would be expected to positively impact government revenues as a result of state taxes and royalties, while natural disasters, which are less likely to occur within the proposed Project Area would result in additional government expenditures. The geographic extent of these projects and natural occurrences range from specific and isolated impacts to population, housing, and demand for government services to statewide impacts to state revenues. While the duration of these projects would be expected to be long term, the likelihood of these projects and natural occurrences occurring is unknown, so likelihood is considered somewhat likely. Overall, the events described above would be expected to result in major positive impacts to employment, minor negative impacts to state revenues during initial operations with increasingly positive impacts in the longer term, and moderately negative impacts to population and housing.
- When combined with Alternative 1, the proposed Action, the most notable cumulative effects would result from modifications from military installments, especially at Eielson in Fairbanks where moderate population, housing and government services are expected to occur as a result of both projects in the same area. It is unlikely that these projects would occur at the same time, but if they did, localized effects of a major magnitude would result. While these effects would be greater than those described for the proposed Project alone, the localized effects result in an overall moderate cumulative impact.
- The cost of construction of an aboveground pipeline would be slightly greater under Alternative 2, resulting in a major negative impact to construct the pipeline. Although this impact is slightly greater, the impact remains of major negative magnitude. The alternative features to the proposed Project design described under Alternative 2 are not expected to significantly affect the cumulative effects and are expected to be similar to those described under Alternative 1.

4.26.9.13.1. Relevant Past/Present Actions, RFFAs and Natural Events Affecting Socioeconomics

Table 4.26-19 summarizes the relevant past and present actions, RFFAs, and natural events that have already or may continue to impact socioeconomics within the proposed Project Area.

Table 4.26-19 Past, Present, and RFFAs with Potential to Affect Socioeconomics

RFFA or Natural Event	Past, Present, RFFA ID Number[a]	Net Effect	Types of Effects
Highway Improvement Projects	48 – 51	Minor Positive/ Negative	• Employment • Revenue and Expenditures • Infrastructure and Services • Housing and Property Values
Ambler Mining District and Tanana Access Roads	55, 56	Minor Positive/ Negative	• Revenue and Expenditures • Infrastructure and Services • Energy supply and demand
Seward Marine Terminal Expansion Planning Project	59	Minor Positive/ Negative	• Employment • Revenue and Expenditures • Infrastructure and Services • Energy supply and demand
Donlin Gold Mine, Livengood Gold, True North, Fort Knox, Ryan Lode Project	3, 4, 5, 6, 7, 36	Moderate Positive/ Negative	• Employment • Revenue and Expenditures • Infrastructure and Services • Energy supply and demand
Military Installation Development Projects	18 – 26	Moderate Positive/ Negative	• Population Trends and Projections • Employment • Housing and Property Values • Revenue and Expenditures • Infrastructure and Services • Energy supply and demand
LNG Transport by Tanker Truck to Fairbanks	29	Moderate Positive/ Negative	• Employment • Revenue and Expenditures • Infrastructure and Services • Energy supply and demand
Point MacKenzie Liquefaction Plant and Rail Extension	31	Moderate Positive/ Negative	• Employment • Revenue and Expenditures • Infrastructure and Services • Energy supply and demand • Housing and Property Values
North Slope Oil & Gas Developments	28, 31, 33, 35, 43a, 43b, 44, 45, 46	Moderate Positive/ Negative	• Employment • Revenue and Expenditures • Energy supply and demand
Alaska Intertie Project - Rail Belt Power Pool Project.	57	Moderate Positive/ Negative	• Infrastructure and Services • Energy supply and demand
Rural Alaska Village Grant Program	60	Moderate Positive/ Negative	• Population Trends and Projections • Employment • Infrastructure and Services • Housing and Property Values
Cook Inlet Redevelopment Project	46	Moderate Positive/ Negative	• Employment • Revenue and Expenditures • Infrastructure and Services • Energy supply and demand

RFFA or Natural Event	Past, Present, RFFA ID Number[a]	Net Effect	Types of Effects
Interior Alaska Oil & Gas Development and Exploration Projects	40, 41	Moderate Positive/ Negative	• Population Trends and Projections • Employment • Revenue and Expenditures • Infrastructure and Services • Energy supply and demand
Management Plans	9 – 12	Major Positive	• Population Trends and Projections • Employment • Housing and Property Values • Revenue and Expenditures • Infrastructure and Services • Energy supply and demand
Alaska LNG Project	33	Major Positive/ Negative	• Population Trends and Projections • Employment • Housing and Property Values • Revenue and Expenditures • Infrastructure and Services • Energy supply and demand
Fairbanks Gas Distribution System	37	Major Positive	• Infrastructure and Services • Energy supply and demand
Interior Alaska Oil & Gas Development and Exploration Projects	39	Major Positive/ Negative	• Population Trends and Projections • Employment • Revenue and Expenditures • Infrastructure and Services • Energy supply and demand
Wildfire	64	Major Negative	• Population Trends and Projections • Housing and Property Values • Revenue and Expenditures • Infrastructure and Services • Energy supply and demand
Flooding	65	Major Negative	• Population Trends and Projections • Housing and Property Values • Revenue and Expenditures • Infrastructure and Services • Energy supply and demand
Earthquakes	66	Major Negative	• Population Trends and Projections • Housing and Property Values • Revenue and Expenditures • Infrastructure and Services • Energy supply and demand

a The RFFA number corresponds to the number listed in Table 4.26-3.
The symbol + indicates a positive effect.

4.26.9.14. Cultural Resources

As discussed in Section 4.19 (Cultural Resources) and summarized in Table 4.26-3 (Past, Present, and RFFAs), the proposed Project would likely result in major direct impacts to cultural resources during construction and operation and maintenance. Potential actions that could result in impacts include physical destruction of, or damage to, all or part of the resource, removal of the cultural resource from its original location, or change in access to traditional use sites by traditional users.

A summary of potential past, present and RFFAs that may contribute to cumulative effects on cultural resources is presented in Table 4.26-20. These activities and events have been ranked using the impact criteria defined in Table 4.26-1 based on the magnitude or intensity of the impact, the geographic extent, the duration and the likelihood of occurrence. Impacts on cultural resources arising from RFFAs include physical destruction or damage, removal of resources, changes to character and setting, increased access to culturally sensitive areas, and loss of cultural identity. Natural events and disasters such as wildfires, flooding, and earthquakes have been identified in Table 4.26-20 as RFFAs that would have potential cumulative impacts to cultural resources. These impacts would result primarily in physical destruction or damage, or removal of cultural resources.

The RFFAs discussed here present direct and indirect impacts to land use resources within the proposed Project Area, independent of which alternative is selected. These RFFAs would therefore represent the only cumulative impacts associated with the No Action alternative (Alternative 3).

The anticipated cumulative effects of the proposed Project in combination with RFFA included in Table 4.26-20 on cultural resources would primarily be related to soil disturbance from construction of the proposed Project, other future projects, wildfires, or flooding. Indirect impacts could also be caused by the addition of noise or vibrations from construction, changes to viewshed, deposition of atmospheric elements (*i.e.*, dust), or changes in access to areas that may be sensitive due to cultural resources. The effects of other projects would be similar to those of the proposed Project in that there is potential to cause adverse effects to known and undiscovered historic properties. As with the proposed Project, other large-scale projects (such as North Slope and interior Alaska oil and gas exploration [RFFAs 33, and 39-45]), would likely have a level of state and federal government involvement that requires compliance with Section 106 of the NHPA. The lead federal agencies for those projects have been or would be required to consult with the SHPO, Indian tribes, and other applicable consulting parties; identify and evaluate cultural resources; and avoid, minimize, or mitigate any effects upon historic properties.

For any non-federal actions in the ROI, project proponents would be required to comply with any identification and evaluation procedures and mitigation measures required by the state. Such regulations could address inadvertent discoveries of cultural resources, the disposition of discovered human remains, and other resource protection laws.

Management plans (RFFAs 8-12) and National Wildlife Refuges and National Parks (RFFAs 13-17) have been included in Table 4.26-20 as a positive, major net effect for RFFA cumulative effects. These plans include the Central Yukon Resource Management Plan and Environmental Impact Statement, North Slope Borough Comprehensive Plan, North Slope Management plan, and the Denali National Park and Preserve Management Plan, and protected areas, complement regulatory restrictions and guidance, to aid in protecting cultural resources. The majority of direct and indirect impacts from the proposed Project to cultural resources range from negligible to major, as do the potential cumulative effects from RFFAs. The level of impact depends on the nature of the activity, whether cultural sites would be directly damaged or removed, and whether indirect impacts described above could degrade the condition of the cultural resource.

Alternative 1 and Alternative 2 would result in similar impacts to cultural resources during both construction and operations phases of the proposed Project. A comparison of Alternative impacts is included in Section 4.19.7.1. The impact ratings for Alternative 1 and Alternative 2 are the same for both construction and operation phases of the proposed Project. Cumulative impacts from RFFAs to cultural resources are considered moderate for proximity to culturally sensitive areas and increased access to culturally sensitive areas and minor for all effects included in Table 4.26-26. This determination is based on the assumption that other development organizations would conduct work according to similar regularity requirements as the proposed Project.

4.26.9.14.1. Relevant Past/Present Actions, RFFAs and Natural Events Affecting Cultural Resources

Table 4.26-20 summarizes the relevant past and present actions, RFFAs, and natural events that have already or may continue to impact cultural resources within the proposed Project Area.

