BIOLOGICAL OPINION

For

Willow Master Development Plan

Consultation with:

U.S. Bureau of Land Management
Arctic District Office
Fairbanks, Alaska

U.S. Army Corps of Engineers
Alaska District
Anchorage, Alaska

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LIST OF ABBREVIATIONS USED IN THIS DOCUMENT

ABR	Alaska Biological Research, Inc.
ACP	Arctic Coastal Plain
ADEC	Alaska Department of Environmental Conservation
ADF&G	Alaska Department of Fish and Game
AO	Authorized Official
AOGCC	Alaska Oil and Gas Conservation Commission
BA	Biological Assessment
BMP	Best Management Practice
BLM	Bureau of Land Management
BO	Biological Opinion
BOEM	Bureau of Ocean Energy Management
CI	Confidence Interval
CPF	Central Processing Facility
CRD	Colville River Delta
CS	Chukchi Sea Subpopulation of Polar Bears
DEC	Department of Environmental Conservation
DEIS	Draft Environmental Impact Statement
DMA	Division of Management Authority
DOI	Department of Interior
DPS	Distinct Population Segment
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FR	Federal Register
GIS	Geographic Information System
HSM	Horizontal Support Member
IPCC	Intergovernmental Panel on Climate Change
ITRs	Incidental Take Regulations
ITS	Incidental Take Statement
IUCN	International Union for Conservation of Nature and Natural Resources
LBCHU	Ledyard Bay Critical Habitat Unit
LOA	Letter of Authorization
MLLW	Mean Lower Low Water
MMPA	Marine Mammal Protection Act
MSIP	Multi Season Ice Pad
MTR	Marine Transit Route
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NPR-A	National Petroleum Reserve Alaska
NSE	North Slope Eider Survey
NSIDC	National Snow and Ice Data Center
OC	Organochlorine Compound
OSR	Oil Spill Response Plan

PBCMP	Polar Bear Conservation Management Plan
PBF	Physical or Biological Features
PBSG	Polar Bear Specialist Group
PCB	Polychlorinated Biphenyls
PCE	Primary Constituent Element
PCH	Porcupine Caribou Herd
POP	Persistent Organic Pollutant
ROD	Record of Decision
ROP	Required Operating Procedure
RPM	Reasonable and Prudent Measure
SBS	Southern Beaufort Sea Subpopulation of Polar Bears
SE	Standard Error
SD	Standard Deviation
SPCCP	Spill Prevention, Control, and Countermeasure Plans
STP	Seawater Treatment Plant
TAPS	Trans-Alaska Pipeline System
USACE	U.S. Army Corps of Engineers
USCG	U.S. Coast Guard
USGS	U.S. Geological Survey
USFWS	U.S. Fish and Wildlife Service
VSM	Vertical Support Member

1. INTRODUCTION

This document transmits the U.S. Fish and Wildlife Service's (Service or USFWS) biological opinion (BO) in accordance with section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 *et seq*.), on a proposal by the Bureau of Land Management (BLM) to issue authorization, and the U.S. Army Corps of Engineers Alaska District (USACE) to issue a permit under Section 404 of the Clean Water Act (33 U.S.C. 1344), for Conoco Phillips Alaska Inc. (CPAI) to construct, operate, and maintain the Willow Master Development Plan (MDP) Project (Project) on lands managed by BLM within the National Petroleum Reserve in Alaska (NPR-A). This BO evaluates the potential effects of the proposed Project on species under the Service's jurisdiction that are listed as threatened or endangered, and designated critical habitat pursuant to the ESA.

The ESA establishes a national program for conserving threatened and endangered species of fish, wildlife, plants, and the habitats on which they depend. Section 7(a)(2) of the ESA states that Federal agencies must ensure that their activities are not likely to:

- Jeopardize the continued existence of any listed species, or
- Result in the destruction or adverse modification of designated critical habitat.

Federal agencies fulfill this obligation by consulting with the Service or National Marine Fisheries Service (NMFS), depending on the species potentially affected (50 C.F.R. §402.14(a)). If a federal action agency determines that an action "may affect, but is not likely to adversely affect" endangered species, threatened species, or designated critical habitat and the consulting agency (the Service or NMFS, as appropriate) concurs, consultation concludes informally (50 C.F.R. §402.14(b)). In the event of a determination that one or more listed species or designated critical habitat are "likely to be adversely affected" by the action, formal consultation is conducted. In this case, the BLM determined (BLM 2022a) that one or more listed species would likely be adversely affected by the proposed Project, so formal consultation was initiated.

The consultation addresses potential effects of the proposed Project on threatened spectacled eiders (*Somateria fischeri*), Alaska-breeding Steller's eiders (*Polysticta stelleri*), polar bears (*Ursus maritimus*), northern sea otters (*Enhydra lutris kenyoni*), and areas designated as critical habitat for these four species, as appropriate. We used information provided in the Biological Assessment (BA; BLM 2022a and appendices[BLM 2022b]), NPR-A Integrated Activity Plan/Record of Decision (BLM 2022c), communications with BLM and USACE, previous BOs, other Service documents, and published and unpublished literature to develop this BO.

2. DESCRIPTION OF THE PROPOSED ACTION

Proposed Action Summary

Based on information provided by BLM, CPAI would construct an all-season gravel road from the existing Greater Mooses Tooth 2 (GMT-2) development southwest to the Project area (Figure 2.1). The Project would include the Willow Processing Facility (WPF), Willow Operations Center (WOC), four gravel drill pads, gravel access and infield roads, airstrip, import and export pipelines, Tiŋmiaqsiuġvik gravel mine site, sealift module delivery via barges, improvements at Oliktok Dock, and an offshore screeding at the barge lightering area. Each of these components is described in detail in subsequent sections. The area where most of the onshore gravel infrastructure would occur (area near the drill sites and new infield and access roads) is referred to as the Project area. Construction would occur over 8 years, and the total Project life would be 30 years (see detailed Project timeline and schedule below). Project-specific *Minimization, Avoidance, and Mitigation* measures that have been incorporated into the Project to reduce Project impacts to the environment are also detailed below.

Proposed Project components

Project Facilities and Gravel Pads **-** Project pads would be constructed for drill sites and support infrastructure (e.g., WPF, WOC, pipeline valve pads). Pads would be constructed of gravel fill and would be a minimum of 5 feet (1.5 m) thick to maintain a stable thermal regime and to protect underlying permafrost. The average thickness and gravel fill volume needed for each pad vary depending on site-specific topography and design criteria. As the topography of the Project area is generally more variable than developments located to the east, average pad thickness would exceed 7 feet (2.1 m) to provide a flat gravel surface above the undulating ground surface. CPAI would use insulation where practicable to reduce the average height, volume and acreage of gravel fill while maintaining thermal properties required to protect permafrost. Embankment side slopes would have a 2 horizontal to 1 vertical ratio (2:1). Erosion potential would be evaluated on a pad-specific basis, and embankment erosion protection measures would be designed and employed as necessary.

Willow Processing Facility – The roughly 22.8 acre (0.092 km^2) WPF would house the main plant facilities for separating and processing produced multiphase fluids (e.g., oil, gas, water) and delivering sales-quality crude oil to the Trans-Alaska Pipeline System. The WPF would be approximately 20.1 miles (32.3 km) from the coast. Produced water, also processed at the WPF, would be re-injected to the subsurface formation to maintain reservoir pressure. Produced natural gas would fuel the WPF and other Project equipment (including electrical power generation), and would be re-injected into a producing reservoir formation to maintain reservoir pressure and be used for gas lift. During WPF startups, shutdowns, and upset conditions, natural gas may be flared; flaring may also occur during predrilling activity at drill sites Bear Tooth 1 (BT1) and 2 (BT2) to support initial well cleanout, stimulation cleanout, and well testing.

Figure 2.1. Overview of the proposed Project in northeast NPR-A, including permanent (gravel) and seasonal infrastructure, existing Kuparuk Unit infrastructure east of the Colville River, and Oliktok Dock.

Processing equipment at the WPF would include emergency shutdown equipment, natural-gas-fired turbine generators, gas-turbine compressors, gas strippers, gas treatment facilities, heat exchangers, separators, stabilizer unit, flare system, utility systems (e.g., heating glycol, nitrogen), oil-producing vessels, pumps, pigging and metering facilities, electrical equipment, fuel supply storage tanks and dispensing facilities, tank farm, and warm storage facilities for equipment.

Willow Operations Center – The roughly 31.3 acre (0.13 km^2) WOC would be located near the WPF and adjacent to the airstrip, approximately 19.2 miles (30.8 km) from the coast. The WOC would contain utility buildings and storage facilities, including the Willow operations camp (living quarters, offices, meeting rooms, dining facilities, central control building, laboratory, medical clinic, and wellness facilities), water and wastewater treatment plants, water tanks, chemical storage, freshwater storage tanks, at least 2 Class I underground injection control disposal well(s), emergency response center (spill response shop, fire department, ambulance bay), essential and emergency generators, gas-turbine generator, hazardous waste storage, drilling shop, craft maintenance shops and tool room, fleet maintenance shop, fabrication and welding shop, warehouse, storage tents, diesel and jet fuel tanks and pump skids, drilling shop, staging areas, drill cuttings storage, operation and maintenance storage, laydown space, rolling stock parking, and a solid waste incinerator.

Airstrip and Associated Facilities – A gravel airstrip would be constructed adjacent to the WOC to provide year-round access to the Project area. The gravel airstrip would be 5,700-foot-long (1,737-m-long) × 200-foot-wide (61-m-wide) with an area of 42.2 acres or 0.17 km^2. The airstrip would be capable of supporting Hercules C-130, DC-6, Otter, CASA, and Bombardier Q400 aircraft, or similar. Additional airstrip facilities would include an air traffic advisory center and approach lighting with airstrip module lighting pads. Trenching may be required to bury power and communications cables between the WOC and airstrip, and along the airstrip between modules and lighting components. Fueling and chemical deicing of aircraft are planned on the airstrip apron; chemical deicing of the runway is not anticipated.

Drill Site Pads – Four drill sites: BT1, BT2, BT3, and BT5[1] would be constructed to house 219 wells. Collectively, drill pads would occupy approximately 68 acres (0.28 km^2). Each drill site would accommodate up to 80 wells, drilling and operations facilities, wellhead shelters, drill rig movement, and material storage. Drill pads would also include emergency shutdown equipment, fuel gas treatment equipment, well test and associated measurement facilities, chemical injection facilities, production heater and associated equipment, pig launchers and receivers, spill response equipment, transformer platforms, operations storage and stand-by tanks, pipe racks and/or manifold piping and valves, high-mast lights, and communications infrastructure. Project wells would use hydraulic fracturing and extended reach drilling to access the targeted hydrocarbon deposits and develop wells.

Valve Pads – Pads to accommodate isolation valves that could be closed in the event of an emergency, would be constructed on either side of pipeline crossings at Uvlutuuq (Fish) and

[1] Drill site BT5 would not be authorized for construction in BLM's ROD and authorization to construct this drill site would be deferred to Year 7 or later.

Iqalliqpik (Judy) creeks. In total, approximately 1.3 acres (0.005 km^2) would be impacted by construction of four valve pads. Valve pads would be set back 400 to 2,000 feet (122 to 610 m) from creeks.

Pipeline Pads – Four pipeline pads would be constructed to support pipeline construction and operations. These pads would include:

- Two horizontal directional drilling (HDD) pads would be constructed on either side of the Colville River near the existing Alpine Pipeline HDD. Equipment on the west bank pad would include a rectifier (anti-corrosion system) and electrical instrumentation module, and both pads would include thermosiphons. In total, HDD pads would impact 0.937 acres (0.004 km^2); and
- A 0.7-acre (0.003 km^2) tie-in pad for the Willow export pipeline would be constructed near the Alpine pipeline and CD4N. This pad would house modules for pigging, overpressure protection, metering equipment, infrastructure to facilitate warm-up or de-inventory the Willow export and seawater pipelines.

Water Source Access Pads – Five freshwater source access pads and spur roads would be constructed to facilitate access to lakes M0015, M0235, M0112, M1523A, and L9911 (Figure 1). Water source access pads would impact 9.6 acres total (0.04 km^2).

Communications Tower Pad – A 0.5-acre (0.002 km^2) communications tower would be constructed adjacent to the WOC on a separate pad to comply with Federal Aviation Administration (FAA) requirements. This pad would be approximately 19 mi (30.9 km) inland and would house communications infrastructure including a self-supported 200-ft (61-m) communications tower. The tower would be lighted in compliance with FAA regulations.

Gravel Roads – In total, approximately 30.3 miles (48.8 km) of new permanent gravel roads would be constructed to support the proposed Project covering an area of 216.4 acres (0.88 km^2). Gravel roads would be at least 5 ft thick with 2:1 side slopes to maintain tundra thermal regime. Road width would vary depending on the road, purpose, and location. Specifically:

- Roads to BT3, BT5, the water source access pads, airstrip, and boat ramps would be 24 feet (7.3 m) wide at the surface with an average toe-to-toe width of approximately 53 feet (16.2 m).
- Roads to BT1, BT2, and the access road from GMT-2 to the Project area would be 32 feet (9.8 m) wide at the surface with an average toe-to-toe width of approximately 61 feet (18.6 m).

Roads would be constructed at least 500 feet (152.4 m) from pipelines to the extent practicable, but with no more than 1,000 feet (305 m) of separation to facilitate road-based visual pipeline monitoring.

Roadway Turnouts and Subsistence Ramps – Seven turnouts with subsistence ramps would be constructed, with one located roughly every 2.5 to 3 mi (4.0 to 4.8 km). Turnouts and subsistence ramps would impact approximately 2.6 acres (0.011 km^2) total.

Boat Ramps – Up to three boat ramps would be constructed to support local subsistence access. Boat ramps would be constructed to provide access at:

- Ublutuoch (Tiŋmiaqsiuġvik) River – between Alpine CD5 and GMT-1;
- Iqalliqpik (Judy) Creek – pending community input; and
- Uvlutuuq (Fish) Creek – pending community input.

Boat ramps would include a pad with space for vehicles to turnaround and parking for approximately 10 trucks with trailers. Ramp footprints would vary by location but are estimated to be approximately 1.8 to 2.1 acres (0.007 to 0.008 km2) per boat ramp for a total of 5.9 acres (0.024 km2) including access roads and parking areas. Pile driving for boat ramp construction is not anticipated. Boat ramps would be designed and constructed to avoid impacts on fish and fish habitat in consultation with BLM and ADF&G.

Bridges – Six bridges would be constructed with minimum bottom chord clearance of 4 feet (1.2 m) above the 100-year design flood elevation, or 3 feet (0.9 m) above the highest documented flood elevation, whichever is higher. The Iqalliqpik and Uvlutuuq creek bridges would be designed to maintain a 13-foot (4.0 m) bottom chord clearance above the 2-year design flood elevation to provide vessel clearance.

Shorter, single-span bridges would be designed, where practicable to avoid placement of piers in the main channel. Multi-span bridges would be constructed on steel-pile pier groups placed approximately 40 to 70 feet apart (12.2 to 21.3 m) with sheet pile abutments above ordinary high water at each end.

Bridges would range from 40 to 420 ft (12.2 to 128 m) in length, and all bridges would be 32 ft wide to accommodate drill rig movement. Specific bridge locations would include crossings at: Iqalliqpik, Kayyaaq, and Uvlutuuq creeks, and Willow Creek 2, Willow Creek 4, and Willow Creek 8.

Culverts – Culverts would be designed to maintain fish passage and stream flow. Culverts would be placed in the road to maintain natural surface drainage, and culverts at stream or swale crossings would be placed perpendicular to the road, where feasible. Fish-passage culverts would be placed as required by ADF&G. Final culvert design, number, and locations would be determined based on field conditions and direct observation, and installation would take place before breakup in the first construction season. Approximately 160 cross-drainage culverts are expected at 1,000 foot (304.8 m) intervals. Additional culverts may be placed as site-specific needs are assessed.

Pipelines - The proposed Project would include infield pipelines and import/export pipelines. Infield pipelines between the WPF and each drill site would carry produced fluids, produced water, seawater, miscible injectant, and gas. The Willow Pipeline would carry sales-quality crude oil processed at the WPF to a tie-in with the existing Alpine sales oil pipeline near Alpine CD4N. Other import/export pipelines would include a seawater pipeline from Kuparuk CPF2 to the WPF, seawater spur pipeline from an existing seawater pipeline to the K-Pad, a diesel pipeline from Kuparuk CPF2 to the existing processing facility at Alpine CD1, five freshwater pipelines from the freshwater source lakes to their respective water source access pads, and treated water and fuel-gas pipelines from the WPF to the WOC.

All pipelines would be aboveground and supported by vertical support members (VSMs), except at road and river crossings. Pipelines would be non-reflective. VSMs would be roughly 55 feet (17 m) apart and support pipelines at least 7 feet (2.1 m) above ground. Each VSM would have a typical diameter of 12 to 24 inches (30 to 61 centimeters) and a disturbance footprint (diameter) of 18 to 32 inches (46 to 76 centimeters or 5.6 $feet^2$). Approximately 12,000 new VSMs would be installed with an overall disturbance footprint of approximately 0.8 acres (0.003 km^2). Pipelines would be offset between 500 and 1,000 feet (152 to 305 m) from gravel roads where practicable. Where pipelines would parallel existing pipelines, new VSMs would be aligned with existing VSMs to the extent practicable.

At Uvlutuuq and Iqalliqpik creeks, pipelines would be placed on structural steel supports attached to bridge girders. At smaller stream crossings, pipelines would be installed on VSMs roughly perpendicular to the channel. VSM placement in streams would be avoided to the extent practicable.

VSMs would also support fiber-optic communications and power cables with a minimum clearance of 7 feet (2.1 m) above ground level. At pipeline-road crossings, fiber optic and power cables would be installed in the roadbed. Cable trenches would be excavated during winter, material would be temporarily sidecast, and backfilled into the trench following cable placement. Cables may also be buried in the HDD pads.

Infield Pipelines – Infield pipelines would include the following pipelines connecting the WPF to each Project drill site and GMT-2:

1. Produced fluids pipeline: Produced crude oil, gas, and water transported from each drill site to the WPF for processing.
2. Injection water pipeline: Seawater or produced water transported from the WPF for injection into target reservoirs to support enhanced oil recovery.
3. Gas pipeline: Lean gas transported from the WPF for artificial lift, pressure support, and fuel gas.
4. Miscible-injectant pipeline: Miscible injectant transported from the WPF for injection to support enhanced oil recovery.

Infield pipeline supports would include space to accommodate future pipelines to support possible future development in the greater Project area. Infield pipelines from GMT-2 would be carried on pipeline supports between GMT-2 and the WPF. All infield pipelines would be designed to allow pipeline inspection and maintenance between each drill site or GMT-2 and the WPF. Permanent pigging facilities would be installed for the produced fluid and injection water pipelines.

Pipelines would be designed to minimize redundant parallel pipelines to the extent practicable. For example, infield pipelines from BT2 would tie into BT1 infield pipelines at BT1 to reach the WPF. An additional set of infield pipelines would connect BT5 to the WPF, GMT-2 to the WPF, and BT3 to the WPF. Infield pipelines would have supports placed on single VSMs, except where anchor supports would be used and in expansion loops, where two VSMs per pipeline support would be used. Infield pipelines for GMT-2 would be carried on the VSMs used to support the export and import pipelines.

Willow Pipeline – The Willow Pipeline (sales oil transport pipeline) would carry sales-quality crude oil processed at the WPF to a tie-in with the Alpine Sales Pipeline at a new pipeline tie-in pad near Alpine CD4N. From CD4N, sales-quality oil would be transported via the existing Alpine Sales Pipeline to the Kuparuk Pipeline and onward to the Trans-Alaska Pipeline System near Deadhorse, Alaska. The 33.5 mi (20.82 km) Willow Pipeline would be placed on new VSMs between the WPF and the tie-in pad near Alpine CD4N. Between the WPF and the tie-in pad near Alpine CD4N, vertical loops or isolation valves would be installed on each side of the Tiŋmiaqsiuġvik River, and on each side of the segment crossing the Nigliagvik Channel, Niġliq Channel, and Lakes L9341 and L9323.

Other pipelines – Other import pipelines would include seawater, diesel, freshwater, treated water, and fuel gas pipelines. The seawater pipeline would transport seawater from the Kuparuk CPF2 to the WPF for injection into the Project’s target reservoirs; a seawater pipeline spur would connect an existing seawater pipeline to the mud plant on the K-Pad. The diesel pipeline would transport diesel fuel and miscellaneous refined hydrocarbon products from Kuparuk CPF2 to the Alpine processing facility at Alpine CD1; from Alpine CD1, diesel fuel would be trucked to the WPF and other locations in the Project area. The diesel pipeline would share new VSMs with the seawater pipeline except for the segment between Alpine CD4N and the Alpine processing facility at Alpine CD1 where it would be placed on existing VSMs. The new VSMs would also carry the Willow Pipeline where available. Between Kuparuk CPF2 and Alpine CD4N, vertical loops would be installed on the diesel pipeline on each side of the Miluveach River, Kachemach River, and Colville River.

The seawater and diesel pipelines would be installed beneath the Colville River using HDD. Each pipeline would be approximately 60 feet (18 m) apart. Pipelines would be insulated and placed within an outer pipeline casing, which would inhibit heat transfer to permafrost, contain fluids in the event of a leak or spill, and provide structural integrity.

Gravel Sources

Tiŋmiaqsiuġvik Mine Site – The Tiŋmiaqsiuġvik Mine Site would be composed of two cells; Mine Site Area 1 and Mine Site Area 2 at 86.1 acres (0.35 km^2), and 28.9 acres (0.12 km^2), respectively. This new gravel source would be approximately 4 to 5 miles (6.4 to 8 km) southeast of the Greater Mooses Tooth 1 (GMT-1) development (Figure 2.1, Inset A).

The Mine Site would be developed with vertical walls and horizontal benches to create an effective side slope of 3:1, and a total disturbance area of 115.0 acres (0.465 km^2). Mining would occur over five winter construction seasons. Mine site operations are described in further detail below, however mine site development would occur as follows:

1. Overburden removal and gravel mining would proceed as material is needed;
2. Mine site excavation would begin with removal of organic overburden through trimming, followed by excavation with heavy equipment
3. Inorganic overburden would be removed through drilling and blasting; and
4. Suitable gravel material would be removed through blasting or with a surface miner.

Mine Site Access - Access for development and excavation of either cell would be via a seasonal ice road. No permanent gravel road would be constructed for mine site access. Summer access to the mine site would be by helicopter. Additionally, a 10-acre (0.04 km^2) multi-season ice pad (MSIP), and several single-season ice pads, 188 acres total (0.76 km^2), would be constructed adjacent to the mine site for:

- Stockpiling organic and inorganic[2] overburden;
- Staging and storing construction equipment (e.g., temporary offices, materials);
- Locating a temporary construction camp; and
- Fuel storage.

Mining Operations – Overburden (organic and inorganic) would be removed prior to extracting gravel material. The organic and inorganic material would be removed and stored separately for later reuse. Overburden removal would occur incrementally as needed throughout the Project's construction phase. Seasonal overburden removal is not expected to substantially exceed the anticipated area to be mined in the associated season. During initial mining activity, some overburden material would be used to form the mine site perimeter berms (29.7 total acres [0.12 km^2] at the end of mining operations). Overburden would be stockpiled within the permitted mining footprint of placed within a mine area as part of reclamation. Excess overburden remaining after perimeter berm construction may be temporarily stockpiled on ice pads adjacent to the mine site area, but no overburden would be stockpiled outside the permitted mining footprint during summer months.

Gravel extraction would be performed using either drilling and blasting methods or surface mining techniques after overburden has been removed in a particular area. Gravel stockpiling is not anticipated; if temporary stockpiles are needed, they would be located within the mine pit or within the footprint of road or pad construction. Gravel material would be loaded into haul

[2] Pending additional mine site design and sequencing, over-summer storage of some organic and inorganic overburden on some portion of the seasonal ice pads within the permitted mining footprint may be required. Timing and specific acreage of ice pads for over-summering overburden would be determined through future engineering.

equipment and hauled to the Project site for gravel road and pad construction. If material processing (e.g., gradation) is required, processing operations would occur within the mine site areas.

While active mining is underway during the winter season, workers would be housed in a temporary camp located on a seasonal ice pad or other nearby location. This temporary camp would be transported to the site at the beginning of the winter season and demobilized at the end of each winter season. The ice pad would be cleaned of all dirt, debris, and other deleterious material as part of camp demobilization. Tundra reclamation below this ice pad is not anticipated. Wastewater would be treated at the camp and disposed offsite at approved disposal facilities. Solid waste would be stored in wildlife-proof containers and be recycled or transported to a landfill in Deadhorse, Fairbanks, or Anchorage.

The construction ice pad would be used to stage and store equipment and materials, including temporary offices. Approximately 20,000 gallons of fuel would also be stored on this ice pad. Fuel would be stored in a double wall tank and the tank would be located a minimum of 500 feet (152 meters) from waterbodies. Fuel storage tanks would be located within site-erected secondary containment designed according to Alaska DEC and U.S. EPA regulations. Tank trucks would transport fuel directly to the work site and refuel storage tanks. Equipment would be refueled using a fuel truck. Minor equipment maintenance would occur on site using secondary containment; major maintenance would occur at the Alpine Fleet Maintenance shop or contractor facilities located outside the Willow Project area.

During mining operations years, pumping would be required to minimize ponding within the mine site. These dewatering activities would generally occur during late fall or early winter but may occur during summer if necessary. A significant volume of dewatering discharge is not anticipated. Discharge water would be pumped to the tundra and discharged through a diffuser. Dewatering discharge locations would be monitored throughout each 12-hour shift during dewatering activities to inspect for erosion. Adaptive management would be used as needed to adjust the discharge location and could be varied during the progression of the work to prevent oversaturation of tundra or erosion at any one location.

Overburden would be used to construct the perimeter berms around the mine, which would minimize the amount of dewatering required while the mine site is open. The perimeter berms would prevent surface water from flowing into the mine, help maintain thermal stability of adjacent permafrost, and provide a physical protective barrier around the mine site to help prevent residents from unknowingly entering the mine site. Mine Site 1 and Mine Site 2 would each have their own perimeter berms. Perimeter berms would be installed directly on the tundra. Once reclamation activity begins, perimeter berms would be incrementally expanded into thermal berms.

Tiŋmiaqsiuġvik Mine Site Rehabilitation – When material is no longer needed from the Tiŋmiaqsiuġvik Mine Site, it will be allowed to naturally fill with water. There would be no constructed hydraulic connection to the mine site from any adjacent stream. Complete mine site recharge is estimated to take a decade or longer. Overburden and some berm material would be used to finish grade the excavated area, with the objective of protecting and stabilizing adjacent permafrost and tundra. Perimeter berms would be incrementally expanded to function as thermal berms. In August or September of the third growing season after mining is complete, perimeter berms would be seeded with indigenous species based on the moisture regime. Following completion of rehabilitation efforts, all equipment and waste materials would be removed from the site, and CPAI would monitor rehabilitation for two years post-completion and until the site fills with sufficient water to prevent erosion and thermal degradation.

Other gravel sources – Existing Kuparuk area gravel sources such as Mine Sites C and E may also be utilized for the proposed Project. For example, gravel for road, pad, and Oliktok Dock upgrades would be sourced from Mine Sites C and E, which are closer than the Tiŋmiaqsiuġvik Mine Site. Mine Sites E and C are existing gravel mines that have undergone ESA section 7 consultation (USFWS 2015a, 2019a).

Seasonal Ice Road and Pads

Ice Roads – Temporary ice roads would facilitate gravel placement, pipeline construction, freshwater lake access, and Tiŋmiaqsiuġvik mine access. For safety, separate ice roads would be used for general traffic, pipeline construction, and gravel placement. Ice road construction would typically begin in November or December, with vehicle access depending on tundra travel opening and closing dates and distance from existing infrastructure. The Project's usable ice road season is expected to be 90 days (approximately January 25 through April 25). Ice roads would be a minimum of 6 inches (15.2 centimeters) thick, with a 35- or 70-foot-wide (10.6- or 21.3-m-wide) surface, depending on the road's purpose.

Ice road routes presented in Figure 2.1 are estimations; final alignments would be determined by optimization and impact minimization prior to initiating construction. During the Project's drilling and operations phases, the proposed Project would use the annual Alpine Resupply Ice Road to support equipment transport and resupply. This ice road is constructed annually to support the Alpine development and was previously evaluated in separate ESA section 7 consultations (USFWS 2004, 2011a). Following the end of the ice road season, all ice road stream crossings would be breached or slotted, and ice built up artificially at crossings (e.g., ice or snow ramps) will be removed to match the static water elevation. Following spring breakup, work crews will pick up litter (known as stick picking) to remove any anthropogenic materials.

Single Season Ice Pads **–** Single-season ice pads would be used during all years of construction to house construction camps, stage construction equipment, and support construction activities. Single-season ice pads would also be used during construction at the Tiŋmiaqsiuġvik gravel mine site, at bridge crossings during gravel road and pipeline construction, at the Colville River HDD crossing, near Kuparuk drill site 2P (DS2P), and at other locations as needed near Project infrastructure.

Multi-Season Ice Pads – MSIPs would be used to stage construction materials between winter construction seasons. MSIP construction would use compacted snow over a base layer of ice with a vapor barrier over the ice to prevent melting from rain and evaporation, and foam insulation and white tarps to insulate the pads. MSIPs would then be covered by rig mats. Once MSIPs are no longer needed, materials would be removed, any spills or releases would be remediated, and the ice base would be cleaned before the ice melts.

MSIPs would be built in one winter to be used over the following summer and winter before being allowed to melt. Each MSIP would last approximately 18 months. In areas where MSIPs would be required for a longer time period, consecutive ice pads would be constructed in a slightly different location so footprints would not overlap. Accordingly, figures showing the locations of MSIPs should be viewed as portraying approximate locations rather than exact locations.

Three 10-acre MSIPs totaling 30 acres (0.12 km^2) would be used during construction: one near GMT-2 for 4 year, one near the WOC for 1 year, and one near the Tiŋmiaqsiuġvik Mine Site for two years (Figure 3.1; BLM 2022a). These pads would allow ice road, gravel mining, and other equipment to be stored on-site over summer to support earlier construction starting dates the following winter, while minimizing gravel fill. Gravel would not be stored on the multi-season ice pad near the mine site.

Other Facilities and Operations

Camps – A camp to support construction would be required at the WOC. Additionally, existing camp space at Alpine, Kuukpik Pad, and Sharktooth would be used. A temporary camp to support ice road construction for module delivery would be located on an ice pad near Kuparuk DS2P. Construction workers may also be lodged at the Kuukpik Hotel in Nuiqsut. Camps to support drilling operations would be located at each drill site. A permanent camp to support Project operations would be located on the WOC pad (Figure 3.1).

Power Generation and Distribution – Electrical power for the Project would be generated by a 98-megawatt power plant at the WPF equipped with natural gas-fired turbines. Power would be delivered to each drill site and the WOC via power cables suspended from pipeline HSMs. Following WPF startup, the power plant would also be used to power drill rigs, except during periods when power from the WPF is unreliable.

During construction and drilling, prior to completion of the permanent power supply, portable generators would provide temporary power at various locations. The portable generators would be fueled by ultra-low- sulfur diesel. Once fuel gas is available for the WPF turbines, on startup of the WPF, diesel-fired emergency backup generators would be installed at the WPF and at the Willow Camp (located at the WOC). Portable diesel-fired emergency backup generators would be available to provide emergency power at drill sites. Permanent electric power generator sets would be fully enclosed or acoustically packaged to reduce noise emissions.

Communications – Communications infrastructure throughout the Project area would be provided by fiber-optic cables suspended from pipe rack HSMs. A total of five permanent communication towers would be located on the communications tower pad near the WOC and at each drill site. The communications towers would be up to 200 feet (61 m) tall, triangular, self-supporting lattice towers and will not use guy-wires. Temporary towers would be pile supported and may require guy-wire supports. Guy-wires would include devices to mitigate bird strikes (e.g., bird diverters). All towers would have warning lights as required by the Federal Aviation Administration for aircraft safety. Bird nesting diversion tactics would be installed on towers consistent with BLM NPR-A ROP E-9 (BLM 2022b).

Water Use

Freshwater

Freshwater would be required for domestic use at Project camps (estimated demand of 100 gallons per person per day), and for ice road and pad construction and maintenance. Freshwater would also be used for hydrostatic pipeline testing with specific volumes required varying based on pipeline diameter and segment length.

Prior to WPF startup, freshwater would be used for hydraulic fracturing. Drilling water requirements are estimated to be 0.4 million gallons (MG) per rig per month for each of the two drill rigs; hydraulic fracturing would require approximately 1.0 MG of water per well. Following WPF startup, hydraulic fracturing would use seawater from the Kuparuk Seawater Treatment Plant. Freshwater for drilling may be withdrawn from lakes near the Project area using a temporary triplex pump and truck connection, as allowed by temporary water use authorization and fish habitat permits, where necessary.

Freshwater for ice roads and pads – Freshwater volumes for ice road construction would vary from approximately 1.0 to 2.5 MG depending on ice road width and thickness. Approximately 0.25 MG of freshwater would be required to construct 1 acre of ice pad. MSIPs would require up to 0.25 MG of water per acre, per foot of thickness and MSIPs would typically be between 5 to 7 feet thick (including insulation and rig mats), depending on site-specific topography. Water for ice roads and pads would be withdrawn from permitted lakes near the construction activities consistent with BLM ROP B-2 (BLM 2022b), as allowed by Alaska Department of Natural Resources water rights and temporary water use authorizations; fish habitat permits from ADF&G would be obtained where necessary. Some water for construction of the Colville River crossing may come from the Colville River.

In total, the Proposed project would use 1,735.9 MG of freshwater over the 30-year life of the development. During construction, seawater would be used for ballast water to support barge delivery to Oliktok Dock.

Potable Water – Lakes L9911, M0015, M1523A, M0235, and M0112 would be the primary sources of freshwater for domestic use to supply water for drilling and operations. The water-source lakes would be accessed by gravel water-source access roads and pads (see *Water Source Access Pads* above). Intake infrastructure at water-source lakes would consist of a pumphouse sitting on the water source access pad connected to intake piping which would extend out into the deep portion of the lakes on VSMs. Water pumped from the water source lakes would then be transported by truck to where it is needed in the Project area.

Freshwater would be treated in accordance with State of Alaska Drinking Water Regulations (18 AAC 80) as required for any potable drinking water system. Prior to operation of the freshwater intake system, potable water for construction and drilling camp use would be withdrawn using temporary equipment and trucked to the water plant at the temporary construction camp. Additional freshwater withdrawals from other local permitted lakes would be needed during construction (e.g., ice road, ice pad, hydrostatic pipeline testing), drilling (e.g., drilling support), and operations (e.g., dust control).

Seawater – After WPF startup, seawater would be used for hydraulic fracturing of production and injection wells, for drilling, and for reservoir injection to support enhanced oil recovery. Hydraulic fracturing is expected to require approximately 1.0 MG of seawater per well. Drilling is expected to require approximately 1.0 MG of seawater per drilling rig per month. Enhanced oil recovery would require approximately 2.1 to 3.8 MG of seawater per day beginning in Year 5.

Seawater would be sourced from the existing Kuparuk Seawater Treatment Plant at Oliktok Point. Seawater would be transported to the Project area from Kuparuk CPF2 via a new seawater pipeline (see *Other Pipelines* above). A seawater pipeline spur would connect an existing seawater pipeline to the mud plant on K-Pad.

Waste Handling

Domestic Wastewater – Sanitary wastes generated from camps would be hauled to the WOC wastewater treatment facility and would be disposed of in the Class I underground injection control (UIC) disposal well located at the WOC. Before UIC well establishment, treated wastewater would be hauled to another approved disposal site or discharged under the Alaska Pollutant Discharge Elimination System (APDES) General Permit (AKG- 572000). Prior to the establishment of the UIC well at the WOC, domestic wastewater would be treated and either hauled to Alpine or Kuparuk (winter only) for injection in an existing UIC disposal well, or in instances where weather or conditions prevent disposal at Alpine, discharged to tundra per APDES permit conditions.

Solid Waste – Domestic waste (e.g., food, paper, wood, plastic) would either be incinerated on-site at the WOC or at Alpine, or if non-burnable, would be recycled or transported to a landfill facility in Deadhorse (North Slope Borough landfill), Fairbanks, or Anchorage. Incinerator ash would be stored on-site until it can be transported to an off-site landfill for disposal. Hazardous and solid waste from the Project would be managed under Alaska Department of Environmental Conservation and U.S. Environmental Protection Agency regulations, as well as under the 2022 BLM ROPs (BLM 2022b).

Drilling Waste – Drilling wastes (e.g., drilling mud, cuttings) would be disposed of on-site through annular disposal (i.e., pumped down well through the space between the two casing strings) and/or transported to an approved disposal well (e.g., Class I UIC disposal well at the WOC). Reserve pits would not be used by the Project, though a temporary storage cell may be constructed for staging drilling muds and cuttings prior to UIC well disposal. Produced water would be processed at the WPF and re-injected to the subsurface through injection wells as part of reservoir pressure maintenance for secondary recovery. Well work waste materials would be managed according to the Alaska Waste Disposal and Reuse Guide (BLM 2022a). In addition to waste handling and disposal regulations, the Project would be managed under the 2022 BLM ROPs (BLM 2022b).

The WOC would have at least two Class I UIC disposal wells; an existing UIC well at Alpine would provide backup, as needed.

Fuel and Chemical Storage

Fuel and other chemicals would primarily be stored at the WPF, with additional storage at drill sites. Diesel fuel would be stored in temporary tanks on-site during construction. During drilling and operations phases, the WPF would include fuel supply storage tank(s) and fueling station, as well as a tank farm to store methanol, crude oil flowback, corrosion inhibitor, scale inhibitor, emulsion breaker, and various other chemicals as required. Jet fuel would be stored on the airstrip apron for helicopter use; jet fuel would be delivered to airplanes by fuel trucks supplied by storage tanks located at the WOC.

Drill sites would have temporary tanks to support drilling activity, including brine tanks, cuttings and mud tanks, and a drill rig diesel-fuel tank (built into the drill rig structure). Production storage tanks at drill sites would include chemical storage tanks that may contain corrosion inhibitor, methanol, scale inhibitor, emulsion breaker, anti-foam, and diesel fuel. Portable oil storage tanks to support well and pad activities and maintenance may be present on an as-needed basis.

Fuel and oil storage would comply with local, state, and federal oil pollution prevention requirements, according to the Oil Discharge Prevention and Contingency Plan (ODPCP) and Spill Prevention Control and Countermeasures Plan. Secondary containment for fuel and oil storage tanks would be sized as appropriate to the container type and according to governing regulatory requirements (18 AAC 75 and 40 CFR 112). Fuel and chemical storage for the Project would be managed under the 2022 BLM ROPs (BLM 2022b).

Access to the Project Area

Access to the Project area from Alpine, Kuparuk, or Deadhorse would occur via ground transportation over ice roads, or by fixed-wing aircraft or helicopter. Access from Alpine would also include travel over existing gravel roads. The large modules comprising the processing facilities at the WPF and drill sites would be delivered to the North Slope by sealift barge. Barge off-loading would be at the existing Oliktok Dock. Sealift modules would be staged at an existing gravel pad near Oliktok Point until the following winter, and they would then be transported to the Project area via existing gravel and task-specific ice road.

Vehicle traffic

Ground traffic would include buses, light commercial trucks, short-haul trucks, passenger trucks, and other miscellaneous vehicles. Ground transportation would also include gravel hauling operations with B70/maxi dump trucks.

Aircraft operations
Fixed wing – Fixed-wing aircraft to support Project operations would include C-130, DC-6, Twin Otter/CASA, Q400, Cessna, or similar. In total, BLM estimates 12,053 fixed-wing flights would take place over the life of the Project at the WOC airstrip.

Helicopters – Helicopters would be used to support Project construction, ongoing environmental studies, ice road permit compliance, and drilling and operations. Helicopter support for future exploration, including exploration wellhead inspections and debris cleanup (i.e., stick picking or litter clean-up) from winter exploration activities is not part of the Project. Helicopters employed by the Project would include A-Star and 206 Long Ranger models, though other similar types of helicopters may also be used. BLM estimates 2,437 helicopter flights would take place over the life of the project throughout the Action Area. Of these, up to 90 flights per year would occur during summer months (BLM 2022a).

Aircraft would maintain minimum altitudes consistent with ROP F-1 (BLM 2022b), except during takeoffs and landings or when doing so could endanger human life or violate safe flying practices.

Sealift operations
Barge Delivery – Barges would deliver large sealift modules (anticipated to weigh up to 4,000 tons [3,630 metric tons]) for the WPF and drill sites, as well as other bulk construction materials (e.g., pipe, VSMs) to the North Slope. Transit routes to Oliktok Dock would follow existing marine transportation routes (Figure 3.*2*) and marine vessels would move slowly (i.e., < 14 knots [16 mph]) through the MTR. Bulk materials weighing less than 550 tons (500 metric tons) would be transferred to the Project area via the annual Alpine Resupply Ice Road; large sealift modules would be transported to the Project area over existing Kuparuk gravel roads and task-specific ice roads.