Table 4.26-20 Past, Present, and RFFAs with the Potential to Affect Cultural Resources

RFFA or Natural Event	Past, Present, RFFA ID Number[a]	Net Effect	Types of Effects
Wildfire	64	Major Negative	• Physical destruction or damage • Removal of the resource from its original location • Vulnerability to erosion • Change to character and setting
Flooding	65	Major Negative	• Physical destruction or damage • Removal of the resource from its original location • Change to character and setting • Change in use and/or access to traditional sites
Earthquake	66	Major Negative	• Physical destruction or damage • Removal of the resource from its original location • Change to character and setting

RFFA or Natural Event	Past, Present, RFFA ID Number[a]	Net Effect	Types of Effects
			• Change in use and/or access to traditional sites
Donlin Gold Mine, Livengood Gold, True North, Fort Knox, Ryan Lode Project	2, 3, 4, 5, 6, 7, 36	Minor Negative	• Physical destruction or damage • Removal of the resource from its original location • Change to character and setting • Change in use and/or access to traditional sites • Proximity of proposed Project components to culturally sensitive areas • Introduction of vibration, noise, or atmospheric (*e.g.*, visual, dust, olfactory) elements • Increased access to culturally sensitive areas • Loss of cultural identity with a resource
Interior Alaska Oil & Gas Exploration Projects	39 – 41	Minor Negative	• Physical destruction or damage • Removal of the resource from its original location • Change to character and setting • Change in use and/or access to traditional sites • Proximity of proposed Project components to culturally sensitive areas • Introduction of vibration, noise, or atmospheric (*e.g.*, visual, dust, olfactory) elements • Increased access to culturally sensitive areas • Loss of cultural identity with a resource
Umiat, Ambler Mining District, and Tanana Access Roads	54 – 56	Moderate Negative	• Increased access to culturally sensitive areas
National Wildlife Refuges and National Parks	13 – 17	Moderate Positive	• Physical destruction or damage • Removal of the resource from its original location • Vulnerability to erosion • Change to character and setting • Change in use and/or access to traditional sites • Proximity of proposed Project components to culturally sensitive areas • Introduction of vibration, noise, or atmospheric (*e.g.*, visual, dust, olfactory) elements • Increased access to culturally sensitive areas • Loss of cultural identity with a resource
Management Plans	8 – 12	Major Positive	• Physical destruction or damage • Removal of the resource from its original location • Vulnerability to erosion • Change to character and setting

RFFA or Natural Event	Past, Present, RFFA ID Number[a]	Net Effect	Types of Effects
			• Change in use and/or access to traditional sites • Proximity of proposed Project components to culturally sensitive areas • Introduction of vibration, noise, or atmospheric (*e.g.,* visual, dust, olfactory) elements • Increased access to culturally sensitive areas • Loss of cultural identity with a resource • Neglect of a property that causes its deterioration
Alaska LNG Project	33	Major Negative	• Physical destruction or damage • Removal of the resource from its original location • Vulnerability to erosion • Change to character and setting • Change in use and/or access to traditional sites • Proximity of proposed Project components to culturally sensitive areas • Introduction of vibration, noise, or atmospheric (*e.g.,* visual, dust, olfactory) elements • Increased access to culturally sensitive areas • Loss of cultural identity with a resource • Neglect of a property that causes its deterioration
North Slope Oil & Gas Exploration and Development	28, 31, 35, 42 – 46	Major Negative	• Physical destruction or damage • Removal of the resource from its original location • Vulnerability to erosion • Change to character and setting • Change in use and/or access to traditional sites • Proximity of proposed Project components to culturally sensitive areas • Introduction of vibration, noise, or atmospheric (*e.g.,* visual, dust, olfactory) elements • Increased access to culturally sensitive areas • Loss of cultural identity with a resource • Neglect of a property that causes its deterioration

[a] The RFFA number corresponds to the number listed in Table 4.26-3.

4.26.9.15. Subsistence

As discussed in Section 4.20 (Subsistence) and summarized in Table 4.26-3 (Past, Present, and RFFAs), the proposed Project would likely result in direct and indirect impacts ranging from minor to major during construction and operations. Proposed Project construction activities could increase noise, traffic, human presence, and barging while

decreasing water availability. These activities could result in disruption of subsistence use areas, a temporary decrease in subsistence resource availability, a temporary reduction in harvester access to the proposed Project Area, and a real or perceived impact on the quality of subsistence foods.

Inupiat communities on the North Slope for instance are reliant on the coastal resources as part of their subsistence culture. This culture is among the most important factors to be considered in assessment of cumulative development impacts on the North Slope. These communities continue to be faced with changes in social infrastructure, culture, economics, climate change and many other factors. Some of these changes are not always negative, but could affect daily life and overall sense of wellbeing (USACE, 1980). The existence of proposed Project infrastructure during the operations phase (roads, material sites, and pipeline ROW) could result in impacts to resource availability, loss of subsistence use areas, and decreased or increased hunter access to subsistence use areas. Finally, operation activities, including traffic maintenance and security activities and proposed Project policies, could affect resource availability, hunter access, and real or perceived altered quality of subsistence foods. The communities that are expected to be impacted in a major way include Minto and Nenana, located west of Fairbanks in the Tanana River Sub-region. Communities that are expected to be moderately affected include Wiseman and Coldfoot.

A summary of potential past, present and RFFAs that may contribute to cumulative effects on subsistence is presented in Table 4.26-21. These activities and events have been ranked using the impact criteria defined in Table 4.26-1 based on the magnitude or intensity of the impact, the geographic extent, the duration and the likelihood of occurrence. The majority of impacts on subsistence activities arising from RFFAs are associated with disruption of subsistence use areas, resource availability, increase in competition of subsistence resources, and increase in cost and time as a result of seeking alternative use areas. The following activities are expected to result in the most notable cumulative effects to subsistence activities:

- North Slope and interior oil and gas exploration and development projects near the proposed Project (RFFAs No. 28, 39, 42 – 45) may result in increased pressure on subsistence activities in the form of disruption of subsistence use areas and resource availability, changes in access and subsistence food quality as well as increased costs associated with seeking alternative subsistence use areas. These combined affects could occur most notably on the North Slope and near Houston and Willow. Additionally, the Toghotthele No.1 - Nenana Basin Oil and Gas Exploration project, which spans approximately 400,000 acres of leased State of Alaska land near Minto and Nenana, could place additional stress on subsistence near these communities that are likely to experience major impacts as a result of the proposed Project.
- In addition to Minto and Nenana, several communities in the Tanana River Sub-region between Livengood and Healy would experience moderate effects on subsistence activities. Several past present and RFFA projects exist in this

area.Ambler Mining District and Tanana access road projects (RFFAs No. 55 and 56) intersect the area of potential affects to subsistence use resources as a result of the proposed Project. Donnelly Training Area Fort Wainwright (RFFA No. 41) covers a large area in close proximity to the community of Nenana, which is expected to experience major impacts to subsistence as a result of the proposed Project. The following RFFAs, management plans, and natural occurrences are likely to result in cumulative impacts with the proposed Project.

- Management plans (RFFAs. No 8-12) provide land management strategies, manage development, and aim to preserve Inupiat values and traditions (such as subsistence hunting). These management plans could positively affect subsistence use, offsetting potentially negative impacts resulting from the proposed Project, or increasing positive impacts resulting from the proposed Project such as improved access to subsistence use areas.
- Natural occurrences, such as flooding, could result in removal or disruption of subsistence use areas, decrease in resource availability, and increased costs and time due to seeking alternative use areas. Flooding typically occurs in the spring and could affect spring subsistence hunts in and around the proposed Project Area. Climate change could result in direct affects to the health, density, distribution, and availability of subsistence resources throughout the state. Climate change could result in natural occurrences, such as changes in precipitation, and flooding, that could pose barriers to accessing subsistence use areas. According to the study *Observations of Changing Conditions in Northwest Alaska* (NPS, 2014), impacts on Subsistence Fishing Practices the effects of climate change on subsistence is already being noticed in Alaska:

  > *Residents are noticing changing weather conditions, shifting break-up and freeze-up patterns, lower river and lake water levels, [thawing] permafrost, increased river bank erosion, and changing populations of some local animal species. These changes have implications for subsistence fishing practices, such as more difficult boating conditions, unfavorable weather for processing fish, poor water conditions for fishing activities, increasingly unpredictable fish movement patterns, and increased blockage of waterways by beaver dams.*

- Finally, poaching (illegal hunting) already occurs in the state. Increased access to undeveloped areas and increases in seasonal worker populations has the potential to increase the occurrence of illegal hunting along the proposed corridor.

If the proposed Project were not constructed (Alternative 3 – No Action), the events described above would still result in impacts to the subsistence resources within the proposed Project Area. The magnitude of the effect of management plans would be positive and major as described above, while the magnitude of the effect of a natural occurrence and development projects that intersect the proposed Project Area subsistence would be negative and major. The geographic extent of the events described above are expected to occur in several areas throughout the proposed Project Area. The

probability of the impact of management plans and development projects on subsistence is likely, while the probability of a natural occurrence within the proposed Project Area or climate change affecting subsistence is possible. The impact of poaching is difficult to describe within these terms, but is generally expected to result in an overall minor negative impact on subsistence activities. When combined, the events described above are expected to contribute a moderately negative impact on subsistence in the proposed Project Area.