A total of 30 barge trips would make deliveries to Oliktok Dock over four open-water seasons during construction; no regular use of barges is planned during drilling and operations phases. Barges would make deliveries in the summers of Year 2, Year 3, Year 4, and Year 6. After delivery by barge to Oliktok Dock, bulk materials and modules will be stored on an existing 12-acre (0.05 km^2) gravel pad approximately 2 miles (3.2 km) south of Oliktok Dock. The following winter, these materials would be transported to the Project area.

Barges would be accompanied by tugboats between Dutch Harbor and Oliktok Dock. Approximately 50 tugboat trips are anticipated to accompany proposed sealift operations. Finally, support vessels (e.g., crew boats, a screeding barge, and other support vessels) would operate between Oliktok Dock and the barge lightering area (see below). Approximately 285 support vessels trips are predicted during the same four years planned for sealift operations.

Barge Lightering and Screeding – To facilitate module and materials delivery, CPAI would use a 9.6-acre offshore barge lightering area in water approximately 10 feet (3.0 m) deep and 1.8 nautical miles (3.27 km) from Oliktok Dock (Figure 2.1). During lightering, the barges would be grounded on the seafloor, which would require screeding (i.e., redistributing and contouring of the existing marine sediments) of the lightering area. Screeding is typically accomplished by dragging a metal plate fixed to a screed barge to move the sediments in a leveling operation. The amount of material moved is generally small and localized; no sediments would be removed from the water, and no new fill material would be added.

A backhoe may be used to assist where required; however, the bucket would not be raised above the water surface during the operation. Following the barge grounding and cargo transfer to the lightering barge, the lightering barge would be grounded in front of Oliktok Dock for offload. To prevent pressure points on the barge hull during the grounding, approximately 2.5 acres of marine area in front of Oliktok Dock would also be screeded prior to the first barge delivery each year. Screeding would occur each barge delivery year in the summer shortly before the barges arrive and would take approximately 1 week to complete. The bathymetry of the screeding area would be measured each year to confirm the seafloor surface is acceptable to the barge operator.

Modifications to Existing Infrastructure and Facilities
Oliktok Dock Modifications – To accommodate 25-foot-high (7.6 m) side-shell sealift barges, the existing dock surface would be raised approximately 6 feet (1.8 m) by adding structural components and a gravel ramp. All modifications to the dock would be within the existing footprint.

An existing 12.0-acre (0.05 km^2) staging pad approximately 2 miles (3.2 km) south of Oliktok Dock would be modified with new gravel to create a minimum thickness of 5 feet (1.5 m). Rig mats would then be installed on the surface to provide further structural support for module storage. No changes would be made to the existing pad footprint.

The existing 2-mile-long (3.2 km) gravel road from Oliktok Dock to the staging pad would be modified to a minimum 5-foot (1.5 m) thickness. This modification would require 40,300 cubic yards (30,800 m^3) of gravel and increase the road footprint by less than 0.1 acre (0.0004 km^2). Additionally, an estimated 12 culverts would be extended within this segment to accommodate the thicker roadway.

Some curves would be widened to accommodate the turning radius of 200-foot-long (61 m) self-propelled module transporters (SPMTs). Approximately 5.0 acres (0.02 km^2) of additional gravel fill would be placed along the existing gravel road to widen these curves within the Kuparuk area. Culverts would be extended as needed. Gravel fill for cur**v**e widening would be placed during summer using material acquired from an existing Kuparuk mine site (e.g., Mine Site C or Mine Site E).

Other materials delivered by barge (i.e., not sealift modules) would also be stored on the existing 12.0-acre gravel pad approximately 2 miles south of Oliktok Dock and transported to the Project area in the winter over existing Kuparuk gravel roads and the existing annual Alpine Resupply Ice Road.

Module storage, transport, Alpine Ice Road and Colville River crossing – Sealift modules stored over winter would be skirted to prevent snow from accumulating beneath them. Each January following a sealift module delivery, modules and other materials would be transported using SPMTs from the staging pad near Oliktok Dock along existing gravel roads to a temporary staging ice pad near DS2P (Figure 3.1). Modules would then be transported on a task specific heavy-haul ice road to GMT-2, crossing the Colville River on a partially-grounded ice bridge near Ocean Point (Figure 3.1). From GMT-2 to the WPF, modules would be transported over the Project's gravel access road.

The Colville River crossing location near Ocean Point was selected based on the following engineering factors:

- Maximum allowable ice road grades for SPMT travel;
- Assumed SPMT dimensions of 27 feet wide × 200 feet long (8.2 × 61 m); and
- A suitable Colville River crossing location (as described below).

The 60-foot-wide (18.3 m), 40.1-mile-long (64.5-km) heavy-haul ice road for module transport would be constructed from both the east and west ends at DS2P and GMT-2, respectively. The segments would meet at the Colville River crossing near Ocean Point where an engineered ice crossing would be constructed to provide sufficient load-carrying capacity to support the sealift modules and SPMTs. The partially-grounded-ice crossing would be approximately 1 river mile (1.6 km) downstream (south) of Ocean Point (as defined on U.S. Geological Survey topographic quadrangle A3 – Harrison Bay). The specific crossing location was selected based on favorable conditions for hydrology, topography, and bathymetry. The crossing location was also sited far enough upstream from the Colville River Delta (CRD) to minimize potential impacts to fish passage.

The Colville River ice crossing would be approximately 2,800 feet (853 m) long from top of bank to top of bank (approximately 700 feet long [213 m] from edge of water to edge of water), and 65 feet wide at the travel surface. Approach and departure ramps at the riverbanks may be wider depending on the amount of fill ice required to construct them. Total ice thickness of the ramp and crossing would range up to 7.1 feet (2.2 m) from the river bottom (natural ice thickness in this area varies and was 0.5 to 6.2 feet [0.15 to 1.9 m] thick in April 2019).

Kuparuk River Unit CPF2 – The Project would include a 1 acre (0.004 km^2) expansion of the existing gravel pad at Kuparuk River Unit (Kuparuk) central processing facility 2 (CPF2), to accommodate installation of new modules and equipment. New modules and equipment at Kuparuk CPF2 would include:

- Diesel transfer tanks, pumps, and pigging facilities for delivery to the Alpine processing facility (at Alpine CD1) and WPF;
- Seawater transfer pumps and pigging facilities for delivery to the WPF; and
- Infrastructure to facilitate warm-up or de-inventory of the Willow Pipeline and seawater pipeline.

Alpine CD1 Pad – Modules, equipment, and storage tanks would be installed on the Alpine CD1 pad at the Alpine processing facility for the following purposes:

- Crude oil surge drum and associated equipment to assist with pressure management of the sales-oil pipeline system;
- Diesel tanks and pigging facilities to receive product from Kuparuk CPF2; and
- Infrastructure to facilitate warm-up or de-inventory of the Willow Pipeline and seawater pipeline.

GMT-2 Pad – Modules, equipment, and storage tanks would be installed on the existing GMT-2 pad to support potential production from GMT-2. This option, if implemented, would include the following:

- Separation and metering equipment to measure fluids crossing the Greater Mooses Tooth-Bear Tooth unit boundary; and
- Chemical storage to support chemical injection into pipelines connecting GMT-2 and the Bear Tooth unit.
- Electrically driven booster compressor to increase gas pressures for injection into the deeper GMT-2 reservoir.
- Electrically driven booster pump to increase water pressure for injection into the deeper GMT-2 reservoir.

The existing mud plant at K-pad would be expanded on existing gravel to accommodate Project requirements. The Alpine CD1 pad, GMT-2 pad, and K-Pad would not require expansion to accommodate the additional facilities described above.

Drill Site Operational Activity

Hydraulic Fracturing – Hydraulic fracturing is a process used to increase the flow of fluids from a reservoir. Each production well would receive a multistage hydraulic fracturing operation like those employed at other North Slope developments. The process would involve isolating well sections and pumping gelled seawater or brine mixed with a proppant (small beads of sand or human-made ceramic material) at high pressure into the formation. The high-pressure fluid creates fractures in the formation, and the proppants prevent the fracture from closing, allowing oil and gas within the formation to flow into the wellbore and ultimately to the surface. It is anticipated that each well would be hydraulically fractured one time, with approximately 12 to 20 individual fracturing locations within the well. Hydraulic fracturing operations would last approximately 6 days per well, with six wells per pad per year being fracture stimulated. Two hydraulic fracturing operations could occur concurrently, although not on the same pad; however, fracturing operations may occur simultaneously with well drilling on the same pad. Total water use for hydraulic fracturing would be approximately 14,000 to 24,000 barrels (0.6 to 1.0 million gallons [MG]) of seawater per well. All hydraulic fracturing activity would comply with Alaska Oil and Gas Conservation Commission regulations (30 AAC 25.283).

Well Drilling - Extended reach drilling would be used to develop Project wells. Wells would be categorized as either production or injection. Production wells would generate the field's oil and gas production, whereas injection wells would inject water (i.e., treated seawater or produced water) and/or natural gas into producing formations to maintain reservoir pressure. Wells would be equipped with appropriate well safety valve systems in accordance with 20 AAC 25.265.

Manifold or pipe rack piping (or both) would combine individual wellhead piping into a common gathering line through which all produced fluids would be transported to the WPF.

Horizontal Directional Drilling – HDD crossings would be constructed during winter. To support HDD drilling and pipeline installation, two HDD single-season ice pads would be constructed (approximately 42 total acres). One ice pad would be constructed on each side of the Colville River adjacent to the existing Alpine pipeline HDD gravel pads.

Project Schedule

Dates and Duration – Timing of the 30-year Project is based on several factors, including permitting and other regulatory approvals, Project sanctioning by CPAI, and the purchase and fabrication of long-lead time components. However, CPAI proposes to construct the Project over approximately 8 years beginning in Project Year 1. The WPF is anticipated to come online in Year 6 (first oil from BT1, BT2, and BT3 production). The earliest possible construction date for BT5 is Year 7, with production from BT5 beginning as early as Project Year 9.

Development drilling results at BT1, BT2, and BT3 would provide information that could extend the BT5 construction duration. The schedule is based on the current best available information, and the schedule may be modified as detailed design progresses or as circumstances require. Operations would run to the end of the Project's field life, which is estimated to be Year 30.

Construction Phase – Gravel mining and placement would be conducted almost exclusively during winter. Prepacking snow and constructing ice roads to access the Tiŋmiaqsiuġvik gravel mine site and gravel road and pad locations would occur in December and January (or as soon as conditions allow), with ice roads assumed to be available for use by February 1. The schedule anticipates typical weather conditions and is subject to change based on actual conditions. Gravel for infrastructure associated with the initial construction (BT1, BT2, BT3, connecting roads, WPF, WOC, and airstrip) would be mined and placed during winter (January through April) for the first 4 to 5 years of construction. One additional winter season of gravel mining and placement would occur to construct BT5 and associated roads beginning in Year 7 (at the earliest).

Gravel roads and pads would be built following the construction of ice roads. Gravel conditioning and compaction would occur during the summer (typically July to October) to expose, thaw, and dewater deeper layers and re-compact the gravel. Culvert locations would be identified and installed per the final design during the first construction season prior to spring breakup. Bridges would be constructed during winter from ice roads and ice pads. Once gravel pads are completed, on-pad facilities would be constructed.

Modules for the WPF, BT1, BT2, and BT3 would be delivered by barge to Oliktok Dock during summer Year 4 and moved to the Project area the following winter. Other materials delivered by barge would arrive in the summers of Year 2, Year 3, Year 4, and Year 6. Drill site BT5 would not be authorized for construction in the BLM's ROD and authorization to construct this drill site would be deferred to Year 7 or later. Modules for BT5 would be delivered via a second sealift barge trip to Oliktok Dock and moved to the Project area during the winter following its authorization.

Pipelines would be installed during winter from ice roads. VSM locations would be surveyed and drilled, and then VSMs and HSMs would be assembled and installed using a sand slurry fill. Alternatively, engineering design may require VSMs to be driven into an undersized hole using a vibratory hammer. The pipelines would be placed, welded, tested, and then installed on pipe saddles atop the HSMs. The Colville River HDD pipeline crossing would be completed during the Year 4 winter construction season. Pipeline installation would take between 1 and 4 years per pipeline type, depending on pipeline length and location.

The subsistence boat ramp along the Tiŋmiaqsiuġvik River would be constructed in the first Project construction seasons. Subsistence boat ramps at Judy (Iqalliqpik) Creek and Fish (Uvlutuuq) Creek would be constructed after site visits and input from local stakeholders and within 2 years of constructing the BT1 and BT2 access roads, respectively. Boat ramp construction methods would be similar to the construction methods described for other gravel placement. Construction would occur primarily in winter, with gravel seasoning and compaction occurring over the following summer season.

Gravel haul and placement to modify Oliktok Dock would occur in summer Year 2. Around mid-July during each summer open-water season, before sealift barge arrival and after the risk of ice encroachment has passed, screeding would occur at Oliktok Dock and in the barge lightering area.

Drilling Phase – Drilling is planned to begin in Year 4 at BT1. The two drill rigs would be mobilized to the Project area, and drilling would begin prior to completion of the WPF and drill site facilities. The approximately 18 to 24 months of pre-drilling activities would allow the WPF to be commissioned immediately following its construction. It is assumed wells would be drilled consecutively from BT1 to BT3 and BT5; however, CPAI would determine the timing and order of drilling based on economics and drill rig availability. Drilling is anticipated to take 7 years. Drilling would include the use of hydraulic fracturing techniques. Hydraulic fracturing would use seawater (sourced from the existing Kuparuk Seawater Treatment Plant) following WPF startup and would occur only in the initial stage of well drilling to stimulate flow at the production and injection wells.

Operations Phase – Following initial drilling and WPF startup, typical operations would consist of well operations and production. Production would begin in Year 6. Well maintenance operations and routine drilling activities would occur intermittently throughout the life of the Project. CPAI’s standard operations and maintenance practices would be implemented for this Project phase.

Abandonment and Reclamation - The abandonment and reclamation of Project facilities would be determined at or before the time of abandonment. The Abandonment and Reclamation Plan would be subject to input from federal, state, and local authorities, as well as private landowners. Abandonment and reclamation may involve the removal of gravel roads and pads or leaving these in place for alternative purposes. Revegetation of abandoned facilities could be accomplished by seeding with native vegetation or through natural colonization. If gravel is reclaimed, it could be used for other development projects. Reclamation standards would be determined by the BLM authorized officer prior to the time of reclamation.

Depending on the types of abandonment and reclamation activities that occur, summer road and air traffic levels would be similar to those experienced during construction activities but at potentially lower intensity levels and for shorter durations.

Minimization Measures
The following sections describe measures CPAI will implement as part of their project design, and Required Operating Procedures or Lease Stipulations (ROPs and STIPs) BLM will require which will minimize or prevent adverse effects to listed species. Specific measures which CPAI will undertake to minimize impacts to polar bears are also described.

BLM's Applicable Lease Stipulations and Required Operating Procedures
Lease Stipulations (LSs) and required operating procedures (ROPs) that directly or indirectly avoid and/or reduce impacts to ESA-listed species and designated critical habitat from the proposed Project are summarized below (BLM 2022b).

The following ROPs apply to waste prevention, handling, disposal, spills, and public safety.

ROP A-1: Waste and Litter
Objective: Protect the health and safety of oil and gas field workers and the general public by disposing of solid waste and garbage in accordance with applicable federal, State, and local laws and regulations.

Requirement/Standard: Areas of operation shall be left clean of all debris.

ROP A-2: Waste Management Plan
Objective: Minimize impacts on the environment from non-hazardous and hazardous waste generation. Encourage continuous environmental improvement. Protect the health and safety of oil field workers and the general public. Avoid human-caused changes in predator populations.

Requirement/Standard: Lessees/permittees shall prepare and implement a comprehensive waste management plan for all phases of exploration and development, including seismic activities. The plan shall be submitted to the AO for approval, as part of a plan of operations or other similar permit application. Waste generation shall be addressed in the following order of priority: 1) prevention and reduction, 2) recycling, 3) treatment, and 4) disposal. The plan shall consider the following requirements:

a. The plan shall identify precautions that are to be taken to avoid attracting wildlife to food and garbage.
b. Requirements prohibit the burial of garbage. Users shall have a written procedure to ensure that the handling and disposal of putrescible waste will be accomplished in a manner that prevents the attraction of wildlife. All putrescible waste shall be incinerated, backhauled, or

composted in a manner approved by the AO. All solid waste, including incinerator ash, shall be disposed of in an approved waste-disposal facility. The burial of human waste is prohibited.

c. BLM requires all pumpable solid, liquid, and sludge waste be disposed of by injection in accordance with EPA, DEC, and AOGCC regulations and procedures.
d. BLM prohibits wastewater discharges or disposal of domestic wastewater into bodies of water, including wetlands, unless authorized by a National Pollutant Discharge Elimination System or State permit.

ROP A-3 Hazardous Substances Contingency Plans
Objective: Minimize pollution through effective hazardous-materials contingency planning.

Requirement/Standard: A hazardous materials emergency contingency plan shall be prepared before transportation, storage, or use of fuel or hazardous substances. The plan shall include a set of procedures to ensure prompt response, notification, and cleanup in the event of a hazardous substance spill or threat of a release. The plan shall include a list of resources available for response. In addition, contingency plans shall include requirements to:

a. Provide refresher spill-response training to NSB and local community spill-response teams on a yearly basis
b. Plan and conduct a major spill-response drill annually
c. Develop spill prevention and response contingency plans and participate in the North Slope Subarea Contingency Plan for Oil and Hazardous Substances Discharges/Releases for the NPR-A operating area.

ROP A-4 Spill Prevention
Objective: Minimize the impact of contaminants on fish, wildlife, and the environment, including wetlands, marshes, and marine waters, as a result of fuel, crude oil, and other liquid chemical spills. Protect subsistence resources and subsistence activities. Protect public health and safety.

Requirement/Standard: Before initiating any oil and gas or related activity or operation, develop a comprehensive spill prevention, control, and countermeasure plan per 40 CFR 112. The plan shall consider the following requirements:

a. Sufficient oil-spill-cleanup materials shall be stored at all fueling points and vehicle-maintenance areas and shall be carried by crews on all overland moves.
b. Fuel and other petroleum products and other liquid chemicals shall be stored in proper containers at approved locations. Fuel, petroleum products, and other liquid chemicals that in total exceed 1,320 gallons shall be stored within an impermeable lined and diked area or within approved alternate storage containers. Within 500 feet (152 meters) of waterbodies, fuel containers are to be stored within appropriate containment.
c. Liner material shall be compatible with the stored product and capable of remaining impermeable during typical weather extremes expected throughout the storage period.
d. Permanent fueling stations shall be lined or have impermeable protection.
e. All fuel containers shall be marked with the responsible party's name, product type, and year filled or purchased.

f. Notice of any reportable spill (as required by 40 CFR 300.125 and 18 AAC 75.300) shall be given to the authorized officer as soon as possible, but no later than 24 hours after occurrence.
g. All oil pans (i.e., "duck ponds") shall be marked with the responsible party's name.

ROP A-5 Refueling and Fuel Storage
Objective: Minimize the impact of contaminants from refueling operations on fish, wildlife, and the environment.

Requirement/Standard: Refueling of equipment within 500 feet (152 meters) of the active floodplain of any waterbody is prohibited. Fuel storage stations shall be located at least 500 (152 meters) feet from any waterbody with the exception that small caches (up to 210 gallons) for motorboats, float planes, ski planes, and small equipment.

ROP A-7 Produced Fluid Disposal
Objective: Minimize the impacts to the environment of disposal of produced fluids recovered during the development phase on fish, wildlife, and the environment.

Requirement/Standard: Discharge of produced water in upland areas and marine waters is prohibited.

ROP A-8: Polar Bear Interaction Plan
Objective: Minimize conflicts resulting from interaction between humans and bears during oil and gas activities.

Requirement/Standard: Lessees will prepare and implement bear-interaction plans to minimize conflicts between bears and humans. These plans shall include measures to:
a. Minimize attraction of bears to the drill sites.
b. Organize layout of buildings and work sites to minimize human-bear interactions.
c. Warn personnel of bears near or on work sites and identify proper procedures to be followed.
d. Establish procedures, if authorized, to discourage bears from approaching the work site.
e. Provide contingencies in the event bears do not leave the site or cannot be discouraged by authorized personnel.
f. Discuss proper storage and disposal of materials that may be toxic to bears.
g. Provide a systematic record of bears on the work site and in the immediate area.

ROP A-9 Air Quality
Objective: Reduce air quality impacts.

Requirement/Standard: All operations (vehicles and equipment) that burn diesel fuels must use "ultra-low sulfur" diesel as defined by the DEC, Division of Air Quality.

ROP A-10: *Prevent Land Degradation and Protect Health*
Objective: Prevent unnecessary or undue degradation of the lands and protect health.

Requirement/Standard: This measure includes the following elements:

a. BLM may require a project proponent to provide a minimum of one year of baseline ambient air monitoring data for any pollutants of concern. If BLM determines baseline monitoring is required, this pre-analysis data must meet DEC and EPA air monitoring standards and cover the year prior to the submittal.
b. BLM may require monitoring for the life of the project, depending on the potential air emissions' magnitude, proximity to a federal Class I area, Class II area, or population center, proximity to a non-attainment or maintenance area, meteorological or geographic conditions, existing air quality conditions, existing area development, or issues identified during the project's NEPA analysis.
c. For an application to develop a potential substantial air pollutant emission source, the proponent shall prepare an emissions inventory that includes quantified emissions of regulated air pollutants from all direct and indirect sources related to the proposed project.
d. For an application to develop a potential substantial air pollutant emission source, BLM may require the proponent to provide an emissions reduction plan.
e. For an application to develop a potential substantial air pollutant emission source, the AO may require air quality modeling analyzing the project's direct, indirect or cumulative impacts to air quality. The modeling shall compare predicted impacts to all applicable local, State, and federal air quality standards and increments, as well as other scientifically defensible significance thresholds.
f. BLM may require air quality mitigation measures and strategies within its authority, in addition to regulatory requirements and proponent committed emission reduction measures.
g. If ambient air monitoring indicates project-related emissions are causing or contributing to impacts that would cause undue degradation, exceedances of NAAQS, or fail to protect health, the AO may require changes to reduce emissions.
h. Publicly available reports on air quality baseline monitoring, emissions inventory, and modeling results shall be provided by the project proponent to the NSB and to local communities and Tribes.

The following ROPs apply to overland moves, seismic work, and any similar cross-country vehicle use of heavy equipment on non-roaded surfaces during the winter season. These restrictions do not apply to the use of such equipment on ice roads after they are constructed.

ROP C-1: Den Buffers and Survey Requirements

Objective: Protect grizzly bear, polar bear, and marine mammal sea ice breathing holes, lairs, and birthing locations.

a. Requirement/Standard: Grizzly bear dens: Cross-country use of vehicles, equipment, and oil and gas activity is prohibited within 0.5 mile (0.5 km) of occupied grizzly bear dens, unless protective measures are approved by BLM.
b. Polar bear dens: Cross-country use of vehicles, equipment, and oil and gas activity is prohibited within 1 mile of known or observed polar bear dens, unless alternative protective measures are approved by BLM.
c. To limit disturbance around known polar bear dens, implement the following:
    1. Onshore activities in known or suspected polar bear denning habitat during the denning season (approximately November to April) must make efforts to locate

occupied polar bear dens. All observed or suspected polar bear dens must be reported to USFWS prior to the initiation of activities.

    2. Permittees must observe a 1-mile operational exclusion zone around all known polar bear dens during the denning season (or until the female and cubs leave the areas). Should previously unknown occupied dens be discovered, work must cease and USFWS must be contacted for guidance. Potential actions may range from cessation or modification of work to conducting additional monitoring.
    3. Use the den habitat map developed by USGS.
    4. Restrict activity timing to limit disturbance around dens.

d. To limit disturbance of activities to seal lairs in the nearshore area (< 9.8-foot [3-meter] water depth):
    1. Prior to the initiation of winter seismic surveys on marine ice, the permittee will conduct a sound source verification test approved by BLM and NMFS.
    2. For all activities:
        i. Maintain airborne sound levels of equipment below 100 db re 20 µPa at 66 feet (20 meters).
        ii. On-ice operations after May 1 will employ a full-time protected species observer on vehicles to ensure that all basking seals are avoided by vehicles by at least 500 feet and will ensure that all equipment with airborne noise levels are operating at distances from observed seals that allow for the attenuation of noise to levels below 100 decibels.
        iii. Sea ice trails must not be greater than 12-feet (3.7-meters) wide.
        iv. No unnecessary equipment or operations will be placed or used on sea ice.

ROP C-2 Winter Tundra Travel
Objective: Protect stream banks, minimize compaction of soils, and minimize the breakage, abrasion, compaction, or displacement of vegetation.

Requirement/Standard:

a. Ground operations shall be allowed only when frost and snow cover are sufficient to protect the tundra. Ground operations shall cease when the spring snowmelt begins (approximately May 15); the exact dates will be determined by the AO.
b. Low-ground-pressure vehicles shall be used for on-the-ground activities off ice roads or pads.
c. Bulldozing of tundra mat and vegetation, trails, or seismic lines is prohibited.
d. To reduce the possibility of ruts, vehicles shall avoid using the same trails for multiple trips unless necessitated by serious safety or superseding environmental concern.
e. The location of ice roads shall be designed and located to minimize compaction of soils and the breakage, abrasion, compaction, or displacement of vegetation. Offsets may be required to avoid using the same route or track in the subsequent year.
f. Motorized ground-vehicle use within the Colville River Special Area associated with overland moves, seismic work, and any similar use of heavy equipment shall be minimized within an area that extends 1 mile west or northwest of the bluffs of the Colville River.

ROP C-3 Ice Bridges
Objective: Maintain natural spring runoff patterns and fish passage, avoid flooding, prevent streambed sedimentation and scour, protect water quality, and protect stream banks.

Requirement/Standard: Crossing of waterway courses shall be made using a low-angle approach. Crossings that are reinforced with additional snow or ice (“bridges”) shall be removed, breached, or slotted before spring breakup. Ramps and bridges shall be substantially free of soil and debris.

The following ROPs apply to facility design and construction.

ROP E-2 Infrastructure Siting Near Waterbodies
Objective: Protect fish-bearing waterbodies, water quality, and aquatic habitats.

Requirement/Standard: Permanent oil and gas facilities are prohibited within 500 feet (152 meters) of fish-bearing waterbodies (as measured from the ordinary high water mark). Essential pipeline and road crossings will be permitted on a case-by-case basis.

ROP E-3 Shoreline Infrastructure
Objective: Maintain free passage of marine and anadromous fish and protect subsistence use and access to subsistence hunting and fishing.

Requirement/Standard: Linear infrastructure that connects to the shoreline (e.g., causeways, docks) is prohibited in river mouths or deltas. Artificial gravel islands and permanent bottom-founded structures are prohibited in river mouths or active stream channels on river deltas.

ROP E-5: Minimize Development Footprint
Objective: Minimize impacts of the development footprint.

Requirement/Standard: Facilities shall be designed and located to minimize the development footprint. Issues and methods to be considered include:

a. Use of maximum extended-reach drilling for production drilling.
b. Sharing facilities with existing development.
c. Collocation of all oil and gas facilities, except airstrips, docks, and seawater-treatment plants, with drill pads.
d. Integration of airstrips with roads.
e. Use of gravel-reduction technologies (e.g., insulated or pile-supported pads).
f. Coordination of facilities with infrastructure in support of offshore development.

Note: Where aircraft traffic is a concern, consideration shall be given to balancing gravel pad size and available supply storage capacity with potential reductions in the use of aircraft to support oil and gas operations.

ROP E-8: Sand and Gravel Mining
Objective: Minimize the impact of mineral materials mining activities on air, land, water, fish, and wildlife resources.

Requirement/Standard: Gravel mine site design and reclamation will be in accordance with a plan approved by the AO. The plan shall consider:

a. Locations outside the active flood plain.

b. Design of gravel mine sites within active flood plains to serve as water reservoirs for future use.
c. Potential use of the site for enhancing fish and wildlife habitat.
d. Potential storage and reuse of sod/overburden for the mine site or at other disturbed sites on the North Slope.

ROP E-9: Prevent Predator Attraction
Objective: Avoidance of human-caused increases in populations of predators of ground nesting birds.

Requirement/Standard:

a. Lessee shall use best available technology to prevent facilities from providing nesting, denning, or shelter sites for ravens, raptors, and foxes. The lessee shall provide the AO with an annual report on the use of facilities by ravens, raptors, and foxes as nesting, denning, and shelter sites.
b. Feeding wildlife is prohibited.

ROP E-10: Facility Visibility Requirements
Objective: Minimize bird collisions with infrastructure, especially during migration and inclement weather.

Requirement/Standard: Flagging of structures (e.g., elevated utility lines, guy wires) shall be required to minimize bird collision. All facility external lighting shall be designed to direct artificial exterior lighting inward and downward or be fitted with shields to reduce reflectivity in clouds and fog conditions.

ROP E-11: Protections for Special Status Bird Species
Objective: Minimize impacts on bird species, particularly those listed under the Endangered Species Act and BLM special status species, resulting from direct or indirect interaction with infrastructure.

Requirement/Standard: Before the approval of infrastructure construction, the following studies shall be conducted, and recommended design elements shall be incorporated.

Special Conditions in Spectacled and/or Steller's Eiders Habitats:

a. BLM requires submittal of a minimum of 3 years of site-relevant survey data before authorization of construction, if such construction is within spectacled and Steller's eider habitats. BLM will evaluate adequacy of survey data and ecological mapping to determine if ground-based nest surveys are required. Information gained from these surveys shall be used to make infrastructure siting decisions.
b. If spectacled and/or Steller's eiders are determined to be present within the proposed development area, the applicant shall work with USFWS and BLM early in the design process to site roads and facilities in order to minimize impacts to nesting and brood-rearing eiders and their habitats.

Special Conditions in Yellow-billed Loon Habitats:
The permittee shall determine and submit to BLM information on yellow-billed loon habitat presence within a project area using the most current data and analysis results from research conducted within the NPR-A.

a. If yellow-billed loon habitat is determined to be present within the project area, BLM will require submittal of a minimum of 3 years of site-relevant survey data of lakes greater than 25 acres within 1 mile (1.6 km) of the proposed infrastructure.
b. The design and location of infrastructure must minimize. The default standard mitigation shall be a minimum 0.5-mile (0.8 km) buffer around all recorded nest sites and shall be up to 1 mile, where feasible. Lakes with yellow-billed loon occupancy shall also include a minimum 1,625-foot (495-meter) buffer around the shoreline. Development would generally be prohibited within buffers; BLM would consider waivers or modifications to this requirement if no other feasible option exists.

ROP E-12: Use of Ecological Mapping or Equivalent
Objective: Use ecological mapping as a tool to assess wildlife habitat before development of permanent facilities to conserve important habitat types during development.

Requirement/Standard: An ecological land classification map of the development area shall be developed before approval of facility construction. The map will integrate geomorphology, surface form, and vegetation at a scale, level of resolution, and level of positional accuracy adequate for detailed analysis of development alternatives.

ROP E-18: Protection for Nesting Steller's and Spectacled Eiders
Objective: Avoid and reduce temporary impacts to productivity from disturbance near Steller's and/or spectacled eider nests.

Requirement/Standard: Ground-level activity (by vehicle or on foot) within 656 feet (200 meters) of occupied Steller's and/or spectacled eider nests from June 1 through August 15, will be restricted to existing thoroughfares, such as pads and roads. Construction of permanent facilities, placement of fill, alteration of habitat, and introduction of high noise levels within 656 feet (200 meters) of occupied Steller's and/or spectacled eider nests will be prohibited.

In cases in which oil spill response training is proposed to be conducted within 656 feet (200 meters) of shore in riverine, marine, or inter-tidal areas, BLM will work with USFWS to schedule the training at a time that is not a sensitive nesting/brood-rearing period or require that nest surveys be conducted in the training area prior to a decision on approving the training.

ROP E-19: GIS Files for Proposed Infrastructure
Objective: Provide information to be used in monitoring and assessing wildlife movements during and after construction.

Requirement/Standard: GIS-compatible shape-files of all new infrastructure construction shall be provided to the AO. Infrastructure includes all gravel roads and pads, facilities built on pads, pipelines and independently constructed powerlines.

ROP E-20: Aboveground Utility Design
Objective: Minimize the impacts on bird species from direct interaction with aboveground utility infrastructure.

Requirement/Standard:

a. To reduce the possibility of birds colliding with aboveground utility lines, such lines would either be buried in access roads or suspended on VSMs. Exceptions are limited to the following situations:
    1. Overhead utility lines may be allowed when located entirely within the boundaries of a facility pad.
    2. Overhead utility lines may be allowed when engineering constraints at the specific and limited location make it infeasible to bury or connect the lines to a VSM.
    3. Overhead utility lines may be allowed in situations when human safety would be compromised by other methods.
b. To reduce the likelihood of birds colliding with them, communication towers would be located on existing pads and as close as possible to buildings or other structures and on the east or west side of buildings or other structures, if possible. Support wires would be avoided to the extent practicable. If support wires are necessary, they would be clearly marked along their entire length to improve visibility to low-flying birds.
c. Design of other utility infrastructure, such as wind turbines, would be evaluated under a specific development proposal.
d. The permittee shall comply with current industry-accepted practices for raptor protection on power lines, such as the most recent Avian Power Line Interaction Committee suggested practices.

The following ROPs apply to use of aircraft for permitted activities

ROP F-1: Minimum Flight Altitudes
Objective: Minimize the effects of low-flying aircraft on wildlife, subsistence activities, and local communities.

Requirement/Standard: The lessee shall ensure that aircraft used for permitted activities maintain altitudes according to the following guidelines (Note: This ROP is not intended to restrict flights necessary to survey wildlife. Flights necessary to gain this information will be restricted to the minimum.):

a. Aircraft shall maintain an altitude of at least 1,500 feet (460 meters) above ground level when within 0.5 mile (0.8 km) of cliffs identified as raptor nesting sites from April 15 through August 15.
b. Aircraft shall maintain an altitude of at least 1,000 (305 meters) feet above ground level over caribou winter ranges from December 1 through May 1.
c. Land user shall submit an aircraft use plan as part of an oil and gas development proposal. The plan shall address strategies to minimize impacts to subsistence hunting and associated activities.
d. Proposed aircraft use plans should be reviewed by appropriate federal, State, and borough agencies. Adjustments, including suspension of all flights, may be required by the AO if resulting disturbance is determined to be unacceptable.

e. The number of takeoffs and landings to support oil and gas operations with necessary materials and supplies should be limited to the maximum extent possible.
f. Use of aircraft, especially rotary wing aircraft, near known subsistence camps and cabins or during sensitive subsistence hunting periods (spring goose hunting and fall caribou and moose hunting) should be kept to a minimum.
g. Aircraft used for permitted activities shall maintain an altitude of at least 2,000 feet (610 meters) above ground level over the Teshekpuk Lake Caribou Habitat Area from May 20 through August 20. Aircraft use by oil and gas lessees in the Goose Molting Area should be minimized from May 20 through August 20.
h. Aircraft used for permitted activities shall maintain an altitude of at least 2,000 feet (610 meters) above ground level over the Utukok River Uplands Special Area from May 20 through August 20.
i. Hazing of wildlife by aircraft is prohibited. Pursuit of running wildlife is hazing.
j. Fixed-wing aircraft used as part of a BLM-authorized activity along the coast shall maintain minimum altitude of 2,000 feet (610 meters) when within a 0.5 mile (0.8 km) of walrus haulouts. Helicopters used as part of a BLM-authorized activity along the coast shall maintain minimum altitude of 3,000 feet (915 meters) and a 1.0-mile (1.6-km) buffer from walrus haulouts.
k. Aircraft used as part of a BLM-authorized activity along the coast and shore fast ice zone shall maintain minimum altitude of 3,000 feet (915 meters) when within 1.0 mile (1.6 km) of all listed marine mammal species.

The following LS applies to abandonment and reclamation plans.

LS G-1: Reclamation Plans
Objective: Ensure long-term reclamation of land to its previous condition and use.

Requirement/Standard: Prior to final abandonment, land used for oil and gas infrastructure shall be reclaimed to ensure eventual restoration of ecosystem function. The leaseholder shall develop and implement an abandonment and reclamation plan approved by BLM. The plan shall describe short-term stability, visual, hydrological, and productivity objectives and steps to be taken to ensure eventual ecosystem restoration to the land's previous hydrological, vegetative, and habitat condition.

The following ROP applies to subsistence consultation for permitted activities.

ROP H-3: Hunting, Fishing, and Trapping by Permittees
Objective: Minimize impacts to sport hunting and trapping species and to subsistence harvest of those animals.

Requirement/Standard: Hunting and trapping by lessee's/permittee's employees, agents, and contractors are prohibited when persons are on "work status." Work status is defined as the period during which an individual is under the control and supervision of an employer. Work status is terminated when the individual's shift ends and he/she returns to a public airport or community (e.g., Fairbanks, Barrow, Nuiqsut, or Deadhorse). Use of lessee/permittee facilities, equipment, or transport for personal access or aid in hunting and trapping is prohibited.

The following additional protections apply to select biologically sensitive areas.

LS K-1: River Setbacks
Objective: Minimize the disruption of natural flow patterns and changes to water quality; the disruption of natural functions resulting from the loss or change to vegetative and physical characteristics of floodplain and riparian areas; the loss of spawning, rearing or over-wintering habitat for fish; the loss of cultural and paleontological resources; the loss of raptor habitat; impacts to subsistence cabin and campsites; the disruption of subsistence activities; and impacts to scenic and other resource values.

Colville River Special Area Management Plan—Protection 1
Minimize the loss of arctic peregrine falcon nesting habitat in the Colville River Special Area.

Requirement/Standard: Permanent oil and gas facilities, including gravel pads, roads, and pipelines, are prohibited in the streambed and adjacent to the rivers listed below. On a case-by case basis, essential pipeline and road crossings will be permitted through setback areas.

a. Colville River: A 2-mile (3.2-km) setback from the boundary of NPR-A where the river determines the boundary along the Colville where BLM-manages both sides of the river up through T5S, R30W, U.M. Above that point to the juncture of Thunder and Storm creeks, the setback is 0.5 mile (0.8 km).
b. Fish (Uvlutuuq) Creek: A 3-mile (4.8-km) setback from the creek downstream from the eastern edge of section 31, T11N, R1E., U.M. and a 0.5-mile (0.8 km) setback farther upstream.
c. Judy (Kayyaak) Creek: A 0.5-mile (0.8-km) setback.
d. Ublutuoch (Tiŋmiaqsiugvik) River: a 0.5-mile (0.8-km) setback.

Colville River Special Area Management Plan—Protection 1
To minimize the direct loss of arctic peregrine falcon nesting habitat and to protect nest sites in the Colville River Special Area, the following protective measures apply:

- Permanent oil and gas facilities, including gravel pads, roads, and pipelines, are prohibited in the streambed and adjacent to the rivers listed below.
- On a case-by-case basis, essential pipeline and road crossings will be permitted through setback areas.

LS K-6: Coastal Area Setbacks
Objective: Protect coastal waters and their value as fish and wildlife habitat (including, but not limited to, that for waterfowl, shorebirds, and marine mammals), minimize hindrance or alteration of caribou movement within caribou coastal insect-relief areas; protect the summer and winter shoreline habitat for polar bears, and the summer shoreline habitat for walrus and seals; prevent loss of important bird habitat and alteration or disturbance of shoreline marshes; and prevent impacts to subsistence resources and activities.

Requirement/Standard:

a. Drill pads and central processing facilities would not be allowed in coastal waters or on islands between the northern boundary of the NPR-A and the mainland, or in inland areas within 1 mile (1.6 km) of the coast. Other facilities necessary for oil and gas production within NPR-A that necessarily must be within this area (e.g., barge landing, seawater treatment plant, or spill response staging and storage areas) would not be precluded. Lessees/permittees shall consider the practicality of locating facilities that necessarily must be within this area at previously occupied sites such as various Husky/USGS drill sites and Distant Early Warning-Line sites. Before conducting open water activities, the lessee shall consult with the Alaska Eskimo Whaling Commission, NSB, and local whaling captains associations to minimize impacts to subsistence whaling activities.

b. Marine vessels used as part of a BLM-authorized activity shall maintain a 1-mile buffer from the shore when transiting past an aggregation of seals, Steller's sea lions, or walruses using a terrestrial haulout. Marine vessels shall not conduct ballast transfers or discharge any matter into the marine environment within 3 miles of the coast, except when necessary for the safe operation of the vessel.

The following ROP applies to summer vehicle tundra access.

ROP L-1: Summer Tundra Travel
Objective: Protect stream banks and water quality; minimize compaction and displacement of soils; minimize the breakage, abrasion, compaction, or displacement of vegetation; protect cultural and paleontological resources; maintain populations of, and adequate habitat for birds, fish, and caribou and other terrestrial mammals; and minimize impacts to subsistence activities.

Requirement/Standard: On a case-by-case basis, BLM may permit low-ground-pressure vehicles to travel off of gravel pads and roads during times other than those identified in ROP C-2a. Permission for such use would only be granted after an applicant has:

a. Submitted studies satisfactory to the AO of the impacts on soils and vegetation of the specific low-ground-pressure vehicles to be used.
b. Submitted surveys satisfactory to the AO of subsistence uses of the area as well as of the soils, vegetation, hydrology, wildlife and fish (and their habitats), paleontological and archaeological resources, and other resources as required by the AO.
c. Designed and/or modified the use proposal to minimize impacts to the AO's satisfaction. Design steps to achieve the objectives may include, timing restrictions, shifting of work to winter, rerouting, and not proceeding when certain wildlife are present or subsistence activities are occurring. At the discretion of the AO, the plan for summer tundra vehicle access may be included as part of the spill prevention and response contingency plan.

ROP M-1: Vehicle Use Plans
Objective: Minimize disturbance and hindrance of wildlife, or alteration of wildlife movements through the NPR-A.

Requirement/Standard: Chasing wildlife with ground vehicles is prohibited. Particular attention will be given to avoid disturbing caribou.

Deviation from ROPs and LSs
Due to technical constraints, some Project components would require deviations from the LSs and ROPs listed above. These would include deviations from ROPs E-2, E-5, and E-11 and LS

K-1. The proposed Project would include road and pipeline crossings within 500 feet (152 m) of fish-bearing waterbodies (including one or more of the waterbodies protected by setbacks in stipulations E-2 and K-1). The Project would also: 1) place new VSMs along existing pipeline corridors due to pipe rack capacity limits (deviation to ROP E-5); 2) separate the Project airstrip from roads due to Federal Aviation Administration regulations and operational safety concerns based on incident history at the Alpine integrated airstrip (deviation from ROP E-5), and 3) cross the default BLM standard mitigation disturbance setback of 1 mile (1.6 km) around recorded nest sites for yellow-billed loons and 500-meter (1,625-feet) setback of the shoreline of nest lakes (deviation to ROP E-11).

CPAI's Minimization and Avoidance Measures

A complete list of CPAI's avoidance and minimization measures are in Appendix A of the BA (BLM 2022a), *Design Features to Avoid and Minimize Impacts*. However, the subset of CPAI's design features that directly or indirectly avoid and minimize adverse effects to polar bears, listed eiders, or northern sea otters, and minimize the destruction or adverse modification of critical habitat are listed below.

The following design features would minimize potential impacts to polar bear critical habitat, listed eider nesting, and near-shore habitat:

Design feature 2:	Construct road surfaces to the minimum width required for Project operations to minimize the placement of gravel fill (ROP E-5);
Design feature 4:	Share use of existing equipment and facilities (e.g., camps, seawater treatment plant, warehouses, maintenance shops, emergency response equipment) to reduce the overall Project gravel- and ice-pad footprint (ROP E-5);
Design feature 5:	Use an ice road to access the Tiŋmiaqsiuġvik mine site (instead of a gravel road) to reduce the Project's overall gravel footprint (ROP E-5);
Design feature 6:	Use 2:1 side slopes (i.e., gravel road and pad embankment slopes) to reduce the Project's overall gravel footprint (ROP E-5);
Design feature 7:	Avoid permanently flooded wetlands by locating Project infrastructure on higher, and relatively drier areas, when practicable;
Design feature 8:	Suspend communications and power cables from horizontal support members to avoid additional fill associated with utility poles and to reduce the potential for bird strikes and perches for predators (ROP E-20);
Design feature 9:	Use ice roads and pads, including multi-season ice pads, for Project access, pipeline construction, camps, and temporary storage of mine site overburden to reduce the Project's overall gravel footprint (ROP E-5);
Design feature 10:	Design pipelines to minimize redundant parallel pipelines to the extent practicable. (For example, infield pipelines from drill site BT2 would tie into drill site BT1 pipelines at BT1; and then drill site BT1 infield pipelines would connect with the WPF. Additionally, the Willow export pipeline would tie into the existing Alpine Sales oil

pipeline at the Alpine CD4N tie-in pad to connect the Project to the Trans-Alaskan Pipeline System.) (ROP E-7);

Design feature 12: Consult with appropriate federal, state, and NSB agencies during mine site design and reclamation. Design mine site to minimize impacts to minimize impacts to wildlife, air quality, and water resources. Mine site operation and reclamation would include the storage and reuse of organic overburden (at the mine site or other disturbed locations on the North Slope) and would consider potential opportunities to provide fish and wildlife enhancement during reclamation (ROP E-8);

Design feature 14: Restrict tundra travel for Project personnel to emergency response or to permitted activities required by statute or regulation (ROP L-1);

Design feature 15: Conduct overland (i.e., tundra) moves and similar off-road or cross-country activity use in accordance with NPR-A ROP C-2 to minimize impacts to streambanks, soil substrate, and vegetation (ROP- C-2);

Design feature 17: Prohibit travel along streambeds unless it can be demonstrated that there would be no additional impacts from such travel to over-wintering fish or the invertebrates they rely on. Rivers, streams, and lakes would only be crossed with ice infrastructure at areas where waterbody or waterway ice has grounded, when practicable (ROP C-4);

Design feature 18: Inject produced water into the reservoir to support enhanced oil recovery and do not discharge it to surface lands, surface waters, or marine waters (ROPs A-2 and A-7);

Design feature 19: Use recent ecological mapping to assess wildlife habitat types to inform the design, placement, and development of permanent (i.e., gravel) infrastructure (ROP E-12);

Design feature 22: Design and construct stream and wetland crossings to ensure the free passage of fish, minimization of erosion, maintenance of natural drainage characteristics, and the minimization of impacts to natural stream flow. Bridges would be used to cross rivers and major streams (ROP E-6); and

Design feature 107: Do not refuel equipment within 500 feet of the active floodplain of any waterbody unless approved by the BLM authorized officer. Fuel-storage stations, except as approved by the BLM authorized officer, would be located at least 500 feet from waterbodies except for small caches (up to 210 gallons) for fueling motorboats, float planes, and small equipment (ROP A-5).

Design feature 113: Remove the airstrip approach lighting access and secondary access roads from the proposed Project design to reduce the gravel footprint.

Design feature 114: Develop a module delivery option that uses the existing Oliktok Dock and staging pad to avoid the need to construct an MTI.

Design feature 115: Minimize the footprint of the gravel mine based on amount of gravel needed.

The following design features would reduce human-polar bear interactions, thereby reducing potential human-polar bear conflicts:

Design feature 46:	Develop a bear-interaction plan for Project personnel to minimize conflicts between bears and humans (ROP A-8);
Design feature 60:	Produce a Wildlife Avoidance and Interaction Plan that would include procedures to eliminate, minimize, and mitigate bear interactions. CPAI conducts training on waste management practices and would conduct Project-specific training on waste management to guide employees and contractors on managing predators (ROPs A-1, A-2, A-8, and I-1);
Design feature 61:	Protect grizzly and polar bear denning sites by prohibiting cross-country travel or use of heavy equipment within 0.5 mile of a grizzly bear den and within 1.0 mile of a polar bear den or seal birthing lairs. Where necessary, CPAI would conduct surveys near coastal areas to locate potential polar bear dens and seal-birthing lairs, in consultation with the U.S. Fish and Wildlife Service and/or the National Marine Fisheries Service, as appropriate, before initiating activities in coastal habitat between October 30 and April 15) (ROP C-1);
Design feature 62:	Conduct training for Project personnel on NPR-A ROPs, standards, and environmental, social, traditional, and cultural concerns specific to the Project region, including training on community interactions. This training would be designed to ensure strict compliance with local and corporate drug and alcohol policies (ROP I-1);
Design feature 63:	Prohibit Project employees from hunting and trapping activities while employees are on active work status to reduce the potential for increased competition for subsistence and recreational wildlife resources;
Design feature 87:	Audit contractor' health, safety, and environment performance to ensure safe practices are followed; and
Design feature 88:	Audit the Project on a scheduled basis to ensure compliance with all environmental laws, regulations, and local requirements, company policies and procedures, and other regulations regarding safety, land use, fire codes.

The following design features would reduce impacts to listed eiders:

Design feature 8:	Suspend communications and power cables from horizontal support members to avoid additional fill associated with utility poles and to reduce the potential for bird strikes and perches for predators (ROP E-20);
Design feature 9:	Use ice roads and pads, including multi-season ice pads, for Project access, pipeline construction, camps, and temporary storage of mine site overburden to reduce the Project's overall gravel footprint (ROP E-5);
Design feature 34:	Implement dust control measures for gravel roads, pads, and mining operations to reduce fugitive dust that can settle on vegetation or snow, which could increase thermal conductivity (i.e., reduce albedo), lead to

thermokarsting, and promote earlier spring thaw in affected areas (ROP A-10);

Design feature 37: Design, construct, and use ice roads that are a minimum of 6 inches thick during winter construction to eliminate or minimize impacts to wetlands and tundra (ROP C-2).

Design feature 38: Prepare an erosion control plan to detail ways the Project would prevent or mitigate erosion that would impact terrestrial and aquatic environments. The plan would include CPAI's operations, monitoring, and maintenance procedures that detail the actions CPAI would undertake to monitor, maintain, and if needed, remediate gravel fill impacting surrounding tundra and wetlands (ROP E-6);

Design feature 39: Place cleared (i.e., plowed) snow in designated snow-storage areas and manage stormwater from all gravel pads to prevent contaminants from being released during spring breakup. Select snow push areas annually based on avoiding areas of thermokarsting, proximity to waterbodies, and evaluations of areas used the previous year (ROP A-3);

Design feature 48: Design facilities to minimize nesting, denning, or sheltering opportunities for ravens, raptors, and foxes (ROP A-8);

Design feature 49: Minimize the amount of light visible from outside of facilities, including directing artificial exterior lighting inward and downward during all months of the year, which would prevent waterfowl (including species listed under the ESA) from striking facilities during low light conditions;

Design feature 50: Minimize the take of species, particularly those listed under the ESA and BLM Special Status Species, by conducting eider and yellow-billed loon surveys and working with resource agencies to ensure facilities minimize impacts to species found (e.g., ensure off pad utility lines are either buried or suspended from pipe racks to the extent feasible, locate towers on pads near existing buildings to the extent feasible, minimize the use of tower guy wires, clearly mark guy wires that are used to prevent collisions). (ROPs E-11 and J);

Design feature 52: Minimize the electrocution hazard by suspending electrical distribution lines from pipe racks or burying cables (versus the use of overhead power lines) off pad.

Design feature 53: Provide the BLM authorized officer with GIS-compatible location information to facilitate agency monitoring and assessment of wildlife movements through the Project area after Project construction;

Design feature 70: Conduct high-disturbance construction activities such as gravel mining and placement, and pipeline and facility construction, primarily during the winter months when ESA-listed eiders are not present.); and

Design feature 72: Within BLM-managed lands, prohibit the use of airboats on rivers within a 50-mile radius of Nuiqsut, except for emergencies and emergency response training.

The following design features would reduce impacts to both listed eiders and polar bears:

Design feature 45:	Maintain air-traffic altitudes consistent with NPR-A ROP F-1, (i.e., 3,000 ft AGL when within 1-mi of all listed marine mammal species) except during takeoffs and landings, and unless doing so would endanger human life or violate safe flying practices. (Some air traffic would be required to support the Project or for regulatory compliance [e.g., wildlife studies, hydrology studies] and to ensure cleanup following the ice-road season could require flying at lower altitudes) (ROP F-1);
Design feature 55:	Locate pipelines parallel to new and existing gravel roads and maintain a minimum separation distance of 500 feet (but not exceeding 1,000 feet), where feasible (ROP E-7);
Design Feature 56:	Contract with a state-registered Primary Response Action Contractor to assist with quick spill response impacts in the event of a spill.
Design feature 66:	Prohibit the disturbance of caribou and strictly prohibit the harassment of wildlife with vehicles (ROP M-1);
Design feature 81:	Use completely enclosed or otherwise acoustically packaged permanent electric power generator sets to abate noise;
Design feature 89:	Employ Field Environmental Coordinators to monitor compliance with permits and other Project requirements;
Design feature 92:	Develop and implement a spill prevention and response contingency plan for the Project (in accordance with 40 CFR 112) to reduce impacts to human health and safety and to minimize potential effects to subsistence resources, including fish and wildlife. The Plan would cover Project operations and describe spill prevention measures and on-site cleanup materials for permanent fueling stations, use of proper storage containers and liner materials, proper container identification, and notice of reportable spills. Identification of drip pans (i.e., "duck ponds") would be addressed through Project operating procedures (ROP A-4)
Design feature 93:	Use a hazardous materials contingency plan (also known as a spill prevention and response contingency plan), that would detail response actions, drills, and responder training (ROP A-3);
Design feature 94:	Build and operate pipelines with the best available technology for detecting and preventing corrosion or mechanical defects to minimize impacts related to point source pollution from oil spills or leaks (ROP E-4); and
Design feature 95:	Install pipeline valves on produced fluid pipelines at each side of Judy (Kayyaaq) and Fish (Uvlutuuq) creek crossings, which would isolate sections of the pipelines between the valves to minimize potential spill impacts in the event of a leak or break. These valves would reduce subsistence user concerns related to downstream contamination from the Project. Pipeline valves or vertical loops would be installed on the Willow (sales oil) pipeline at crossings of the Ublutuoch

(Tiŋmiaqsiuġvik) River, the Nigliagvik Channel, the Niġliq Channel, and lakes L9341 and L9323 and on the seawater and diesel pipelines at the Colville River;

Design feature 96: Implement CPAI's "Target Zero" spill prevention program, which is designed to raise awareness around spill prevention and pass on lessons learned, for the Project (ROPs A-3, A-4, and A-5);

Design feature 97: Implement a fuel transfer standard operating procedure and use secondary containment on regulated oil and hazardous materials storage tanks (ROPs A-4 and A-5).

Design feature 98: Continue to implement an extensive corrosion inspection program which includes ultrasonic inspection, radiographic inspection, coupon monitoring, metal loss detection pigs and geometry pigs (applicable to pig-capable pipelines), and infrared (heat signature detection) technology. The inspection programs are API Standard 570-based programs that focus inspection efforts on areas of greatest potential for spills.

Design feature 99: Continue CPAI's operating practice to immediately and completely clean up all spills, recovering 100% of spilled material for recycling when possible.

Design feature 100: Periodically treat pipeline fluids, as appropriate to product types, with chemicals to limit corrosion potential.

Design feature 101: Equip and maintain oil spill response equipment intended for use in winter conditions for effective use in Arctic conditions (i.e., in a manner to prevent the freezing or icing of the equipment).

Design feature 103: Provide access to the GMT and Alpine developments to offer additional response capabilities and minimize response time in the event of a spill or other intended release or emergency.

Design feature 104: Stage spill response equipment in strategic locations (e.g., drill sites) for initial spill response. On-site staged equipment would facilitate the rapid deployment of response personnel and may minimize or reduce the overall impacts associated with a spill or other accidental release.

Design feature 105: Designate Spill Response Teams and Hazardous Materials Response Teams, consisting of trained volunteer spill and hazardous materials response personnel on site.

Design feature 106: Continue to participate in the Mutual Aid Agreement among North Slope operators to supply labor and equipment for immediate spill response. Spill response drills and exercises would ensure response readiness and awareness; these drills would be scheduled according to the National Preparedness and Response Exercise Program guidelines and typically involves production, drilling, or pipeline spill response scenarios

Design feature 108: Design well cellars to contain fluid drips and leaks.

Polar Bear Mitigation Measures
CPAI would adhere to implementing a number of measures for the life of the proposed Project which will serve to significantly reduce the potential impacts of the Project to Polar Bears. These mitigation measures fall into two primary categories described in detail below:

1. *Measures to Avoid and Minimize Potential Polar Bear Incidental Harassment*
2. *Measures to Avoid and Minimize Potential Polar Bear Deterrence*

These measures include all the mitigation measures that CPAI would typically be required to implement under MMPA authorizations for both incidental take and take by deterrence (i.e., intentional, non-lethal take) to Project activities. However, CPAI's implementation of these measures does not depend on future MMPA authorization, and they are part of the proposed Project.

1. Measures to Avoid and Minimize Potential Polar Bear Incidental Harassment
The following measures summarized below and detailed in Appendix B of the BA would be employed to avoid and minimize potential polar bear incidental harassment:

1. Project activities will be conducted in accordance with CPAI's *Polar Bear Avoidance and Interaction Plan* (June 2021). A copy of this plan will be kept on-site and will be available for reference by all Project personnel. A copy of the current plan is on file with BLM and USFWS.
2. All employees, contractors, and personnel performing activities for the Willow Project will observe and carry out all applicable terms and conditions set forth in the 2022 regulations 50 CFR 18 subpart J, which are provided in BLM 2022b, *Mitigation, Monitoring, and Reporting Requirements for the 2021-2026 Beaufort Sea Incidental Take Regulations*. Monitoring reports will be submitted to BLM and USFWS Marine Mammals Management Office (MMM) via email at fw7_mmm_reports@fws.gov.
3. All personnel will limit encounters with polar bears by being observant of approaching polar bears and by allowing polar bears to pass unhindered when possible.
4. If a polar bear interaction escalates into a life-threatening situation, MMPA section 101(c) allows, without specific authorization, the take (including lethal take) of a polar bear if such taking is necessary for self-defense or to save the life of a person in immediate danger. Such taking will be reported to USFWS and BLM as soon as possible, but no later than 48 hours after the incident.
5. Work activities will not take place within 1.0 mile (1.6 km) of known polar bear dens without prior authorization. Two polar bear aerial infrared den detection surveys of all denning habitat within 1.0 mile (1.6 km) of human activity will be conducted during the maternal denning period (as specified in the 2021-2026 Beaufort Sea ITR). These den detection surveys would be subject to weather restrictions or other factors, but would take place from approximately November 25 – January 20). Should occupied dens be identified within 1.0 mile (1.6 km) of Project activities at any time, work in the area will cease and BLM and USFWS MMM will be contacted.
6. Vessel operators will maintain the maximum distance possible and take every precaution to avoid harassment of concentrations of polar bears. Vessels will reduce speed and maintain a minimum 0.5-mile (805-m) operation exclusion zone around polar bears observed on ice.

7. BLM and USFWS will be notified of changes to the Project, including changes to activities, locations, or methods, prior to implementation.

2. Measures to Avoid and Minimize Potential Polar Bear Deterrence

The following measures would be employed to avoid and minimize potential polar bear deterrence:

1. Project activities will be conducted in accordance with CPAI's *Polar Bear Avoidance and Interaction Plan* (June 2021). A copy of this plan will be kept on site and be available for reference by all Project personnel. A copy of this plan is on file with BLM and USFWS.
2. CPAI will ensure that only trained and qualified personnel are assigned the task of polar bear deterrence. Prior to initiation of activities, a list of trained personnel responsible for deterrence and a description of their training will be submitted to USFWS MMM.
3. Should firearms be used for polar bear deterrence, CPAI will ensure that personnel comply with all laws and regulations regarding the carry and use of firearms.
4. Within 48 hours of occurrence, CPAI or its designated agent, will document and report to USFWS MMM all instances involving polar bear deterrence activities. A final report of all polar bear deterrence activities will be submitted to BLM and USFWS MMM. Reports will be submitted to BLM and USFWS MMM via email at fw7_mmm_reports@fws.gov.
5. Appropriate deterrence techniques will include use of (but not limited to), bear monitors, airhorns, electric fences, bear spray, acoustic recordings, vehicles, and projectiles (e.g., beanbags, rubber bullets, "cracker" shells, "bangers", and "screamers"). Deterrence techniques must not cause the injury or death of a polar bear. Any injury or death of a polar bear will be reported to BLM and USFWS MMM as soon as possible but no later than 48 hours after the incident.
6. Prior to conducting a deterrence activity, CPAI will:
    a. Make a reasonable effort to reduce or eliminate attractants.
    b. Secure the site, notify supervisor, and mover personnel to safety.
    c. Ensure the polar bear has escape route(s).
    d. Ensure communication with all personnel.
7. When conducting a deterrence activity, CPAI will:
    a. Never deter a polar bear for convenience or to aid Project activities. The safety and welfare of the polar bear is second only to the safety and welfare of humans in a deterrence situation.
    b. Shout at the polar bear before using projectiles or other techniques.
    c. Begin with the lowest level of force or intensity that is effective and increase the force or intensity of the technique, or use additional techniques, only as necessary to achieve the desired result.
8. After a deterrence event, CPAI will:
    a. Monitor the polar bear's movement (to ensure no return).
    b. Notify supervisor and personnel when it is safe to resume work.
    c. Submit a report to USFWS MMM within 48 hours.

Additional Minimization Measures
The following measures would also apply to permitted activities associated with the proposed Project.

Erosion Control
The Project would follow a Facilities Erosion Control Plan, which would outline procedures for operation, monitoring, and maintenance of various erosion control methods. The Facilities Erosion Control Plan would contain Project snow removal and dust control measures. Snow removal plans would include the use of snow-blowing equipment to minimize gravel carryover to the tundra and the placement of cleared snow in designated areas. Snow push areas would be determined annually, based on avoiding areas of thermokarst, proximity to waterbodies, and evaluating how the area looks based on the previous years' activities. The Willow Dust Control Plan includes gravel road watering guidelines to minimize dust impacts to tundra. A Stormwater Pollution Prevention Plan would describe management of surface water drainage for the Project pads.

Spill Prevention and Response
Facilities would be designed to mitigate spills with spill prevention measures and spill response capabilities. Spill prevention and response measures to be used during construction, drilling, and operations would be outlined in a Project ODPCP and Spill Prevention Control and Countermeasures Plan, consistent with NPR-A ROP A-3 (BLM 2022a). CPAI would implement a pipeline maintenance and inspection program and an employee spill-prevention training program to further reduce the likelihood of spills. Production facility design would include provisions for secondary containment for hydrocarbon-based and hazardous materials. If a spill occurs on a pad, the fluid would remain on the pad, unless the spill is near the pad edge or exceeds the retention capacity of the pad. Fuel transfers near pad edges would be limited to the extent practicable to mitigate this risk.

Spill Prevention – CPAI would design and construct pipelines to comply with state, federal, and local regulations. Pipelines would be constructed of high-strength steel and would have wall thicknesses in compliance with or exceeding regulatory requirements. Pipeline welds would be validated using nondestructive testing (e.g., radiography, ultrasonic) during pipeline construction to ensure their integrity, and the pipelines would be hydrostatically tested prior to operation. The production fluids, water injection, seawater, and export pipelines would fully accommodate pigs for cleaning and corrosion inspection.

CPAI would use two methods of leak detection for the seawater and diesel pipeline crossings under the Colville River:

1. Leak detect mass balance (primary).
2. Optical leak detection (secondary within the pipeline carrier casing).

To further minimize the risk of a pipeline leak under the Colville River, the diesel and seawater pipelines would be installed inside high-strength casing pipes. The simultaneous failure of both a pipeline and the casing is highly unlikely. If fluids leak from the pipelines, they would be captured within the space between the outer wall of the pipelines and the inner walls of the casing rather than reaching the subsurface river environment. To prevent external corrosion, the casing pipes and pipeline would be protected by an abrasion-resistant coating, in accordance with industry standards.

CPAI would maintain a corrosion control and inspection program that includes ultrasonic inspection, radiographic inspection, coupon monitoring, metal loss detection and geometry pigs, and infrared technology. The inspection programs are American Petroleum Institute Standard 570-based programs that focus inspection efforts on areas with the greatest spill potential.

Spill Response

The Project ODPCP would demonstrate readily accessible inventories of fit-for-purpose oil spill response equipment, and personnel would be available at Project facilities. In addition, a state-registered primary response action contractor would provide trained personnel to manage spill response(s).

Threats to rivers and streams from a possible pipeline spill would be minimized by quickly intercepting, containing, and recovering spilled oil near the waterway crossing point once detected. Valves would be installed on each side of pipeline crossings at Fish (Uvlutuuq) Creek and Judy (Iqalliqpik) Creek, which would isolate produced fluids pipelines on either side of the creeks to minimize the potential spill impact in the event of a pipeline leak or break. Spill response equipment would be pre-staged at strategic locations across the Project area for rapid deployment, as outlined in the Project's ODPCP. During summer, pre- staged containment booms would be placed at strategic locations near selected river channels. Pre-deployed booms may also be placed within select stream channels to mitigate a spill, should one occur. During the summer, spill containment equipment would likely be staged or deployed using helicopters or boats. If a spill occurs, response measures could include helicopter and watercraft (e.g., jetboats, airboats) use to access affected areas.

Spill Training and Inspections

CPAI provides regular training for its employees and contractors on preventing oil or hazardous material spills, in addition to other environmental and certification classes. The CPAI Incident Management Team participates in regularly scheduled training programs and conducts spill response drills in coordination with federal, state, and local agencies. Employees are encouraged to participate in the North Slope Spill Response Team, and as part of the team, members receive regularly scheduled spill response training to ensure the continuous availability of skilled spill responders on the North Slope.

CPAI is required to conduct visual examinations of pipelines and facility piping at least monthly during operations. CPAI would conduct aerial overflights as necessary to allow both visual and infrared inspection using aircraft or from the ground using handheld systems. Infrared technology can detect warm spots (i.e., oil) in low-light conditions or when other circumstances (e.g., light fog, drifted snow) limit visibility.

CPAI would also conduct regular visual inspections of facilities and pipelines from gravel roads and aircraft (for sections of pipelines not paralleled not paralleled by gravel roads [i.e., more than 1,000 feet of separation]).

Compensatory Mitigation Plan for the Fill of Wetlands and Other Waters of the U.S.
Description of Compensatory Mitigation Projects
A compensatory mitigation plan for impacts to wetlands and other waters of the U.S. was developed for the Project in October 2020. There are no mitigation banks or in-lieu fee programs with service areas that are authorized to operate in the Project area. Therefore, permittee responsible mitigation (PRM) was proposed as the only available option to provide compensatory mitigation for the fill of wetlands and other Waters of the U.S. Mitigation site selection was conducted to determine PRM project availability. Credit calculations were conducted using U.S. Army Corps of Engineers (USACE) functional assessment and credit-debit methodologies. Construction of proposed rehabilitation projects would use a phased approach and monitoring would be conducted under a long-term management plan.

For site selection, CPAI examined potential wetland enhancement and preservation projects that would occur within the same watershed as the Project, support aquatic resource functions, benefit the community of Nuiqsut, and ensure economic and logistical practicability. No onsite alternatives for compensatory mitigation were available due to the undeveloped nature of the area and land ownership constraints. The ten-digit hydrologic unit code watersheds have experienced 0.24% overall disturbance from previous activities and no watershed would exceed 0.62% disturbance with the Project.

Under PRM, three projects were proposed to offset impacts to aquatic resources (Figure 2.2). The projects included enhancement of 209.1 acres (0.85 km^2) of palustrine wetlands and preservation of 800 acres (3.24 km^2) of pristine Arctic Coastal Plain (ACP) wetlands at Cape Halkett (Figure 2.3). In addition to the proposed PRM, voluntary culvert repair would be completed in Nuiqsut to enhance 11.8 acres (0.05 km^2) of Waters of the U.S. abutting the Nigliq Channel of the Colville River (Figure 2.4).

The two wetland enhancement projects would provide Nuiqsut (Figure 2.5) and Anaktuvuk Pass Subsistence Trail tundra rehabilitation. Summer all-terrain vehicle use for subsistence activities in both communities has crated rutting and damage to vegetation, soils, hydrology, and aesthetics in wetlands. An open cell, semi-rigid geogrid material will be installed to provide a more resilient trail surface. Disturbed tundra wetland functions would be enhanced through the use of a single, geogrid-constructed trail.

The Cape Halkett preservation area would preserve lands in one of two areas through the use of a site protection instrument, limiting allowable activities to subsistence use or other non-disturbance activities. The site protection instrument would be a deed restriction or conservation easement if a third-party holder can be identified. Wetlands in this area are ecologically valuable and high functioning, in areas of potential future development activity, and connected to lands preserved for other compensatory mitigation projects.

Under the voluntary Nuiqsut culvert repair project, four culverts in Nuiqsut would be replaced to better convey water from a beaded stream to the Colville River (Figure 2.4). The culvert repair project would be supported on a voluntary basis as a site protection instrument could not be ensured for all adjacent property parcels. No mitigation credits were requested by CPAI for the culvert replacement project.

The 2017 USACE North Slope Rapid Assessment Method was used to determine credits and the 2016 USACE Alaska Credit-Debit Methodology was used to calculate offsets for impacts to aquatic resources. The 209.1 acres of wetland enhancement for subsistence trail improvements resulted in 59.6 mitigation credits. The remaining credits needed to offset project impacts would come through preserving land at Cape Halkett. Using the 2016 USACE Alaska Credit-Debit Methodology, preserving 107 acres at Cape Halkett would provide 90.6 mitigation credits. The compensatory mitigation plan applied several ratios for determining mitigation credits based on the proposes 800 acres of preservation as an alternative credit calculation.

Compensatory mitigation projects would be completed in a phased approach coincident with Project construction. Long-term management and maintenance would be conducted under a long-term management plan, with local community control. Monitoring would occur pre-construction and every year at the end of the growing season for 3 years for wetland enhancement projects and during pre-construction and at 5 and 10 years for the preservation project.

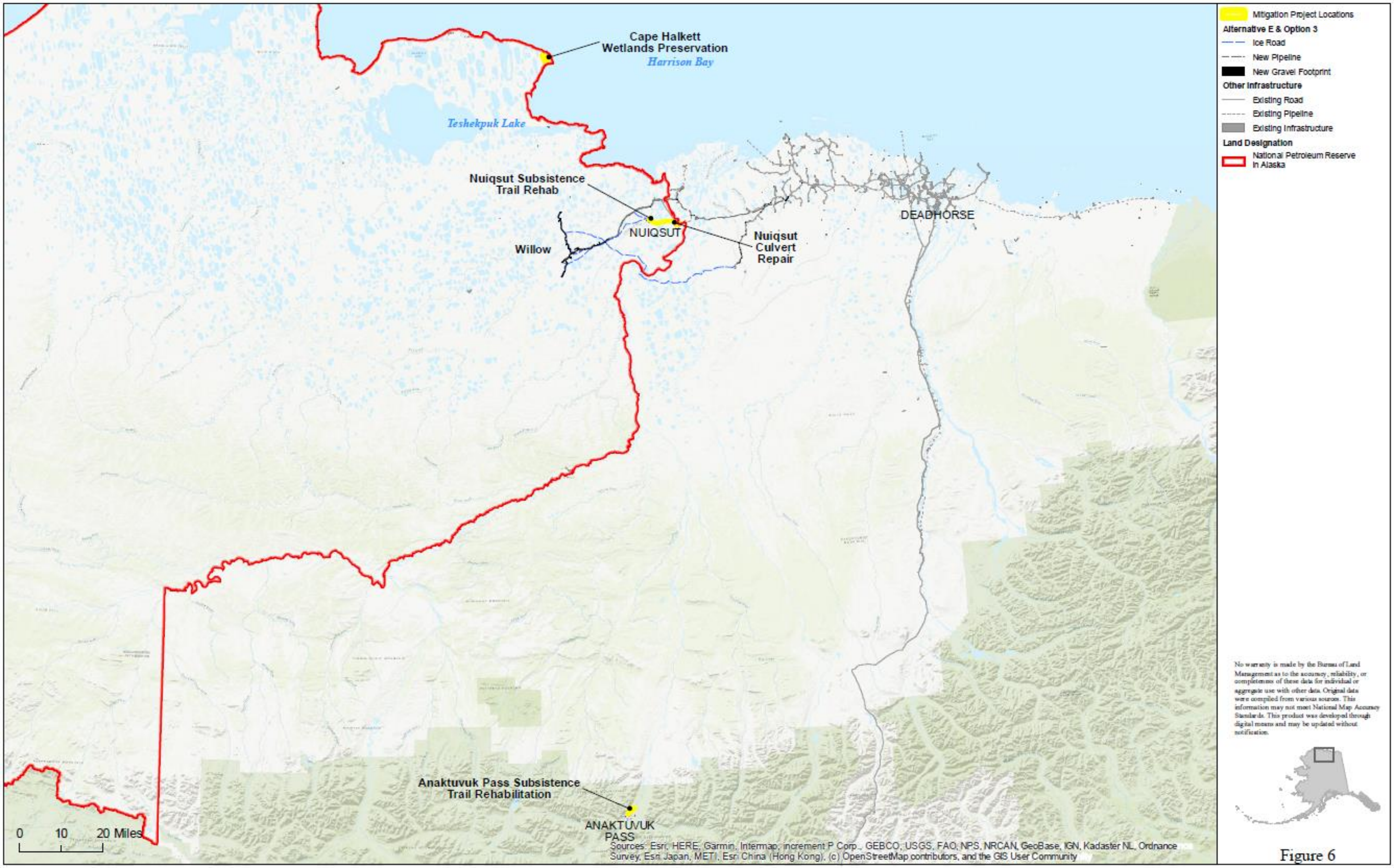


Figure 2.2. Location of three proposed mitigation projects associated with the proposed Project: Nuiqsut and Anaktuvuk Pass subsistence trail rehabilitation projects, and land preservation area at Cape Halkett.

Figure 2.3. Proposed 800-acre (3.24 km^2) land preservation area at Cape Halkett associated with compensatory mitigation for the proposed Project.

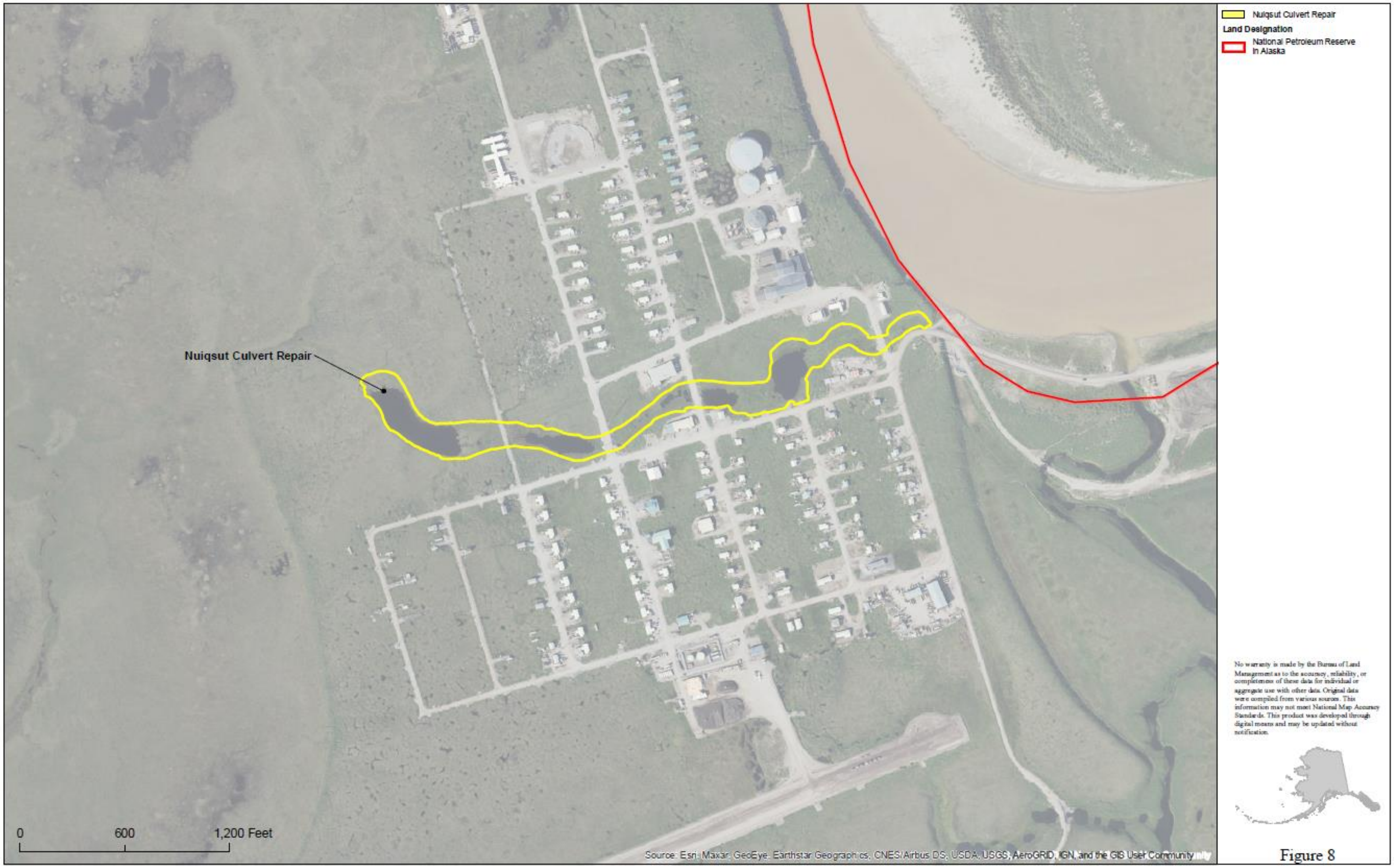


Figure 2.4. Proposed voluntary culvert repair to enhance 11.8 acres (0.05 km^2) of Waters of the U.S. abutting the Nigliq Channel of the Colville River near Nuiqsut, Alaska.

Figure 2.5. Detail of the proposed subsistence trail rehabilitation project near Nuiqsut, associated with compensatory mitigation for the Project

3. ACTION AREA

Under regulations implementing Section 7 of the ESA, the Action Area includes all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action. In determining the effects of the action, and hence the Action Area, we consider the consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that result from the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action.

Here, the Action Area includes terrestrial and offshore areas. The terrestrial Action Area is the area within 1 mile (1.6 km) of Project activities and compensatory mitigation projects. This was determined to be the Action Area because it encompasses the area of physical disturbance coupled with a one mile buffer within which disturbance to polar bear dens could occur from noise, vibration, physical presence, and human activity associated with the Project (Figure 3.1). We expect this area would also encompass all potential impacts to ESA-listed eiders.

The offshore Action Area is the area within 1.5 miles (2.4 km) of offshore Project components: the marine transit route (MTR) for barge transit from Dutch Harbor in the southern Bering Sea to the offshore barge lightering area, the screeding area for barge lightering, the barge and support vessel route from the lightering area to Oliktok Dock, and the area encompassing construction, screeding, and offloading activities at Oliktok Dock (Figure 3.2 Inset A). The offshore action area for screeding and Oliktok Dock work was determined by using the estimated distance to the National Marine Fisheries Service (NMFS) acoustic harassment disturbance threshold for non-impulsive noise sources (120 decibels [dB] referenced to one microPascal root mean square [dB re 1 μPa rms]). To estimate the distance to the 120 dB re 1 μPa threshold for the MTR, a source level of 170 dB re 1 μPa rms at 3.28 feet (1 m) (Blackwell and Greene 2003) and a transmission loss of 15 log(R) were used, resulting in an estimated distance of 7,067 feet (2,154 m), or 1.3 miles (2.1 km). This distance was then rounded up to 1.5 miles (2.4 km).

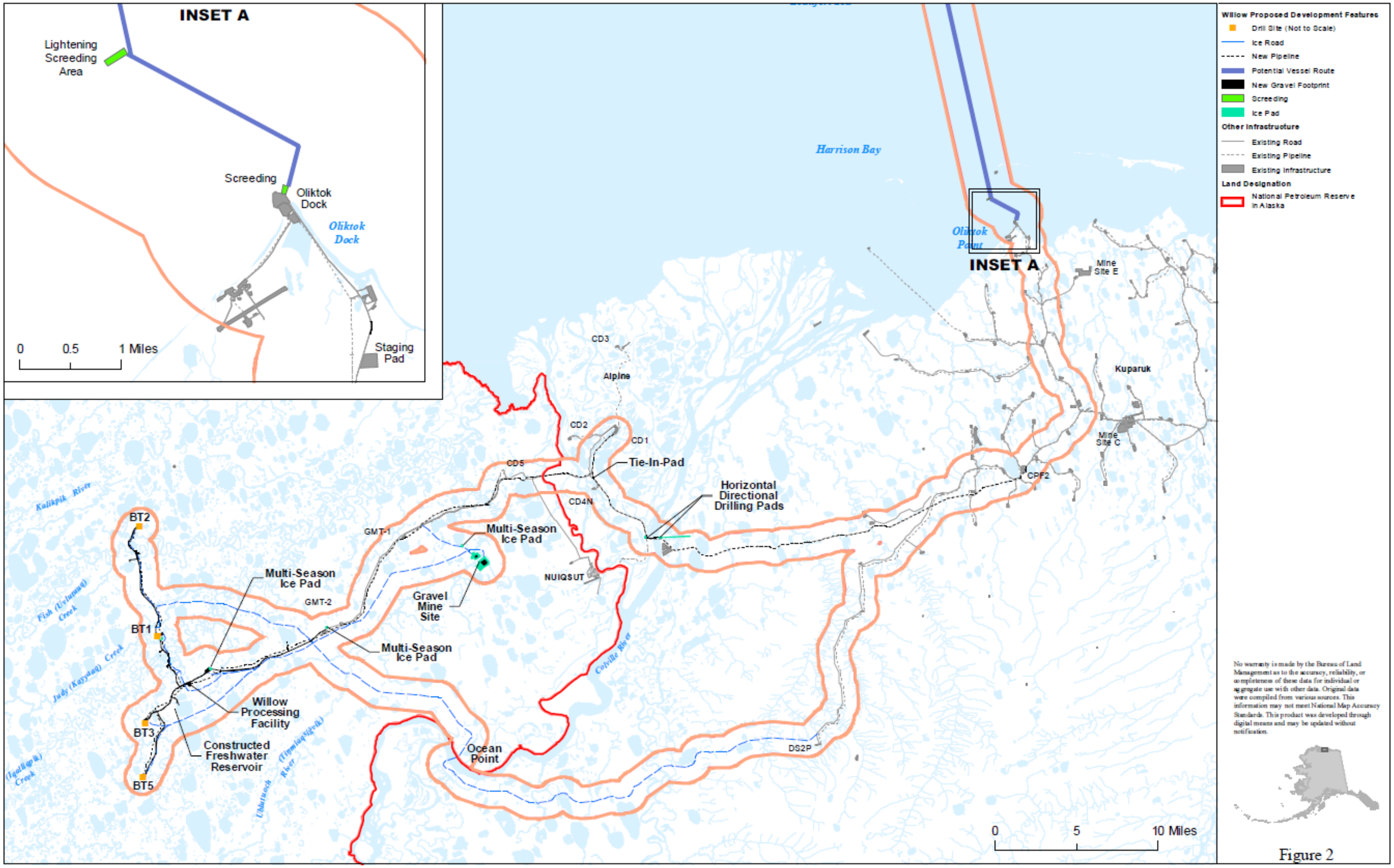


Figure 3.1. The proposed terrestrial portion of the Action Area including existing and proposed, permanent and seasonal infrastructure, and multi-season ice pads, associated with the proposed Project.