When combined with the impacts of Alternative 1, potential major impacts to subsistence could result due to the combined impacts of several oil and gas, mining and road construction projects intersecting areas that are likely to have moderate impacts as a result of the proposed Project. The Toghotthele No.1 - Nenana Basin Oil and Gas Exploration project, which spans approximately 400,000 acres of leased State of Alaska land near Minto and Nenana, could place additional stress on subsistence near these communities that are likely to experience major impacts as a result of the proposed Project. Ambler Mining District and Tanana access road projects (RFFAs No. 55 and 56) intersect the area of potential affects to subsistence use resources as a result of the proposed Project. The development of these new roads combined with the development of the proposed Project access roads could result in cumulative disruption of subsistence use areas during construction, and could result in permanently altered access to subsistence use areas. Donnelly Training Area Fort Wainwright (RFFA No. 41) covers a large area in close proximity to the community of Nenana, which is expected to experience major impacts to subsistence as a result of the proposed Project. Due to the number of past, present and RFFA projects in the area including those described above (road projects, military projects, and interior oil and gas development projects) that could also place stress on subsistence resources, it is possible that these communities experience may a major impact on subsistence activities as a result of cumulative effects during proposed Project construction. As a result, several communities that could expect moderate impacts as a result of the proposed Project could expect major impacts as a result of the cumulative effects described above.

The cumulative impacts resulting from Alternative 2 and the cumulative events described above are expected to be similar to the cumulative impacts described under Alternative 1.

4.26.9.15.1. Relevant Past/Present Actions, RFFAs and Natural Events Affecting Subsistence

Table 4.26-21 summarizes the relevant past and present actions, RFFAs, and natural events that have already or may continue to impact subsistence within the proposed Project Area.

Table 4.26-21 Past, Present, and RFFAs with Potential to Affect Subsistence

RFFA or Natural Event	Past, Present, RFFA ID Number[a]	Net Effect	Types of Effects
Wildfire	64	Minor Positive/ Negative	• Removal or disruption of subsistence use areas • Decrease in resource availability • Increased costs and time due to seeking alternative use areas
Highway Improvement Projects	48 – 51	Minor Negative	• Increase in competition from outside harvesters due to increased access
Interior Alaska Oil & Gas Exploration and Development Projects	40, 41	Minor Negative	• Removal or disruption of subsistence use areas • Decrease in resource availability • Reduction in harvester access to the proposed Project Area • Contamination (real or perceived) • Loss of subsistence use areas • Increased costs and time due to seeking alternative use areas • Increase in competition from outside harvesters due to increased access
North Slope Oil & Gas Exploration and Development	28, 31, 33, 35, 42 – 46	Moderate Negative	• Removal or disruption of subsistence use areas • Decrease in resource availability • Reduction in harvester access to the proposed Project Area • Contamination (real or perceived) • Loss of subsistence use areas • Increased costs and time due to seeking alternative use areas
Interior Alaska Oil & Gas Exploration and Development Projects	39	Moderate Negative	• Removal or disruption of subsistence use areas • Decrease in resource availability • Reduction in harvester access to the proposed Project Area • Contamination (real or perceived) • Loss of subsistence use areas • Increased costs and time due to seeking alternative use areas • Increase in competition from outside harvesters due to increased access
Ambler Mining District and Tanana Access Roads	55, 56	Moderate Negative	• Removal or disruption of subsistence use areas • Increase in competition from outside harvesters due to increased access
Flooding	65	Moderate Negative	• Removal or disruption of subsistence use areas • Decrease in resource availability • Increased costs and time due to seeking alternative use areas

RFFA or Natural Event	Past, Present, RFFA ID Number[a]	Net Effect	Types of Effects
Management Plans	8 – 12	Moderate Positive	• Removal or disruption of subsistence use areas • Decrease in resource availability • Reduction in harvester access to the proposed Project Area • Contamination (real or perceived) • Loss of subsistence use areas • Increased costs and time due to seeking alternative use areas • Increase in competition from outside harvesters due to increased access
Climate Change	67	Moderate Negative	• Removal or disruption of subsistence use areas • Decrease in resource availability • Increased costs and time due to seeking alternative use areas
Poaching	68	Moderate Negative	• Decrease in resource availability • Increase in competition from outside harvesters due to increased access • Increased costs and time due to seeking alternative use areas

a The RFFA number corresponds to the number listed in Table 4.26-3.
The symbol + indicates a positive effect.

4.26.9.16. Public Health

As discussed in Section 4.21 (Public Health) and summarized in Table 4.26-3 (Past, Present, and RFFAs Occurring Within or Near the Project Area), the proposed Project would likely result in direct and indirect impacts ranging from minor to moderate during construction and operations. The presence of construction camps housing non-local employees as well as increased traffic and population have potential to affect social determinants of health (maternal health status, depression/anxiety prevalence, substance abuse rate, suicide rate, teen pregnancy rates, domestic violence and family stress, economy and employment). Improved employment opportunities and wages could alleviate stress and provide income to support family health. General construction activities as well as the potential for leaks, fires, or explosions have the potential to affect safety in the proposed Project Area. Although the estimated proposed emission impacts from the Project are below NAAQS and AAAQS, any development activity could result in some impacts to the pristine air quality along the proposed Project ROW, and air quality could be degraded. Should HAP emissions (individual or aggregate) approach criteria thresholds, further analysis and or permitting would be required. Additional impacts that could occur as a result of pipeline construction and operation activities include impacts to food, nutrition, and subsistence activity; infectious and non-communicable disease transmission; impacts to water and sanitation (positive or negative); and health services infrastructure and capacity (positive and negative).

A summary of potential past, present and RFFAs that may contribute to cumulative effects on public health is presented in Table 4.26-22. These activities and events have been ranked using the impact criteria defined in Table 4.26-1 based on the magnitude or intensity of the impact, the geographic extent, the duration and the likelihood of occurrence. While oil and gas development in some form has been ongoing around Alaska's North Slope since the late 1970s, communities are now faced with balancing preservation of a traditional, subsistence lifestyle with modern culture in an era when the cumulative effects of development, climate change, increased traffic and population and the prospect of offshore development are converging under a backdrop of social change. The relatively recent and rapid transition from a traditional subsistence culture to a more cash-oriented economy is creating stress in terms of cultural identity, community and individual social and physical welfare. The following activities are expected to result in the most notable cumulative effects to public health:

- Management plan (RFFAs N. 8-12) employ a range of management strategies that support: preservation of Inupiat values and traditions such as subsistence hunting; identifying, prioritizing, and allocating funding for health related facility and infrastructure needs; and general community safety. It is likely that management plans could impact the proposed Project Area positively, resulting in a decrease in magnitude of negative impacts to subsistence, public health infrastructure, and general community health and safety in several areas within the proposed Project Area. Table 4.26-3 provides the specific management plans and locations of these impacts.
- Modifications to military installments (RFFAs No. 18-26) including reduction of personnel at Fort Wainwright and infrastructure improvements at Clear Airforce Base, Eielson Air force Base, Joint Base Elmendorf-Richardson, and Fort Greely could cumulatively impact all of the public health indicators potentially affected by the proposed Project. Most notably, the expansions at Eielson Air Force Base would result in increased opportunities for employment that could lead to decreased family stress, improved access to health care, and increased government funding available to support health service. The increase in population would, however, place stress on current health services. Increasing populations within a limited geographical area could increase the number of people occupying areas in close proximity to hazardous materials, such as military installments.
- Other oil and gas development projects including the Alaska LNG project, North Slope oil and gas exploration and development projects, and interior Alaska oil and gas exploration and development projects could cumulatively impact all of the public health indicators potentially affected by the proposed Project. North Slope development projects and development projects near Houston and Willow would be likely to have the most notable cumulative impacts, as their impacts to public health are likely to intersect with the proposed Project geographically. The Alaska LNG project could result in similar impacts to public health as those impacts resulting from the proposed Project; however, given the common purpose of both projects to

deliver natural gas from the North Slope to Southcentral Alaska, it is unlikely that both would be constructed.

- The most notable cumulative impacts that could result from natural occurrences such as wildfire, flooding, and earthquakes include physical impacts to existing health related infrastructure such as access to clean water and sanitation, shelter form the elements, and access to health care services. Additionally, limited access to health services and infrastructure could lead to increased occurrence of both infectious and non-communicable diseases, exposure to hazardous materials, and accidents and injuries. While the likelihood of these occurrences is low, the magnitude of the cumulative impacts to public health would be major.
- Proposed and Current Mining Projects (RFFAs No. 1-7) have the potential to result in cumulative impacts to public health. Due to their geographic location and close proximity to the proposed Project Livengood Gold, Fort Knox, and Ryan Lode projects near Fairbanks would have the most notable cumulative impacts to public health. The most notable impacts to public health as a result of these projects could include exposure to hazardous materials through water, or soil exposure; real or perceived impacts to food, nutrition, and subsistence activity; and increase potential for accidents and injuries associated with mining operations.

The events summarized in the bulleted list above would occur regardless of whether the proposed Project were constructed and are considered cumulative effects associated with Alternative 3, No Action. Many of the events described above could lead to stress on health care services and existing infrastructure, which could lead to an increase infectious and non-communicable diseases, and accidents and injuries of magnitudes ranging from minor to major. Many of the events described above would also increase the real or perceived potential for human exposure to hazardous materials. Although it is difficult to estimate the magnitude of effects, management plans would contribute a positive effect to infrastructure development and government services that may lessen the impacts described in some areas. Overall, the geographic extent affected by each of the events described above is expected to be on the borough or village level. The possibility of a major natural occurrence affecting the proposed Project Area in the next 10 years is unlikely, but possible. The impacts of a moderate to major magnitude resulting from these events (mostly expected during the construction phases) would generally occur over a period of 1 to 6 years. Overall, these projects, RFFAs, and natural occurrences would be expected to have a moderate cumulative effect on public health.

The impacts of these activities when combined with impacts from Alternative 1, the proposed Action, would be expected to cumulatively increase the magnitude and geographic extent of impacts to public health. Although the likelihood of the cumulative effects described happening concurrently with construction of the proposed Action are unlikely, the additional stress placed on health services infrastructure and capacity would be expected to increase to moderate overall.

Under Alternative 2, there are no significant changes to the impact on public health, so this alternative is expected to impact public health in a similar way to Alternative 1.

4.26.9.16.1. Relevant Past/Present Actions, RFFAs and Natural Events Affecting Public Health

Table 4.26-22 summarizes the relevant past and present actions, RFFAs, and natural events that have already or may continue to impact public health within the proposed Project Area.

Table 4.26-22 Past, Present, and RFFAs with Potential to Affect Public Health

RFFA or Natural Event	Past, Present, RFFA ID Number[a]	Net Effect	Types of Effects
Highway Improvements	48 – 51	Minor Positive	• Social Determinants of Health • Health Services Infrastructure and Capacity
Seward Marine Terminal Expansion Planning Project	59	Minor Positive/ Negative	• Social Determinants of Health • Accidents and Injuries • Food, Nutrition, and Subsistence Activity • Infectious Disease • Water and Sanitation • Non-Communicable and Chronic Disease • Health Services Infrastructure and Capacity
Ambler Mining District and Tanana Access Roads	55, 56	Minor Positive/ Negative	• Social Determinants of Health • Accidents and Injuries • Food, Nutrition, and Subsistence Activity • Infectious Disease • Water and Sanitation • Non-Communicable and Chronic Disease • Health Services Infrastructure and Capacity
Proposed and Current Mining Projects	2 – 7	Moderate Positive/ Negative	• Social Determinants of Health • Accidents and Injuries • Exposure to Hazardous Materials • Food, Nutrition, and Subsistence Activity • Infectious Disease • Water and Sanitation • Non-Communicable and Chronic Disease • Health Services Infrastructure and Capacity
Interior Alaska Oil & Gas Exploration and Development	39 – 41	Moderate Positive/ Negative	• Social Determinants of Health • Accidents and Injuries • Exposure to Hazardous Materials • Food, Nutrition, and Subsistence Activity • Infectious Disease • Water and Sanitation • Non-Communicable and Chronic Disease • Health Services Infrastructure and Capacity

RFFA or Natural Event	Past, Present, RFFA ID Number[a]	Net Effect	Types of Effects
North Slope Oil & Gas Exploration and Development	28, 31, 33, 35, 42 - 46	Moderate Positive/ Negative	• Social Determinants of Health • Accidents and Injuries • Exposure to Hazardous Materials • Food, Nutrition, and Subsistence Activity • Infectious Disease • Water and Sanitation • Non-Communicable and Chronic Disease • Health Services Infrastructure and Capacity
Wildfire	64	Moderate Negative	• Accidents and Injuries • Water and Sanitation • Health Services Infrastructure and Capacity
Flooding	65	Moderate Negative	• Accidents and Injuries • Water and Sanitation • Health Services Infrastructure and Capacity • Infectious Disease
Earthquakes	66	Moderate Negative	• Accidents and Injuries • Water and Sanitation • Health Services Infrastructure and Capacity
Resource Management Plans, Conveyances and Refuges	8 - 17	Moderate Positive	• Social Determinants of Health • Accidents and Injuries • Exposure to Hazardous Materials • Food, Nutrition, and Subsistence Activity • Infectious Disease • Water and Sanitation • Non-Communicable and Chronic Disease • Health Services Infrastructure and Capacity
Military Installation Developments	18 - 26	Moderate Positive/ Negative	• Social Determinants of Health • Accidents and Injuries • Exposure to Hazardous Materials • Food, Nutrition, and Subsistence Activity • Infectious Disease • Water and Sanitation • Non-Communicable and Chronic Disease • Health Services Infrastructure and Capacity
Alaska LNG Project	33	Moderate Positive/ Negative	• Social Determinants of Health • Accidents and Injuries • Exposure to Hazardous Materials • Food, Nutrition, and Subsistence Activity • Infectious Disease • Water and Sanitation • Non-Communicable and Chronic Disease • Health Services Infrastructure and Capacity

a The RFFA number corresponds to the number listed in Table 4.26-3.

4.26.9.17. Air Quality, Climate Change, and GHG Emissions

As discussed in Section 4.22 (Air Quality, Climate Change and GHG Emissions) and summarized in Table 4.26-3 (Past, Present, and RFFAs Occurring Within or Near the Project Area), the proposed Project would likely result in moderate negative air quality impacts during construction and minor negative air quality impacts during operation and maintenance. The proposed Project may also result in a conservatively minor positive air quality impact in the Fairbanks non-attainment area during operation and maintenance. Because the EPA reclassified FNSB's air quality from "moderate" to "serious" this year and news sources have been comparing the air quality to Beijing, China, there is an increased urgency in the region to use cleaner fuels for heating. Proposed Project and RFFA actions that could result in potential impacts include the operation of fossil fuel-fired equipment, excavation and transportation activities, and ongoing operation and maintenance of temporary and permanent facilities and the pipeline.

A summary of potential past, present and RFFAs that may contribute to cumulative effects on air quality is presented in Table 4.26-23. These activities and events have been ranked using the impact criteria defined in Table 4.26-1 based on the magnitude or intensity of the impact, the geographic extent, the duration and the likelihood of occurrence. Air quality impacts arising from RFFAs are associated with increased levels of air contaminant concentrations and GHGs, increased fugitive dust, natural events and climate change, and decreased emissions because of increased access to natural gas.

Smoke and ash from wildfires frequently impact air quality across the state of Alaska during the summer season. Wildfire smoke contains gases and fine particles (those smaller than 2.5 μ in diameter) that could irritate eyes and the respiratory system as well as worsen chronic heart and lung conditions (CDC, 2017). Smoke generated from these seasonal fires would contribute to air contaminant concentrations produced through the combustion of fossil fuels during construction and operation activities associate with the proposed Project and other RFFAs. Increasing temperatures and drier seasonal conditions resulting from climate change could result in frequent droughts and insect infestations, which would contribute to an increase in wildfire frequency, duration, and magnitude (EPA, 2016c). Wildfire smoke would be a moderate impact on cumulative air quality as impacts could be regional, would result in a noticeable change in the resource, is mostly likely to happen, but temporary in duration.

During all phases of the proposed Project and during similar phases of current and RFFAs, the burning of fossil fuels would contribute to air pollution, atmospheric GHG concentrations, and an increased climate change potential. The addition of GHGs to the Earth's collective GHG pool could result in an increase in the greenhouse effect, resulting in a rise in the Earth's surface temperature. GHGs from human activities are the most significant driver of observed climate change according to the EPA, and contribute significantly to the warming effect of the plant (EPA, 2016d). Increasing

temperatures associated with climate change also have the potential to increase ground-level ozone, and possibly other air pollutants (EPA, 2016c).

The RFFAs discussed here present direct and indirect impacts to air quality resources within the proposed Project Area, independent of which alternative is selected. These RFFAs would therefore represent the only cumulative impacts associated with the No Action alternative (Alternative 3).

Construction and operation activities associated with the proposed Action would contribute to an increase in levels of air contaminant concentrations through the operation of fossil fuel-fired engines and during operation and maintenance of aboveground facilities. Current and future North Slope and interior Alaska oil and gas exploration and operations (RFFAs 28, 39-45), U.S. military activities (RFFAs 18-26), mining operations (RFFAs 6 and 7), and highway improvement projects (RFFAs 48-51) would contribute to the concentration of these contaminants within the proposed Project Area. These impacts would be both temporary and short-term and result from the operation of construction camp generators, excavators, trucks, and other diesel and gasoline powered motors needed for construction activities. Current and RFFAs near Denali NPP could impact the air quality monitoring data that is collected in the park as part of its Class I designation. Current and RFFAs near Denali NPP includes the highway construction along the Parks Highway. Increased traffic near the park as a result of any of the RFFAs included in Table 4.26-3 also has the potential to impact air quality within the park.

Air quality also would be affected by increases in fugitive dust associated with construction and operation activities. It is likely that most RFFAs identified as contributing to increases in the level of air contaminants would also contribute to increases in fugitive dust. Fugitive dust may be generated while conducting construction activities such as clearing, grading, excavating, and blasting activities, and during operation and maintenance by vehicle traffic.

Increasing the availability of utility grade natural gas to FNG or GVEA (RFFAs No. 37 and 53) could have minor, positive cumulative effect on eliminating the existing FNSB nonattainment area. The extent of this beneficial effect to air quality would be dependent upon existing energy sources (wood, fuel oil, and coal) being replaced with natural gas. Increasing the amount of natural gas would also depend on the unit cost of natural gas and costs to convert or upgrade existing equipment to use natural gas. Air quality would be improved to the extent utility grade natural gas is used as an energy-source substitute in homes, businesses, and military facilities. An increase in available natural gas from other existing sources and future developments were also included in Table 4.26-23 and considered positive cumulative net effects for air quality.

Alternatives 1 and 2 would result in similar impacts to air quality during both construction and operations phases of the proposed Project (*e.g.,* emissions from fossil fuel-fired vehicles and construction equipment and fugitive dust, etc.). RFFAs conducting similar activities would also contribute to similar impacts. Section 4.22.7,

Table 4.22-10 rates the level of impact of construction-related activities as moderate, and operation activities as minor for both Alternative 1 and 2. Cumulative air quality effects from RFFAs would also have a moderate impact during construction activities as they would likely occur, be short-term in duration, and could affect air quality on a regional level. Impacts from RFFA operation and maintenance would be minor as the degree of fugitive dust and air contaminants would be greatly reduced following the completion of construction activities. Overall, impacts from cumulative activities on contaminant concentrations and fugitive dust emissions are considered minor negative as the period over which moderate impacts would take place as a result of construction is significantly less than the operations phase.