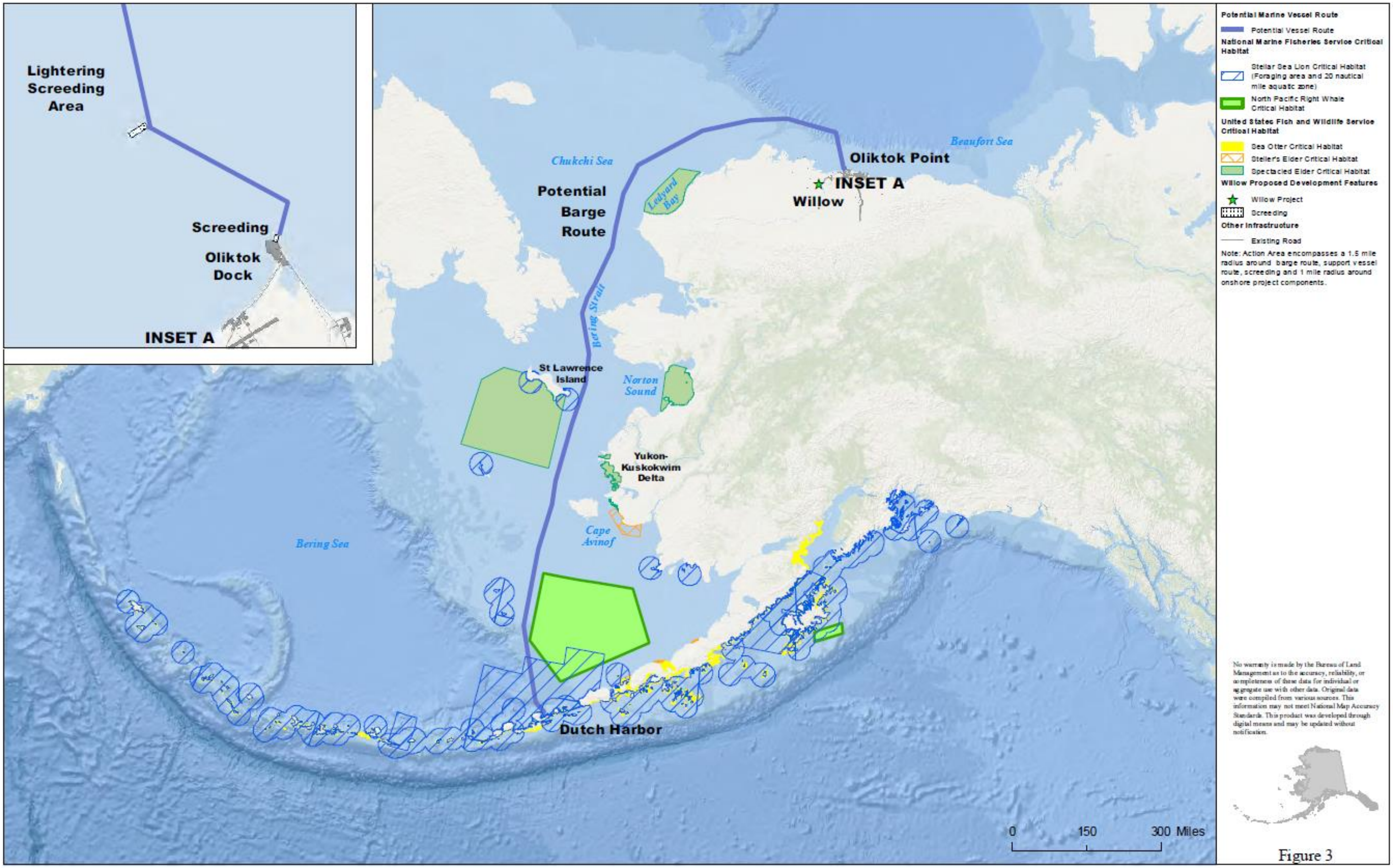


Figure 3.2. The proposed Marine Transit Route (MTR), from Dutch Harbor to Oliktok Dock, where barges and tugboats would operate during construction of the proposed Project.

4. EFFECT DETERMINATIONS FOR STELLER'S EIDERS, NORTHERN SEA OTTERS, AND DESIGNATED CRITICAL HABITAT FOR THESE SPECIES

Alaska-breeding Steller's Eider

The Service listed the Alaska-breeding population of the Steller's eider as threatened on June 11, 1997 (62 FR 31748). In Alaska, Steller's eiders breed almost exclusively on the Arctic Coastal Plain (ACP), migrating to the breeding grounds in late spring with brood-rearing females and remaining in the region as late as mid-October. Nesting is concentrated in tundra wetlands near Utqiaġvik, and Steller's eiders occur at extremely low densities elsewhere on the ACP (Figure 4.1; USFWS 2015b).

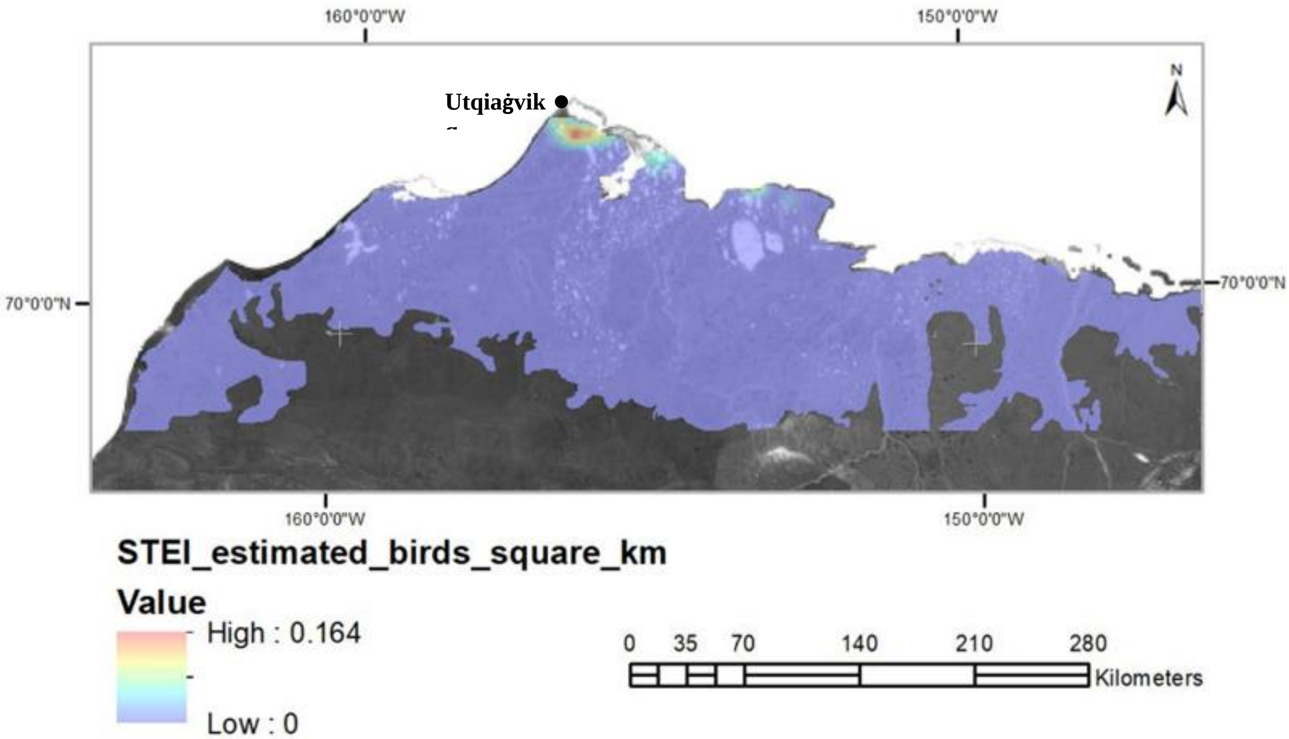


Figure 4.1. Estimated density of Steller's eiders on the Arctic Coastal Plain of Alaska.

Effects to Steller's eiders in the terrestrial Action Area

Available data indicate Steller's eiders are extremely unlikely to nest in the Action Area, therefore impacts to nesting Steller's eiders are not expected and are discountable. Small numbers of non-breeding or migrating Steller's eiders could pass through the terrestrial portion of the Action Area, and if so, could potentially be subject to disturbance from Project activities. However, we expect impacts from any disturbance to non-breeding or migrating eiders would be minor (i.e., limited to changes in behavior that would not be biologically significant) because non-nesting individuals can respond to human presence or disturbance by moving away to a safe distance. Because disturbance to non-breeding or migrating Steller's eiders would be so minor that injury or death is not expected, effects of disturbance to this species would be insignificant.

Effects to Steller's eiders in the offshore Action Area

Disturbance – During the Project construction phase, barges and support vessels could encounter and disturb Steller's eiders within the MTR (Figure 3.2). However, Steller's eiders occur at low density throughout the offshore Action Area. Furthermore, because the MTR avoids areas where concentrations of Steller's eiders occur (e.g., Kuskokwim Shoals, southern portions of nearshore Bristol Bay), we expect encounters between Project vessels and Steller's eiders would be limited to migratory individuals, and those wintering in the vicinity of Dutch Harbor. Because few vessels would operate at any given time, and sealift operations are only expected over four years (BLM 2022a); we expect project vessels to encounter very few individuals. We also expect disturbance from sealift operations to be minor (i.e., limited to changes in behavior that would not be biologically significant) and temporary because 1) barges and tugs would move slowly (i.e., < 14 knots [16 mph]) through the MTR, and 2) Steller's eiders can respond to vessel disturbance by moving away to a safe distance. Because disturbance to Steller's eiders in the marine environment would be rare, and so minor that injury or death is not expected, effects of vessel disturbance on these individuals would be insignificant.

Collisions – Migrating Steller's eiders could also be at risk of colliding with vessels in the MTR. Using the best available information, we estimated collision risk for Steller's eiders from barge and tugboat traffic associated with the proposed Project. We used king and common eiders as surrogates for Steller's eiders due to their greater abundance, using observations of vessel collisions collected by biological observers in a structured monitoring and reporting effort of collisions of King and common eiders in the Chukchi Sea. We first calculated a *per capita* risk of collision per vessel operating during a single season in the Chukchi Sea, based on collisions during Royal Dutch Shell's (Shell) 2012 Exploratory Program, and the estimated number of eiders migrating through the region. We then multiplied the estimated per capita collision rate (collisions per eider per vessel per season) by the estimated abundance of Alaska-breeding Steller's eiders, based on estimates from aerial surveys on the Arctic Coastal Plain. We then approximated the number of collisions expected for Steller's eiders during 80 vessel trips through the MTR, over the life of the project. Finally, because barges and tugboats could theoretically operate over a longer period each season than the duration of Shell's 2012 open-water campaign, we adjusted the calculations to estimate collisions over an extended operations period. A typical open-water season in Arctic waters is approximately 150 days. We expect the proposed sealift operations would be of shorter duration (likely much shorter) than the length of a typical open-water season, but the timing of operations would be difficult to estimate precisely due to several factors including seasonal variation in sea ice conditions and marine forecasts. Therefore, lacking greater certainty in project timing, we conservatively extrapolated our estimate to cover a full open-water season. We believe this significantly overestimates the number of days that vessels would be underway and present in waters where Steller's eiders occur, and therefore represents a substantial overestimation of collision risk to listed Steller's eiders. Our calculations are presented in Appendix A.

Using the approach described above and detailed in Appendix A, we roughly estimate the number of Steller's eiders that would be injured or killed through collisions with vessels during the predicted 30-year project, as 0.07, suggesting that collisions are possible, but unlikely. While acknowledging the limitations of applying observations from vessels operating in one area to vessels that differ in size and structure operating in different areas, our estimates are based on the best information available, and we believe are likely to substantially overestimate collision risk.

Oil & Hazardous Substance Spills
Due to their low density in the area, impacts to Alaska-breeding Steller's eiders from spills in the terrestrial portion of the Action Area, or marine waters near Oliktok Dock, are not anticipated.

BLM (2022b) expects spills in the MTR would be limited to sealift operations, and would be very small to small (10 to 99.9 gallons), limited to refined products (e.g., diesel fuel), and be localized and of short duration (< 4 hours). Given spill prevention and response measures in place, the likelihood of small spills in the MTR would be very low to low (BLM 2022b) and these spills would be limited to the vicinity of Dutch Harbor (e.g., during fuel transfers).

Although BLM anticipates most spills in the MTR would be very small to small, a medium (100 to 999.9 gallons) to very large spill (> 100,000 gallons) would be conceivable if a tug or barge were to run aground, sink, or have its compartments breached (BLM 2022b). The duration and spatial extent of this type of spill could range from one to several days depending on the location, sea state, and proximity to shore-based response. However, the International Maritime Organization Polar Code is mandatory under the International Convention for the Safety of Life at Sea (SOLAS) and the International Convention for the Prevention of Pollution from Ships (MARPOL) for ships operating in arctic waters (IMO 2019). Provisions of the Polar Code include standardized safety procedures addressing design, construction, equipment, operational, training, environmental protection standards, and use of designated shipping lanes (IMO 2019). Due to these established marine safety practices, vessel sinking is a rare occurrence. Furthermore, given that all vessels associated with the proposed Project would follow established shipping routes, which greatly reduces the chance of running aground or sinking, the likelihood of such an accident would be very low (BLM 2022a). Furthermore, given that the duration and frequency of vessel traffic in the MTR would be limited (i.e., sealift operations would take place during a 4-year subset of the construction phase; BLM 2022a), the likelihood of a medium to very large spill in the marine environment would be discountable.

Although they occur at low density, Steller's eiders in the MTR could conceivably be impacted by small spills during vessel re-fueling at Dutch Harbor. However, the BLM has indicated spills during these operations would be uncommon, localized and of short duration (BLM 2022a). Therefore, we anticipate impacts to Steller's eiders from small spills would be unlikely. Furthermore, because the likelihood of greater volume spills (>100 gallons) resulting from the limited vessel operations would be very low (Appendix D in BLM 2022a), impacts from large spills on Steller's eiders in the MTR would be discountable.

In summary, 1) adverse effects to Steller's eiders from impacts to nesting habitat or disturbance are not expected, 2) impacts from small spills would be unlikely and large spills would be discountable, and 3) although vessel traffic associated with sealift operations has the potential to pose risk of collisions between Steller's eiders and vessels, our estimate, based on the best available information, is that collisions are not likely to occur. Therefore, collectively the proposed action is *not likely to adversely affect* Alaska-breeding Steller's eiders.

Steller's Eider Critical Habitat

Critical habitat was designated for Steller's eiders on the Yukon-Kuskokwim Delta and in four marine areas, including three along the Alaska Peninsula and one just south of the Yukon-Kuskokwim Delta at the Kuskokwim Shoals (66 FR 8850). The MTR from Dutch Harbor through the Bering, Chukchi, and Beaufort seas, (Figure 3.2), is well outside of all designated units.

As described above, BLM anticipates accidental spills during sealift operations would likely be limited to small spills originating from fuel transfers in the vicinity of Dutch Harbor. Wintering habitat in Izembek Lagoon, the nearest critical habitat unit to Dutch Harbor, is 270 km away. Furthermore, sealift operations would not take place from October through April when wintering areas are used by Steller's eiders (BLM 2022a). Therefore, it is extremely unlikely that any oil or hazardous materials from re-fueling spills would be carried into designated critical habitat, and we do not anticipate adverse impacts to Steller's eider critical habitat from small spills. Although conceivable, larger spills from vessels operating in the MTR would be discountable.

Because 1) impacts to terrestrial critical habitat from the Proposed Action would not occur, 2) vessel disturbance within designated marine critical habitat is expected to be infrequent and short-term (i.e., insignificant), and 3) due to geographic and temporal separation, impacts from spills during refueling of vessels are not anticipated; collective impacts to Steller's eider critical habitat from the Proposed Action are expected to be discountable. Therefore, we conclude the proposed Project is *not likely to adversely affect* designated Steller's eider critical habitat.

Northern sea otter

The Service listed the southwest Alaska distinct population segment (DPS) of the northern sea otter as threatened on August 9, 2005 (70 FR 46366). Vessels associated with sealift operations during Project construction may encounter listed sea otters when transiting in and out of Dutch Harbor in the vicinity of Unalaska Island *en route* to Oliktok Dock.

However, sea otter density is relatively low in the vicinity of Dutch Harbor, and we expect sea lift barges and tugs would encounter very few individuals. We would also expect disturbance from barge traffic to be minor (i.e., limited to changes in behavior that would not be biologically significant) and temporary because: 1) barges would move slowly (i.e., < 14 knots [16 mph]) throughout the MTR and vicinity of Dutch Harbor as they arrive and depart from the port, and 2) sea otters can respond to vessel presence or disturbance by moving away to a safe distance. Because disturbance to listed sea otters would be limited to changes in behavior that would not be biologically significant, injury or death is not expected. Therefore, we expect the effects of disturbance would be insignificant.

We also evaluated whether listed sea otters could be impacted by unintentional spills during vessel transit through the MTR. Overlap between the range of listed sea otters and the MTR is minor and limited to the vicinity of Dutch Harbor. Furthermore, BLM has indicated the likelihood of spills in the marine environment would be very low to low, and any spills would likely be very small to small in size (10 to 99.9 gallons), and localized and of short duration (< 4 hours; Appendix D in BLM 2022). Therefore, we anticipate impacts to listed sea otters from small spills in the MTR would be unlikely. Hence, because 1) vessel operations in the MTR would be limited to 4 open water seasons reducing the potential for spills, and 2) BLM anticipates greater volume spills (> 100 gallons) in the MTR would be very unlikely, impacts from large spills on listed sea otters are not likely to occur.

In summary, because effects of disturbance would be minor (i.e., limited to changes in behavior that would not be biologically significant) and temporary, and impacts from spills would be discountable, the Service concludes that the proposed Project is *not likely to adversely affect* the southwest Alaska DPS of the northern sea otter.

Northern sea otter critical habitat

The Service designated critical habitat for the southwest Alaska DPS of the northern sea otter on October 8, 2009 (74 FR 51988). The Eastern Aleutian Critical Habitat (Unit 2) occurs in nearshore marine waters around Unalaska Island ranging from the mean high tide line seaward for a distance of 100 meters, or to a water depth of 20 meters. Barge and tug traffic during the Project construction phase may enter designated critical habitat near Dutch Harbor and Unalaska Island.

We evaluated whether designated critical habitat for sea otters could be impacted by unintentional spills during vessel re-fueling in Dutch Harbor. BLM has indicated the likelihood of spills in the marine environment would be very low to low, and any spills would likely be very small to small in size (<10 to 99.9 gallons), and localized and of short duration (< 4 hours; BLM 2022a, Appendix D). Therefore, we anticipate impacts to sea otter critical habitat from very small or small refueling spills would be insignificant. Furthermore, due to the very low likelihood of a greater volume spill (> 100 gallons) during sealift operations, impacts from large spills on sea otter critical habitat would be very unlikely and are therefore, discountable.

Because, 1) overlap between barge traffic and designated sea otter critical habitat would be limited to the vicinity of Dutch Harbor and Unalaska Island, which represents a very small proportion of designated sea otter critical habitat, 2) vessel presence in critical habitat would be temporary as barges and tugs pass through the area, and 3) spills from re-fueling would be expected to be small, localized, and remediated quickly; action-specific impacts from proposed vessel traffic in the MTR are expected to be discountable. Therefore, the proposed Project is *not likely to adversely affect* designated sea otter critical habitat.

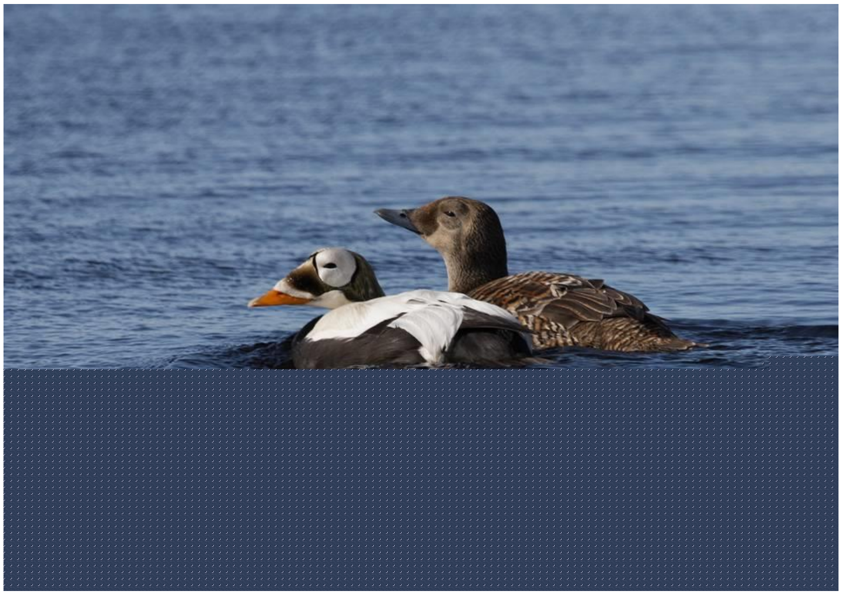
5. STATUS OF THE SPECIES

This section presents biological and ecological information relevant to the BO. Appropriate information on species' life history, habitat and distribution, and other factors necessary for their survival is included for analysis in later sections.

Spectacled Eider

Spectacled eiders (quageq in Central Yup'ik, qavaasuk in Inupiaq, iyegaatelek in St. Lawrence Island Yupik, *Somateria fischeri*; in Latin Figure 5.1A) were listed as threatened throughout their range on May 10, 1993 (USFWS 1993), based on indications of steep declines in the two Alaska-breeding populations. There are three primary spectacled eider populations, corresponding to breeding grounds; these are 1) the Yukon-Kuskokwim Delta (Y-K Delta) breeding population, the Alaska Coastal Plain (ACP) breeding population, and the Arctic Russia breeding population. The Y-K Delta population of spectacled eiders declined 96 percent between the early 1970s and 1992 (Stehn et al. 1993). Data from the Prudhoe Bay oil fields (Warnock and Troy 1992) and information from Native elders at Wainwright, Alaska (R. Suydam, pers. comm. in USFWS 1996) suggested concurrent localized declines on the ACP, although data for the entire breeding population were not available. An estimate of the Arctic Russia breeding population was also unavailable at the time of listing. Spectacled eiders molt in several discrete areas (Figure 5.1B) during late summer and fall, with birds from different populations and sexes apparently favoring different molting areas (Petersen et al. 1999). All three spectacled eider populations overwinter together in openings in pack ice of the central Bering Sea, with the historical core wintering area located south of St. Lawrence Island (Petersen et al. 1999; Figure 5.1B). They remain in the wintering area until March–April (Lovvorn et al. 2003). Critical habitat was designated for molting spectacled eiders in Norton Sound and Ledyard Bay, nesting areas on the Y-K Delta, and wintering areas southwest of St. Lawrence Island (Figure 5.1B).

(A)



(B)

Figure 5.1. (A) Male and female spectacled eiders in breeding plumage. (B) Distribution of spectacled eiders. Molting areas (green) are used July to October. Wintering areas (yellow) are used October to April. The full extent of molting and wintering areas is not yet known and may extend beyond the boundaries shown.

Life History (Breeding) – In Alaska, spectacled eiders breed primarily on the Y-K Delta and the ACP. The coastal fringe of the Y-K Delta is the only subarctic habitat where spectacled eiders occur at high densities. Although spectacled eiders historically occurred throughout the coastal zone of the Y-K Delta, they currently breed primarily in the central coast zone within about nine miles of the coast from Kigigak Island (Kigigak) north to Kokechik Bay (USFWS 1996). However, sightings on the Y-K Delta have also occurred both north and south of this area during the breeding season (R. Platte, USFWS, pers. comm. 1997). On the ACP, spectacled eiders breed north of a line connecting the mouth of the Utukok River to a point on the Shaviovik River about 15 miles inland from its mouth, with breeding density varying across the ACP (Figure 5.2) but generally lower than on the Y-K Delta. Lake (2007) documented some female spectacled eiders begin to breed in their third year, although most wait until their fourth year. Age at first breeding has not been determined for males, but probably occurs the third or fourth year, coinciding with the acquisition of adult plumage (Petersen et al. 2000).

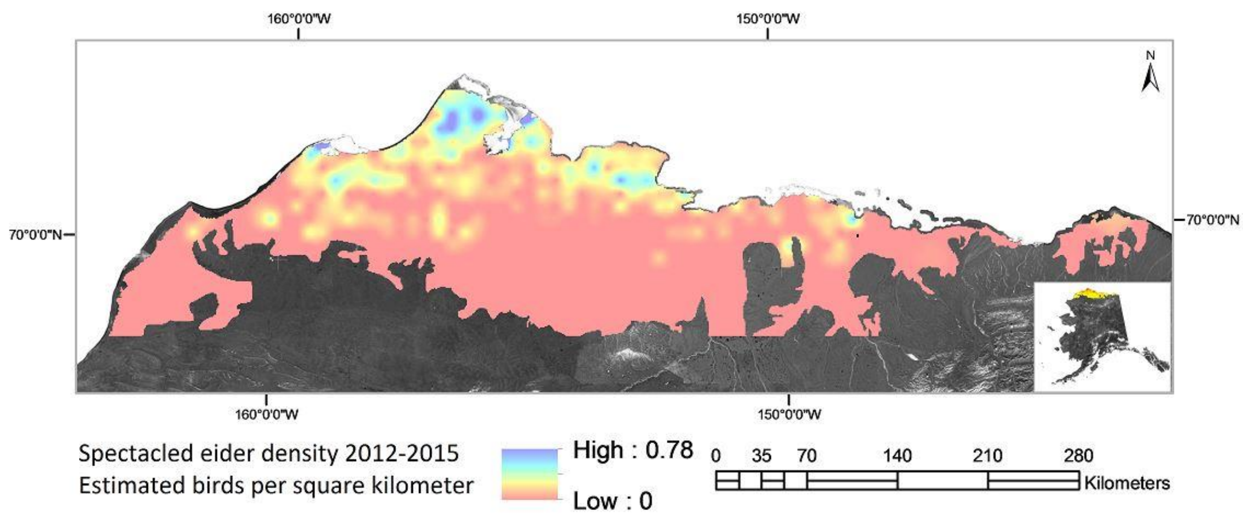


Figure 5.2. Density distribution of spectacled eiders observed on aerial transects of wetland tundra on the North Slope of Alaska during breeding pair surveys in June, 2012–2015 (USFWS 2015b).

Spring migration and breeding, including arrival, nest initiation, hatch, and fledging, is generally 3 to 4 weeks earlier on the Y-K Delta than on the ACP. Spectacled eiders breeding on the Y-K Delta typically arrive to the breeding grounds by the second week of May. During 1985 to 2014, mean nest initiation date on the Y-K Delta was May 28 (range May 18 to June 7; Fischer et al. 2018). Spectacled eiders typically arrive on the ACP breeding grounds in late May to early June, and numbers of breeding pairs peak in mid-June and decline 4 to 5 days later when males begin to depart from the breeding grounds (Smith et al. 1994, Anderson and Cooper 1994, Anderson et al. 1995, Bart and Earnst 2005). During 2010 to 2019, mean nest initiation date on the ACP ranged from June 6 to June 29 (Safine 2011, 2012, 2013, 2015a; Graff 2016, 2018, 2020). Average clutch size reported from studies at Kigigak was 4.0 to 5.5 (Gabrielson and Spragens 2013, Moore and Sowl 2017); clutch size near Utqiaġvik averaged 3.2 to 4.1, with clutches of up to 8 eggs reported (Quakenbush et al. 1995, Safine 2011); and mean clutch size on the Colville River Delta (CRD) of the ACP has been reported as 4.3 (Bart and Earnst 2005). Incubation lasts

20 to 25 days (Kondratev and Zadorina 1992, Harwood and Moran 1993, Moran and Harwood 1994, Moran 1995), and hatching occurs from mid- to late July (Warnock and Troy 1992).

Following hatch, broods move from nests to freshwater ponds, brackish ponds, or flooded tundra usually traveling < 3 km, but occasionally up to 13 km (Petersen et al. 2000). On these breeding grounds, spectacled eiders dabble in ponds and wetlands feeding on mollusks, insect larvae (craneflies, caddisflies, and midges), small freshwater crustaceans, and plants and seeds (Kondratev and Zadorina 1992). Ducklings fledge approximately 50 days after hatch, when females with broods move from freshwater to marine habitat prior to fall migration (USFWS 2010a).

Nest survival – Nest success, the probability that a nest survives with at least one duckling hatching, is highly variable across both years and sites (Table 5.1) and is thought to be greatly influenced by predators (Petersen 1998, Lake 2007), including gulls (*Larus* spp.), jaegers (*Stercorarius* spp.), red foxes (*Vulpes vulpes*), and arctic foxes (*Alopex lagopus*). Studies on Kigigak found nest survival probability tended to be higher in years with low fox numbers or activity (i.e., no denning) or when foxes were eliminated from the island prior to the nesting season (study period 1992 to 2007; Lake 2007). On the Y-K Delta, nest success at Kigigak and the Kashunuk study site showed similar variation during 1992 to 2002 but did not appear to be correlated in most years (Flint et al. 2016). Nest success estimates from Kigigak in more recent years, 2003 to 2015, have shown similar annual variation and range. The available data suggest that nest success is lower on the ACP than on the Y-K Delta.

Table 5.1. Spectacled eider nest success estimates at study sites across Alaska.

	Years	Estimate of Apparent Nest Success
Y-K Delta		
Kashunuk[1]	1992-2002	0.04-0.92; average = 0.53, SE = 0.07
Kigagak[1]	1992-2002	0.04-0.92; average = 0.73, SE = 0.06
Kigigak[2]	2003-2015	0.05-0.91
ACP		
Utqiaġvik[3]	2009-2019	0.19-0.72
Kuparuk[4]	1993-2007	0.125-0.923; mean = 0.417
Colville Delta[5]	1994-1999	0.11-1.00; mean = 0.31

[1] Data from Flint et al. 2016
[2] Data from Gabrielson and Spragens 2013, Moore and Sowl 2017, Rizzolo et al. 2019
[3] Data from Safine 2011, 2012, 2013, 2015; Graff 2016, 2018, 2020
[4] Data from Anderson et al. 2007 in USFWS 2021a.
[5] Data from Bart and Earnst 2005

Egg viability – Spectacled eider egg viability varies over time and among nesting areas. Available data indicate egg hatchability is high for spectacled eiders nesting on the ACP but considerably lower in the coastal region of the Y-K Delta. On the ACP, spectacled eider eggs that are addled or that do not hatch are very rare in the Prudhoe Bay area (Declan Troy, TERA, *pers. comm.* 1997); and at Utqiaġvik, no inviable eggs were found in half the years from 2010 to

2019, while 6 to 20 percent of spectacled eider nests had at least one inviable egg in other years (Safine 2012, 2013, 2015; Graff 2016, 2018, 2020). In contrast, on the Y-K Delta, 11 to 30 percent of spectacled eider nests at Kashunuk (1992 to 2004) and Kigigak (1992 to 2015) had at least one inviable egg, and 7.7 percent of eggs were inviable overall (Grand and Flint 1997, Moore and Sowl 2017).

Duckling and brood survival – Recruitment rate (the percentage of young eiders that hatch, fledge, and survive to sexual maturity) of spectacled eiders is poorly known (USFWS 1999) because there is limited data on juvenile survival. On the Y-K Delta, duckling survival to 30 days was found to vary annually, with an estimated rate of 0.39 at Kashunuk (1993 to 2002) and 0.67 at Kigigak (1999 to 2000; Flint et al. 2016). Mean brood survival (the percentage of females hatching a clutch that fledged at least one duckling) across years was estimated as 0.55 and 0.85 at Kashunuk and Kigigak, respectively (process variation[3] [σ] = 0.001 and 0.009, respectively; Flint et al. 2016). Survival of juveniles from 30 days after hatch to departure from the breeding grounds was estimated at 0.71 at Kashunuk during 1997 to 1999 (Flint et al. 2000). At Utqiaġvik, spectacled eider brood survival from 2011 to 2012 was estimated as 0.76 (95% CRI = 0.626–0.815; Rizzolo 2020).

Adult survival – Survival of adult females is a major driver of spectacled eider population dynamics (USFWS 2021a). Data from the Y-K Delta and from Arctic Russia show annual survival rate of adult females varies across years (Table 5.2) and may be primarily influenced by exposure to lead in some breeding areas, and by winter sea ice conditions (USFWS 2021a). In spectacled eiders breeding on the Y-K Delta from 1993 to 1996, females exposed to lead survived at a lower rate than females not exposed to lead (estimated at 0.48, σ = 0.14 and 0.88, σ = 0.06, respectively; Flint et al. 2016). Overall, estimated annual female survival rates at Kashunuk and Kigigak showed the greatest variation during years with more severe sea ice conditions (Flint et al. 2016). Using a dataset from Kigigak spanning 1992 to 2015, Christie et al. (2018) found some support for higher annual survival under moderate sea ice conditions (compared to annual survival under severe or minimal ice cover). Information about survival rates from the ACP breeding population of spectacled eiders is lacking.

Non-breeding distribution – As with many other sea ducks, spectacled eiders spend the 8- to 10-month non-breeding season at sea. Spectacled eider migrating, molting, and wintering areas have been identified via satellite telemetry and aerial surveys. These studies are summarized in Petersen et al. (1999) and Larned et al. (1995). Results of more recent satellite telemetry research (2008 to 2011) are consistent with earlier studies (Matt Sexson, USGS, *pers. comm.*).

Post-breeding distribution and migration – Phenology of fall migration is similar between birds breeding on the Y-K Delta and on the ACP. Individuals depart breeding areas July to September, depending on breeding status and success, and molt in in the marine environment during September to October (Matt Sexson, USGS, *pers. comm.*).

[3] Process variation [σ] is the component of total variation that explains environmental variation. The other component is sampling variation.

Table 5.2. Annual survival rate estimates of adult female spectacled eiders in Alaska and Arctic Russia.

	Years	Estimated Annual Survival
Y-K Delta		
Kashunuk[1]	1993-1996	0.63-094; mean = 0.78, σ = 0.007
Kigagak[1]	1993-1996	0.55-0.95; mean = 0.81, σ = 0.009
Kigigak[2]	1992-2015	0.50 (SE = 0.05) -1.0
ACP		
Utqiaġvik		not available
Arctic Russia		
Chaun[3]	2003-2015	mean = 0.77 (SE = 0.04)

[1] Data from Flint et al. 2016
[2] Data from Christie et al. 2018
[3] Data from Solovyeva et al. 2017

Males generally depart breeding areas when females begin incubation, which is late June on the ACP (Anderson and Cooper 1994, Bart and Earnst 2005). Individuals sometimes spend several weeks staging in the Beaufort, Chukchi, and Bering Seas before moving to their molting areas (Petersen et al. 1999). Use of the Beaufort Sea by departing males is variable. Of 14 males implanted with satellite transmitters in one study, only 4 spent an extended period of time (11 to 30 days) in the Beaufort Sea (TERA 2002), appearing to prefer areas near large river deltas such as the CRD, where open water is more prevalent in early summer when much of the Beaufort Sea is still frozen. In a recent satellite telemetry study that marked spectacled eiders from both the Y-K Delta and ACP breeding populations, most adult males migrated to northern Russia to molt (USGS, unpublished data). These two studies suggest that male eiders typically follow coastlines (Matt Sexson, USGS, *pers. comm.*), and may move rapidly (e.g., average travel of 1.75 days; TERA 2002) over nearshore waters from breeding grounds to the Chukchi Sea. Alternatively, some males move to the Chukchi Sea over land after departing the breeding areas (TERA 2002), and some migrate straight across the northern Bering and Chukchi Seas *en route* to northern Russia (Matt Sexson, USGS, *pers. comm.*).

Females generally depart the breeding grounds later than males, with timing of female departure for the molting grounds depending on nesting success. Unsuccessful females move to molting areas in July, and successful females in August and September (Petersen et al. 1999). Females breeding on the ACP may make greater use of the Beaufort Sea compared to males. Females implanted with satellite transmitters spent an average of 2 weeks staging in the Beaufort Sea (range 6 to 30 days), with the western Beaufort Sea the most heavily used (TERA 2002). Females also appeared to migrate through the Beaufort Sea an average of 6.2 miles farther offshore than males (Petersen et al. 1999). Greater use of the Beaufort Sea and offshore areas by females was attributed to the greater availability of open water when females depart the ACP breeding area (Petersen et al. 1999, TERA 2002). Recent telemetry data indicate molt migration of failed/non-breeding females from the CRD through the Beaufort Sea is relatively rapid (2 weeks) compared to 2 to 3 months spent in the Chukchi Sea (Matt Sexson, USGS, *pers. comm.*).

Molting distribution
Beginning in late June, males arrive on molting areas, marine areas with relatively shallow coastal water usually less than 118 ft (36 m) deep (USFWS 2021a), where they remain through mid-October. Non-breeding females, and those that nested but failed, arrive at molting areas in late July, while successfully breeding females and young of the year reach molting areas in late August through late September and remain through October.

Larned et al. (1995) and Petersen et al. (1999) found spectacled eiders show strong preference for specific molting locations, and concluded that spectacled eiders molt in four discrete areas during late summer and early fall: (1) eastern Norton Sound in the northern Bering Sea; (2) Ledyard Bay in the eastern Chukchi Sea; (3) Mechigmenskiy Bay off the coast of Russia in the western Bering Strait; and (4) the Indigirka-Kolyma River Deltas in the East Siberian Sea (Table 5.3; Petersen et al. 1999). Available data suggest male spectacled eiders do not necessarily favor molting areas near their breeding areas, and the majority molt in northern Russia (Petersen et al. 1999, USGS unpublished data), while females generally use molting areas nearest their breeding grounds (Petersen et al. 1999; Sexson et al. 2014, 2016). Satellite transmitter data collected from the 1990s and 2008 to 2011 show that marked spectacled eiders used the same general molting areas identified in Petersen et al. (1999), but the core distribution within each area has shifted (Sexson et al. 2016).

Table 5.3. Important molting areas for male (M) and female (F) spectacled eiders from each breeding population. Locations identified in Petersen et al. 1999; Sexson et al. 2014, 2016; USGS, unpublished data.

Major Molting Areas	**Breeding Population and Sex**					
	ACP		**Y-K Delta**		**Russia**	
	M	F	M	F	M	F
Ledyard Bay, eastern Chukchi Sea	X	X			X	
Eastern Norton Sound, NE Bering Sea		X	X	X		
Mechigmenskiy Bay, western Bering Strait	X	X	X		X	
Indigarka-Kolyma River Deltas, East Siberian Sea	X		X		X	
Unknown						X

Wintering – Spectacled eiders from all three breeding populations generally depart molting areas in late October/early November (Petersen and Douglas 2004, Sexson et al. 2014, Sexson

2015), migrating offshore in the Chukchi and Bering seas to their wintering areas in the Bering, Beaufort, and Chukchi seas. Spectacled eiders use marine habitats in the open ocean or in polynyas (open water at predictable, recurrent locations in sea ice covered regions), or open leads (more ephemeral breaks in the sea ice, often along coastlines) at water depths of less than 263 ft (Petersen et al. 2000; Rizzolo et al. 2021).

The majority of spectacled eiders from all three breeding populations intermix and mingle in a single wintering area in the central Bering Sea, the “core wintering area” south-southwest of St. Lawrence Island, through March or April (Figure 5.1B). In this relatively shallow area, spectacled eiders (Petersen et al. 1999) rest and feed, diving up to 230 ft to eat bivalves, other mollusks, and crustaceans (Cottam 1939, Petersen et al. 1998, Lovvorn et al. 2003, Petersen and Douglas 2004). Recent data suggest the winter distribution of spectacled eiders and timing of northward pre-breeding movement is changing, likely as a result of decreased extent of sea ice in the Bering Sea in later winter. Y-K Delta-breeding spectacled eiders instrumented with satellite transmitters provided location data during winters 2018–2019 and 2019–2020. The data suggest some portion of the spectacled eider population moves north of the core wintering area as early as February, and the northward movements coincide with the northward movement of sea ice (Rizzolo et al. 2021).