4.26.9.17.1. Relevant Past/Present Actions, RFFAs and Natural Events Affecting Air Quality, Climate Change, and GHG Emissions

Table 4.26-23 summarizes the relevant past and present actions, RFFAs, and natural events that have already or may continue to impact air quality within the proposed Project Area.

Table 4.26-23 Past, Present, and RFFAs with Potential to Affect Air Quality, Climate Change, and GHG Emissions

RFFA or Natural Event	Past, Present, RFFA ID Number[a]	Net Effect	Types of Effects
Donlin Gold Mine, Livengood Gold, True North, Fort Knox, Ryan Lode Project	3, 4, 5, 6, 7, 36	Minor Negative	• Increase in levels of air contaminant concentrations • Increase in Fugitive Dust emissions
Port MacKenzie Rail Extension	53	Minor Negative	• Decreased emissions as a result of improved access to natural gas
Alaska Intertie Project - Rail Belt Power Pool Project	57	Minor Positive	• Decreased emissions as a result of improved electrical energy access
Fairbanks Gas Distribution System	37	Moderate Positive	• Decreased emissions as a result of improved access to natural gas
Cook Inlet Redevelopment Project	46	Moderate Positive / Negative	• Increase in levels of air contaminant concentrations • Increase in Fugitive Dust emissions • Decreased emissions as a result of improved access to natural gas
Ninilchik Plant Development	47	Moderate Positive / Negative	• Increase in levels of air contaminant concentrations • Increase in Fugitive Dust emissions • Decreased emissions as a result of improved access to natural gas
Wildfire	64	Moderate Negative	• Increase in levels of air contaminant concentrations
Management Plans	8 – 12	Major Positive	• Increase in levels of air contaminant concentrations • Increase in Fugitive Dust emissions • Decreased emissions as a result of improved access to natural gas

RFFA or Natural Event	Past, Present, RFFA ID Number[a]	Net Effect	Types of Effects
Military Installation Developments	18 – 26	Major Negative	• Increase in levels of air contaminant concentrations • Increase in Fugitive Dust emissions
North Slope Oil & Gas Exploration and Development	28, 31, 33, 35, 42 – 46	Major Negative/ Minor / Positive	• Increase in levels of air contaminant concentrations • Increase in Fugitive Dust emissions • Decreased emissions as a result of improved access to natural gas
Interior Alaska Oil & Gas Exploration and Development	39 – 41	Major Negative/ Minor Positive	• Increase in levels of air contaminant concentrations • Increase in Fugitive Dust emissions • Decreased emissions as a result of improved access to natural gas
Climate Change	67	Minor to Major Negative	• Increase in levels of air contaminant concentrations

a The RFFA number corresponds to the number listed in Table 4.26-3.

4.26.9.18. Noise

As discussed in Section 4.23 (Noise) and summarized in Table 4.26-3 (Past, Present, and RFFAs Occurring Within or Near the Project Area), the proposed Project would likely result in direct and indirect impacts ranging from minor to major during construction and operations. Noise impacts resulting from the proposed Project construction activities, ongoing operation and maintenance activities, pressure relief valves, and pipeline blowdowns may result in effects to ambient noise levels. Changes in ambient noise levels could in turn result in disturbance to sensitive receptors including both humans and wildlife. The most notable noise impacts would occur as a result of the Denali NPP Commercial Area HDD and the Kashwitna River HDD. Noise impacts would be temporary and intermittent throughout proposed Project construction and operations activities.

A summary of potential past, present and RFFAs that may contribute to cumulative effects on noise is presented in Table 4.26-24. These activities and events have been ranked using the impact criteria defined in Table 4.26-1 based on the magnitude or intensity of the impact, the geographic extent, the duration and the likelihood of occurrence. Noise from construction activities for the proposed Project could result in cumulative effects with other large construction projects if their construction phases occur concurrently and in close geographic proximity. The following activities are expected to result in the most notable cumulative noise impacts:

- Expansion of the FNG distribution system could create noise that would be local, short-term and temporary in the same geographic area and concurrently with construction of the Fairbanks Lateral. This is a developed area and sensitive receptors would include residential areas.

- Modifications to military installments (RFFAs No. 18-26) including infrastructure improvements at Clear Airforce Base and Eielson Air force Base near Fairbanks as well as Joint Base Elmendorf-Richardson (Anchorage) could result in cumulative noise impacts if construction occurred at the same time as construction of the proposed Project.
- Other oil and gas development projects including the Alaska LNG project, North Slope oil and gas exploration and development projects, and interior Alaska oil and gas exploration and development projects could cumulatively impact noise if construction were to take place at the same time as the proposed Project. The Icewine Oil Prospect (RFFA No. 45) and development projects near Houston and Willow (RFFA No. 39) would be likely to have the most notable cumulative impacts as they are in close geographic proximity with the proposed Project. Although noise impacts would be intermittent and temporary, TAPS (RFFA No. 35) operation and maintenance activities are likely to occur simultaneously with construction and operation of the proposed Project in close geographic proximity. The Alaska LNG project could result in similar noise impacts to those impacts resulting from the proposed Project; however, given the common purpose of both projects to deliver natural gas from the North Slope to Southcentral Alaska, it is unlikely both would be constructed.
- The Seward Marine Terminal expansion planning project (RFFA No. 59) includes plans to address improvements or additions to existing and future marine and land-based infrastructure, Mainline and/or yard rail configuration, road connectivity, and real estate utilization. Impacts resulting from this project combined with noise form increased traffic associated with the proposed Project would result in greater noise impacts to both human and wildlife receptors in this area.

Under Alternative 3, No Action, the impacts resulting from the events described above are expected to occur. These impacts would include

The noise impacts resulting from Alternative 1, the proposed Action are described in Section 4.23, Noise. Under Alternative 1, the impacts resulting from cumulative effects are expected to be similar to the effects of Alternative 1 for most of the proposed route. The exceptions are in the areas of Denali National Park and the Fairbanks Lateral for the reasons described below. While major negative effects could be expected near Denali National park during the construction phase, impacts during pipeline operations are expected to be negligible. Given the short duration of construction in comparison to operations, the expected cumulative noise impacts during both construction and operations is expected to be minor. Based on the events described above, it is possible that the Fairbanks area could see significant cumulative impacts to noise as a result of proposed projects in the area. Impacts to noise receptors resulting from construction of the Fairbanks Lateral are considered minor as the nearest receptors are at least a mile away from the proposed route, and construction is expected to occur over a period of two months. When combined with the potential impacts of the proposed military

installments and expansion of the FNG distribution system in the FNSB, the cumulative effects to noise receptors could increase in areas where receptors would intersect, if construction were to occur at the same time. It is also unlikely that these projects would be constructed at the same time, given the short construction period for the Fairbanks Lateral. It is difficult to estimate where the receptors of all projects in the area would intersect, and given this unknown, a conservative impact of minor is expected along the Fairbanks Lateral.

Under Alternative 2, the elimination of the Yukon River HDD and use of an aerial bridge crossing would reduce noise impacts in the area from moderate to minor. Cumulative effects are not expected to be significant in this area, so the cumulative effects are expected to be similar to those described under Alternative 1.

4.26.9.18.1. Relevant Past/Present Actions, RFFAs and Natural Events Affecting Noise

Table 4.26-24 summarizes the relevant past and present actions, RFFAs, and natural events that have already or may continue to impact noise within the proposed Project Area.

Table 4.26-24 Past, Present, and RFFAs with Potential to Affect Noise

RFFA or Natural Event	Past, Present, RFFA ID Number[a]	Net Effect	Types of Effects
Resource Management Plans, Conveyances and Refuges	8 - 17	Minor Positive	• Effects to Ambient Noise Levels • Disturbance • Stress and Biological Impacts
Donlin Gold Mine, Livengood Gold, True North, Fort Knox, Ryan Lode Project	3, 4, 5, 6, 7, 36	Minor Negative	• Effects to Ambient Noise Levels • Disturbance
Highway Improvements	48 – 51	Minor Negative	• Effects to Ambient Noise Levels • Disturbance • Stress and Biological Impacts
Ambler Mining District Access Road	55	Minor Negative	• Disturbance • Stress and Biological Impacts
Denali National Park and Preserve	16	Minor Negative	• Effects to Ambient Noise Levels • Disturbance • Stress and Biological Impacts
Military Installation Development	18 – 26	Moderate Negative	• Effects to Ambient Noise Levels • Disturbance
North Slope Oil & Gas Development and Exploration	28, 31, 33, 35, 42 – 46	Moderate Negative	• Effects to Ambient Noise Levels • Disturbance • Stress and Biological Impacts
Seward Marine Terminal Expansion Planning Project	59	Moderate Negative	• Effects to Ambient Noise Levels • Disturbance • Stress and Biological Impacts
Fairbanks Gas Distribution System	37	Moderate Negative	• Effects to Ambient Noise Levels • Disturbance • Stress and Biological Impacts

RFFA or Natural Event	Past, Present, RFFA ID Number[a]	Net Effect	Types of Effects
Alaska LNG Project	33	Moderate Negative	• Effects to Ambient Noise Levels • Disturbance • Stress and Biological Impacts

a The RFFA number corresponds to the number listed in Table 4.26-3.

4.26.9.19. Navigation Resources

Navigable waters have three distinct definitions: for navigation of vessels, for ownership of submerged land, and for regulatory authority for water quality purposes. This section addresses the waters used for navigational purposes as defined by USACE. The proposed Project would make 11 crossings over 8 different streams USACE considers navigable under Section 10 of the Rivers and Harbors Act. The proposed Project crossings of these water bodies would not result in a negative cumulative effect to vessel travel.

Ocean going vessels arriving at the Port of Seward would not require modifications to existing docking facilities or vessel traffic. The proposed Seward Marine Terminal Expansion Project could have short-term effects on navigation by displacing vessels within the Port Area. However, the duration of the proposed expansion project is not currently known. Similar effects are expected from the proposed ASAP Project at West Dock though dredging and modifications under Alternatives 1 and 2 are only expected to occur over two winter seasons and would only result in minor impacts to navigation in that localized area. Vessel traffic associated with summer delivery of the GCF modules under Alternatives 1 and 2 would cause short-term displacement of other regularly scheduled vessel traffic. However, this is only planned to occur over two-three month periods. Other RFFAs include vessel traffic in the Port of Seward associated with tourism, commercial and recreational fishing, commercial shipping and private vessels. The cumulative effects of Alternatives 1 and 2, when considered with the RFFAs within the proposed Project Area are expected to result in only minor negative cumulative effects on navigation. Under Alternative 3, it is possible that the AK LNG Project could proceed through the EIS and FERC permitting processes. Impacts associated with the AK LNG Project could include increased vessel traffic due to shipping or barge traffic as well as construction associated with the Seward Terminal Expansion project. Both of these impacts could result in negligible to moderate cumulative impacts on navigation. Changes in the specific details of proposed activities would require re-evaluation once those details are available.

4.26.9.19.1. Relevant Past/Present Actions, RFFAs, and Natural Events Affecting Navigation

Table 4.26-25 summarizes the relevant past and present actions, RFFAs, and natural events that have already or may continue to impact navigational resources within the proposed Project Area.

Table 4.26-25 Past, Present, and RFFAs with Potential to Affect Navigation Resources

RFFA or Natural Event	Past, Present, RFFA ID Number[a]	Net Effect	Types of Effects
Cook Inlet Redevelopment Project	46	Minor Negative	• Increased Vessel Traffic • Displacement of Routine Vessels
Earthquakes	66	Minor Negative	• Displacement of Routine Vessels
Cook Inlet Area wide Oil & Gas Lease Sales	32	Moderate Negative	• Increased Vessel Traffic • Displacement of Routine Vessels
North Slope Borough Comprehensive Plan and North Slope Management Plan	9, 10	Major Positive	• Increased Vessel Traffic • Displacement of Routine Vessels
North Slope Offshore Development Projects	28, 31, 35, 43, 43a, 43b	Moderate Negative	• Increased Vessel Traffic • Displacement of Routine Vessels
Alaska LNG Project	33	Moderate Negative	• Increased Vessel Traffic • Displacement of Routine Vessels
Seward Marine Terminal Expansion Planning Project	59	Moderate Negative	• Increased Vessel Traffic • Displacement of Routine Vessels
Marine Shipping and Other Vessel Traffic	59a	Moderate Negative	• Increased Vessel Traffic

a The RFFA number corresponds to the number listed in Table 4.26-3.

4.26.9.20. Summary of Cumulative Impacts of Alternatives 1 and 2

Table 4.26-26 provides a summary of impacts to Alternatives 1 and 2 as a result of the proposed Project Alternatives 1 and 2 and compares this with the expected cumulative effects of the proposed Project combined with past, present, and RFFAs.

Table 4.26-26 Summary of Direct, Indirect, and Cumulative Effects

	Alternative 1		Alternative 2		Alternative 3	
Types of Effects	**Construction**	**Operation**	**Construction**	**Operation**	**Construction**	**Operation**
Soils & Geology						
Effects to local topography, soil, and geology	*Major (-)*	*Major (-)*	*Major (-)*	*Major (-)*	*Negligible*	*Negligible*
Effects to permafrost and geology	*Major (-)*	*Major (-)*	*Major (-)*	*Major (-)*	*Negligible*	*Negligible*
Water						
Altered Surface Water Quality	*Moderate (-)*	*Minor (-)*	*Moderate (-)*	*Minor (-)*	*Negligible*	*Negligible*
Altered Groundwater	*Major (-)*	*Moderate (-)*	*Major (-)*	*Moderate (-)*	*Negligible*	*Negligible*
Stream Bank Stabilization and Geomorphology	*Moderate (-)*	*Moderate (-)*	*Moderate (-)*	*Moderate*	*Negligible*	*Negligible*
Flooding	*Moderate (-)*	*Moderate (-)*	*Moderate (-)*	*Moderate (-)*	*Negligible*	*Negligible*
Altered Water Availability	*Moderate (-)*	*Moderate (-)*	*Moderate (-)*	*Moderate (-)*	*Negligible*	*Negligible*
Vegetation					*Negligible*	*Negligible*
Vegetation Loss/Disturbance	*Moderate (-)*	*Minor (-)*	*Moderate (-)*	*Minor (-)*	*Negligible*	*Negligible*
Non-native, Invasive, and Noxious Plants	*Moderate (-)*	*Moderate (-)*	*Moderate (-)*	*Moderate (-)*	*Negligible*	*Negligible*
Habitat Fragmentation	*Major (-)*	*Minor (-)*	*Major (-)*	*Minor (-), Negligible on the Beaufort Coastal Plain*	*Negligible*	*Negligible*
Soil Compaction and Erosion	*Moderate (-)*	*Minor (-)*	*Moderate (-)*	*Minor (-)*	*Negligible*	*Negligible*
Wetlands						
Loss of Wetlands	*Moderate (-)*	*Minor (-)*	*Moderate (-)*	*Minor (-)*	*Negligible*	*Negligible*
Wetland Fragmentation	*Major (-)*	*Minor (-)*	*Major (-), Moderate (-) on the Beaufort Coastal Plain*	*Minor (-), Negligible on the Beaufort Coastal Plain*	*Negligible*	*Negligible*
Change in Function, Value, or Water Type Code	*Ranging from Minor to Moderate (-)*	*Minor (-)*	*Ranging from Minor to Moderate (-)*	*Minor (-)*	*Negligible*	*Negligible*
Wildlife						
Mortality	*Minor (-)*	*Minor (-)*	*Minor (-)*	*Minor (-)*	*Negligible*	*Negligible*
Reproductive Effects/Function/Health/ Resilience	*Moderate (-)*	*Moderate (-)*	*Moderate (-)*	*Moderate (-)*	*Negligible*	*Negligible*
Fish						
Mortality	*Minor (-)*	*Negligible*	*Minor (-)*	*Negligible*	*Negligible*	*Negligible*
Reproductive Effects/Growth/Health/ Distribution	*Minor (-)*	*Negligible*	*Minor (-)*	*Negligible*	*Negligible*	*Negligible*

	Alternative 1		Alternative 2		Alternative 3	
Types of Effects	**Construction**	**Operation**	**Construction**	**Operation**	**Construction**	**Operation**
Effects to habitat	*Minor (-)*	*Negligible*	*Minor (-)*	*Negligible*	*Negligible*	*Negligible*
Marine Mammals						
Mortality	*Minor (-)*	*Negligible*	*Minor (-)*	*Negligible*	*Negligible*	*Negligible*
Displacement, Disturbance, Diminished Reproduction	*Ranging from Minor to Moderate (-)*	*Negligible*	*Ranging from Minor to Moderate (-)*	*Negligible*	*Negligible*	*Negligible*
Disease, Invasives, Predation, Exposure to Toxins	*Negligible*	*Negligible*	*Minor (-)*	*Negligible*	*Negligible*	*Negligible*
Benthic						
Mortality	*Negligible*	*Negligible*	*Minor (-)*	*Negligible*	*Negligible*	*Negligible*
Reproductive Effects/Function/Health/ Resilience	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*
Threatened & Endangered Species						
Injury or Mortality	*Moderate (-) if injury or mortality, Minor if disturbance*	*Moderate (-) if injury or mortality, Minor if disturbance*	*Moderate (-) if injury or mortality, Minor if disturbance*	*Moderate (-) if injury or mortality, Minor if disturbance*	*Negligible*	*Negligible*
Physical habitat loss, alteration, and fragmentation	*Minor (-)*	*Minor (-)*	*Minor (-)*	*Minor (-)*	*Negligible*	*Negligible*
Biological and behavioral responses to disturbance, including changes to distributions	*Minor (-)*	*Minor (-)*	*Minor (-)*	*Minor (-)*	*Negligible*	*Negligible*
Changes to predator distributions and increased predation	*Minor (-)*	*Minor (-)*	*Minor (-)*	*Minor (-)*	*Negligible*	*Negligible*
Introduced non-native, invasive, and parasitic species	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*
Turbidity	*Minor (-)*	*Minor (-)*	*Minor (-)*	*Minor (-)*	*Negligible*	*Negligible*
Spills and Contaminants	*Minor (-)*	*Minor (-)*	*Minor (-)*	*Minor (-)*	*Negligible*	*Negligible*
Land Use						
Effects to Land Use Planning and Conservation	*Minor (-)*	*Minor (-)*	*Minor (-)*	*Minor (-)*	*Negligible*	*Negligible*
Effects to Existing Transportation and Utilities; Easements/ROW Rights	*Minor (-)*	*Minor (-)*	*Minor (-)*	*Minor (-)*	*Negligible*	*Negligible*
Effects to Forestlands; Agriculture; Important Farmlands; Developed Areas	*Moderate (-)*	*Moderate (-)*	*Moderate (-)*	*Moderate (-)*	*Negligible*	*Negligible*
Waste Generation	*Minor (-)*	*Minor (-)*	*Minor (-)*	*Minor (-)*	*Negligible*	*Negligible*
Land Ownership and Zoning	*Minor (-)*	*Minor (-)*	*Minor (-)*	*Minor (-)*	*Negligible*	*Negligible*
Recreation						