Spring migration – Observations of spectacled eiders arriving from the north or northwest to the Y-K Delta breeding area resulted in the hypothesis that spectacled eiders used pre-breeding staging areas north of the core wintering area (Dau and Kistchinski 1977, McCaffery et al. 1999). Data collected through satellite telemetry supports this hypothesis. Spectacled eiders instrumented with satellite transmitters from 2008 to 2011 dispersed from the northern Bering Sea wintering area as sea ice retreated northward, in March or April (Figure 5.3; Sexson et al. 2014). Most eiders used nearshore areas of the western Bering Strait, near Mechigmenskiy Bay, prior to moving to staging areas. Birds moved to staging areas in ice leads immediately offshore of breeding areas in April (Y-K Delta) or May (eastern Chukchi Sea or East Siberian Sea). Some marked spectacled eiders also staged in southern Norton Sound prior to moving to the Y-K Delta breeding area (Sexson et al. 2014). Timing of arrival to pre-breeding and breeding areas is dictated by availability of open water in marine areas *en route* and adjacent to terrestrial breeding habitat (Petersen et al. 2000), and spectacled eiders likely make extensive use of the eastern Chukchi Sea spring lead system.

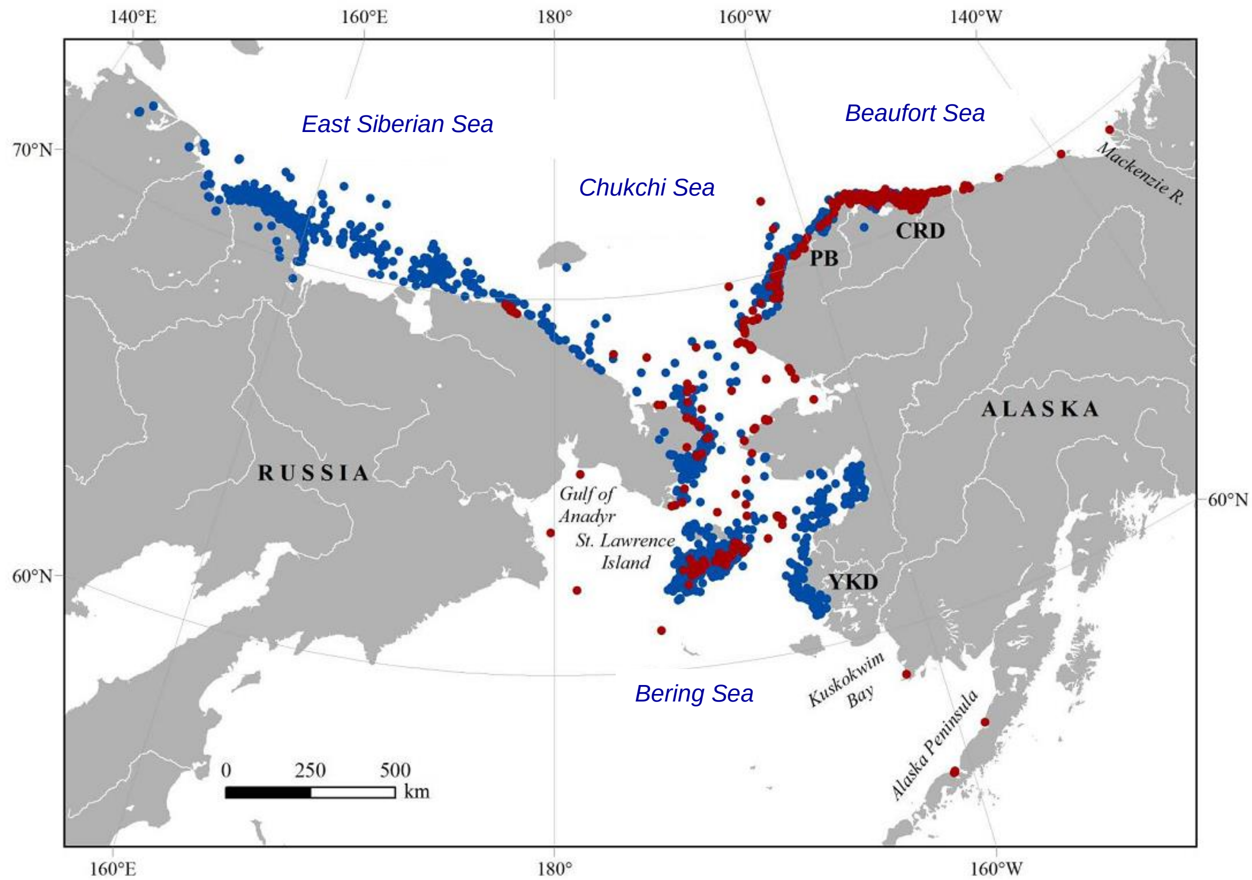


Figure 5.3. Satellite telemetry locations received from 89 adult (blue points, n = 6,813) and 27 juvenile (red points, n = 371) spectacled eiders between 30 May 2008 and 9 August 2012. We implanted satellite transmitters in spectacled eiders in the Y-K Delta in 2008, at Peard Bay (PB) in 2009, and in the CRD in 2009–2011 (Sexson et al. 2014).

Abundance and trends – All three breeding populations winter together in one area of the Bering Sea, and surveys of spectacled eiders in the wintering area therefore present an opportunity to estimate the size of the global population. Aerial surveys of the wintering area in the Bering Sea were conducted 1995 to 1998, 2009 to 2010, and 2020 (Rizzolo et al. 2021, Larned et al. 2012). The best estimate of the wintering population during 1995 to 1998 is from 1997, which resulted in an estimate of 363,030 spectacled eiders (95% CI = 333,526–392,532; Larned and Tiplady 1997; Larned et al. 2012). The best survey from 2009 to 2010 was conducted in 2010 and resulted in an estimate of 369,122 spectacled eiders (90% CI = 364,190–374,054; Larned et al. 2012). These surveys were designed as near censuses, were conducted under optimal conditions, and we consider them to be accurate characterizations of the minimum size of the global population (USFWS 2021a).

The most recent aerial survey was conducted in 2020, using methods similar to previous surveys. The 2020 survey resulted in a count of 76,592 spectacled eiders (USFWS 2021a). Spectacled eider flock behavior, size, and location were notably different in 2020 than in the two prior survey periods, as were sea ice conditions. Additionally, detection within the survey area was likely less than 100 percent due to smaller flock size and increased open water conditions. Thus, the 2020 count should be considered as a crude minimum count, which is not comparable to previous counts (USFWS 2021a).

Y-K Delta breeding population – The Y-K Delta spectacled eider population is thought to have declined by about 96 percent from the 1970s to 1992 (Stehn et al. 1993). Evidence of the dramatic decline in spectacled eider nesting on the Y-K Delta was corroborated by Ely et al. (1994), who found a 79 percent decline in eider nesting near the Kashunuk River between 1969 and 1992. Aerial and ground survey data indicated that spectacled eiders declined 9 to 14 percent per year from 1985 to 1992 (Stehn et al. 1993). Furthermore, from the early 1970s to the early 1990s, the number of breeding pairs on the Y-K Delta declined from 48,000 to 2,000, apparently stabilizing at that low level (Stehn et al. 1993). Since listing, the Service has relied on two coordinated surveys to provide indices of spectacled eider abundance on the Y-K Delta. A standardized aerial survey was conducted in the coastal zone of the Y-K Delta from 1985 to 2019 (breeding pair survey; Fischer et al. 2018, Lewis et al. 2019). This survey provides indices of population abundance, uncorrected for detection. In addition, a ground-based nest survey was conducted in a smaller subset of the Y-K Delta breeding area from 1985 to 2019 (nest plot survey; Fischer et al. 2018, Lewis et al. 2019). This survey reported the number of nests found, corrected for imperfect detection.

Fischer and Stehn (2013) used combined annual ground-based and aerial survey data to estimate the number of spectacled eider nests on the coastal area of the Y-K Delta in 2012 and evaluated long-term trends in the breeding population from 1985 to 2012. In a given year, the estimated number of nests reflects the minimum number of breeding pairs in the population and does not include non-nesting individuals or nests that were destroyed or abandoned (Fischer and Stehn 2013). The total number of spectacled eider nests on the Y-K Delta in 2012 was estimated at 8,062 (SE = 1,110, or 90% CI = 6,236–9,888). The average population growth rate based on these surveys was 0.999 (90% CI = 0.986–1.012) in 1985–2012, and 1.058 (90% CI = 1.005–1.113) over the most recent 10 years of data (2003 to 2012; Fischer and Stehn 2013). Log-linear regressions based solely on the long-term Y-K Delta aerial survey data indicate positive population growth rates of 1.070 (90% CI = 1.058–1.081) in 1988 to 2010 and 1.073 (90% CI = 1.046–1.100) in 2001 to 2010 (Platte and Stehn 2011).

To estimate the abundance and growth of the Y-K Delta breeding population over the most recent time period, Dunham et al. (2021) used a Bayesian state-space model and annual estimates of breeding birds (2007 to 2019), corrected for detection. The posterior mean abundance of the Y-K Delta breeding population in 2019, was 16,113 eiders (95% CRI = 12,313–21,352; Dunham et al. 2021). This estimate represents breeding birds in the Y-K Delta population and does not include non-nesting individuals and juveniles that may have remained in marine areas. The posterior mean population growth rate of the Y-K Delta breeding population was 0.016 (95 percent CRI: -0.065–0.091) from 2007 to 2019 (Dunham et. al. 2021).

In addition, the Service conducted a Bayesian population viability analysis to estimate population abundance and growth rate of spectacled eiders using the available demographic data and population abundance data. The Integrated Population Model-Population Viability Analysis

(IPM-PVA) model is detailed in USFWS (2021). The IPM-PVA estimated mean abundance of the Y-K Delta breeding population in 2019 as 14,027 spectacled eiders (95% CI = 9,781–18,257), and the mean annual population growth rate from 1988 to 2019 as 1.053 (95% CI = 1.035–1.069; USFWS 2021a).

ACP breeding population – Population indices for spectacled eiders breeding on the ACP prior to 1992 are unavailable. However, Warnock and Troy (1992) documented an 80 percent decline in spectacled eider abundance from 1981 to 1991 in the Prudhoe Bay area. Since 1992, the Service has conducted annual aerial surveys for breeding spectacled eiders on the ACP. The survey underwent some changes to methodology in 2007, and that methodology has been used consistently since (Wilson et al. 2018).

The 2010 population index based on these aerial surveys was 6,286 birds (95% CI = 4,877–7,695; unadjusted for detection probability), which is 4 percent lower than the 18-year mean (Larned et al 2011). In 2010, the index growth rate was significantly negative for both the long-term (0.987; 95% CI = 0.974–0.999) and most recent 10 years (0.974; 95% CI = 0.950–0.999; Larned et al. 2011). Stehn et al. (2006) developed a North Slope-breeding population estimate of 12,916 (95% CI = 10,942–14,890) based on the 2002 to 2006 ACP aerial index for spectacled eiders and relationships between ground and aerial surveys on the Y-K Delta. If the same methods are applied to the 2003 to 2012 ACP aerial index, the resulting adjusted population estimate for North Slope-breeding spectacled eiders is 14,814 (90% CI = 13,501–16,128; Stehn et al. 2013).

To estimate the abundance and growth of the ACP breeding population over the most recent time period, Dunham et al. (2021) used a Bayesian state-space model and annual estimates of breeding birds (2007 to 2019), corrected for detection. The posterior mean abundance of the ACP breeding population in 2019, which is the best available estimate for the number of spectacled eiders breeding in this region, is 6,401 eiders (95% CRI = 3,766–9,750; Dunham et. al. 2021). The posterior mean population growth rate of the ACP breeding population is -0.005 (95% CRI: -0.092–0.082) from 2007 to 2019 (Dunham et. al. 2021).

The IPM-PVA model estimated mean abundance of the ACP breeding population in 2019 as 5,408 spectacled eiders (95% CI = 3,696–7,364), and the mean annual population growth rate from 1988 to 2019 as 0.996 (95% CI = 0.982–1.008). Restricted to 2007 – 2019, the mean annual growth rate is estimated as -0.025 (95 percent CRI: -0.055 – 0.004; USFWS 2021a).

Arctic Russia breeding population – Information on abundance, distribution, and trend of the Arctic Russia breeding population is extremely limited. Aerial surveys conducted in Arctic Russia from 1993 to 1995 produced an index of 146,425 spectacled eiders (coefficient of variation = 0.08, unadjusted for detection rate; Hodges and Eldridge 2001). These surveys were conducted within 124 miles of the coast, between the Kolyuchin and Lena rivers, where most of the population is thought to nest. Current Arctic Russia breeding population trend and abundance are unknown, except what can be inferred from estimates of the global wintering population. Using the most recent estimate of global population size, less the combined Alaska breeding population estimates, the minimum Arctic Russia breeding population of spectacled eiders in March 2020 was 46,995 spectacled eiders (USFWS 2021a).

The 2020 survey represents a low count for the global wintering population of spectacled eiders. A decline in the Arctic Russia breeding population cannot be ruled out as a possible contributor to the low count, but data is not available with which to estimate a trend (USFWS 2021a). The low count in the 2020 survey of the global population could also reflect incomplete detection within the survey area, and/or the presence of spectacled eiders outside the survey area (USFWS 2021a).

Spectacled eider recovery criteria – The Spectacled Eider Recovery Plan (USFWS 1996) presents research and management priorities with the objective of recovery and delisting so that protection under the ESA is no longer required. Although the cause or causes of the spectacled eider population decline is/are not known, factors that affect adult survival are likely to have the most influence on population growth rate. These include lead poisoning from ingested spent shotgun pellets, which may have contributed to the rapid decline observed in the YK-Delta (Franson et al. 1995, Grand et al. 1998), and other factors such as habitat loss, increased nest predation, overharvest, and disturbance and collisions caused by human infrastructure. Under the Recovery Plan, the species will be considered recovered when each of the three recognized populations (Y-K Delta, North Slope of Alaska, and Arctic Russia): (1) is stable or increasing over 10 or more years and the minimum estimated population size is at least 6,000 breeding pairs, or (2) numbers at least 10,000 breeding pairs over 3 or more years, or (3) numbers at least 25,000 breeding pairs in one year. Spectacled eiders do not currently meet these recovery criteria.

Threats – Factors which may have contributed to the current status of spectacled eiders include but are not limited to long-term habitat loss through development and disturbance, environmental contaminants, increased predator populations, harvest, collisions with structures, research, and climate change. These threats are summarized below; a more comprehensive analysis of these threats to spectacled eiders can be found in the Species Status Assessment (USFWS 2021a).

Terrestrial habitat loss and disturbance through development – Destruction or modification of spectacled eider nesting habitat and development-related disturbance have been limited and are not believed to have contributed substantially to population declines of spectacled eiders. However, development has likely impacted individual spectacled eiders by reducing available nesting and brood-rearing habitat. Human activity has likely impacted individual spectacled eiders through disturbance to nesting females and young, and disturbance to juveniles and adults during molt, fall and spring migration, and the wintering period.

On the Y-K Delta, long-term habitat loss from human development has been minimal (USFWS 2021a). No oil and gas or mining activities have occurred within the primary breeding area of spectacled eiders or within designed critical habitat. While there has been some population increase in the handful of communities within the Y-K Delta, village footprints have seen little expansion; and overcrowding of housing is an ongoing, significant issue (AHFC 2017). On the

ACP, extensive oil and gas development has occurred around Prudhoe Bay, extending from the western border of the Arctic National Wildlife Refuge to eastern portions of the NPR-A. This has resulted in long-term loss of spectacled eider breeding habitat, directly (e.g., through gravel extraction and the building of roads and other infrastructure) and indirectly (e.g., through disturbance from oilfield activities). The actual footprint of oil and gas infrastructure is small relative to the overall geographic distribution of spectacled eiders on the ACP. However, oil and gas developments have gradually progressed westward across the ACP. Given ongoing industry interest in the region (expressed in lease sales, seismic surveys, and exploratory wells), industrial development farther into spectacled eider breeding habitat on the ACP is likely to continue.

Additionally, community populations on the ACP, including that of Utqiaġvik, have been increasing. With the development of community infrastructure, spectacled eiders likely have experienced some loss of reproductive potential from direct and indirect habitat loss. Overall, direct, long-term habitat loss on the ACP due to both community and oil and gas development has not had a major impact on the core area of spectacled eider terrestrial habitat in this region to-date but may be a concern in the future with continued expansion. Similar data due to community infrastructure and industrial development is unavailable for Arctic Russia. However, this region of Russia is generally characterized as remote and sparsely populated.

Disturbance from human activities may affect individual spectacled eiders in a variety of ways, including by forcing birds to move away from preferred foraging, nesting, and brood-rearing habitats; by flushing incubating birds off nests or hens away from broods, increasing vulnerability of eggs and young to exposure and predation; and finally, by reducing adult survival if disturbance is frequent and/or in combination with other stressors. It is unknown to what degree spectacled eiders can reproduce successfully in disturbed areas or move to less-disturbed areas to successfully reproduce. The likelihood that disturbance from activities associated with human development is currently affecting spectacled and eiders at the population-level is low, given their wide breeding distribution versus the relatively limited human footprint within the Action Area and Arctic Russia. However, as infrastructure expands, the overall effect of disturbance and habitat loss may increase.

Environmental contaminants – Deposition of lead shot in tundra wetlands and shallow marine habitat where eiders forage is considered a threat to spectacled eiders, and also affects the suitability of designated critical habitat. Lead poisoning has been documented in spectacled eiders on the Y-K Delta (Franson et al. 1995; Grand et al. 1998; Flint et al. 2016) and in Steller's eiders on the ACP (Trust et al. 1997; Service unpublished data). The use of lead shot in waterfowl hunting has been prohibited in the United States since 1991. On the ACP and Y-K Delta, lead shot is prohibited in the hunting of all bird species (banned by the State of Alaska at the request of regional advisory boards in 2006 and 2007, respectively), and on the Y-K Delta (where critical habitat is designated for spectacled eiders) it is also prohibited. It is hypothesized that lead poisoning has contributed to population declines of spectacled eiders, but to what extent, on its own or in combination with other stressors, is unknown. While the use of lead shot appears to be declining in the Action Area, there is evidence lead shot is still available for purchase in some communities adjacent to habitats used by spectacled eiders (including designated critical habitat; USFWS, unpublished observations). Waterfowl will presumably continue to be exposed to residual lead shot in the environment annually and for some time into the future, and lead exposure will continue to be a factor affecting spectacled eiders and the suitability of designated critical habitat on the Y-K Delta.

Other contaminants, including petroleum hydrocarbons from local sources or globally distributed heavy metals, may also affect spectacled eiders. For example, spectacled eiders wintering near St. Lawrence Island exhibited high concentrations of metals as well as subtle biochemical changes (Trust et al. 2000). Additionally, spectacled eiders breeding and staging in areas of industrial development, including the CRD, may be exposed to petroleum hydrocarbons, heavy metals, and other contaminants. Vessel traffic and industrial development also pose a risk of hydrocarbon exposure as a result of oil spills to the marine environment, including to critical habitat designated for spectacled eiders. Overall, risk of contaminant exposure and potential affects to spectacled eiders and critical habitat are unmeasured. With vessel traffic and industrial development increase within the marine habitats used by spectacled eiders, risk of hydrocarbon and other contaminant exposure will also increase.

Collisions with structures – Migratory birds suffer considerable risk from collisions with human-made structures (Manville 2005), including light poles, buildings, drill rigs, towers, wind turbines, and overhead powerlines. Collisions can cause immediate mortality, injury leading to death, or temporary injury. A study in the Prudhoe Bay oil fields found that collision rate along a 7.8-mile power line during 1986 and 1987 was related to flight height (Anderson and Murphy 1988). Johnson and Richardson (1982) reported that 88 percent of eiders observed in a study along the Beaufort Sea coast flew below an estimated altitude of 32 feet, and well over half flew below 16 feet. Day et al. (2003) estimated a mean flight altitude of 6 feet for eider species flying past St. Lawrence Island, Alaska in the fall. This tendency to fly low puts eiders at risk of striking even relatively low objects in their path.

Spectacled eiders are most at risk of collision with structures on the breeding grounds and during migration. Human structures, including buildings and powerlines, are sparse and limited on the Y-K Delta, and collision risk to spectacled eiders is not significant in this region, including within designated critical habitat. Relative to the Y-K Delta and Arctic Russia spectacled eider breeding populations, ACP-breeding spectacled eiders likely have a higher collision risk due to more extensive human development in the Prudhoe Bay oil fields, near Utqiaġvik, and along the Beaufort Sea coast, where several offshore oil facilities are operating or in construction. While systematic surveys have not been conducted, low numbers of spectacled eider collisions with powerlines or structures were documented from 1991 to 2019 near Utqiaġvik and in Prudhoe Bay (USFWS, unpublished data).

It is difficult to measure the population-level effect of collisions on spectacled eiders. Several factors confound accurate collision estimates, including (1) annual variation in eider density and distribution; (2) how feature configurations (e.g., presence or absence of guy wires) contribute to avian attraction, disorientation, and collision; and (3) how variations in weather and lighting conditions affect probability of collisions. The Service consults with Federal agencies on most industrial and community development on the ACP and seeks to minimize collision risk through various measures (including design considerations, such as avoiding the use of guyed towers, keeping lighting to a minimum). Nevertheless, some unknown level of collision risk remains over the life of human-made infrastructure, and evidence suggests some number of individual spectacled eiders are killed annually by collisions. Development is projected to increase on the ACP and along the coast of Arctic Russia in the future (BOEM 2018, Rosneft 2020a; b), which will likely increase the risk of collisions for spectacled eiders.

Vessel disturbance and collisions – Vessels used for shipping, fishing, research, and tourism transit through spectacled eider marine habitats, including migration corridors, molting areas, and wintering areas. The majority of spectacled eider marine habitat, including designated critical habitat in molting areas in Norton Sound and Ledyard Bay and the wintering area southwest of St. Lawrence Island, has historically had low levels of vessel traffic (USFWS 2021a).

In the marine environment, spectacled eiders may be most at risk of vessel disturbance and collision during molt, when they have limited ability to move away and are under higher energetic demand, and during winter, when light and weather conditions might contribute to risk (USFWS 2021a). Some vessel traffic is subject to consultation with the Service; and for those that consult, the Service recommends measures to mitigate disturbance and risk of collision. Recommended measures include reduced vessel speed or avoiding major molting areas during the molting period. As vessel traffic increases, disturbance and collisions may become more of a concern for spectacled eiders, including in designated critical habitat.

Increased Predator Populations – Human development within the range of spectacled eiders may artificially increase the availability of food and nest/denning sites for avian and mammalian predators, thereby driving predator population increases and indirectly increasing predation on spectacled eiders and their eggs. Human-made structures provide denning sites for foxes and nest sites for ravens, which have allowed them to expand their range to parts of the ACP and Y-K Delta where they were not found prior to human development (Eberhardt et al. 1983; Day 1998; Powell and Backensto 2009; USFWS, unpublished observations). Reduced fox trapping on the ACP and increased anthropogenic food sources in developed areas of both regions (e.g., from landfills) may support higher gull, raven, and fox populations than were historically present (Day 1998, Powell and Backensto 2009). On the Y-K Delta, where critical habitat has been designated in spectacled eider nesting areas, predator populations may be increasing but at lower rates than on the ACP (USFWS 2021a). No systematic surveys of nest predators are conducted in Arctic Russia, but observations at Chaun suggest the population of large gulls may have increased over the past three decades (Solovyeva and Zelenskaya 2016) and may have resulted in higher spectacled eider nest predation rates (Solovyeva et al. 2018).

Individual spectacled eiders in the vicinity of communities and industrial areas have likely been impacted by increased predator populations. Ravens are highly efficient egg predators (Day 1998), and have been observed depredating Steller’s eider nests near Utqiaġvik (Quakenbush et al. 2004). It is possible increased predator populations have had consequences at the population-level, but the overall severity of impacts has been difficult to quantify. While some localized efforts have been made to reduce predator populations that have increased due to human subsidies, there is no information regarding the effectiveness of these measures (USFWS 2021a).

As the number of anthropogenic attractants increases near breeding populations of spectacled eiders, reproductive success of spectacled eiders may decrease, and population-level effects may become more apparent.

Harvest, including egging and shooting – An unknown level of incidental and intentional harvest of spectacled eiders and their eggs occurs in both Alaska and Russia. Regulatory mechanisms and outreach/education efforts may lower harvest of spectacled eiders and their eggs in the future, but to our knowledge such efforts are confined to Alaska and have not occurred in Russia. Spectacled eiders may be harvested during migration, during the breeding period on the tundra, or in the marine staging and molting areas.

All harvest of spectacled eiders was closed in 1991 by Alaska State regulations and Service policy, and outreach efforts have been conducted on the ACP by the Service, North Slope Borough (NSB), and BLM to encourage compliance. However, annual harvest surveys indicate that some spectacled eiders continue to be incidentally taken during subsistence activities in the NSB. Although local knowledge suggests spectacled eiders have not been specifically targeted for subsistence, spectacled eiders may be subject to misidentification and inadvertent harvest. They could also be taken if hunters are unaware of species-specific closures, or they could be taken deliberately (USFWS 2022). Ongoing efforts to help subsistence users avoid incidental harvest are being implemented in NSB villages, particularly in Utqiaġvik where the perceived risk for spectacled eiders is greatest due to their relatively high rates of occurrence and occupancy in areas commonly used for hunting. Similar outreach is not conducted on the Y-K Delta at this time.

The harvest of spectacled eiders is legally prohibited in Russia, as is any activity that may result in habitat degradation or a reduction in numbers (USFWS 2021a). Exceptions include subsistence purposes for indigenous people. We do not have reliable information on the enforcement of harvest regulations and harvest levels in Russia (USFWS 2021a).

Research – Field-based scientific research has also intensified in response to interest in climate change and its effects on arctic ecosystems. While some activities have no impact on spectacled eiders (e.g., a project that occurs when eiders are absent or employs remote sensing tools), other activities could have negative direct (e.g., through nest trampling or collection of eiders or their eggs) and indirect (e.g., through disturbance) effects. Activities that could affect spectacled eiders through disturbance include aerial surveys, on-tundra activities, or remote aircraft landings. Many of these activities are considered in intra-Service consultations, or under a programmatic consultation with the BLM for summer activities in the NPR-A.

The Service has also issued permits under Section 10 of the ESA to authorize take of endangered or threatened species for the purpose of propagation, enhancement, or survival. Since 1993, annual reporting requirements associated with section 10 permits for spectacled eiders indicate that approximately 11 spectacled eider adults and 5 eggs have been taken as an indirect result of research activities.

Disease, parasites, bacteria, and biotoxins – Spectacled eiders may be affected by naturally occurring diseases, parasites, and biotoxins (e.g., from harmful algal blooms) through a direct effect on individuals or through impacts to food quality (USFWS 2021a). Exposure may result in a one-time, temporary effect to individuals, or exposure may be chronic and affect future reproductive potential and survival (USFWS 2021a). The effects of disease, parasites, toxins, and bacteria to individual eiders have not been evaluated, and studies on population-level effects of these stressors on sea ducks are lacking (Hollmen and Franson 2015; USFWS 2021a).

Climate Change – The environmental baseline includes consideration of ongoing and projected changes in climate, using terms as defined by the Intergovernmental Panel on Climate Change (IPCC). Various types of changes in climate can have direct or indirect effects on species. These effects may be positive, neutral, or negative, and they may change over time, depending on the species and other relevant considerations, such as the effects of interactions of climate with other variables (e.g., habitat fragmentation).

Globally, climate change is characterized by warming atmospheric and ocean temperatures, diminishing snow and ice cover, and rising sea levels (IPCC 2014). High latitude regions such as the ACP, Arctic Russia, and even the subarctic Y-K Delta are thought to be especially sensitive to effects of climate change (Quinlan et al. 2005; Smol et al. 2005; Schindler and Smol 2006). Climate change will likely have impacts at multiple scales (e.g., at the level of individual organisms and the community level), but it is difficult to predict with certainty how effects will manifest. Biological, climatological, and hydrologic components of the ecosystem are interlinked and operate on varied spatial, temporal, and organizational scales with feedback between components (Hinzman et al. 2005).

Marine environment – The North Pacific Ocean, including the Bering Sea, is subject to longer-term cycles in oceanic conditions, such as the Pacific Decadal Oscillation, and regime shifts that are defined by rapid changes in ecosystem structure. We do not have adequate information to characterize the effects of marine regime shifts on spectacled eiders (USFWS 2021a), but signals of regime shifts include alterations to primary productivity, invertebrate populations, and fisheries that then persist at a decadal time scale (Overland et al. 2008).

Despite regime shifts over decadal scales, data suggests the North Pacific Ocean and Arctic Ocean, which includes the Beaufort, Chukchi, and East Siberian seas, may be warming overall. Over large areas of the seasonally ice-free Arctic, summer sea surface temperatures have increased around 0.5° per decade from 1982 to 2017 (IPCC 2019). Trend analyses of the Chukchi Sea have shown warming over the past 96 years, and the rate of warming has increased in recent decades (Danielson et al. 2020). Historically, the climate of the Bering Sea has shifted from alternating warm and cold years, but more recently has been dominated by multi-year warm periods (Stabeno et al. 2007). Climate-induced changes in sea surface temperature may have cascading effects to the marine ecosystem, including negative effects on bivalves that result from a corresponding increase in ocean acidification. An indirect effect of climate change to spectacled eiders may therefore be a decrease in the abundance of benthic bivalve prey in marine habitats.

Arctic sea ice, including that in the Chukchi, Beaufort, and Bering seas, has been declining in extent and concentration in recent decades (IPCC 2019). Changes in sea ice are particularly apparent in the Bering Sea, and it is very likely that projected Arctic warming will result in a continued loss of sea ice in the future (USFWS 2021a). A reduction or disappearance of sea ice during portions of the winter could affect spectacled eiders by requiring them to remain in open water rather than use sea ice as a resting platform. Spectacled eiders may also have to contend with more extreme wave conditions in the absence of sea ice and its dampening effect. Both factors may directly affect spectacled eiders by increasing energetic requirements during winter, with possible negative effects to body condition, reproduction, and even survival (Lovvorn et al. 2009). In addition, with extended open water season and increased extent of open water in the Bering and southern Chukchi seas, vessel traffic is expected to increase, which increases the risk to spectacled eiders of collisions, disturbance, and oil spills.

Climate-related changes in the marine environment could reduce the suitability of designated critical habitat for spectacled eiders. We do not know whether spectacled eiders might behaviorally adapt to such ecosystem changes by moving to new habitat. Data show at least some portion of the spectacled eider wintering population may move north in response to sea ice retreat (USFWS 2021a), but we do not know how northward migration affects subsequent survival or reproductive capacity.

Terrestrial and freshwater environment – A wide variety of climate-related changes are also occurring in terrestrial habitat across the circumpolar Arctic, including tundra areas where spectacled eiders nest and raise broods. Some impacts from increasing air temperatures in the sub-Arctic and Arctic include: erratic weather patterns, changing snow conditions, increased pond temperatures that could influence primary productivity and invertebrate communities, permafrost degradation and erosion contributing to declines in pond area and abundance, and storm surge flooding that increases salinity in freshwater ponds.

Spectacled eiders depend on landscapes dominated by freshwater wetlands for foraging and brood rearing (Quinlan et al. 2005). Water bodies in subarctic and arctic tundra are draining in response to thawing permafrost (Oechel et al. 1995; Smith et al. 2005), or due to increased evaporation and evapotranspiration during prolonged ice-free periods (Schindler and Smol 2006; Smol and Douglas 2007). Such climate-related changes could have cascading effects to the reproductive success of spectacled eiders. Changes in water chemistry or temperature are altering nutrient loads, primary productivity, and invertebrate communities that form the basis of the arctic food web (Chapin et al. 1995; Hinzman et al. 2005; Quinlan et al. 2005; Smol et al. 2005; Lougheed et al. 2011). We do not know how these changes act singularly or in combination to affect the quality of nesting or brood-rearing habitat, the aquatic invertebrate community spectacled eiders depend on for food, or whether they contribute to phenological mismatches between spectacled eiders and their tundra wetland invertebrate prey stock (USFWS 2021a).

In the Utqiaġvik Triangle, there has been a 30.3 percent net decrease in pond area and a 17.1 percent decrease in pond abundance from 1948 to 2010 (Andresen and Lougheed 2015), and there is strong evidence that permafrost loss caused by climate change is decreasing large lake area and abundance in areas with discontinuous permafrost, including parts of subarctic Alaska (Riordan et al. 2006). Permafrost degradation could also contribute to a decrease in tundra pond habitat for nesting and brood-rearing eiders in areas with continuous permafrost, such as the ACP and Arctic Russia. The low-relief Y-K Delta could also be susceptible to impacts from an increase in the magnitude and frequency of coastal storm surges and storm-driven flood ties (Jorgenson and Ely 2001, IPCC 2014); and increased storminess may be exacerbated by a reduction in sea ice coverage, which has a dampening effect on wave action (IPCC 2014). During flood-tide events in this region, coastal lakes and low-lying wetlands are often breached, altering soil/water chemistry as well as floral and faunal communities (USGS 2006; Terenzi et al. 2014). The frequency and magnitude of coastal storm surges is expected to continue increasing (IPCC 2014). When coupled with softer, semi-thawed permafrost, reductions in sea ice have also significantly increased coastal erosion rates (USGS 2006). The overall effect may be a reduction in available coastal tundra habitat over time, especially on the Y-K Delta. Critical habitat has been designated on the Y-K Delta for spectacled eiders, and impacts in this region could be detrimental, especially to the nesting success of spectacled eiders (USFWS 2021a).

Changes in precipitation patterns and air and soil temperatures are also affecting terrestrial ecosystems in the subarctic and Arctic (Chapin et al. 1995; Hinzman et al. 2005; Prowse et al. 2006). Snow cover duration in the Arctic is projected to decrease 5 to 25 percent by the end of the century (IPCC 2019), while total precipitation and rain-on-snow events are expected to increase (IPCC 2014, ACIA 2005). These conditions may affect microtine populations (Aars and Ims 2002, Kausrud et al. 2008, Gilg et al. 2009), with possible cascading effects to predator-prey dynamics and other changes throughout the tundra ecosystem (USFWS 2021a). Additionally, changing weather patterns could expose spectacled eiders to harsher weather during the breeding season, which could increase energy requirements and/or impact reproductive effort and success (USFWS 2021a).

While the impacts of climate change are ongoing, and the ultimate effects on spectacled eiders and critical habitat are unclear, climate-related changes in habitats used by each species throughout the annual cycle are predicted to continue. Some species may adapt and thrive under changing environmental conditions, while others decline or suffer reduced biological fitness. Species with small populations are more vulnerable to the impacts of environmental change (Crick 2004), but the net effect of climate-related changes to spectacled eiders remains to be measured.

Polar bear

Status and distribution – Due to threats to sea ice habitat, on May 15, 2008, the Service listed the polar bear as threatened under the ESA (73 FR 28212) throughout its range. In the U.S., the polar bear is also protected under the MMPA and the Convention on International Trade in Endangered Species of Wildlife Fauna and Flora. Polar bears are widely distributed throughout the Arctic where the sea is ice-covered for large portions of the year. Polar bears are subdivided into 19 recognized subpopulations or stocks (Figure 5.4). The U.S. contains portions of two subpopulations: the Chukchi Sea (CS) (also called the Alaska-Chukotka subpopulation in the U.S.–Russia Bilateral Agreement) and the Southern Beaufort Sea (SBS) subpopulation.

Population size estimates and trends – The most current global population estimate for polar bears is approximately 26,000 individuals (95 % CI = 22,000-31,000; Wiig et al. (2015). The International Union for Conservation of Nature and Natural Resources, Species Survival Commission (IUCN/SSC) Polar Bear Specialist Group (PBSG) ranked three of the 19 subpopulations as "declining," including the SBS subpopulation, and nine, including the CS subpopulation, as "data deficient." They ranked five as "stable" and just two as "increasing" (PBSG 2016; USFWS 2017).

Species biology and life history – Polar bears are the largest living bear species (DeMaster and Stirling 1981) with a longer neck and proportionally smaller head than other ursids. They are sexually dimorphic; females weigh 400 to 700 pounds (lbs) and males up to 1,440 lbs (USFWS 2017).

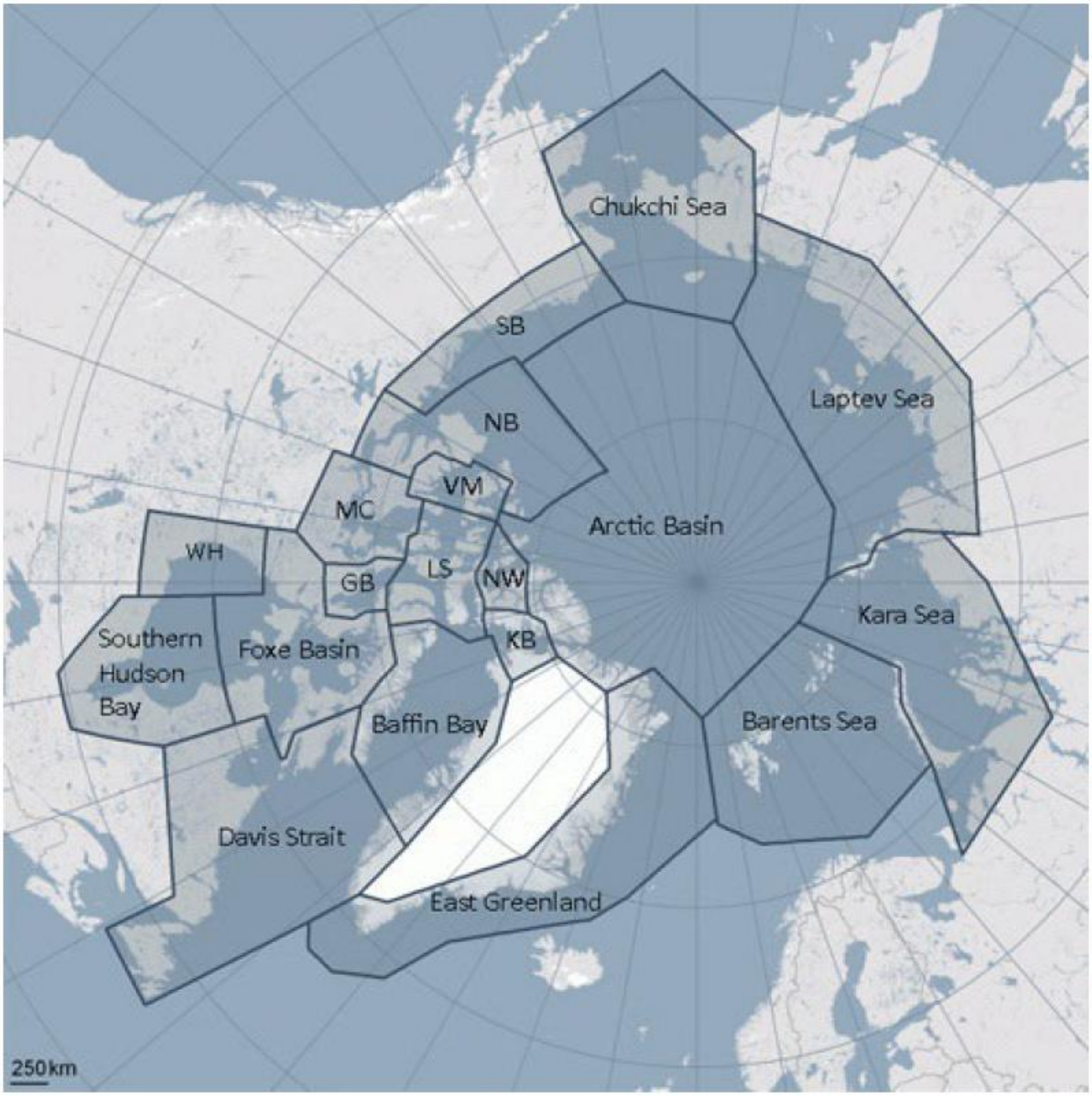


Figure 5.4. Global distribution of polar bear subpopulations as defined by the Polar Bear Specialist Group (Obbard et al. 2010; http://pbsg.npolar.no/en/status/population-map.html). Subpopulations include the Southern Beaufort Sea (SBS), Chukchi Sea, Laptev Sea, Kara Sea, Barents Sea, East Greenland, Northern Beaufort (NB), Kane Basin (KB), Norwegian Bay (NW), Lancaster Sound (LS), Gulf of Boothia (GB), McClintock Channel (MC), Viscount Melville (VM), Baffin Bay, Davis Strait, Foxe Basin, Western Hudson Bay (WH), and Southern Hudson Bay.

Breeding and reproduction – Polar bears are a K-selected species, characterized by late sexual maturity, small litter sizes, and extended maternal investment in raising young. All of these factors contribute to the species' low reproductive rate (Amstrup 2003). Females generally mature and breed for the first time at 4 or 5 years and give birth at 5 or 6 years of age. Litters of two cubs are most common, but 3-cub litters are seen on occasion across the Arctic (Amstrup 2003). The minimum reproductive interval for adult females is three years. Cubs stay with their mothers until weaning, which occurs most commonly in early spring when cubs are 2 1/2 years old. Female bears are available to breed again after their cubs are weaned (USFWS 2017).

Survival – Polar bears are long-lived and are not generally susceptible to disease or parasites. Due to extended maternal care of young and low reproductive rates, polar bears require high adult survival rates, particularly of females, to maintain population levels (Eberhardt 1985; Amstrup and Durner 1995). Survival rates are generally age dependent, with cubs-of-the-year having the lowest rates, estimated at fifty percent (90 percent CI: 33-67 percent) for the SBS subpopulation from 2001-2006 (Regehr et al. 2010), and prime-age adults (prime reproductive years are between approximately 5 and 20 years of age) having survival rates that can exceed 90 percent (Regehr et al. 2007a). Survival rates exceeding 90 percent for adult females are essential to sustain polar bear populations (Amstrup and Durner 1995).

Changes in body condition have been shown to affect bear survival and reproduction, which could, in turn, have population-level effects (Regehr et al. 2010; Rode et al. 2010). Survival of polar bear cubs-of-the-year has been directly linked to their weight and the weight of their mothers, with lower weights resulting in reduced survival (Derocher and Stirling 1996; Stirling et al. 1999). Changes in body condition indices were documented in the Western Hudson Bay subpopulation before a statistically significant decline in that subpopulation was documented (Regehr et al. 2007b). Thus, changes in these indices may signal reductions in survival and abundance are imminent (USFWS 2017).

Feeding – Polar bears are top predators in the Arctic marine ecosystem. They prey heavily on ice-seals, principally ringed seals (*Phoca hispida*), and to a lesser extent, bearded seals (*Erignathus barbatus*). Areas near ice edges, leads, or polynyas where ocean depth is minimal are the most productive hunting grounds (Durner et al. 2004). Bears occasionally take larger animals, such as walruses (*Odobenus rosmarus*) and belugas (*Delphinapterus leucas*) (Kiliaan and Stirling 1978).

Bowhead whale carcasses, leftover after subsistence harvest, have been available to polar bears as a food source on the North Slope since the early 1970s (Koski et al. 2005). The use of whale carcasses as a food source likely varies among individuals and years. Stable isotope analysis of polar bears in 2003 and 2004 suggested that bowhead whale carcasses comprised 11%-26% (95% CI) of the diets of sampled polar bears in 2003, and 0%-14% (95% CI) in 2004 (Bentzen et al. 2007).

Threats to the polar bear – Because the polar bear depends on sea ice for its survival, loss of sea ice due to climate change is its largest threat worldwide, although polar bear subpopulations face different combinations of human-induced threats (73 FR 28212; Obbard et al. 2010). The largest direct human-caused loss of polar bears is from subsistence hunting, but for most subpopulations where subsistence hunting of polar bears occurs, it is a regulated and/or monitored activity (Obbard et al. 2010). A thorough account of subsistence hunting, sport harvest, poaching, defense-of-life removals, and the management systems controlling these direct removal activities can be found in USFWS (2017). Other threats include accumulation of persistent organic pollutants in polar bear tissue, tourism, human-bear conflict, and increased development in the Arctic (Obbard et al. 2010).

Climate change – As described in the Polar Bear Conservation Management Plan (PBCMP) (USFWS 2016), polar bears evolved over thousands of years to life in a sea ice-dominated ecosystem and depend on sea ice for essential life functions. Climate-induced habitat degradation and loss are negatively affecting some polar bear subpopulations, and unabated global warming is expected to reduce the worldwide polar bear population (Obbard et al. 2010). Patterns of increased temperatures, earlier spring thaw, later fall freeze-up, increased rain-on-snow events (which may cause dens to collapse), and potential reductions in snowfall are also occurring. Loss of sea ice habitat due to climate change is identified as the primary threat to polar bears (73 FR 28212; Schliebe et al. 2006; Obbard et al. 2010).

The sea ice ecosystem supports ringed seals and other marine mammals that comprise the polar bear's prey base (Stirling and Archibald 1977; Smith 1980, 1985; Iverson et al. 2006). Sea ice cover is shown to be strongly, negatively correlated with surface temperature, which is increasing at about 3 times the global average in the Arctic (Comiso 2012). Declines in sea ice area more pronounced in summer than winter (NSIDC 2011a; b). The mean linear rate of decline for August sea ice extent is 29,000 square miles per year, or 10.4 percent per decade since 1979 relative to the 1981 to 2010 average (NSIDC 2018). Thus, average Arctic sea ice extent in August is approximately 40% less now than 40 years ago. Positive feedback systems (i.e., sea-ice albedo) and naturally occurring events, such as warm water intrusion into the Arctic and changing atmospheric wind patterns, can cause fragmentation of sea ice, reduction in the extent and area of sea ice in all seasons, retraction of sea ice away from productive continental shelf areas throughout the polar basin, reduction of the amount of heavier and more stable multi-year ice, and declining thickness and quality of shore-fast ice (Parkinson et al. 1999; Rothrock et al. 1999; Comiso 2003, 2006; Fowler et al. 2004; Lindsay and Zhang 2005; Holland et al. 2006; Serreze et al. 2007; Stroeve et al. 2014).

Loss of access to prey – The decline of sea ice habitat due to changing climate is affecting the ability of polar bears to forage in several ways. Sea ice provides a platform for hunting and feeding, seeking mates and breeding, denning, resting, and for long-distance movement. Polar bears depend on sea ice to hunt seals, and temporal and spatial availability of sea ice is predicted to decline. Once sea ice concentration drops below 50 percent, polar bears have been documented to abandon sea ice for land, where access to their primary prey is almost entirely absent, or they may retreat northward with more consolidated pack ice over the polar basin, which is likely less productive foraging habitat (Whiteman et al. 2015). In either case, polar bears are likely to have reduced access to prey resources (Whiteman et al. 2015). Ware et al. (2017) found that polar bears are increasingly occurring on ice over less-productive waters in summer. Although polar bears occasionally capture ringed seals in open water (Furnell and Oolooyuk 1980), typically ice seals in open water are inaccessible to polar bears (Harwood and

Stirling 1992). Thus, species experts do not believe that polar bears will readily adapt to the loss of sea ice by adopting other hunting methods, such as hunting seals in ice-free water (Stirling and Derocher 1993; Derocher et al. 2004).

Effects of climate change on polar bear prey species – Ice seals, principally ringed seals, and to a lesser extent bearded seals, are the primary prey of polar bears, although other food sources are occasionally exploited (USFWS 2017a). Climate change and the loss of Arctic sea ice are expected to affect ice seal populations significantly, and in response in 2012 the NMFS listed the Arctic subspecies of ringed seal (*Phoca hispida hispida*) and the Beringia DPS of the bearded seal (*Erignathus barbatus nauticus*) as threatened species under the Act (77 FR 76706; 77 FR 76740).

Ice seal population dynamics reflect a complex mix of biotic and abiotic factors (Pilfold et al. 2015), making it difficult to accurately assess the effects of changes in sea ice. However, several mechanisms by which a warming environment have affected ice seals, or plausibly should be expected to, have been identified. An adequate snow layer providing insulation around birth lairs is crucial for thermoregulation and survival of young pups (Stirling and Smith 2004). Pups in lairs with thin snow roofs are also more vulnerable to predation than pups in lairs with thick roofs (Hammill and Smith 1991; Ferguson et al. 2005), and when lack of snow cover has forced birthing to occur in the open, nearly 100% of pups died (Smith and Lydersen 1991; Smith et al. 1991). Rain-on-snow events during the late winter are increasing in frequency and can damage or eliminate snow-covered pupping lairs. Exposed pups are then vulnerable to hypothermia and predation by polar bears and arctic foxes (*Alopex lagopus*) (Stirling and Smith 2004). Pupping habitat on landfast ice (McLaren 1958; Burns 1970) and drifting pack ice (Wiig et al. 1999; Lydersen et al. 2004) can also be affected by earlier warming and break-up in the spring, which shortens the length of time pups have to grow and mature (Kelly 2001).

Although the rate and extent of population-level response of ice seals to changes in sea ice conditions remain unclear, effects to ice seal populations will certainly affect polar bear populations. Polar bear populations fluctuate with prey abundance (Stirling and Lunn 1997), and regional declines in ringed and bearded seal numbers and productivity have been linked to marked declines in the associated polar bear subpopulations (Stirling and Øritsland 1995; Stirling 2002).

Redistribution of polar bears in response to changes in sea ice – Several studies have shown that changes in sea ice, including the timing of melt in spring and freeze-up in fall, correlate with changes in the distribution of polar bears and their body condition or other indices of fitness. In Western Hudson Bay, sea ice break-up now occurs approximately 2.5 weeks earlier than it did 30 years ago because of increasing spring temperatures (Stirling et al. 1999; Stirling and Parkinson 2006), which is also correlated with when female bears come ashore and when they are able to return to the ice (Cherry et al. 2009). Similarly, changes in summer sea ice conditions have resulted in an increase in the time spent on shore during summer and the proportion of the population on shore in the Southern Beaufort Sea and Chukchi Sea subpopulations (Rode et al. 2015; Atwood et al. 2016). Rode et al. (2015) also found that changes in sea ice likely explain shifts in summer distribution of the Chukchi Sea subpopulation, from use of both Alaskan and Russian coastal areas before reductions in sea ice, to almost exclusive use of coastal areas in Russia after reductions in sea ice.

Changes in the distribution of polar bears in response to changes in sea ice may increase exposure to some threats. If bears spend more time on land during the open water period, there is potential for increased disease transmission (Kirk et al. 2010; Prop et al. 2015; Wiig et al. 2015), particularly where bears concentrate at dwindling food resources (e.g., remains of subsistence-harvested whales at Barter Island, Cross Island, and Point Barrow). Aggregations could also increase the number of individuals exposed in the event of oil spills (BOEM 2014). Increased use of onshore habitat by polar bears has also led to an increase in human-polar bear conflicts (Dyck 2006; Towns et al. 2009). In two studies from northern Canada, researchers found that the majority of polar bears killed in defense of human life occurred during the open water season (Stenhouse et al. 1988; Dyck 2006). Thus, as more bears come on shore during summer, remain on shore longer, and become increasingly food-stressed, the risk of human conflict increases along with a probable increase in defense-of-life kills.

Demographic response – Reduced access to preferred prey (i.e., ice seals; Thiemann et al. 2008) is likely to have demographic effects on polar bears. For example, in the Southern Beaufort Sea subpopulation, the period when sea ice is over the continental shelf has decreased significantly over the past decade, resulting in reduced body mass and productivity (Rode et al. 2010, 2014) and likely reduced population size (Bromaghin et al. 2015).

Changes in movements and seasonal distributions caused by climate change have been shown to affect polar bear nutrition and body condition (Stirling and Derocher 2012). Declining reproductive rates, subadult survival, and body mass have occurred because of longer fasting periods on land resulting from progressively earlier ice break-ups (Stirling et al. 1999; Derocher et al. 2004). Rode et al. (2010) suggested that declining sea ice has resulted in reduced body size and reproductive rates in the Southern Beaufort Sea subpopulation, and Regehr et al. (2007a) found that reduced sea ice habitat correlated with a reduction in the number of yearlings produced per female. In the Western Hudson Bay subpopulation, sea ice related declines in vital rates led to reduced abundance and declining population trends (Regehr et al. 2007b).

To date, however, researchers have documented demographic effects of sea ice loss in only a few of the 19 polar bear subpopulations (Regehr et al. 2007a; Rode et al. 2012). Rode et al. (2014) found that even though sea ice loss during summer had been substantial in the Chukchi Sea, polar bears in that subpopulation had not yet exhibited concomitant declines in body mass or productivity.

Reduced denning success – Climate change could negatively influence polar bear denning (Derocher et al. 2004). Insufficient snow would prevent den construction or result in use of poor sites where the roof could collapse (Derocher et al. 2004). Changes in the amount and timing of snowfall could also impact the thermal properties of dens, and because cubs are born helpless and remain in the den for three months before emergence, major changes in the thermal properties of dens could negatively impact cub survival (Derocher et al. 2004). Unusual rain events are projected to increase throughout the Arctic in winter (Liston and Hiemstra 2011), and increased rain in late winter and early spring could cause den collapse (Stirling and Smith 2004). The proportion of bears denning on ice has decreased for some subpopulations (Atwood et al. 2016) and not others, but the consequences of these shifts to cub survival are unknown.

While polar bears can successfully den on sea ice (Amstrup and Gardner 1994; Fischbach et al. 2007), for most subpopulations, maternity dens are located on land (Derocher et al. 2004). Female polar bears can repeatedly return to specific denning areas on land (Harington 1968; Ramsay and Stirling 1990; Amstrup and Gardner 1994). For bears to access preferred denning areas on land, pack ice must drift close enough or freeze sufficiently early to allow pregnant females to walk or swim to the area by late October or early November (Derocher et al. 2004). As distance increases between the pack ice edge and coastal denning areas, it will become increasingly difficult for females to access terrestrial denning locations unless they are already on or near land. Distance between the ice edge and shore is one factor thought to limit denning in western Alaska in the CS subpopulation (Rode et al. 2015). Increased travel distances could negatively affect denning success and ultimately population size of polar bears (Aars et al. 2006).

For example, over the last two decades, the Southern Beaufort Sea subpopulation has experienced a marked decline in summer sea-ice extent, along with pronounced lengthening of the open-water season (Stroeve et al. 2014; Stern and Laidre 2016). The dramatic changes in extent and phenology of sea-ice habitat have coincided with evidence suggesting use of terrestrial habitat has increased during open-water periods and prior to denning.

In addition to increased use of land during the open-water season, Southern Beaufort Sea polar bears have also increasingly used land for maternal denning. Olson et al. (2017) examined the choice of denning substrate (land compared to sea ice) by adult females between 1985 and 2013 and determined that the frequency of land-based denning increased over time, constituting 34.4 percent of all dens from 1985 to 1995, 54.6 percent from 1996 to 2006, and 55.2 percent from 2007 to 2013. Additionally, the frequency of land denning was directly related to the distance that sea ice retreated from the coast. From 1985 to 1995 and 2007 to 2013, the average distance from the coast to 50 percent sea ice concentration in September (when sea ice extent reaches its annual minimum) increased 351 ± 55 km (218.10 ± 34.17 mi), while the distance to 15 percent sea ice concentration increased by 275 ± 54 km (170.88 ± 33.55 mi). Rode et al. (2018) determined that reproductive success was greater for females occupying land-based dens compared to ice- based dens, which may be an additional factor contributing to an individual's increase of land- based den sites.

Under most climate-change scenarios, the distance between the edge of the pack ice and land will increase during summer. Bergen et al. (2007) found that between 1979 and 2006, the minimum distance polar bears traveled to denning habitats in northeast Alaska increased by an average rate of 3.7-5.0 miles per year, have nearly doubled since 1992, and would likely increase threefold by 2060. Comiso (2002) predicted that under future climate change scenarios (i.e., by the 2050s), pregnant female polar bears will be unable to access many of the most important denning areas in the north coast of the central Beaufort Sea (Derocher et al. 2004)

Shipping and transportation – A decline in Arctic sea ice has increased the navigability of Arctic waters, with previously ice-covered sea routes now opening in summer, allowing access for commercial shipping, natural resource development, and tourism. Potential effects include fracturing of sea ice, disturbance of polar bears and their prey, increased human-polar bear encounters, introduction of waste/ litter and toxic pollutants into the environment, and increased risk of oil spills (USFWS 2017). Although shipping is expected to increase in Arctic waters in response to declining sea ice, the PBCMP concluded that trans-Arctic shipping poses minimal risk to polar bears in the long-term (USFWS 2016). Arctic nations are increasingly working cooperatively to track changes in shipping and manage possible increases in environmental impacts (USFWS 2017).

Oil and gas development – Polar bears overlap with both active and planned oil and gas operations throughout their range. Impacts on polar bears from industrial activities, such as oil and gas development, may include: disturbance from increasing human-bear interactions, resulting in direct displacement of polar bears, preclusion of polar bear use of preferred habitat (most notably, denning habitat); and/or displacement of primary prey.

Although oil and gas exploration, development, and production throughout the Arctic has declined since the time of the listing, offshore oil and gas activities may increase due to a decline in summer sea ice (USFWS 2016, 2017). Plans are also underway for new oil and gas development and infrastructure in polar bear habitat (e.g., natural gas pipeline from Mackenzie Delta to southern Canada, exploration offshore from Greenland, Russia, and Alaska [Beaufort Sea]), and proposed offshore and onshore lease sales. In the United States, potential effects on polar bears are in part mitigated through: 1) development of activity-specific human-bear interaction plans (to avoid disturbance), 2) safety and deterrence training for industry staff, 3) bear monitoring and reporting requirements, and 4) implementation of project-specific protection measures (e.g., 1 mile buffers around den sites).

Contaminants – In the final rule listing the polar bear as a threatened species, the Service identified three categories of contaminants in the Arctic that present the greatest potential threats to polar bears and other marine mammals, these are persistent organic pollutants, heavy metals, and petroleum hydrocarbons (PCBs) (73 FR 28288-28291). In the PBCMP (USFWS 2016), the Service concluded that contaminant concentrations were not thought to have population level effects on most polar bear populations but noted that contaminants may become a threat in the future, especially in subpopulations experiencing declines related to nutritional stress brought on by sea ice loss and environmental changes.

Petroleum hydrocarbons/oil spills – Oil spills could potentially affect polar bears through: 1) affecting their ability to thermoregulate if their fur is oiled, 2) lethal or sublethal effects of ingestion of oil from grooming or eating contaminated prey, 3) habitat loss or decreased availability of preferred habitat; and 4) impacts to the abundance or health of prey. At the time of listing, no major oil spills had occurred in the marine environment within the range of polar bears and the Service had determined that the probability of a large oil spill occurring in polar bear habitat was low. We also noted that, in Alaska: 1) previous operations in the Beaufort and Chukchi seas have been conducted safely, and effects on wildlife and the environment have been minimized; 2) regulations exist to require pollution prevention and control; and 3) plans are reviewed by both leasing and wildlife agencies to ensure appropriate species-specific protective measures for polar bears are included. However, we also noted that increased oil and gas development coupled with increased shipping elevated the potential for spills, and if a large spill were to occur, it could have significant impacts to polar bears and their prey, depending on the size, location, and timing of the spill.

Persistent Organic Pollutants (POPs) – Persistent organic pollutants are organic chemicals resistant to biodegradation and can affect apex predators such as polar bears that have low reproductive rates and high lipid levels because POPs tend to bioaccumulate and biomagnify in fatty tissues. While the levels of some contaminants, such as PCBs, generally seem to be decreasing in polar bears, others, such as hexachlorocyclohexanes, were relatively high, and newer compounds, such as polybrominated diphenyl ethers and perflouro-octane sulfonates, posed a potential future risk to polar bears. The effects of these contaminants at the population level are relatively unknown (USFWS 2017).

Metals – The most toxic or abundant elements in marine mammals are mercury, cadmium, selenium, and lead. Of these, mercury is of greatest concern because of its potential toxicity at relatively low concentrations and its tendency to bioaccumulate and biomagnify in the food web (73 FR 28291). In the final rule to list the polar bear (73 RF 28212) the Service noted that although mercury found in marine mammals often exceed levels that have caused effects in terrestrial mammals, most marine mammals appear to have evolved mechanisms that allow tolerance of higher concentrations of mercury (AMAP 2005). Although population-level effects are still widely undocumented for most polar bear subpopulations, increasing exposure to contaminants may become a more significant threat in the future, especially for declining polar bear subpopulations and/or bears experiencing nutritional stress (USFWS 2017).

Ecotourism – Polar bear viewing and photography are popular forms of tourism that occur primarily in Churchill, Canada; Svalbard, Norway; and the north coast of Alaska (near the communities of Kaktovik and Utqiaġvik). In the final listing rule for the polar bear, the Service noted that, while it is unlikely that properly regulated tourism will have a negative effect on polar bear subpopulations, increasing levels of public viewing and photography in polar bear habitat might lead to increased human-polar bear interactions. Tourism can also result in inadvertent displacement of polar bears from preferred habitats or alter natural behaviors (Dyck and Baydack 2004; Eckhardt 2005). Conversely, tourism can have the positive effect of increasing the worldwide constituency of people with an interest in polar bears and their conservation (USFWS 2017).

Polar Bear Critical Habitat

The polar bear was listed as a threatened species throughout its range, but the regulatory authority to designate critical habitat (50 CFR 424.12(h)) is limited to areas of U.S. jurisdiction, which in the case of the polar bear includes Alaska and adjacent territorial and U.S. waters. The Service designated 484,734 square kilometers of critical habitat for the polar bear in 2010 (75 FR 76086).

Designation of critical habitat requires, within the geographical area occupied by the polar bear, identification of the physical or biological features (PBFs) essential to the conservation of the species that may require special management or protection. We identified the following three PBFs essential to the conservation of the polar bear:

1. Sea-ice habitat used for feeding, breeding, denning, and movement, which is further defined as sea-ice over waters 300 m or less in depth that occurs over the continental shelf with adequate prey resources (primarily ringed and bearded seals) to support polar bears.
2. Terrestrial denning habitat, which includes topographic features, such as coastal bluffs and riverbanks, with suitable macrohabitat characteristics. Suitable macrohabitat characteristics are:
    1. Steep, stable slopes (range 15.5–50.0 degrees), with heights ranging from 1.3 to 34 m, and with water or relatively level ground below the slope and relatively flat terrain above the slope;
    2. Unobstructed, undisturbed access between den sites and the coast;
    3. Sea-ice in proximity to terrestrial denning habitat prior to the onset of denning during the fall to provide access to terrestrial den sites; and
    4. The absence of disturbance from humans and human activities that might attract other polar bears.
3. Barrier island habitat used for denning, refuge from human disturbance, and movements along the coast to access maternal den and optimal feeding habitat, including all barrier islands along the Alaska coast and their associated spits, within the range of the polar bear in the United States, and the water, ice, and terrestrial habitat within 1.6 km of these islands.

Considering the three PBFs, and the quantity and spatial arrangement of them necessary to support conservation of the polar bear, we designated the following three critical habitat units, each of which contains at least one of the PBFs:

Unit 1, Sea Ice Habitat – Sea ice habitat covers approximately 464,924 km^2 of primarily marine habitat extending from the mean high tide line of the Alaska coast seaward to the 300 m depth contour, and spans west to the international date line, north to the Exclusive Economic Zone, east to the US–Canada border, and south to the southern limit of the known distribution of the Chukchi Sea polar bear subpopulation. Sea ice is used by polar bears for the majority of their life cycle for activities such as hunting seals, breeding, denning, and traveling.

Unit 2, Terrestrial Denning Habitat – Terrestrial denning habitat occurs within approximately 14,652 km^2 of land along the northern coast of Alaska from the Canadian border west to near Point Barrow. It encompasses approximately 95% of the known historical terrestrial den sites from the Southern Beaufort Sea subpopulation (Durner et al. 2009a). The inland extent of denning distinctly varies between two longitudinal zones, with 95 percent of known dens between the Alaska/Canada border and Kavik River occurring within 32 km of the mainland coast, and 95 percent of dens between the Kavik River and Utqiaġvik occurring within 8 km of the mainland coast. The inland boundary of the Terrestrial Denning Unit reflects this difference in the distribution of known den sites, with the boundary drawn at 32 km inland between the Alaska/Canada border and the Kavik River and 8 km inland between the Kavik River and Utqiaġvik.

Unit 3, Barrier Island Habitat – Barrier island habitat covers approximately 10,575 km^2 of barrier islands and the associated complex of spits, water, ice, and terrestrial habitats within 1.6 km of barrier islands. There is significant overlap between this unit and the Terrestrial Denning and Sea Ice units. Like the Sea Ice Unit, the Barrier Island Unit extends from near the Alaska/Canada Border to near Hooper Bay in southwestern Alaska but only occurs where barrier islands exist.

Exclusions within Designated Polar Bear Critical Habitat – Within the Terrestrial Denning and Barrier Island units, critical habitat does not include manmade structures (e.g., houses, gravel roads, airport runways and facilities, pipelines, well heads, generator plants, construction camps, sewage treatment plants, hotels, docks, seawalls, and the land on which they were constructed) that existed on the effective date of the rule. The communities of Utqiaġvik and Kaktovik were also excluded.

6. ENVIRONMENTAL BASELINE

The environmental baseline refers to the condition of the listed species or its designated critical habitat in the Action Area, without the consequences caused by the proposed action. The environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the Action Area, the anticipated impacts of all proposed Federal projects in the Action Area that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process. The consequences to listed species or designated critical habitat from ongoing agency activities or existing agency facilities that are not within the agency's discretion to modify are part of the environmental baseline.

Baseline of spectacled eiders in the terrestrial Action Area

Spectacled eiders nest and raise broods in the Action Area at low density from late May through late October. Within the Action Area, spectacled eiders are widely distributed near lakes or coastal margins with a trend toward higher abundance near the coast, and they nest primarily in non-patterned wet meadows, and in wetland complexes containing emergent grasses and sedges (Anderson and Cooper 1994; Anderson et al. 2009). After hatching, spectacled eider hens with broods occupy deep *Arctophila* and shallow *Carex* habitat (Safine 2011). There is no overlap between terrestrial designated critical habitat for spectacled eiders and the Action Area.

Factors which may have contributed to the current status of spectacled eiders in the Action Area include but are not limited to, long-term habitat loss through development and disturbance, environmental contaminants, increased predator populations, subsistence harvest, collisions with structures, research, and climate change. These impacts are occurring throughout much of the species' range, including within the Action Area.

Habitat loss through development and disturbance
The Action Area is located in northeastern NPR-A, where industrial development, human habitation, and disturbance have been limited to date. The community of Nuiqsut and CPAI's existing developments of CD 5, GMT-1, and GMT-2 are the only year-round human habitation in or near the Action Area. Nonetheless, as a consequence of these existing developments and human habitation, it is likely that spectacled eiders in eastern NPR-A have experienced some loss of reproductive potential resulting from direct and indirect habitat loss. However, the degree to which spectacled eiders can reproduce in disturbed areas or move to other less disturbed areas to reproduce, is unknown.

Given industry's interest in the NPR-A as expressed by lease sales, seismic surveys, drilling of exploratory wells, and the development of the Alpine and Greater Moose's Tooth fields in recent decades, expansion of industrial development is likely to continue along the ACP further into spectacled eider breeding habitat. Overall, although direct, long-term habitat loss on the ACP is minimal, but is likely to increase in the future (USFWS 2021a).

Ingestion of Lead Ammunition
Historically, hunters have used lead ammunition (shotgun pellets) for hunting and shooting within spectacled eider nesting, brood-rearing, pre-migration staging, and migration areas. Presently, the illegal use of lead shotgun pellets for hunting continues to an unknown degree. Spectacled eiders ingest lead pellets when feeding and collecting grit in freshwater and brackish wetlands (Franson et al. 1995, Flint et al. 1997, 2016). Ingestion of lead pellets has been identified as the source of high and harmful lead levels in spectacled eiders through blood samples, radiographs, necropsy, and lead isotope analysis (A. Matz, USFWS Biologist, pers. comm., Franson et al. 1995, Flint et al. 1997).

The effects of lead exposure on individuals and breeding populations are well-documented in waterfowl. Toxic effects of ingesting lead vary among individuals, but include lethal and sub-lethal effects (Jordan and Bellrose 1951, Franson et al. 1995, Baldassarre and Bolen 2006). Lead exposure has been shown to kill spectacled eiders and to have measurable negative effects on annual survival rates of spectacled eider populations (Grand et al. 1998, Flint et al. 2016). The probability of exposure to lead is higher for females than males or juveniles, as they remain on the breeding grounds for a longer period of time (Flint et al. 1997).

Waterfowl hunting with lead shot is prohibited in Alaska, and for hunting all birds on the North Slope. However, it may persist in the environment and may still be used by hunters in some areas (Service, unpublished data). Exposure to lead deposited in tundra wetlands would likely be limited to areas adjacent to the community of Nuiqsut and frequently used travel corridors, and the concentration of lead presumably would decline with increasing distance from these areas. Although the use of lead shot appears to be declining, residual lead shot may be present in the environment and be available to waterfowl for an unknown period into the future.

Exposure to Contaminants (other than lead)
In addition to lead, other contaminants such as globally distributed heavy metals, and spilled hydrocarbons may also affect spectacled eiders. For example, spectacled eiders sampled in winter near St. Lawrence Island exhibited high concentrations of metals, as well as subtle biochemical changes (Trust et al. 2000). In terrestrial habitat east of the Action Area, oil spills have occurred from pipelines. For example, over 200,000 gallons of oil were released from a 0.25-inch hole in a 34-inch pipeline at Prudhoe Bay in 2006. Smaller spills from pipelines have occurred on the ACP since that time (e.g., in 2009, 13,500 gallons of crude spilled from a frozen pipe in the greater Prudhoe Bay area), and this risk is likely to increase with future onshore development.

Spectacled eiders breeding, making local movements, staging or migrating through the Action Area may have experienced limited exposure to petroleum hydrocarbons, heavy metals, and other contaminants from existing Industry developments. However, the risk of exposure to contaminants and their potential affects to spectacled eiders in the Action Area have not been fully quantified.

Increased predator populations
Predator and scavenger populations have increased near rural communities and industrial infrastructure on the ACP in recent decades (Eberhardt et al. 1983; Day 1998; Powell and Backensto 2009). Reduced fox trapping, anthropogenic food sources in rural communities, and an increase in availability of nesting/denning sites at human-built structures may have resulted in increased numbers of arctic foxes (*Alopex lagopus*), common ravens (*Corvus corax*), and glaucous gulls (*Larus hyperboreus*) in developed areas of the ACP (Day 1998). For example, ravens are highly efficient egg predators (Day 1998), and have been observed depredating Steller's eider nests near Utqiaġvik (Quakenbush et al. 2004). Ravens also appear to have expanded their breeding range on the ACP by using manmade structures for nest sites (Day 1998). Given the anthropogenic influence of Nuiqsut and the existing CD5 and GMT developments, spectacled eiders in the vicinity of these areas of human habituation have likely been impacted by increased predators although the severity of impacts are difficult to quantify. Nonetheless, as the number of structures and anthropogenic attractants associated with industrial development and human habitation on the North Slope increase, reproductive success of spectacled eiders may decrease.

Subsistence harvest including egging and shooting
Although local knowledge suggests spectacled eiders and their eggs were not specifically targeted for subsistence, an unknown level of harvest occurred across the North Slope prior to listing spectacled eiders under the ESA (Braund et al. 1993). Harvest of spectacled eiders was closed in 1991 by Alaska State regulations, and outreach efforts have been conducted by the Service, the BLM, and the North Slope Borough to encourage compliance. However, annual harvest data indicate that at least some spectacled eiders and their eggs continue to be inadvertently or deliberately taken during subsistence activities on the North Slope. Annual intra-Service consultations are conducted for the Migratory Bird Subsistence Hunting Regulations, and although estimates are imprecise, harvest of all migratory bird species, including spectacled eiders, is reported annually (USFWS 2021a).

Instances of inadvertent harvest or egging would likely be concentrated near Nuiqsut and nearby gravel infrastructure (i.e., existing and proposed Industry roads), and we expect the frequency of inadvertent harvest would decline with increasing distance from infrastructure as access becomes more difficult. Furthermore, due to low density of spectacled eiders in the Action Area, harvest of this species is likely uncommon.

Collisions with structures

Migratory birds suffer considerable mortality from collisions with man-made structures (Manville 2005) including light poles, buildings, drill rigs, guyed towers or poles, and overhead powerlines. Birds are particularly at risk of collision when visibility is impaired by darkness or inclement weather (Weir 1976). There is also evidence that lights on structures increase collision risk (Reed et al. 1985, Russell 2005, numerous authors cited by Manville 2000). Anderson and Murphy (1988) monitored bird behavior and strikes to a 12.5 km power line in the Lisburn area (the southern portion of the Prudhoe Bay oil fields) during 1986 and 1987. They documented line strike mortality in 18 different species of birds, including at least one eider. Results indicated that strike rate was related to flight behavior, in particular the height of flight. Johnson and Richardson (1982) in their study of migratory bird behavior along the Beaufort Sea coast reported that 88% of eiders flew below an estimated altitude of 10 m (32 ft) and well over half flew below 5 m (16 ft). This tendency to fly low puts eiders at risk of striking even relatively low objects in their path. However, Day et al. (2003) observed all eider movements over the ocean during fall migration in the Beaufort Sea, rather than land, suggesting that eider strikes on structures on land are less likely during migration and winter.

Spectacled eiders are most at risk of collision with structures in nesting habitat and during migration. Although human structures, including buildings and powerlines, are sparse within the Action Area to date, ACP-breeding spectacled eiders likely have comparatively higher collision risk than breeding birds on the YK-Delta due to more extensive human development just outside the Action Area (e.g., in the Prudhoe Bay oil fields, near Utqiaġvik, and along the Beaufort Sea coast), where several offshore oil facilities are operating or in construction. While systematic surveys have not been conducted, low numbers of spectacled eider collisions with powerlines or structures have been documented from 1991 to 2019 near Utqiaġvik and in Prudhoe Bay (USFWS, unpublished data).

An unknown level of collision risk remains for the life of man-made structures. Several factors confound accurate collision estimates for spectacled eiders, including: 1) temporal changes in eider density and distribution, 2) lack of understanding how feature configurations contribute to avian collisions, and 3) how variations in weather and lighting conditions effect probability of collisions. However, some design considerations may reduce or eliminate collision risk for listed eiders, including shielded lighting to limit outward-radiating light and minimize potential attraction and/or disorienting effects to eiders, and avoiding use of guyed towers and overhead lines, and marking lines with bird flight diverters when overhead lines or guy wires are unavoidable.

Research
Field-based scientific research has increased in the Arctic in response to interest in climate change and its effects on Arctic ecosystems. While some activities have no impact on spectacled eiders (e.g., project timing occurs when eiders are absent or employs remote sensing tools), aerial surveys, on-tundra activities, or remote aircraft landings may disturb spectacled eiders. Many of these activities are considered in intra-Service, or project-specific, consultations with BLM, the National Science Foundation, or other Action Agencies.

Climate change – terrestrial environment
Globally, climate change is characterized by warming atmospheric and ocean temperatures, diminishing snow and ice cover, and rising sea levels (IPCC 2014). High latitude regions such as the ACP, Arctic Russia, and even the subarctic Y-K Delta are thought to be especially sensitive to effects of climate change (Quinlan et al. 2005; Smol et al. 2005; Schindler and Smol 2006). Climate change will likely have impacts at multiple scales (e.g., at the level of individual organisms and the community level), but it is difficult to predict with certainty how effects will manifest. Biological, climatological, and hydrologic components of the ecosystem are interlinked and operate on varied spatial, temporal, and organizational scales with feedback between components (Hinzman et al. 2005).

A wide variety of climate-related changes are also occurring in terrestrial habitat across the circumpolar Arctic, including tundra areas where spectacled eiders nest and raise broods. Some impacts from increasing air temperatures in the sub-Arctic and Arctic include: erratic weather patterns, changing snow conditions, increased pond temperatures that could influence primary productivity and invertebrate communities, permafrost degradation and erosion contributing to declines in pond area and abundance, and storm surge flooding that increases salinity in freshwater ponds (USFWS 2021a).

Spectacled eiders depend on landscapes dominated by freshwater wetlands for foraging and brood rearing (Quinlan et al. 2005). Water bodies in subarctic and arctic tundra are draining in response to thawing permafrost (Oechel et al. 1995; Smith et al. 2005), or due to increased evaporation and evapotranspiration during prolonged ice-free periods (Schindler and Smol 2006; Smol and Douglas 2007). Such climate-related changes could have cascading effects to the reproductive success of spectacled eiders. Changes in water chemistry or temperature are altering nutrient loads, primary productivity, and invertebrate communities that form the basis of the arctic food web (Chapin et al. 1995; Hinzman et al. 2005; Quinlan et al. 2005; Smol et al. 2005; Lougheed et al. 2011). We do not know how these changes act singularly or in combination to affect the quality of nesting or brood-rearing habitat, the aquatic invertebrate community spectacled eiders depend on for food, or whether they contribute to phenological mismatches between spectacled eiders and their tundra wetland invertebrate prey stock (USFWS 2021a).

In the Utqiaġvik Triangle, there has been a 30.3 percent net decrease in pond area and a 17.1 percent decrease in pond abundance from 1948 to 2010 (Andersen and Lougheed 2015), and there is strong evidence that permafrost loss caused by climate change is decreasing large lake area and abundance in areas with discontinuous permafrost, including parts of subarctic Alaska

(Riordan et al. 2006). Permafrost degradation could also contribute to a decrease in tundra pond habitat for nesting and brood-rearing eiders in areas with continuous permafrost, such as the ACP. The low-relief Y-K Delta could also be susceptible to impacts from an increase in the magnitude and frequency of coastal storm surges and storm-driven flood ties (Jorgenson and Ely 2001, IPCC 2014); and increased storminess may be exacerbated by a reduction in sea ice coverage, which has a dampening effect on wave action (IPCC 2014). During flood-tide events in this region, coastal lakes and low-lying wetlands are often breached, altering soil/water chemistry as well as floral and faunal communities (USGS 2006; Terenzi et al. 2014). The frequency and magnitude of coastal storm surges is expected to continue increasing (IPCC 2014). When coupled with softer, semi-thawed permafrost, reductions in sea ice have also significantly increased coastal erosion rates (USGS 2006). The overall effect may be a reduction in available coastal tundra habitat over time, especially on the Y-K Delta. Critical habitat has been designated on the Y-K Delta for spectacled eiders, and impacts in this region could be detrimental, especially to the nesting success of spectacled eiders (USFWS 2021a).

Changes in precipitation patterns and air and soil temperatures are also affecting terrestrial ecosystems in the subarctic and Arctic (Chapin et al. 1995; Hinzman et al. 2005; Prowse et al. 2006). Snow cover duration in the Arctic is projected to decrease 5 to 25 percent by the end of the century (IPCC 2019), while total precipitation and rain-on-snow events are expected to increase (IPCC 2014, ACIA 2005). These conditions may affect microtine populations (Aars and Ims 2002, Kausrud et al. 2008, Gilg et al. 2009), with possible cascading effects to predator-prey dynamics and other changes throughout the tundra ecosystem (USFWS 2021a). Additionally, changing weather patterns could expose spectacled eiders to harsher weather during the breeding season, which could increase energy requirements and/or impact reproductive effort and success (USFWS 2021a).

While the impacts of climate change are ongoing, and the ultimate effects on spectacled eiders and critical habitat are unclear, climate-related changes in habitats used by this species throughout their annual cycle are predicted to continue. Some species may adapt and thrive under changing environmental conditions, while others decline or suffer reduced biological fitness. Species with small populations are more vulnerable to the impacts of environmental change (Crick 2004), but the net effect of climate-related changes to spectacled eiders remains to be measured.

Baseline of spectacled eiders in the offshore Action Area

Chukchi and Bering seas – Spectacled eiders occur along the MTR during migration. In spring, spectacled eiders move through leads in the sea ice consistent with patterns exhibited by other sea duck species that migrate from wintering areas in the Bering Sea to breed in coastal Alaska (Sexson et al. 2014). In summer and autumn, post-breeding males, non-breeding individuals, and/or failed nesting females return to open waters along the Chukchi Sea coast, and may remain in these areas to molt. Large numbers of molting spectacled eiders are present in the Ledyard Bay Critical Habitat Unit (LBCHU) from late June through late October (Larned et al. 1995; Petersen et al. 1999).

A recent study in which spectacled eiders were marked with satellite telemetry devices at coastal areas adjacent to Peard Bay and in the Colville River Delta has provided information regarding how the species uses the eastern Chukchi Sea (approximately within 70 km of the coast of northern Alaska) during migration (Sexson et al. 2014; Sexson 2015). Spectacled eiders used this area during pre-breeding migration, breeding, post-breeding migration, and/or post-fledging dispersal. Adult males that used the eastern Chukchi Sea during post-breeding migration arrived in early July and departed in early September, although departure dates varied substantially, ranging from 4 July to 5 October (Sexson et al. 2014). Consequently, sustained occupancy among adult males during post-breeding migration ranged from 30–97 days (Sexson et al. 2014). Adult females that used the eastern Chukchi Sea during post-breeding migration arrived in August and departed in October (Sexson et al. 2014), although the timing of arrival during post-breeding migration varied considerably; arrival occurred as early as 15 July and as late as 28 September. Consequently, the duration of sustained occupancy among adult females during post-breeding migration ranged from 16–84 days. Juveniles that fledged in tundra wetlands near or adjacent to the Beaufort Sea arrived in the eastern Chukchi Sea in early October and stayed for 13–29 days before departing by late October. Thus, spectacled eiders use the eastern Chukchi Sea continuously from pre-breeding staging through post-fledgling dispersal.