	Alternative 1		Alternative 2		Alternative 3	
Types of Effects	**Construction**	**Operation**	**Construction**	**Operation**	**Construction**	**Operation**
Changes to Recreational Quality	*Moderate (-)*	*Minor (-)*	*Moderate (-)*	*Minor (-)*	*Negligible*	*Negligible*
Changes to Recreational Access	*Moderate (-)*	*Minor (-)*	*Moderate (-)*	*Minor (-)*	*Negligible*	*Negligible*
Visual						
MP 0 to MP 62 (GCF to TAPS PS2)	*Moderate (-)*	*Minor (-)*	*Moderate (-)*	*Moderate (-)*	*Negligible*	*Negligible*
MP 62 to MP 400 (TAPS PS2 to Livengood)	*Moderate (-)*	*Minor (-)*	*Moderate (-)*	*Moderate (-)*	*Negligible*	*Negligible*
MP 400 to MP 535 Livengood to Denali NPP	*Moderate (-)*	*Minor (-)*	*Moderate (-)*	*Moderate (-)*	*Negligible*	*Negligible*
MP 535 to MP 634 Denali NPP to Byers Lake in Denali State Park	*Moderate (-)*	*Moderate (-)*	*Moderate (-)*	*Moderate (-)*	*Negligible*	*Negligible*
MP 634 to End	*Moderate (-)*	*Moderate (-)*	*Moderate (-)*	*Moderate (-)*	*Negligible*	*Negligible*
Fairbanks Lateral: Along Murphy Dome and Old Murphy Dome Roads	*Minor (-)*	*Minor (-)*	*Minor (-)*	*Minor (-)*	*Negligible*	*Negligible*
Denali NPP Route Variation: Mainline MP 536 to MP 543	*N/A*	*N/A*	*Moderate (-)*	*Minor (-)*	*N/A*	*N/A*
Socioeconomics						
Population Trends and Projections	*Moderate (-)*	*Moderate (-)*	*Moderate (-)*	*Moderate (-)*	*Negligible*	*Negligible*
Employment	*Major (+)*	*Moderate (+)*	*Major (+)*	*Moderate (+)*	*Negligible*	*Negligible*
Housing and Property Values	*Moderate (-)*	*Moderate (-)*	*Moderate (-)*	*Moderate (-)*	*Negligible*	*Negligible*
Government Revenue and Expenditures	*Major (-)*	*Major (+)*	*Major (-)*	*Moderate (+)*	*Negligible*	*Negligible*
Infrastructure and Services	*Moderate (-)*	*Major (-)*	*Moderate (-)*	*Major (-)*	*Negligible*	*Negligible*
Increased Energy Supply	*Negligible*	*Major (+)*	*Negligible*	*Major (+)*	*Negligible*	*Negligible*
Cultural Resources[a]						
Cultural Resource Effects – Direct Impact Area	*Major (-) (26)*		*Major (-) (25)*		*Negligible*	
Cultural Resource Effects – Direct Impact Area	*Moderate (-) (11)*		*Moderate (-) (10)*		*Negligible*	
Cultural Resource Effects – Direct Impact Area	*Minor (-) (21)*		*Minor (-) (21)*		*Negligible*	
Cultural Resource Effects – Direct Impact Area	*Negligible (14)*		*Negligible (14)*		*Negligible*	
Subsistence[b]						
Communities with Impact Ranking: 15-18	*Major (-) (3)*	*Major (-) (2)*	*Major (-) (3)*	*Major (-) (2)*	*Negligible*	*Negligible*
Communities with Impact Ranking: 10-14	*Moderate (-) (10)*	*Moderate (-) (11)*	*Moderate (-) (10)*	*Moderate (-) (11)*	*Negligible*	*Negligible*
Communities with Impact Ranking: 5-9	*Minor (-) (16)*	*Minor (-) (7)*	*Minor (-) (16)*	*Minor (-) (7)*	*Negligible*	*Negligible*
Communities with Impact Ranking: 0-4	*Negligible (22)*	*Negligible (31)*	*Negligible (22)*	*Negligible (31)*	*Negligible*	*Negligible*
Public Health						
Social Determinants of Health	*Moderate (-)*	*Moderate (-)*	*Moderate (-)*	*Moderate (-)*	*Negligible*	*Negligible*

	Alternative 1		Alternative 2		Alternative 3	
Types of Effects	**Construction**	**Operation**	**Construction**	**Operation**	**Construction**	**Operation**
Accidents and Injuries	*Moderate (-)*	*Moderate (-)*	*Moderate (-)*	*Moderate (-)*	*Negligible*	*Negligible*
Exposure to Hazardous Materials	*Moderate (-)*	*Minor (-)*	*Moderate (-)*	*Minor (-)*	*Negligible*	*Negligible*
Food, Nutrition, and Subsistence Activity	*Moderate (-)*	*Moderate (-)*	*Moderate (-)*	*Moderate (-)*	*Negligible*	*Negligible*
Infectious Disease	*Moderate (-)*	*Moderate (-)*	*Moderate (-)*	*Moderate (-)*	*Negligible*	*Negligible*
Water and Sanitation	*Minor (-)*	*Negligible*	*Minor (-)*	*Negligible*	*Negligible*	*Negligible*
Non-Communicable and Chronic Disease	*Moderate (-)*	*Minor (+)*	*Moderate (-)*	*Minor (+)*	*Negligible*	*Minor (-)*
Health Services Infrastructure and Capacity	*Minor (-)*	*Negligible*	*Minor (-)*	*Negligible*	*Negligible*	*Negligible*
Air Quality, Climate Change, and Greenhouse Gas Emissions						
Increased levels of air contaminant concentrations (criteria pollutants and HAPs)	*Moderate (-)*	*Minor (-)*	*Moderate (-)*	*Minor (-)*	*Negligible*	*Negligible*
Increased Fugitive Dust emissions	*Moderate (-)*	*Minor (-)*	*Moderate (-)*	*Minor (-)*	*Negligible*	*Negligible*
Decreased emissions as a result of improved access to natural gas	*Negligible*	*Minor (+)*	*Negligible*	*Minor (+)*	*Negligible*	*Negligible*
Noise[c]						
Channel Dredging and Access Construction on Prudhoe Bay	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*
Mainline Segment 1a	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*
Mainline Segment 1b	*Minor (-)*	*Negligible*	*Minor (-)*	*Negligible*	*Negligible*	*Negligible*
Yukon River HDD Residential	*Moderate (-)*	*N/A*	*N/A*	*N/A*	*Negligible*	*Negligible*
Recreational	*Negligible*	*N/A*	*N/A*	*N/A*	*Negligible*	*Negligible*
Yukon Aerial Crossing (Suspension Bridge Construction) Residential	*N/A*	*N/A*	*Major (-)*	*Negligible*	*Negligible*	*Negligible*
Recreational	*N/A*	*N/A*	*Negligible*	*Negligible*	*Negligible*	*Negligible*
Mainline Segment 2 Residential	*Minor (-)*	*Negligible*	*Minor (-)*	*Negligible*	*Negligible*	*Negligible*
Recreational	*Ranging from Minor to Moderate (-)*	*Ranging from Negligible to Minor (-)*	*Ranging from Minor to Moderate (-)*	*Ranging from Negligible to Minor (-)*	*Negligible*	*Negligible*
Tanana River HDD Residential	*Moderate (-)*	*N/A*	*Moderate (-)*	*N/A*	*Negligible*	*Negligible*
Recreational	*Negligible*	*N/A*	*Negligible*	*N/A*	*Negligible*	*Negligible*
Mainline Segment 3 Residential	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*