Beaufort Sea – Use of the Beaufort Sea by spectacled eiders varies over time and by breeding status, and is in part controlled by ice cover on the sea surface (Schamel 1978, TERA 2002, Fischer and Larned 2004). Breeding male spectacled eiders generally depart the terrestrial environment in late June when females begin incubation (Anderson and Cooper 1994, Bart and Earnst 2005). Use of the Beaufort Sea by departing males is variable as indicated by satellite telemetry studies (TERA 2002). Of 14 males implanted with transmitters, only 4 spent an extended period of time (11–30 days), in the Beaufort Sea (TERA 2002). Preferred areas were near large river deltas such as the Colville River where open water is more prevalent. Some appeared to move directly to the Chukchi Sea over land, although the majority moved rapidly (average travel of 1.75 days) over nearshore waters from breeding grounds to the Chukchi Sea (TERA 2002).

Female spectacled eiders generally depart the breeding grounds later than males, when much more of the Beaufort Sea is ice-free, allowing for more extensive use of the area. Females spent an average of 2 weeks in the Beaufort Sea (range 6-30 days) with the western Beaufort Sea the most heavily used (TERA 2002). Females also appeared to migrate through the Beaufort Sea an average of 10 km farther offshore than the males (Petersen et al. 1999). This offshore migration route and the greater use of the Beaufort Sea by females is attributed to decreased sea ice later in summer when females migrate through the region (Petersen et al. 1999; TERA 2002).

Factors which may have contributed to the current status of spectacled eiders in the MTR include but are not limited to, environmental contaminants, collisions with offshore or coastal structures and vessels, and climate change. These impacts are occurring throughout much of the species' range, including within the MTR.

Environmental contaminants
Spectacled eiders in the marine environment can be exposed to contaminants through ingesting prey items that have contaminants in their tissues (Franson 2015) or by coming in contact with the substance externally. Bivalves, the primary prey of spectacled eiders, can have high concentrations of both heavy metals and organic contaminants (Franson 2015). Stout et al. (2002) examined spectacled eiders collected at St. Lawrence Island, Utqiaġvik, Russia and the Y-K Delta and also found that Ca, Cu, Pb and Se were higher than levels found in other waterfowl.

However, due to the lack of industrial development and minimal human presence and vessel traffic in the region, the Chukchi Sea is currently largely in natural condition. Current industrial impacts are minimal and pollution and/or sediments occur at very low levels in the area. The majority of water flowing into this marine environment is not subject to human activity or stressors and is considered unimpaired (ADEC 2003). Furthermore, there are no Section 303(d) impaired waterbodies identified within the Arctic Subregion by the State of Alaska. Background hydrocarbon concentrations in the Chukchi Sea appear to be biogenic (naturally occurring) and on the order of 1 part per billion or less; concentrations in the Hope Basin and Chukchi Sea are entirely biogenic in origin and are typical of levels found in unpolluted marine water and sediments. A study of heavy metals in sediments collected from portions of the eastern Chukchi in the 1990's (Naidu 2005) found concentrations were low and the environment was considered "pristine."

While no large spills of crude oil have occurred in the Beaufort Sea, small spills of refined petroleum products do occur. These spills decrease habitat quality and pose a risk to migrating eiders. However, there are detailed oil spill contingency plans associated with each industry development, and rapid spill response measures limit the area impacted by spills. Furthermore, wildlife hazing during spill response reduces the probability that spectacled eiders contact spilled product. Similar to the Chukchi Sea, the area of the Beaufort Sea within the MTR is likely minimally impacted by spills or other contaminants.

Collisions with offshore or coastal structures
There are several oil facilities, currently operating or planned, along the Beaufort Sea coast (e.g., Nanashuk, Oooguruk, and North Star). These facilities have likely resulted in small-scale, localized impacts on individual spectacled eiders as is described in the Biological Opinions issued for these projects (USFWS 2006, 2011b, 2019b). Onshore and offshore structures at these developments pose a potential collision risk for spectacled eiders moving through the MTR. As described above in *Collisions with Structures*, birds are particularly at risk of collision when visibility is impaired by darkness or inclement weather (Weir 1976). There is also evidence that lights on structures increase collision risk (Reed et al. 1985; Manville 2000; Russell 2005). Johnson and Richardson (1982), in their study of migratory bird behavior along the Beaufort Sea coast, reported that 88% of eiders flew below an estimated altitude of 10 m (32 ft) and well over half flew below 5 m (16 ft). Thus, structures of almost any height pose a collision risk to migrating eiders.

Collisions with vessels

As described above, migratory birds suffer considerable mortality from collisions with anthropogenic objects including vessels. Vessels operating within the MTR may overlap spectacled eider migration corridors and molting areas in the Bering, Chukchi and Beaufort seas, posing a collision risk. Bright lights on fishing boats, particularly during stormy or foggy conditions, can cause birds to become disoriented and land on or collide with vessels (Reed et al. 1985). Most documented collision incidents occurred at night with large, lighted fishing vessels. Published examples include a single event with 899 seabirds striking a vessel in the Southern Ocean (Black 2005) and a similar event with crested auklets occurred in the North Pacific Ocean (Dick and Donaldson 1978). Two spectacled eider collision events have been reported recently: (1) a flock of spectacled eiders struck a fishing vessel near St. Lawrence Island in October 2019 and 22 spectacled eiders were found dead on the deck (Anchorage Fish and Wildlife Conservation Office, pers. comm.); and, (2) 11 dead spectacled eiders were found after a collision with a research vessel in the Bering Strait area in October 2020.

However, reported collisions inevitably, and perhaps significantly, underestimate the actual mortality due to ship collisions because: 1) collisions are often episodic, and those resulting from light attraction in inclement weather may be particularly so, such that observations collected on a few vessels in a single year may not be representative of collisions in general, 2) monitoring for collisions is difficult and an unknown number of collisions may go undetected, even by trained bird observers, and 3) low visibility often coincides with increased collisions (Ronconi et al. 2015), which may increase the number of undetected collisions. Therefore, although spectacled eider collisions with vessels at sea are known to occur, the collective impacts of collisions on spectacled eiders in the MTR are difficult to quantify.

Climate change – marine environment

The North Pacific Ocean, including the Bering Sea, is subject to longer-term cycles in oceanic conditions, such as the Pacific Decadal Oscillation, and regime shifts that are defined by rapid changes in ecosystem structure. We do not have adequate information to characterize the effects of marine regime shifts on spectacled eiders (USFWS 2021a), but signals of regime shifts include alterations to primary productivity, invertebrate populations, and fisheries that then persist at a decadal time scale (Overland et al. 2008).

Despite regime shifts over decadal scales, data suggests the North Pacific Ocean and Arctic Ocean, which includes the Beaufort, Chukchi, and East Siberian Seas, may be warming overall. Over large areas of the seasonally ice-free Arctic, summer sea surface temperatures have increased around 0.5° per decade from 1982 to 2017 (IPCC 2019). Trend analyses of the Chukchi Sea have shown warming over the past 96 years, and the rate of warming has increased in recent decades (Danielson et al. 2020). Historically, the climate of the Bering Sea has shifted from alternating warm and cold years, but more recently has been dominated by multi-year warm periods (Stabeno et al. 2012). Climate-induced changes in sea surface temperature may have cascading effects to the marine ecosystem, including negative effects on bivalves that result from a corresponding increase in ocean acidification. An indirect effect of climate change to spectacled eiders may therefore be a decrease in the abundance of benthic bivalve prey in marine habitats.

Arctic sea ice, including that in the Chukchi, Beaufort, and Bering seas, has been declining in extent and concentration in recent decades (IPCC 2019). Changes in sea ice are particularly apparent in the Bering Sea, and it is very likely that projected Arctic warming will result in a continued loss of sea ice in the future (USFWS 2021a). A reduction or disappearance of sea ice during portions of the winter could affect spectacled eiders by requiring them to remain in open water rather than use sea ice as a resting platform. Spectacled eiders may also have to contend with more extreme wave conditions in the absence of sea ice and its dampening effect. Both factors may directly affect spectacled eiders by increasing energetic requirements during winter, with possible negative effects to body condition, reproduction, and even survival (Lovvorn et al. 2009). In addition, with extended open water season and increased extent of open water in the Bering and southern Chukchi seas, vessel traffic is expected to increase, which increases the risk to spectacled eiders of collisions, disturbance, and oil spills.

Climate-related changes in the marine environment could reduce the suitability of designated critical habitat for spectacled eiders. We do not know whether spectacled eiders might behaviorally adapt to such ecosystem changes by moving to new habitat. Data show at least some portion of the spectacled eider wintering population may move north in response to sea ice retreat (USFWS 2021a), but we do not know how northward migration affects subsequent survival or reproductive capacity.

In summary, the Bering, Chukchi and Beaufort seas, which include the MTR, are undergoing physical changes due to climate change, including increasing water temperatures, ocean acidification, and loss of sea ice. Loss of sea ice could directly affect spectacled eider energetic requirements or result in earlier northward movements in the winter. Ecosystem changes, such as shifts in benthic invertebrate communities, have been observed, but the effect of such changes on spectacled eiders has not been measured.

Baseline of spectacled eider critical habitat in the Action Area

There is no overlap between terrestrial designated critical habitat for spectacled eiders and the Action Area. The MTR passes adjacent to the Ledyard Bay Critical Habitat Unit (LBCHU) designated to protect molting spectacled eiders, and a critical habitat unit used by wintering spectacled eiders south of St. Lawrence Island (Figure 3.*2*), but it does not overlap with the eastern Norton Sound spectacled eider critical habitat unit.

Several key environmental factors, such as good water quality and lack of contamination, contribute to what can be considered the current environmental conditions of the LBCHU. The LBCHU is currently largely in natural condition, free of physical modification or significant water or sediment pollution; and its physical and biological processes are functioning and promote production of a rich and abundant benthic community upon which spectacled eiders feed when they occupy LBCHU.

In wintering critical habitat south of Saint Lawrence Island, spectacled eiders' preferred food resources may be in decline and organic deposition and benthic biomass in this area have declined steadily since the late 1980s (66 FR 9146). A long-term trend in benthic communities continues. The formerly abundant bivalve *Macoma calcarea* has declined relative to another clam *Nuculana radiata*, which has 76% lower lipid content and 26% lower energy density (J.R.

Lovvorn, Univ. Wyoming, pers. comm. 2000). The average length and mass of bivalves has also declined in the long term. Because nearly all spectacled eiders spend each winter occupying an area of ocean less than 50 km (27.0 nautical miles) in diameter, they may be particularly vulnerable to environmental changes that appear to be impacting the benthic communities in this area.

Baseline of Polar Bears in the Action Area

The Southern Beaufort Sea (SBS) polar bear subpopulation occurs in the Action Area. The highest number of polar bears in the Action Area occurs on land during the late summer / fall (July through November) and an average of 140 bears may occur on shore during any week during the period July through November between Utqiagvik and the Alaska-Canada border (Wilson et al. 2017b). At this time some polar bears move onto the coastline and Barrier Islands adjacent to the Beaufort Sea as they abandon melting sea ice. They use these terrestrial areas as travel corridors, resting areas and to some degree foraging areas (particularly subsistence harvested whale carcasses near Kaktovik, which is outside of the Action Area), or, for pregnant females, suitable den sites. Bears may also spend some time on land while transiting to other areas. If bears come ashore due to fall storms, melting sea ice, and/or ocean currents, they may remain along the coast or on barrier islands for several weeks until sea ice returns.

Polar bears in the SBS subpopulation historically spent the entire year on the sea ice hunting for seals, except for a relatively small proportion of adult females that would come ashore during autumn and overwinter to den. However, over the last two decades, the SBS subpopulation has experienced a marked decline in summer sea-ice extent, along with a pronounced lengthening of the open-water season (period of time between sea ice break-up and freeze-up; Stroeve et al. 2014; Stern and Laidre 2016). The dramatic changes in the extent and phenology of sea-ice habitat have coincided with evidence suggesting that use of terrestrial habitat has increased during summer and prior to denning, including in the Action Area. Rode et al., (2015) and Atwood et al. (2016) linked the length of time polar bears spent in these coastal habitats to sea ice dynamics.

The SBS subpopulation had an estimated population size of 900 individuals (Bromaghin et al. 2021) of which, approximately 565 occur in Alaska (95 percent CI: 340–920). This represents a significant reduction from previous estimates of approximately 1,800 in in 1986 (Amstrup et al. 1986) and 1,526 in 2006 (Regehr et al. 2006). However, the population appears to have remained stable from 2010 to 2015 (Atwood et al. 2020).

Polar bears have no natural predators (though cannibalism is known to occur; Stirling et al. 1993); however, their life-history (e.g., late maturity, small litter size, prolonged breeding interval) is conducive to low intrinsic population growth. The lifespan of wild polar bears is approximately 25 years (Rode and Stirling 2018). Females reach sexual maturity at 3-6 years old giving birth one year later (Ramsay and Stirling 1988). In the SBS region, females typically give birth at five years old (Lentfer & Hensel 1980). On average, females produce litters of 1.3-2.3 cubs (Derocher 1999) at intervals that vary from one to three or more years depending on cub survival (Ramsay and Stirling 1988) and foraging conditions. For example, when foraging conditions are unfavorable, polar bears may delay reproduction in favor of survival (Derocher and Stirling 1996; Eberhardt 2002). The determining factor for growth of polar bear subpopulations is adult female survival (Eberhardt 1990). In general, rates above 90 percent are essential to sustain polar bear subpopulations (Amstrup and Durner 1995) given low cub litter survival, which was estimated at fifty percent (90 percent CI: 33-67 percent) for the SBS subpopulation from 2001-2006 (Regehr et al. 2010). In the SBS, the probability that adult females will survive and produce cubs-of-the-year is negatively correlated with ice-free periods over the continental shelf (Regehr et al. 2007a). In general, survival of cubs-of-the-year is positively related to the weight of the mother and their own weight (Derocher and Stirling 1996; Stirling et al. 1999).

Females without dependent cubs typically breed in the spring (Amstrup 2003, Stirling et al. 2016). Pregnant females enter maternity dens between October and December (Durner et al. 2001; Amstrup 2003), and young are usually born between early December and early January (Van de Velde et al. 2003). Only pregnant females den for an extended period during the winter (Rode et al. 2018). Other polar bears may excavate temporary dens to escape harsh winter conditions, however shelter denning is rare for Alaskan polar bear subpopulations (Olson et al. 2017).

Typically, SBS females emerge from the den with their cubs around March (mean emergence: March 1 ± 2.1 days, Rode et al. 2018), and commonly begin weaning when cubs are approximately 2.3-2.5 years old (Ramsay and Stirling 1988, Arnould and Ramsay 1994, Amstrup 2003, Rode et al. 2020). Cubs are born blind, with limited fat reserves and are only able to walk after 60-70 days (Blix and Lentfer 1979; Kenny and Bickel 2005), thus if the mother moves young cubs from the den before they can walk or withstand the cold, risk of cub mortality increases (Hansson and Thomassen 1983, Van de Velde 2003, Derocher and Wiig 1999, Amstrup et al. 2006, Lentfer 1975). Therefore, it is thought that successful denning, birthing, and rearing activities require a relatively undisturbed environment.

In the Action Area, the greatest impact to polar bears is loss of sea ice resulting from climate change. Other factors such as subsistence hunting, recreation and research, oil and gas development, and environmental contaminants are also discussed in this section.

Climate change – Global climate change and its effects in the Arctic are likely to have serious consequences for the worldwide population of polar bears and their prey (Amstrup et al. 2007; Amstrup et al. 2008; Hunter et al. 2010; Atwood et al. 2015). The associated reduction of summer Arctic sea ice is expected to be a primary threat to polar bear populations (Stirling and Derocher 2012), and projections indicate continued climate warming at least through the end of this century (IPCC 2013). The Service issued a final Polar Bear Conservation Management Plan (USFWS 2016). In it, the Service reaffirms the 2008 ESA-listing decision, that the decline of sea ice habitat due to changing climate, driven primarily by increasing atmospheric concentrations of greenhouse gases, is the primary threat to polar bears.

Climate change is expected to impact polar bears in a variety of ways. The timing of ice formation and breakup will impact seal distributions and abundance, and, consequently, how efficiently polar bears can hunt seals. Reductions in sea ice are expected to increase the polar bears' energetic costs of traveling, as moving through fragmented sea ice and swimming in open water requires more energy than walking across consolidated sea ice (Cherry et al. 2009; Pagano et al. 2012; Rode et al. 2014). Research has linked declines in summer sea ice to reduced physical condition, growth, and survival of polar bears (Bromaghin et al. 2015).

Habitat loss due to declining Arctic sea ice throughout the polar bear's range has been identified as the primary cause of population decline and is expected to continue for the foreseeable future (73 FR 28212). Amstrup et al. (2007) projected a 42 percent loss of optimal summer polar bear habitat by 2050. They concluded that if current Arctic sea-ice declines continue, polar bears may eventually be excluded from onshore denning habitat in the Polar Basin Divergent Region. Amstrup et al. (2007) projected the SBS subpopulation may be extirpated within the next 45–75 years, if sea-ice declines continue at current rates.

The occurrence of polar bears along the Beaufort Sea coast has increased in recent years (Schliebe et al. 2008) in correlation with the distance of pack ice from the coast at that time of year (i.e., more bears are observed onshore when the leading edge of the ice is further offshore; Schliebe et al. 2006). We expect this trend to continue in the future, and surmise that an increasing number of bears onshore for longer periods of time during the open water season may increase the potential for human-bear conflicts. Additionally, in recent years when sea ice has retreated far from the Beaufort Sea coast, researchers have observed polar bears swimming in open water, far from the nearest sea ice or land, presumably placing them at risk of exhaustion (Durner et al. 2011; Pagano et al. 2012). In the fall of 2004, four drowned polar bears were observed in the Beaufort Sea during a BOEM coastal aerial survey program (Monnett and Gleason 2006).

Schliebe et al. (2008) determined that an average of 4.0 percent of the SBS subpopulation of polar bears was on land in autumn during 2000 to 2005, and that the percentage increased when sea ice was farther from the coast. More recently, Atwood et al. (2016) determined that the percentage of radio-collared adult females coming ashore in summer and fall increased from 5.8 to 20 percent between 2000 and 2014. Over the same period, the mean duration of the open-water season increased by 36 days and the mean length of stay on land by polar bears increased by 31 days (Atwood et al. 2016). While on shore, the distribution of polar bears is largely influenced by the opportunity to feed on the remains of subsistence-harvested bowhead whales. Most polar bears are aggregated at three sites along the coast, Utqiaġvik, Cross Island, and Kaktovik (Rogers et al. 2015; McKinney et al. 2017; Wilson et al. 2017b).

In addition to increased use of land during the open-water season, polar bears in the SBS subpopulation have also increasingly used land for maternal denning. Olson et al. (2017) examined the choice of denning substrate (land compared to sea ice) by adult females between 1985 and 2013 and determined that the frequency of land-based denning increased over time, constituting 34.4 percent of all dens from 1985 to 1995, 54.6 percent from 1996 to 2006, and 55.2 percent from 2007 to 2013. Additionally, the frequency of land denning was directly related to the distance that sea ice retreated from the coast. From 1985 to 1995 and 2007 to 2013, the average distance from the coast to 50 percent sea ice concentration in September (when sea ice extent reaches its annual minimum) increased 351±55 km (218.10±34.17 mi), while the distance to 15 percent sea ice concentration increased by 275±54 km (170.88±33.55 mi). Rode et al. (2018) determined that reproductive success was greater for females occupying land-based dens compared to ice-based dens, which may be an additional factor contributing to the increase in land-based denning. However, this increase in the proportion of dens occurring in the terrestrial environment may increase the potential for disturbance at dens from industrial development and other human activities.

Subsistence harvest – The Inuvialuit-Inupiat Polar Bear Management Agreement, a Native-to-Native agreement, between the Inupiat from Alaska and the Inuvialuit in Canada was created for the SBS stock of polar bears in 1988. The agreement establishes quotas and recommendations concerning protection of denning females, family groups, and methods of harvest.

In 1988, the Inuvialuit-Inupiat Council (Council) established a sustainable harvest quota of 76 bears for the SBS stock. In 2011, the Council reduced the quota to 70 polar bears. The Alaska Native subsistence harvest of polar bears from the SBS population has declined. From 1990 to 1999, an average of 42 bears were taken annually. The annual average decreased in the years 2000-2010 to 21 bears annually, and from 2015-2020, Alaska Natives harvested an average of 11 bears annually. The reason for the decline of harvested polar bears from the SBS population is unknown. Alaska Native subsistence hunters and harvest reports have not indicated a lack of opportunity to hunt polar bears or disruption by Industry activity.

Research – Polar bear research takes place within Action Area. The long-term goal of research programs is to gain information on the ecology and population dynamics of polar bears to help inform management decisions, especially in light of climate change. These activities may cause short-term disturbance and/or minor injuries (e.g., sedation, tissue sampling, marking, etc.) to individual polar bears targeted in survey and capture efforts, and may incidentally disturb other individuals. In rare cases, research efforts may lead to serious injury or death of polar bears. Polar bear research is authorized through Division of Management Authority (DMA) permits issued under the MMPA. These permits include estimates of the maximum number of bears likely to be impacted during the life (typically five years) of the permit.

Tourism – As more polar bears are spending time onshore, there has been an increase in “polar bear viewing” tourism, although very little has likely occurred in the Action Area. The influx of visitors may result in increased anthropogenic disturbance of polar bears (e.g., from humans on foot, ATVs, snow machines, or other vehicles). Although difficult to quantify, these disturbances are usually temporary, which may limit the severity of their impact, although the frequency could increase.

Oil and Gas Development – Oil and gas development and its associated activities such as seismic surveys, gravel mining and road and pad construction, and operation of facilities may impact polar bears within the action area through habitat loss, disturbance, an increase in human-polar bear encounters, and oil and hazardous materials spills (were they to occur). To date, existing facilities within the Action Area include the Kuparuk and Alpine Developments, GMT-1, and GMT-2 (Figure 3.1). With the exception of Oliktok Dock and some Kuparuk infrastructure, these facilities are located > 2 miles from the Beaufort Sea coast and hence their intersection with polar bears is low and their potential impacts have been further mitigated by the implementation of conditions of Letters of Authorization (LOAs) which have been issued to these projects pursuant to the MMPA. Reports from these facilities (required by the LOAs) suggest some minor disturbance of individual polar bears has occurred, but no injury or mortalities have been documented.

Environmental contaminants – Exposure to environmental contaminants may affect polar bear survival or reproduction. Three main types of contaminants in the Arctic are thought to pose the greatest potential threat to polar bears: petroleum hydrocarbons, persistent organic pollutants (POPs), and heavy metals. To date, no large oil spills from oil and gas activities have occurred in marine waters of arctic Alaska.

However, contamination of the Arctic and sub-Arctic regions through long-range transport of pollutants has been recognized for over 30 years (Bowes and Jonkel 1975; Proshutinsky and Johnson 2001; Lie et al. 2003). Arctic ecosystems are particularly sensitive to environmental contamination due to 1) the slower rate of breakdown of POPs including organochlorine compounds (OCs), 2) relatively simple food chains, and 3) the presence of long-lived organisms with low rates of reproduction and high lipid levels that favor bioaccumulation and biomagnification. Consistent patterns between OC and mercury contamination and trophic status have been documented in Arctic marine food webs (Braune et al. 2005), and the highest concentrations of persistent organic pollutants in Arctic marine mammals have been found in seal-eating walruses and polar bears near Svalbard (Norstrom et al. 1988; Muir et al. 1999; Andersen et al. 2001).

However, contaminant concentrations are not presently thought to have population-level effects on most polar bear populations. However, increased exposure to contaminants has the potential to operate in concert with other factors, such as nutritional stress from loss or degradation of sea ice habitat, decreased prey availability and accessibility, or lower recruitment and survival rates. Extended fasting seasons, as a result of sea ice decline will cause polar bears to depend more heavily on their lipid reserves for energy, which can release lipid-soluble contaminants, such as persistent organic pollutants and mercury, into the bloodstream and organ tissues. The increased levels of contaminants in the blood and tissues can affect polar bear health and body condition which has implications for reproductive success and survival (Jenssen et al. 2015). These combined stressors could ultimately have negative population level effects on polar bears.

Baseline of Polar Bear Critical Habitat in the Action Area

The Action Area includes small portions of each of the three polar bear critical habitat units. The proposed Action would primarily occur within terrestrial denning habitat, but, in the event of unexpected circumstances, spilled oil could also reach the sea ice and barrier island critical habitat units. The majority of the MTR would also pass through areas designated as sea ice critical habitat. However, because MTR operations would be limited to open-water periods, there would be no temporal overlap between activities in the MTR and designated sea ice critical habitat.

Habitat loss – Historically, habitat used for terrestrial denning by polar bears in the Action Area has been subject to industry development and/or support infrastructure including Oliktok Dock, and the Mustang, Alpine and Greater Moose's Tooth Developments (Figure 6.1). However, existing anthropogenic infrastructure was exempted from inclusion in critical habitat at the time of designation (75 FR 76086). Therefore, permanent alteration of the physical and biological features of terrestrial denning habitat in the Action Area, since designation in 2010, has been relatively limited, although some new development and expansion of existing industry infrastructure in or adjacent to the Action Area have occurred (e.g., the Mustang and Nanushuk Developments and Nuiqsut Spur Road). The Action Area has also been subject to localized short-term human disturbance from seasonal ice roads, and access by researchers, recreational and subsistence users. At a larger spatial scale, globally distributed pollutants and climate change have diminished the quality of polar bear critical habitat; however, estimating the magnitude of these effects within the Action Area is difficult to assess.

Environmental contaminants – Exposure to environmental contaminants may affect polar bear survival or reproduction, as discussed above in the *Baseline of Polar Bears*. Thus, the presence of contaminants within polar bear critical habitat could affect the conservation value of the habitat.

Petroleum hydrocarbon contamination from oil and gas development has had a limited effect on the environmental baseline of polar bear critical habitat. A single large spill has been reported for the Chukchi and Beaufort seas: in August 1988, 68,000 gallons (1,619 barrels) of heating fuel were spilled by a tanker 3–6 miles north of the barrier islands off Brownlow Point approximately 150 km southeast of the Action Area. However, no large spills from oil and gas activities have occurred in Arctic Alaska. Some small terrestrial spills have occurred, although they have been infrequent, small in number, and thus far, have affected a limited area. Although polar bears in Arctic Alaska and designated polar bear critical habitat in Alaska have unquestionably been affected by exposure to environmental contaminants, at this time we have no reason to believe the critical habitat's ability to support polar bears has been affected.

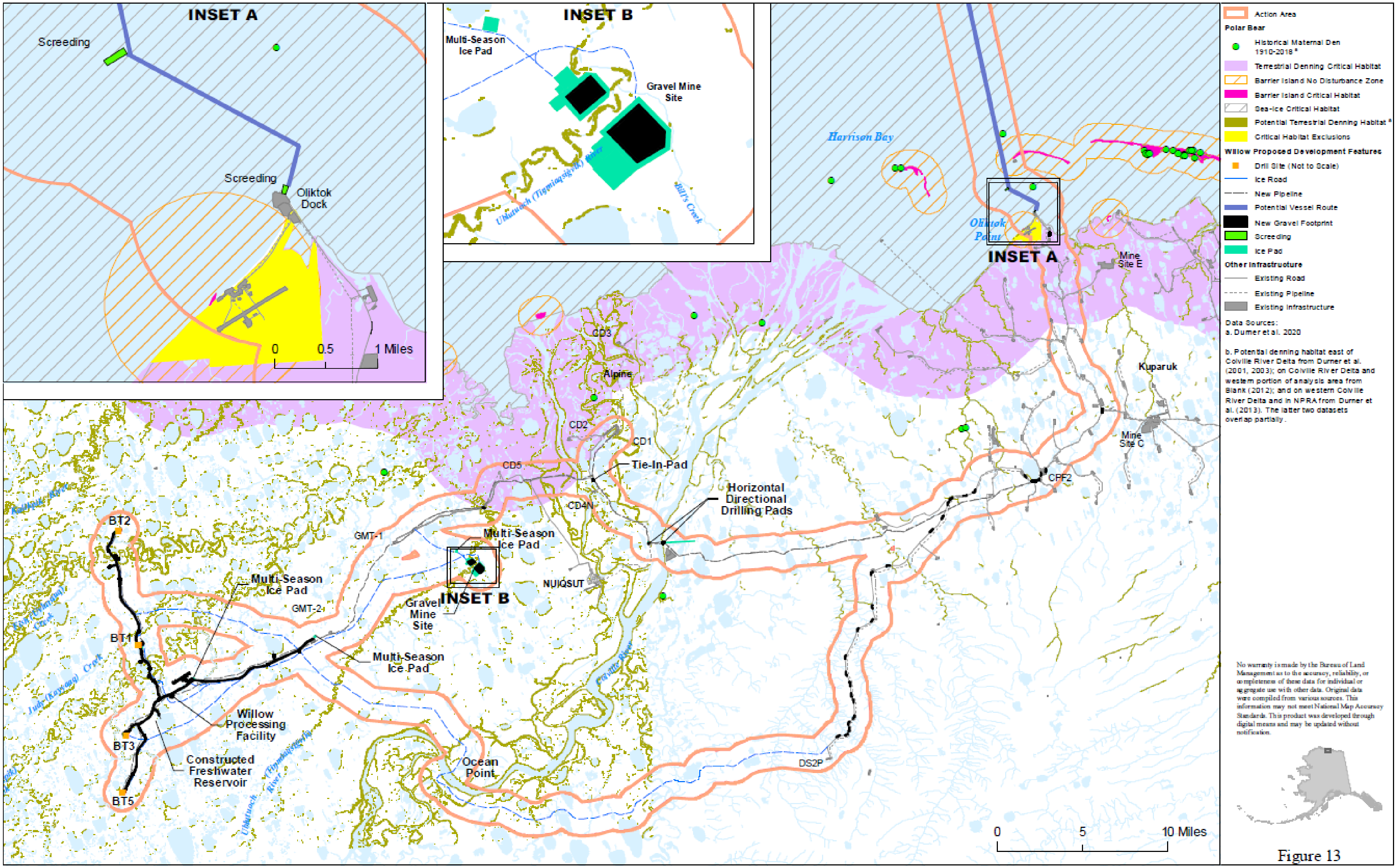


Figure 6.1. Designated polar bear Terrestrial Denning critical habitat (pink), designated Barrier Island critical habitat (fushia with orange buffer and hatch), potential terrestrial denning habitat based on topographic relief (olive green), and historical dens (green points) in relation to the proposed Project, and existing industry developments in the Action Area.

Climate change – Climate change is contributing to the rapid decline of sea ice throughout the Arctic, and some of the largest declines are predicted to occur in the Chukchi and southern Beaufort seas (Durner et al. 2009a). This directly affects the PBFs of the sea ice critical habitat unit, which provide feeding, breeding, denning, and traveling habitat for polar bears. Decreased quality and quantity of sea ice may increase the importance of barrier islands and terrestrial habitat for foraging, denning, and resting. For example, Schliebe et al. (2006) demonstrated an increasing trend in the number of observed polar bears using terrestrial habitats in the fall. Additionally, Fischbach et al. (2007) hypothesized that reduced availability of older, more stable sea ice is contributing to the observed decrease in the proportion of female polar bears denning on sea ice in northern Alaska.

Climate change may also affect the availability and quality of denning habitat on land. Durner et al. (2006) found that 65% of terrestrial dens found in Alaska between 1981 and 2005 were on coastal or island bluffs. These areas are suffering rapid erosion and slope failure as permafrost melts and wave action increases in duration and magnitude. In all areas, dens are constructed in autumn snowdrifts (Durner et al. 2003). Changes in autumn and winter precipitation or wind patterns (Hinzman et al. 2005) could significantly alter the availability and quality of snowdrifts for denning.

7. EFFECTS OF THE ACTION ON LISTED SPECIES

This section of the BO provides an analysis of the effects of the action on listed species and critical habitat. Effects of the action are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action.

Effects to spectacled eiders

We evaluated whether the proposed Project could result in potential adverse effects to spectacled eiders in the terrestrial environment due to long-term habitat loss, disturbance from new infrastructure and on-tundra aircraft landings, increased predators, spills, collisions with structures, and inadvertent harvest. Additionally, we evaluated whether spectacled eiders in the Marine Transit Route (MTR) could be affected by disturbance, spills, and/or collisions with vessels. The likelihood and magnitude of each of these factors is evaluated in more detail below.

Effects of the terrestrial Action Area

Long-term habitat loss (Winter travel) – According to the proposed schedule (BLM 2022a), single-season ice roads and pads to support construction, drilling and operations would be used during the first eight years of the Project. We evaluated whether these could damage tundra vegetation, and indirectly affect nesting habitat for spectacled eiders. Research indicates damage from winter trails occurs on higher, drier sites with little or no damage in wet or moist tundra areas (Pullman et al. 2003) when ice roads or snow trails are used. Jorgenson (1999) found impacts were limited to isolated patches of scuffed high microsites and crushed tussocks. Similarly, Yokel and VerHoef (2014), found disturbance from seismic and ice road activity was greatest in drier, shrubby habitat than in moist habitat. McKendrick (2003) studied several riparian willow areas and found although some branches were damaged, the affected plants survived. Spectacled eiders prefer to nest in low moist tundra areas (Anderson and Cooper 1994, Anderson et al. 2009), and we anticipate limited damage in these habitats from winter routes associated with the proposed Project. Therefore, we do not anticipate significant long-term habitat loss from single-season winter routes and ice pads associated with construction, drilling and operations, and conclude these activities are not likely to adversely affect spectacled eiders.

Long-term habitat loss – Gravel excavation, fill, and MSIPs– Direct, permanent habitat loss would result from the extraction or placement of gravel fill for infrastructure associated with the proposed Project, impacting a total of 543.5 acres (2.20 km^2) of wetlands as follows:

1. Approximately 428.5 acres (1.73 km^2) would be permanently impacted by fill for roads, pads, boat ramps, access roads, the airstrip, Oliktok Road curve widening, and mine site berm construction from overburden;
2. Approximately 115.0 acres (0.47 km^2) would be permanently impacted by excavation of the Tiŋmiaqsiuġvik mine site.

Coupled with permanent gravel fill, construction of the Project would be facilitated by 3 multi-season ice pads (MSIPs) totaling roughly 30 acres (0.12 km^2; BLM 2022a). Each MSIP would be roughly 10-acres (0.04 km^2). One would be constructed near the existing GMT-2 pad, a second would be adjacent to the WOC, and a third would be located adjacent to the Tiŋmiaqsiuġvik mine site for staging equipment and overburden, and a work camp (Figure 3.1; BLM 2022a). These insulated ice pads would be constructed in winter, remain in place over the following summer, to be re-used during the next winter and allowed to melt during breakup of the second summer. The duration of an MSIP at any given location would be no more than 18 months (BLM 2022a).

Although these pads would reduce permanent impacts from gravel fill, quantitative effects to wetland vegetation can be long-term (ABR 2015), but generally are not well documented. For example, early site visits to a former MSIP in place over the summer of 2002 in northern NPR-A, documented mostly dead vegetation inside the former pad footprint, with extensive damage to *Eriophorum vaginatum* (tussock cottongrass), and little regrowth (ABR 2015). Following monitoring and eventual active rehabilitation with fertilizer application in 2010, the site achieved an objective performance standard of ≥ 60% total live vascular cover compared to adjacent reference tundra in 2014, more than a decade after MSIP removal (ABR 2015).

Quantitative monitoring of other former MSIPs on the North Slope has either not been performed or reports are unavailable. Therefore, although limited, ABR's 2015 report is the best available information documenting tundra recovery post-MSIP. While employing MSIPs reduces the need for gravel extraction and permanent fill, and data indicate eventual recovery of vegetation, impacts to affected tundra habitat can be severe and prolonged (ABR 2015). The severity of impacts likely varies with location and vegetative community, and may be reduced by improved

MSIP construction practices. Nonetheless, we adopt a conservative approach in evaluating the impacts of MSIPs on nesting spectacled eiders, and assume each MSIP would render the affected tundra un-suitable for nesting for the life of the Project.

In addition to permanent and longer-term habitat loss from gravel fill and MSIPs, we also anticipate indirect habitat loss via disturbance would occur within a 200 m (656.2 ft.) zone of influence surrounding new development from on-pad activities, road operations, and maintenance activities. The two principal mechanisms through which disturbance can adversely affect eiders on their breeding grounds are:

1. Displacing adults and/or broods from preferred habitats during pre-nesting, nesting, brood rearing, and migration; and
2. Displacing females from nests, exposing eggs or small young to inclement weather and predators.

We also evaluated whether the proposed *Compensatory Mitigation Plan* could result in habitat loss or disturbance to nesting spectacled eiders. Components of the proposed plan within the range of spectacled eiders would be limited to: the *Nuiqsut Subsistence Trail Rehabilitation* and *Culvert Repair* projects (Figure 2.4 andFigure 2.5). These two projects would directly impact 109 acres (0.441 km^2) and 12.3 acres (0.05 km^2), respectively, and indirectly impact (i.e., through the zone of influence) 1,119.6 acres (4.53 km^2) and 155.2 acres (0.47 km^2), respectively (BLM 2022a). However, trail rehabilitation would entail installation of geogrid material along an existing trail alignment and this installation would take place outside the spectacled eider nesting season (June 1 through July 31; BLM 2022a). Because we would not expect eiders to nest within the disturbed area of the existing trail, and project activities would avoid the nesting period (thereby avoiding disturbance to any eiders nesting in adjacent habitat), we would not anticipate direct or indirect effects of the proposed trail rehabilitation on spectacled eiders.

Similarly, the proposed culvert repair project would occur within the footprint of the existing zone of influence for Nuiqsut (Figure 2.4), and work would avoid the nesting period for spectacled eiders (BLM 2022a). Therefore, we expect collective effects of the proposed Compensatory Mitigation Plan on spectacled eiders would be discountable because: (1) project timing would avoid direct disturbance to nesting individuals, and (2) given existing levels of human activity along the trail alignment and in the vicinity of the culvert project in Nuiqsut, additional disturbance of spectacled eiders is not anticipated.

In the discussion below, we provide an assessment of potential loss of spectacled eider production resulting from estimated impacts to nesting habitat from the proposed Project.

Effects to nesting spectacled eiders – Broad-scale aerial surveys conducted in multiple years allow us to estimate how density of listed eiders varies across the landscape. These estimates were developed at a coarse regional scale and are not site- or habitat-specific; however, they reasonably reflect the density of breeding spectacled eiders in the Project Action Area. Observations during aerial surveys of the ACP in 2012–2015 indicate spectacled eider density within the Action Area was low, ranging from 0 to 0.055 spectacled eiders/km^2 (USFWS 2015b), with a mean density of 0.021 spectacled eiders/km^2 across the Action Area as a whole. This estimate was then adjusted for imperfect detection by assuming ~75% of spectacled eiders are seen during aerial surveys (Wilson et al. 2017a), which resulted in an estimated 0.03 spectacled eiders/km^2. Last, assuming one potential nest for every two adults, we divided estimated density by two to convert the estimate to number of pairs or nests/km^2. Applying this process, we estimate an average density of 0.015 spectacled eider pairs or nests/km^2 across the terrestrial portion of the Action Area.

To evaluate impacts to spectacled eiders from an estimated 2.20 km^2 total development footprint for the Project, plus a 200-m zone of influence around new infrastructure, we estimated the total affected area (area of fill + zone of influence) of 69.06 km^2 (17,064.2 acres[4]). We then estimated the density of spectacled eiders within the affected area (which is a subset of the terrestrial Action Area as a whole), adjusted for imperfect detection as described above, and estimate density within the affected area to average 0.03 eiders/km^2, or 0.015 eider pairs or nests/km^2. By multiplying the average annual density of spectacled eider breeding pairs in the Action Area (0.015 eider pairs or nests/km^2) by the size of the total impacted area (69.06 km^2), we estimate a potential loss of 1.04 nests/year, totaling 31 nests over the 30-year life of the project (see below).

$$0.015 \text{ nests/km}^2 \times 69.06 = 1.04 \text{ nests/year}$$
$$1.04 \text{ nests/year} \times 30 \text{ years} = 31.2 \text{ nests over 30 years}$$

Several assumptions are inherent in this process, each of which we believe make this a more protective estimate. These are that:

(1) All pairs within the zone of influence would fail to produce young (i.e., no pairs within the zone of influence would nest successfully, and none would move elsewhere to avoid disturbance and then nest successfully),
(2) All nests within the zone of influence would survive in the absence of Project disturbance (i.e., spectacled eider nest survival elsewhere on the North Slope ranges from 0.20 [95% CI: 0.05–0.42] to 0.62 [95% CI: 0.28–0.83]; Safine 2015b; Graff 2018). Therefore, not all nests would be expected to survive under natural conditions, and,
(3) All failures can be ascribed to effects of the Proposed Action.

Nonetheless, this estimate is consistent with the low density of spectacled eiders in the Action Area and reasonably approximates potential loss of production from habitat loss and disturbance during nesting.

[4] Two of the three planned MSIPs would be subsumed by the zone of influence of adjacent gravel infrastructure (Figure 2.1). However, the MSIP near the Tiŋmiaqsiuġvik mine site would be outside the disturbance area. Therefore, the 0.04-km^2 (10-acre) footprint of this MSIP is added to the estimated affected area, 69.02 km^2 (17,054.2 acres; BLM email 11/29/22), for a collective direct impact area and zone of influence of 69.06 km^2.