		Alternative 1		Alternative 2		Alternative 3	
Types of Effects		**Construction**	**Operation**	**Construction**	**Operation**	**Construction**	**Operation**
	Recreational	*Ranging from Minor to Moderate (-)*	*Ranging from Negligible to Minor (-)*	*Ranging from Minor to Moderate (-)*	*Ranging from Negligible to Minor (-)*	*Negligible*	*Negligible*
Denali NPP Route Variation	Residential	*N/A*	*N/A*	*Negligible*	*Negligible*	*Negligible*	*Negligible*
	Recreational	*N/A*	*N/A*	*Moderate (-)*	*Negligible*	*Negligible*	*Negligible*
Denali NPP Commercial Area HDD		*Major (-)*	*N/A*	*Major (-)*	*N/A*	*Negligible*	*Negligible*
	Recreational	*Major (-)*	*N/A*	*Major (-)*	*N/A*	*Negligible*	*Negligible*
Honolulu Creek HDD		*Negligible*	*N/A*	*Negligible*	*N/A*	*Negligible*	*Negligible*
Mainline Segment 4	Residential	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*
	Recreational	*Minor (-)*	*Negligible*	*Minor (-)*	*Negligible*	*Negligible*	*Negligible*
Troublesome Creek HDD		*Negligible*	*N/A*	*Negligible*	*N/A*	*Negligible*	*Negligible*
Chulitna River HDD		*Negligible*	*N/A*	*Negligible*	*N/A*	*Negligible*	*Negligible*
Kashwitna River HDD	Residential	*Major (-)*	*N/A*	*Major (-)*	*N/A*	*Negligible*	*Negligible*
	Recreational	*Negligible*	*N/A*	*Negligible*	*N/A*	*Negligible*	*Negligible*
Willow Creek HDD		*Negligible*	*N/A*	*Negligible*	*N/A*	*Negligible*	*Negligible*
Fairbanks Lateral	Residential	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*
	Recreational	*Minor (-)*	*Negligible*	*Minor (-)*	*Negligible*	*Negligible*	*Negligible*
Navigation							
Increased Navigational Resource Use by Vessels		*Minor (-)*	*Negligible*	*Minor (-)*	*Negligible*	*Negligible*	*Negligible*
Displacement of Vessels from Current Route		*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*
Non-native and Invasive Species		*Negligible*	*N/A*	*Negligible*	*N/A*	*Negligible*	*Negligible*
Reliability and Safety							
Fatalities		*Minor (-)*	*Minor (-)*	*Moderate (-)*	*Minor (-)*	*Negligible*	*Negligible*
Injuries or Property Damage (>$114,000)		*Moderate (-)*	*Minor (-)*	*Moderate (-)*	*Minor (-)*	*Negligible*	*Negligible*
Gas Supply Interruptions		*N/A*	*Moderate (-)*	*N/A*	*Moderate (-)*	*N/A*	*N/A*

a For cultural resources, the effect categories are not mutually exclusive, and certain effects (*e.g.*, introduction of vibration, noise, or atmospheric elements) could occur from construction activities, operational activities, and/or proposed Project infrastructure. For this reason, the construction and operational impacts are expected to be similar. Additionally, cultural resources are categorized by the number of sites at each impact ranking rather than type of impact. The number in parenthesis indicates how many communities/cultural resource sites may be affected.
b The number in parenthesis for subsistence indicates how many communities may be affected.
c Impact ratings for noise are the same for residential and recreational in rows that are not divided.

4.26.9.21. Cumulative Effects Associated with Alternative 3 (No Action)

Under the No Action alternative, energy demand for natural gas in the rail belt would not be met with known natural gas resources from the Cook Inlet area. Without an additional source of natural gas, the state and local jurisdictions and local utilities would need to be aggressive in finding ways to meet existing and future energy demands. The measures currently being considered include energy conservation, using depleted natural gas reservoirs for temporary storage to meet short falls of natural gas during extended cold snaps, importing LNG, constructing wind farms and new hydroelectric projects, and providing additional economic incentives to discover and develop commercially viable natural gas resources in the Cook Inlet area. The FNG and GVEA are separately exploring the opportunity to produce and truck LNG from Prudhoe Bay to Fairbanks. Restarting the Healy Clean Coal electrical generating facility is being considered and ADEC recently issued a permit for the restart of that project. All of these options are in the active consideration and/or planning stages. In the long-term, there is potential that electrical generation could be produced economically by tidal currents, geothermal potential on the flanks of Mount Spurr, or converting municipal solid waste to heat and electrical energy. Currently, these later activities are considered speculative, until such time that they could be shown to be economically feasible, and are not discussed further.

An estimated peak of 6,400 temporary construction jobs and 50-75 permanent jobs associated with the proposed Project would not materialize. An additional unknown number of jobs associated with constructing and operating the flow lines on the North Slope would also not occur. The potential property tax and land lease revenues from the estimated $9.97 billion proposed Project would not be realized.

Under the No Action alternative, it is recognized the AK LNG Project could proceed through the EIS and FERC permitting processes. While currently not part of the AK LNG Project design, there would remain the potential to construct a lateral pipeline system to Cook Inlet. This spur line could follow the general proposed Project alignment from the Fairbanks area. However, it is unlikely that the AK LNG Project would be operational before there would be a significant short fall of natural gas in the rail belt area.

Energia Cura on behalf of the Fairbanks Pipeline Company (FPC) in August 2010 published a "Non-Binding Open Season-Basic Package" describing a proposal to construct the "Arctic Fox Natural Gas Pipeline system." The Arctic Fox project conceptually involves a market based 514-mile-long, 12- to 18-inch buried pipeline system from the North Slope to Fairbanks. Potential customers would be GVEA, FNG, Flint Hills Refinery and local military bases. FPC announced its intention to start negotiations with gas producers for the acquisition of natural gas for the Arctic Fox project. Details of those negotiations, which were expected to be completed by March 2011, have not been announced (FPC, 2011). No applications for construction of the Arctic Fox project have been filed. The initial projected start-up date was 2014. Under

the No Action alternative, it is reasonably foreseeable that Energia Cura/FPC would re-evaluate the Arctic Fox project and its relationship to the APP and then determine whether to proceed with developing the detailed information necessary to permit and construct the conceptual pipeline system.

The No Action alternative would eliminate one set of proximity issues with TAPS, Highways, and the Intertie. It also would reduce long-term competition for use of existing gravel sources needed for maintenance of TAPS, highways, and ARRC between the North Slope and MP 401. A linear modification for 727 miles of vegetation and wetlands would reduce the cumulative effects within the PLO 510 Transportation Corridor between the North Slope and MP 401, and the transportation and utility corridors occupied by the Parks Highway, ARRC, and Intertie. New disturbances across the Minto Flats State Game Refuge and from MP 701 to 727 would be eliminated, as would proximity issues to Denali State Park, Nancy Lake State Park and other smaller units of the state park and state recreation and rivers systems. The existing viewshed on state land associated with the entrance area to Denali NPP would be retained, but extending the pedestrian/bike path to McKinley Village would not occur. Overall, negative cumulative impacts of the No Action alternative are likely to be mostly economic. Air quality and public health benefits in the Fairbanks area that would result from the proposed Project and a Fairbanks gas distribution system (as described in Section 4.21, Public Health) would not be realized.

4.27. Irreversible and Irretrievable Commitments of Resources

An irreversible or irretrievable commitment of resources refers to impacts on or losses to resources that cannot be recovered or reversed. Examples include permanent conversion of wetlands, or loss of cultural resources, soils, wildlife, and socioeconomic conditions. The losses are permanent. Irreversible is a term that describes the loss of future options. It applies primarily to the effects of use of nonrenewable resources, such as natural gas or cultural resources, or to those factors, such as soil productivity, that are renewable only over long periods of time. Irretrievable is a term that applies to the loss of production or use of natural resources. The production lost is irretrievable, but the action is not irreversible. Following is a summary of irreversible and irretrievable commitments of resources associated with the proposed ASAP Project and Alternatives.

4.27.1. Alternatives 1 (Proposed Action) and 2 (Denali NPP Route Variation)

Proposed Alternatives 1 and 2 would irreversibly and irretrievably commit a broad range of natural, physical, human, and financial resources. Each of these alternatives would adversely affect soils, vegetation, wetlands, and habitat within the proposed Project Area. Although mitigation measures would be implemented during proposed Project construction, re-creation or restoration of some of these areas would not be possible.

A substantial amount of construction materials such as gravel fill and steel would be expended. Substantial amounts of human labor and physical resources would be used to

fabricate and prepare construction materials, and these resources are generally not retrievable. However, these resources are not in short supply, and their use would not have an adverse effect upon their continued availability; construction is not predicted to exhaust known sources of these materials. In addition, the purpose of the proposed Project is to irreversibly and irretrievably use natural gas resources.

Either of the proposed Alternatives 1 or 2 would require a substantial expenditure of funds, which would not be retrievable. As stated in Section 2.6.3, the [cost estimate] for the proposed ASAP Project (as described in its Clean Water Act 404/10 application) is based on an Association for the Advancement of Cost Engineering Class 3 level of engineering design and cost information. The 2014 cost estimate for Class 3 Total Installed Cost with contingency for Alternative 1 was approximately $9.9 billion (AGDC, 2016f). The Class 3 cost estimate has an accuracy of +/- 20 percent and takes into account a large number of factors that are subject to change. The Total Installed Cost with Contingency for Alternative 2 would be greater than Alternative 1 given the increased amount of steel and man-hours required to install the pipeline aboveground on VSMs between MP 0 and 62 (see Section 2.6.3). These cost estimates do not include costs for operations or maintenance.

4.27.2. Alternative 3 (No Action)

Alternative 3 (No Action) would involve no construction, and therefore, would not irreversibly or irretrievably commit resources.

4.28. Short-term and Long-term Productivity

Under NEPA, the assessment of environmental impacts considers the natural productivity of the land to be long-term, renewable resource, whereas a developed use of land is considered a short-term use with a relatively short economic life. Therefore, conversion of the land use from its natural productivity to a developed use is an environmental impact.

4.28.1. Alternatives 1 (Proposed Action) and 2 (Denali NPP Route Variation)

For the proposed ASAP Project, the long-term productivity that would be lost is the current productivity of soils, wetlands, and vegetated uplands within the proposed cut and fill limits of Alternatives 1 and 2. This natural productivity would be replaced by the short-term use of the land for the purposes of transporting natural gas for the life of the proposed Project.

However, it is assumed these short-term uses of the environment by the proposed Project would be consistent with federal, state, and local land use plans, which are the same for Alternatives 1 and 2. In this context, there is little difference between proposed Project alternatives.

4.28.2. Alternative 3 (No Action)

Under Alternative 3 (No Action), there would be no development of natural land; therefore, there would be no adverse effect on the long-term productivity of the renewable resources within the proposed Project Area.