Disturbance from aircraft landings and on-tundra activities – Summer aircraft landings and associated ground-based activities (e.g., surveys, stick picking and/or other debris removal) could disturb nesting and brood-rearing spectacled eiders in the Action Area. For example, landing close to a nest would likely flush a female and prevent her from returning for as long as the aircraft and associated human activity remain near the nest, exposing the nest or young to predators or inclement weather. Furthermore, aircraft landings and associated activities may also disturb or fragment hens with broods, although we assume these impacts would be minor (i.e., limited to changes in behavior that would not be biologically significant) and temporary because hens with broods are mobile and could move away from disturbance.

An absence of empirical data makes it difficult to estimate the effect of aircraft landings and tundra-based activities upon nesting and brood-rearing listed eiders. Our estimates are therefore based on a series of assumptions. Landing close to a nest would likely flush the incubating female and prevent her from returning for as long as the aircraft and associated human activity remain near the nest. We assume that all hens within a 600-m radius of a landing site will be flushed, and nests will subsequently be at increased risk of abandonment or depredation. Because the likelihood of a nesting hen flushing, and her reluctance to return to the nest, would presumably decrease as distance from human activity increases, we assume no effects to nesting hens outside of this 600-m radius. We also assume the 600-m radius centered on the landing site would encompass the area affected by associated on-tundra activities, and after landing, project personnel would conduct work over an unspecified area.

Using the assumptions described above, we estimate potential effects of aircraft and human disturbance on eider nest success would occur within a 600-m radius, or 1.13 km^2 area, at each landing site, and multiply this area of impact by the number of summer landings expected annually (maximum 90 [i.e., 82 flights originating from the Project and 8 originating from Alpine]; BLM 2022a). We then use our assumption regarding distance over which take-offs/landings may affect eider nests, combined with estimates of eider density (0.03 spectacled eiders/km^2 or 0.015 nests/km^2), to estimate the number of nests potentially subject to disturbance over the 30-year project life. Finally, because not all nests subjected to disturbance would be expected to fail, we multiply the estimated reduction in nest success by the number of nests potentially disturbed, to estimate the total number of nest failures that could result from aircraft activities Associated with the Project.

Biases in assumptions – Our assumptions in this analysis contain a number of biases, likely contributing to an inflated (i.e., conservative) estimate of loss of production due to disturbance associated with the proposed activities.

1. Our estimate of the number of nests within a 600-m radius (1.13 km^2) of aircraft landing sites, is based on the assumption each listed eider pair sighted during the ACP aerial surveys subsequently nests; however, an unknown proportion of these pairs may not nest. Thus, our initial estimate of nest density may be biased high.
2. The true radius of the zone is unclear and likely varies among sites and individual sensitivity to disturbance. However, we believe the 600-m radius (i.e., 1.2 km diameter) zone of influence around a landing site is conservative (i.e., biased high).

3. The area impacted by helicopter sites may be smaller than the 1.13 km^2 zone of influence used in the effects analysis. We assume the 1.13 km^2 zone of influence includes potential nest disturbance from on-tundra activities beyond the discrete location of the landing site, although this area may be smaller if:
    1. Activities take place within a smaller footprint, or
    2. If multiple landings occur at the same location, reducing the number of landing sites and the overall disturbance footprint.

    Therefore, it is possible that helicopter landings/takeoffs would disturb nesting hens within a much smaller zone of influence Thus, our calculations may overestimate the number of nests potentially disturbed.
4. We base our estimates of the magnitude to which disturbance may decrease nest success on studies in which researchers intentionally flushed eiders from nests, whereas in the proposed action, project personnel would not deliberately flush hens.
5. We are unable to separate activities into those that occur during the nesting, brood-rearing, and post-fledging periods based on the information available to us; therefore, we have assumed that all activities have similar impacts on nest success regardless of timing.

For these reasons, we have likely overestimated impacts of disturbance associated with the proposed activities on nest success. Nonetheless, these estimates are based on the best information available. Our calculations are presented in Appendix A.

Using the approach described above and detailed in Appendix A, we estimate loss of production from a total of nine spectacled eider nests due to disturbance associated with on-tundra aircraft landings over the 30-year life of the project.

Increased predators – As discussed in the *Environmental Baseline* for spectacled eiders, abundance of predators and scavengers has increased near industrial infrastructure to the east of the Action Area. In particular, ravens have expanded their breeding range on the ACP by using manmade structures for nesting and perching. Therefore, as the number of structures and anthropogenic attractants associated with development increase, reproductive success of listed eiders may decrease.

Estimating the effects of predators on spectacled eider production in the Action Area is extremely difficult. We expect structures associated with the Project would increase the number of potential nesting and perching sites for ravens, and increased availability of anthropogenic food sources may also attract predators to the Action Area. However, measures requiring proper waste management and disposal, and methods of discouraging predators from sheltering or building nests at facilities (i.e., ROPs A-1, A-2, and A-8 as detailed in the *Description of the Proposed Action*) would reduce potential increases in predators responding to anthropogenic attractants, and potential subsequent depredation of spectacled eider nests. Therefore, we do not anticipate measurable impacts to spectacled eiders from increased predator populations resulting from the Proposed Action.

Spills – In the terrestrial Action Area, accidental spills of produced water, seawater, produced or refined oil, other petroleum products, or hazardous materials could occur during all phases of the Project originating from the WPF, WOC, airstrip, satellite pads, Tiŋmiaqsiuġvik mine site, terrestrial pipelines, vehicles, and heavy equipment operating in the Action Area. Exposure to oil, petroleum products, or other hazardous substances may impact spectacled eiders in several ways, depending on the volume, location, and timing of a spill, and severity of exposure. For example, waterfowl directly contacting even small amounts of oil may lose the hydrophobic, insulative properties of their feathers and suffer impaired thermoregulation. These birds may become wet, hypothermic, or potentially drown (Jenssen 1994). Birds sublethaly exposed to oil may also suffer reduced reproductive success. Mortality of embryos and nestlings follows exposure to even small amounts of hydrocarbons (light fuel oil, crude oil, or weathered oil) transferred to eggs or ducklings from adults with lightly oiled plumage (Parnell et al. 1984; Hoffman 1990; Szaro et al. 1980; Stubblefield et al. 1995). Furthermore, waterfowl ingesting oil in the course of normal foraging or preening behaviors may experience toxicological effects including gastrointestinal irritation, pneumonia, dehydration, red blood cell damage, impaired osmoregulation, immune system suppression, hormonal imbalance, inhibited reproduction, retarded growth, and abnormal parental behavior (Albers 2003; Briggs et al. 1997; Epply 1992; Fowler et al. 1995; Hartung and Hunt 1966; Peakall et al. 1982). Birds also bioaccumulate hydrocarbons and are vulnerable to both acute and sublethal effects from contaminated food supplies (Albers 2003).

Spills during construction – Both the likelihood and consequences of spills during construction would be avoided and minimized by compliance with BLM's ROPs A-3, A-4, A-5, CPAI's Design Features 56, 60, 88, 91-108, and project-specific *Oil Discharge* Prevention *and Contingency* (ODPCP), Spill Prevention Control and Countermeasures (SPCCP), and Facility Response Plans FRP; BLM 2022a and 2022b).

During the construction phase, BLM expects the likelihood of very small to small terrestrial spills of refine petroleum products (< 10 to < 99.9 gallons) would be low to medium (e.g., during fuel transfers; BLM 2022a). These small spills would be localized, likely of short duration, be quickly contained and remediated, and be limited to infrastructure or tundra immediately adjacent to infrastructure (BLM 2022a). The likelihood of medium to medium-large spills (100 to 9,999.9 gallons e.g., large truck accident) would be very low. A spill of this size would also be expected to be mostly localized, of short duration, and be quickly contained. The likelihood of large spills (10,000 to 100,000 gallons; e.g., complete loss from a bulk tanker) would be very low (BLM 2022b). The spatial extent of a large spill would vary with the season and circumstances, but could affect up to 0.5 acres of adjacent habitat (BLM 2022a). Very large spills (> 100,000 gallons) are not expected to occur during construction (BLM 2022a).

Spills during drilling and operations – During the drilling and operations phases, BLM expects the likelihood of wellhead spills would be low to very low. Although unlikely, the size of a wellhead spill could range from very small to large but would likely be contained within the boundaries of gravel infrastructure (BLM 2022a).

Pipeline spills – Spills from facility piping (i.e., infield and on-pad pipelines) could be very small to very large in size, although the likelihood of spills in these categories ranges from very high to very low, respectively (BLM 2022a). Pipeline spills would be expected to be limited to the inside of piping facilities or be contained within the boundaries of gravel infrastructure (BLM 2022a).

Spills from other pipelines (e.g., production, seawater, and export pipelines) could range from very small to medium-large, and the duration could be very short or prolonged (e.g., days or weeks) depending on the type of spill or location. However, the likelihood of spills from pipelines is expected to be low to very low (BLM 2022a). Very small spills would be localized and quickly contained, although large spills could impact a few acres of adjacent tundra (BLM 2022a). The location and timing of a pipeline spill would also influence the spatial extent of the spill; a larger spill during snow free periods could reach freshwater systems and impact a larger area downstream. For example, a pipeline spill at a stream crossing could reach the channels of Uvlutuuq Creek or Kalikpik River, particularly during periods of flooding. However, if spilled material were to enter freshwater lakes or streams, the relatively low flow and convoluted nature of streams in the area would preclude most spilled material from reaching the Beaufort Sea coast. Furthermore, in the unlikely event of a large spill, staged spill response equipment and pre-deployed containment boom at key stream locations would reduce the duration and extent of a petroleum product spill (BLM 2022a).

Aboveground storage tanks (ASTs) – Due to the volume of ASTs, spills originating from these structures could range from very small to very large, although the likelihood of any spill from an AST would be low to very low (BLM 2022a). Furthermore, due to required secondary containment, in the unlikely event of a complete AST failure, spilled material would be expected to be contained by the secondary containment, or at the worst, within the boundaries of gravel infrastructure, and would not impact adjacent tundra (BLM 2022a). Because the likelihood of AST spills would be low, and secondary containment would prevent spilled material from contaminating adjacent tundra habitat, impacts on spectacled eiders from spills originating from ASTs are not anticipated.

Very large oil spills (VLOS) – Similar to spills during construction, the consequences of spills during drilling and operations would be avoided and minimized by compliance with BLM's ROPs A-3–A-5, CPAI's Design Features 56, 60, 88, 91-108, and appropriate project-specific spill prevention and response plans (e.g., the ODPCP, SPCCP, and FRP; BLM 2022a and 2022b).

The likelihood of a VLOS (e.g., from a shallow-gas or well blowout) would be very low (i.e., approaching zero; BLM 2022a), although an unlikely event, such a spill would have a longer duration compared to other spills and could impact up to 25 acres of surrounding tundra habitat (BLM 2022a). If released oil were to enter adjacent freshwater streams or channels during snow-free periods, the impacts could occur over a broader spatial scale. However, oil from a very large spill such as a blowout would be unlikely to reach Beaufort Sea coast due to the inland location of Project satellite pads and production infrastructure. For example, BT2, the closest satellite pad to the coast, would be approximately 13 miles overland from the coast, 3 miles east of the Kalikpik River and roughly 1 mile west of Iqalliqpik Creek (Figure 3.1). Because freshwater systems in the Action Area are highly convoluted, spilled oil would likely spread slowly, become stranded along streambanks and be recovered (BLM 2022a). Similar to pipeline spills, in the unlikely event of a VLOS, staged spill response equipment and pre-deployed containment boom at key stream locations would reduce the duration and extent of a VLOS (BLM 2022a). Finally, because the likelihood of a VLOS would be very low (approaching zero), we do not anticipate spectacled eiders would be impacted by a VLOS.

Hazardous materials spills – In addition to potential oil and other spills discussed above, spills of hazardous materials could occur during Project drilling and operations. Hazardous materials associated with the Project would include, but not be limited to, biocides (within the seawater system to kill micro-organisms which cause corrosion), corrosion inhibitors, methanol, antifreeze, other glycols, acids, lube oils, used oil, and hydraulic fluids. These materials would be stored inside buildings, or in ASTs within secondary containment.

Hazardous material spills could range from small to medium, and based on historical North Slope industry data, the likelihood of a hazardous material spill occurring during the 30-year project life would be very high (BLM 2022a). However, the volume of potential hazardous materials spills would be expected to be very small (< 10 gallons) and they would be identified and responded to quickly, in compliance with the project-specific Hazardous Substance Contingency Plan (ROP A-3), ODPCP, and SPCCP. Required secondary containment would also be expected to contain a spill to the immediate area, and hazardous materials spills would not be expected to extend beyond gravel or ice infrastructure (BLM 2022a). Therefore, we do not anticipate spectacled eiders would contact, or be effected by hazardous material spills.

Spill effects summary – Small spills would be more likely to occur than medium or large spills, and we expect the majority of small spills would occur on production pads, be confined to a small area, and be remediated quickly, and hence not come into contact with, or affect spectacled eiders. Very large spills are not anticipated, and hence effects to spectacled eiders are not expected from these types of spills. Furthermore, compliance with ROPs A-3, A-4, A-5 (including requirements for immediate response and notification of Federal agencies), CPAI's Design Features 56, 60, 88, 91-108, and project-specific ODPCP, SPCCP, and HSCP, would further avoid or reduce the potential for impacts to spectacled eiders from spills. Although disturbance of spectacled eiders could occur during spill response efforts, this disturbance is expected to be minor (i.e., limited to changes in behavior that would not be biologically significant) and temporary as eiders would be expected to move away to a safe distance.

Given historical North Slope spill data (ADEC 2019), some spills would be likely during the Project despite continued improvements in engineering design and greater emphasis on prevention and response. However, because spectacled eider density in the Action Area is low spills and spills are expected to be uncommon, the likelihood of spectacled eiders encountering spills would be extremely low. Furthermore, because 1) most spills would be low volume, impacts would be localized, and spilled material would be contained and remediated quickly, 2) eiders would likely avoid disturbance associated with areas of active response, and 3) material handling, spill prevention, and response measures required by the BLM through ROPs and respective spill prevention response and contingency plans include numerous measures to minimize impacts to spectacled eiders in the event of a spill; we anticipate measurable impacts of spills on spectacled eiders over the predicted 30-year life of the Project would be discountable.

Collisions with structures – As discussed in the *Environmental Baseline*, migratory birds are at risk from collisions with human-built structures. Spectacled eiders migrating east during spring and west during summer/fall would be at risk of colliding with onshore Project structures. These structures include light poles, buildings, drill rigs, and booms.

Satellite telemetry studies from the eastern ACP indicated male spectacled eiders depart the area early in summer and generally remain close to shore, sometimes crossing overland, during westward migration (TERA 2002; see also Petersen et al. 1999). However, we anticipate spectacled eider collision risk with structures from mid-May through late July would be greatly reduced by the visibility of structures during 24 hours of daylight in the project area. When females and juveniles migrate during late summer/fall, decreasing daylight and frequent foggy weather conditions could increase collision risk. Longer nights increase the duration that eiders are vulnerable to collisions with unseen structures and may compound susceptibility to attraction and disorientation from project lighting. However, we expect collision risk with structures would be reduced by the BLM's ROPs E-10 and E-20, which include lighting plans that would shield outward-radiating light and minimize potential disorienting and attracting effects to eiders, avoidance of overhead lines, and communication tower configurations that would reduce collision risk to the extent practicable (e.g., co-location of towers adjacent to structures and avoidance of guys wires).

There is little empirical information that can be used to assess the frequency and number of collisions of spectacled eiders with oil and gas facilities on the ACP to date. Industry employees occasionally report observations of bird fatalities at facilities, including collisions, but the reported observations have a number of associated biases that prevent their use in numerically estimating collisions. However, of > 500 bird fatalities reported at North Slope oil and gas facilities between 2000 and early 2020, only three pertain to spectacled eiders colliding with oil and gas facilities in the onshore environment. Although multiple biases likely cause observed and reported cases of mortality to underestimate the actual number of mortalities, the limited number of observed spectacled eider fatalities suggests that spectacled eider collisions with onshore oil and gas infrastructure occur rarely.

Overall, we anticipate the likelihood of collisions of spectacled eiders with Project structures would be low because 1) Project structures are located inland from the coast and spectacled eiders occur at low density in the Action Area, 2) good visibility of project structures in late spring and early summer due to extended daylight would likely reduce collision risk, 3) facility lighting would be designed to reduce the potential for attracting or disorienting eiders in flight (BLM ROP E-10), 4) lines for power or communication would be buried or suspended on VSMs, except in rare circumstances where specific conditions are met (BLM ROP E-20) and 5) guy wires on communication towers would be avoided to the extent practicable, and marked with bird flight diverters if they are unavoidable (BLM ROP E-20). Therefore, given the factors described above, we anticipate few (< 4) adult or fledged juvenile spectacled eiders could be killed or injured due to collisions with onshore Project structures over the 30-year life of the Project.

Inadvertent harvest – Because the Project Description includes components meant to improve access to surrounding undeveloped areas (i.e., gravel ramps and rehab of an existing subsistence trail near Nuiqsut; Figure 2.5), we evaluated whether spectacled eiders would be at risk of potential increased harvest during subsistence activities. As discussed in the Environmental Baseline, annual harvest data indicate that at least some spectacled eiders continue to be inadvertently or deliberately taken during subsistence activities on the North Slope, despite local knowledge suggesting spectacled eiders are not specifically targeted for subsistence. Spectacled eiders often fly in mixed flocks with king and common eiders, and due to similarities in size and female/juvenile plumage, they may be subject to misidentification and inadvertent harvest.

Instances of inadvertent harvest would likely be concentrated nearest Nuiqsut and nearby gravel roads (i.e., existing and proposed Industry roads), and we expect the frequency of inadvertent harvest would decline with increasing distance from permanent infrastructure as access becomes more difficult. Furthermore, due to low density of spectacled eiders in the Action Area (0 to 0.055 spectacled eiders/km^2; USFWS 2015), harvest of this species would be very rare. Furthermore, undeveloped areas of the North Slope, including the Action Area, have long been used for subsistence purposes despite the absence of permanent infrastructure granting access, and we anticipate the Action Area will continue to be used for subsistence purposes, at the same or similar frequency, regardless of improved access facilitated by project infrastructure. Therefore, we consider any inadvertent harvest related to the Project would likely be in lieu of, rather than additive to, harvest associated with traditional access points, and for the reasons described above, we do not anticipate an increase in inadvertent harvest associated with enhanced access from Project components.

Effects in the offshore Action Area

Disturbance from vessels – During the Project construction phase, barges and support vessels could encounter spectacled eiders within the MTR (Figure 3.2). However, because 1) spectacled eiders occur at low density throughout the offshore Action Area, 2) few vessels would operate at any given time, including lightering at Oliktok Dock, and 3) because sealift operations are only expected over four years (BLM 2022a); we expect project vessels would encounter very few individuals. We also expect disturbance from sealift operations to be minor (i.e., limited to changes in behavior that would not be biologically significant) and temporary because 1) barges and tugs would move slowly (i.e., < 14 knots [16 mph]) through the MTR, and 2) spectacled eiders can respond to vessel disturbance by moving away to a safe distance. Because disturbance to non-breeding, migrating, or marine foraging spectacled eiders would be so minor that injury or death is not likely, effects of vessel disturbance on these individuals would be insignificant.

Spills – BLM (2022a) expects most spills during sealift operations in the MTR would be very small to small (< 10 to 99.9 gallons), limited to refined products (e.g., diesel fuel that would be expected to quickly degrade), and be localized and of short duration. Due to the low density of spectacled eiders in the MTR, the likelihood of spectacled eiders encountering small spills in the MTR would be very low. Furthermore, given spill prevention and response measures in place we do would not expect spectacled eiders to be impacted by small spills in the MTR.

Although BLM anticipates most spills in the MTR would be very small to small, a medium (100 to 999.9 gallons) to very large spill (> 100,000 gallons) would be conceivable if a tug or barge were to run aground, sink, or have its compartments breached (BLM 2022b). The duration and spatial extent of this type of spill could range from one to several days depending on the location, sea state, and proximity to shore-based response. However, the International Maritime Organization Polar Code is mandatory under the International Convention for SOLAS and MARPOL for ships operating in arctic waters (IMO 2019). Provisions of the Polar Code include standardized safety procedures addressing design, construction, equipment, operational, training, environmental protection standards, and use of designated shipping lanes (IMO 2019). Due to these established marine safety practices, vessel sinking is a rare occurrence. Furthermore, given that all vessels associated with the proposed Project would follow established shipping routes, which greatly reduces the chance of running aground or sinking, the likelihood of such an accident would be very low (BLM 2022a). Furthermore, given that the duration and frequency of vessel traffic in the MTR would be limited (i.e., sealift operations would take place during a 4-year subset of the construction phase; BLM 2022a), the likelihood of a medium to very large spill in the marine environment effecting spectacled eiders would be discountable.

Collisions with vessels – Spectacled eiders would also be at risk of colliding with vessels in the MTR (Figure 3.2). Using the best available information, we estimated collision risk for spectacled eiders from barge and support traffic. We used king and common eiders as surrogates for spectacled eiders due to their greater abundance, using observations of vessel collisions collected by biological observers in a structured monitoring and reporting effort. To do that, we used observed collisions of king and common eiders with vessels in the Chukchi Sea. We first calculated a *per capita* risk of collision per vessel operating during a single season in the Chukchi Sea, based on collisions during Royal Dutch Shell's (Shell) 2012 Exploratory Program, and the estimated number of eiders migrating through the region. We then multiplied the estimated *per capita* collision rate (collisions per eider per vessel per season) by the estimated abundance of spectacled eiders, based on estimates from aerial surveys on the Arctic Coastal Plain. We then approximated the number of collisions expected for spectacled eiders from approximately 365 total vessel trips[5] through the MTR. Finally, because project vessels could theoretically operate over a longer period each season than the duration of Shell's 2012 open-water campaign, we adjusted the calculations to estimate collisions over an extended operations period. A typical open-water season in Arctic waters is approximately 150 days. We expect the proposed barging operations would be of shorter duration (likely much shorter) than the length of a typical open-water season, but the timing of barge operations would be difficult to estimate

[5] The applicant estimates a total of 30 barges and 50 ocean-going tugs would operate in the MTR within the range of spectacled eiders during 4 years of sea lift operations during construction. Additionally, 365 support vessel trips (e.g., support vessels, screeding barges, etc.) would take place near Oliktok Dock. Therefore, spectacled eider collision risk is estimated to be:

30 barges + 50 ocean-going tugs + 285 Oliktok support vessels = collision exposure from 365 vessel trips

precisely due to several factors including seasonal variation in sea ice conditions and marine forecasts. Therefore, lacking greater certainty in project timing, we conservatively extrapolated our estimate to cover a full open-water season. We believe this significantly overestimates the number of days that vessels would be underway and present in waters where spectacled eiders occur, and therefore represents a substantial overestimation of collision risk to spectacled eiders. Our calculations are presented in Appendix A.

Using the approach described above and detailed in Appendix A, we roughly estimate seven adult or fledged juvenile spectacled eiders would be injured or killed through collisions with vessels. While acknowledging the limitations of applying observations from vessels operating in one area to vessels that differ in size and structure operating in different areas, our estimates are based on the best information available, and we believe are likely to substantially overestimate collision risk.

Summary – In summary, appreciable adverse effects to spectacled eiders from increased predator populations, spills, and inadvertent harvest are not anticipated. However, adverse effects to spectacled eiders could occur through habitat loss and disturbance, including on-tundra activities, and collisions with Project structures and vessels resulting from the Proposed Action. Over the 30-year project, we estimate:

1. Loss of production from 31 nests due to long-term habitat loss and associated disturbance;
2. Loss of production from 9 nests due to on-tundra activities; and
3. Loss of 11 adult or fledged juvenile spectacled eiders injured or killed from collisions attributed to the Proposed Action, including 4 due to collisions with structures and 7 due to collisions with vessels.

As described above, the estimated loss of production from habitat loss and disturbance, including on-tundra activities, is predicated on a number of assumptions, including: (1) all pairs sighted during the ACP aerial surveys subsequently nest, (2) all pairs within the zone of influence would fail to produce young, (3) all nests within the zone of influence would survive in the absence of Project disturbance, (4) all failures could be ascribed to effects of the Proposed Action. Nonetheless, these estimates are consistent with the low density of spectacled eiders in the Action Area and reasonably approximate potential loss of production from the Proposed Action. Because the most recent population estimate for North Slope-breeding spectacled eiders is 6,401 eiders (95% CRI = 3,766–9,750; Dunham et. al. 2021), we would not anticipate population-level effects from loss of production of 40 spectacled eider nests and 11 adult or fledged juvenile spectacled eiders over the 30-year life of the proposed Project.

Effects to spectacled eider critical habitat

The Service designated critical habitat for spectacled eiders on March 8, 2001 (66 FR 9145). Terrestrial critical habitat occurs on the YK-Delta and marine critical habitat occurs in eastern Norton Sound, Ledyard Bay (both are molting areas), and south of Saint Lawrence Island (wintering habitat). We anticipate sealift operations associated with the proposed Project would have no effect on terrestrial critical habitat for spectacled eiders.

Although barges and tugs associated with the Project would follow established MTRs that ordinarily avoid critical habitat (BLM 2022a), because the MTR passes adjacent to LBCHU, barges or tugs could conceivably enter this unit during inclement weather or other emergencies. However, we expect these instances would be rare. Primary constituent elements (PCEs) of eastern Norton Sound and LBCHU include marine waters greater than 5 m (16.4 ft) and less than or equal to 25 m (82.0 ft) in depth at mean lower low water (MLLW), along with associated marine aquatic flora and fauna in the water column, and the underlying marine benthic community.

We do not anticipate a few vessels rarely passing through the LBCHU would affect the physical or biological features for which critical habitat was designated. Last, given the size of LBCHU and the expected rarity of vessels passing through, we do not anticipate vessel traffic associated with the proposed Project would appreciably affect spectacled eider access to, or use of, LBCHU such that the function and conservation value of the LBCHU for spectacled eiders would be reduced.

Accidental spills during sealift operations would likely be limited to small spills originating from fuel transfers in the vicinities of Dutch Harbor and Oliktok Dock. Wintering habitat south of St. Lawrence Island, the nearest critical habitat unit to Dutch Harbor, is 800 km away. Furthermore, sealift operations would not take place from October through April when the wintering area is used by spectacled eiders (BLM 2022a). Therefore, it is extremely unlikely that any oil from re-fueling spills would be carried into designated critical habitat, and we do not anticipate adverse impacts to spectacled eider critical habitat from small spills. Although conceivable, larger spills from vessels operating in the MTR would be extremely unlikely and are therefore discountable.

Because 1) impacts to terrestrial critical habitat from the Proposed Action are not expected, 2) impacts to the physical and biological features of the LBCHU are not expected from rare incursions by vessels *en route* to Oliktok Dock, 3) disturbance to eiders within designated marine critical habitat is expected to be infrequent and limited to minor short-term disturbance, and 4) due to geographic and temporal separation, impacts from spills during refueling of vessels are not anticipated; collective impacts to spectacled eider critical habitat from the Proposed Action are expected to be insignificant.

Effects to Polar Bears

In this section we evaluate potential effects of the proposed action to polar bears. First, we review what is known of polar bear use in the Action Area. We evaluate use by non-denning bears and denning bears because these types of use occur at different times of the year, involve different members of the population; and because denning polar bears are more sensitive to disturbance, and less capable of moving away from disturbance or other impacts. We then review factors that would serve to influence potential impacts, including relevant protective measures built into the proposed action. Last, we identify and discuss the potential mechanisms of impact to polar bears, which include disturbance, human-polar bear interactions, impacts to polar bear prey, possible changes in subsistence practices prompted by increased access for hunters and exposure to spilled oil or other contaminants.

Polar Bear use of the North Slope of Alaska

Maternal Denning Bears

Polar bears breed on sea ice from March to June, peaking in early April through mid-May (Schliebe et al. 2006). Pregnant females later move from areas and habitats occupied in late summer and autumn, which are generally on pack ice but increasingly on shore as sea ice conditions in late summer deteriorate (Rode et al. 2015), to prospect for den sites in suitable denning habitat in late October or early November (Derocher et al. 2004). Females excavate a den in drifted snow in fall or early winter (Amstrup and Gardner 1994), enter the den in late November, give birth in late December, and emerge in late March or April (Ramsay and Stirling 1988). After emerging from dens, most females with cubs remain near dens (within 100 m; Smith et al. 2007) for several days [range 1 – 18 days (Streever and Bishop 2014); mean 6 – 8 days (Smith et al. 2007)] before permanently abandoning the den site.

Polar bears from the SBS subpopulation den on Alaska's Arctic Coastal Plain (Durner et al. 2013), drifting pack ice, shorefast ice, and land (Amstrup and Gardner 1994). Terrestrial dens can occur on barrier islands, along the coast, or inland. Key characteristics of maternal denning habitat are surface anomalies or topographic features that collect drifting snow in autumn and early winter, as dens require snow accumulations at least 2.0 m deep (Liston et al. 2015). Durner et al. (2003) found that 69 percent of dens in terrestrial habitat in Alaska were on coastal banks, however dens also occur on barrier islands and on the lee side of coastal bluffs and banks lining rivers, streams or lakes (Amstrup and Gardner 1994; Durner et al. 2001, 2003, 2006; Fischbach et al. 2007; summarized by USFWS 2010b and USFWS 2016).

Historical records of polar bear den sites provide insight on the characteristics of suitable denning habitat, the distribution and extent of suitable habitat, the distribution of known den sites, and occurrence of dens in the Action Area. Durner et al. (2001; 2003) identified characteristic habitat features of terrestrial maternal den sites and Durner et al. (2013) used automated interpretation of fine-grain elevation data to map suitable denning habitat across the North Slope. Although terrestrial habitat with features suitable for denning is broadly distributed on the Arctic Coastal Plain, it is also relatively scarce. For example, in NPR-A, habitat with features suitable for denning comprises roughly 0.1 percent of the total area (Durner et al. 2013). Further, although seemingly suitable habitat is broadly distributed, most dens west of the Kavik River, including NPR-A, have occurred near the coast. Of 19 dens between the Kavik River and Utqiaġvik prior to 2009, all were within 5 miles of the coast and 95% were within 2.8 miles of the coast (with historical den sites west of Utqiaġvik too few in number to examine for spatial relationships; Durner et al. 2009b).

Records of polar bear den sites include dens found by several means, including targeted den searches, dens found incidentally during other human activities, and radio tracking of collared female polar bears. Because targeted den searches and incidental observations can overemphasize den sites near villages or industrial sites while underemphasizing dens in more remote areas, dens found by tracking females wearing radio collars, particularly those tracked by satellites, reduce or avoid this bias. Based on den locations of females with radio collars, Figure 7.1 illustrates the variation in density of terrestrial den sites across the North Slope.

Recent observations indicate the distribution of maternal dens in the Beaufort Sea region is shifting from sea ice to onshore areas, and from west to east on sea ice, in response to decreasing quality and stability of sea ice as arctic regions warm (Fischbach et al. 2007). As these trends continue, it may become increasingly difficult for females to access terrestrial denning habitat in autumn and early winter as the distance between pack ice and coastal areas increases (Derocher et al. 2004; USFWS 2016; Olson et al. 2017). Continuing changes in sea ice may likely affect the future distribution of dens (Derocher et al. 2004; Rode et al. 2015; USFWS 2016a).

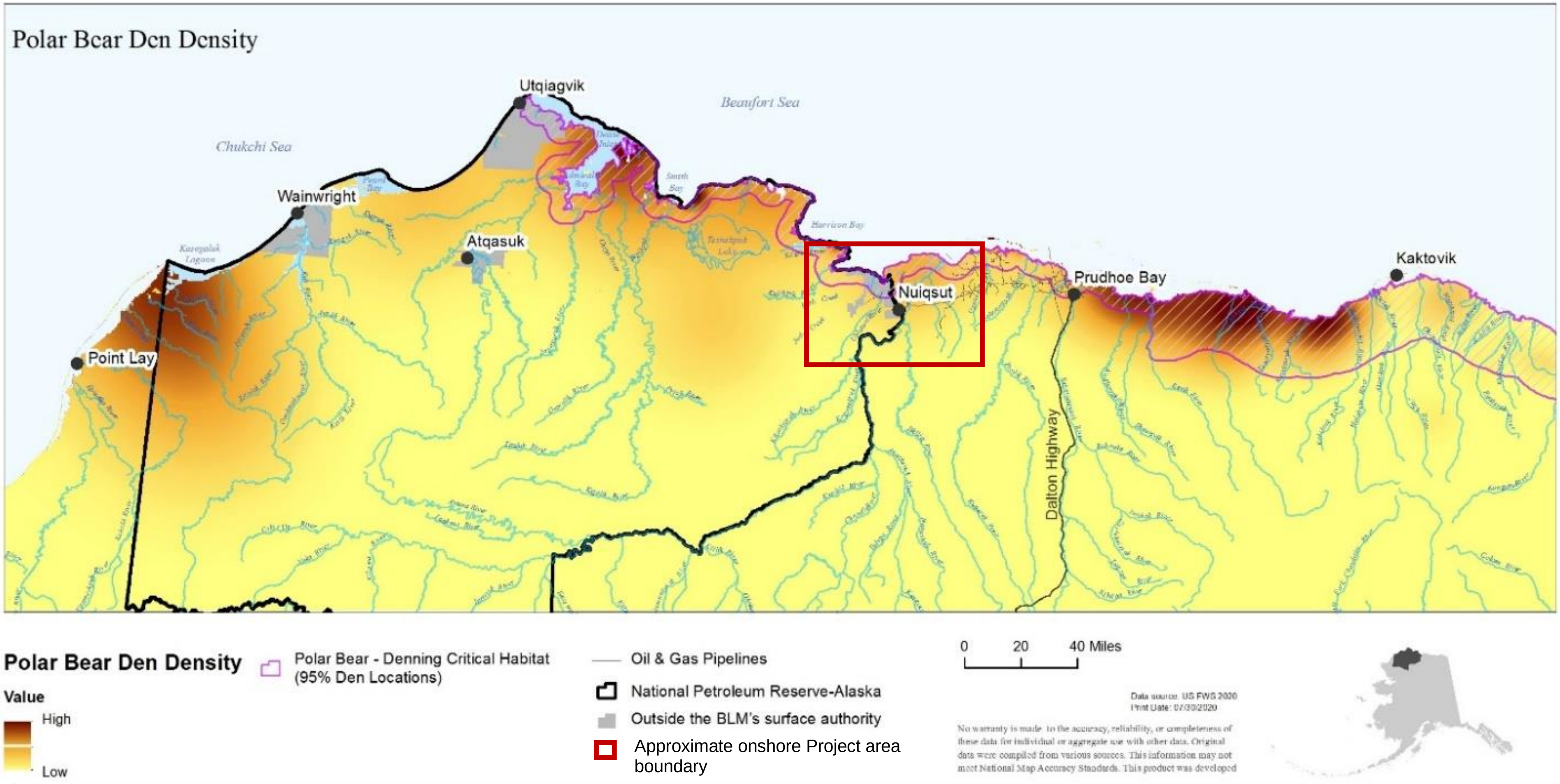


Figure 7.1. Relative density of polar bear maternal dens on the North Slope of Alaska. (Map is a density kernel map developed by Service and U.S. Geologic Survey scientists using Program R [R Core Development Team 2022] based on 33 den locations discovered by tracking VHF-radio telemetry and GPS collared females [den sites from Durner et al. 2010; G. Durner unpublished data] with land management and critical habitat boundaries added by BLM GIS specialists).

Non-denning polar bears

Polar bears of the SBS subpopulation historically spent most of the year on sea ice (Amstrup 2000; Atwood et al. 2016). Amstrup (2000) noted that for the Chukchi and Beaufort sea areas of Alaska and northwest Canada less than 10 percent of radio relocations were on land, the majority of which were females occupying maternal dens during winter. However, polar bears also use terrestrial habitat on the ACP during late summer and fall, particularly where and when sea ice conditions are poor. Schliebe et al. (2008) reporting on weekly aerial surveys of the coast between Utqiaġvik and the Canada border in September – October of 2000 – 2005, reported an average of 4 (± 2) bears/100 km, with a maximum of 8.6 bears/100 km and a maximum total of 122 polar bears observed. Relative to estimates of the number in the SBS subpopulation at that time, Schliebe et al. (2008) estimated that represented an average of 3.7 percent and maximum of 8 percent of polar bears in the SBS subpopulation occurred along the coast of Alaska in late summer and autumn. Density was over six times higher in areas where subsistence-hunted whale carcasses were available, with the highest number (69% of total bears onshore) on Barter Island near Kaktovik, Cross Island and near Utqiaġvik, at the northern boundary of NPR-A (Schliebe et al. 2008). The highest densities were seen at Barter Island (17.0 ± 6.0 polar bears/100 km), with lower densities seen near Utqiaġvik (2.2 ±1.8 polar bears/ 100 km) and Cross Island (2.0 ± 1.8/100 km). Herreman and Peacock (2013) used genetic mark-recapture methods near Utqiaġvik to document use, turnover, and the number, age, and sex of polar bears visiting carcasses, and estimated that 228 individual bears fed at the bone pile in the winter of 2010 – 2011 (November to February), possibly representing up to 15 percent or more of the SBS subpopulation. Atwood et al. 2016, using radio telemetry data from autumn (just prior to and after subsistence whale hunting in fall), found the greatest percentage of bears near Barter Island (40%), followed by Cross Island (33%), and < 2% were observed in the vicinity of Point Barrow (near Utqiaġvik).

Wilson et al. (2017), analyzed results from the same aerial surveys along the coast as Schliebe et al. (2008), but included later years and a longer interval (2000 – 2014), and reported the mean number of bears onshore was 140 (95% CI 127-157). As in earlier years, polar bears were concentrated near Kaktovik, with 63.8% of observations (95% CI 58.4 – 68.9%) on or adjacent to Barter Island, and 25.1% of observations (95% CI 14.4 – 38.8%) near Cross Island. Bears were more likely to occur in coastal areas with early ice retreat, whale carcasses, and barrier islands. Comparing counts to estimates of population size, Wilson et al. (2017) estimated about 15% of the SBS subpopulation occurred along the Alaska coastline during any given week between late August and late October. There was no trend in the number of bears using the coast, but the highest number occurred in 2012, corresponding to the year with lowest sea ice extent. Atwood et al. (2016) also examined use of the Beaufort Sea coast by polar bears in late summer and fall in the same interval (2000 – 2014) using information from radio-collared female polar bears. They found a marked decline in sea ice during September in the southern Beaufort Sea and the average duration of the open-water season increased by 36 days. Although most individual bears remained on sea ice during summer, the proportion of the population coming ashore tripled, from 5.8 to 20 percent in 15 years (with a high of 37 percent in 2013). Bears that came ashore did so earlier (5 days/decade on average), departed later (7 days/decade on average) and stayed longer (7 days/decade on average), and these changes related to declines in sea ice extent and changes in sea ice phenology. Including radio-tracking information from the late

1990s, when use of terrestrial habitat during open-water season was rare and limited to short intervals, the average time bears stayed on land increased by 31 days (Atwood et al. 2016). Atwood et al. (2016), using radio telemetry data, found an increase in the *proportion* of the SBS subpopulation coming ashore, although Wilson et al. (2017), using counts in the same area in the same time interval, did not detect an increase in the *absolute number* along the shore. Multiple possible explanations exist, but Wilson et al. (2017) concluded that no detectable trend in the number counted comports with an increasingly larger proportion of a subpopulation (as found by Atwood et al. 2016) that was declining in abundance (from approximately 1,500 in 2004 to 900 in 2010, as found by Bromaghin et al. 2015) coming ashore.

Protections Inherent in the Project Description

When evaluating potential effects of the proposed Project on polar bears, we considered measures BLM and CPAI would implement to reduce impacts to polar bears. The Proposed Action is discussed in detail in the Project Description, above, but in summary, the project would extend an all-season gravel road from the existing GMT-2 development southwest to the Action Area (Figure 2.1). The Project would include the Willow Processing Facility, Willow Operations Center, four gravel drill pads, gravel access and infield roads, an airstrip, import and export pipelines, Tiŋmiaqsiuġvik gravel mine site, sealift module delivery via barges, improvements at Oliktok Dock, and an offshore screeding at a barge lightering area.

Modifications from the 2020 Proposed Action

Changes to the 2020 Proposed Action that may reduce impacts to wildlife, including ESA-listed species, would include:

- Removal of the proposed freshwater reservoir. Instead year-round access to four new freshwater lakes would be added as Project water sources, thereby reducing the overall footprint associated with constructing the previously proposed Action.
- Elimination of Drill Site BT4, located within the Teshekpuk Lake Special Area (TLSA).
- Relocation of Drill Site BT2 to a location north of Fish Creek.
- A reduction in the proposed Tiŋmiaqsiuġvik mine site excavation footprint (from approximately 149.3 acres to 119.4 acres), again reducing the overall project footprint.
- An overall reduction in the number of wells, gravel fill volume, gravel fill acreage, gravel road mileage, pipeline mileage, freshwater use, acres of ice infrastructure (e.g., ice roads, ice pads), and traffic (e.g., ground, air, marine).

Project Location

The majority of the Action Area is farther inland than polar bears typically occur, including transient (non-denning) individuals and females prospecting for den sites and/or establishing dens. Apart from activities at and around Oliktok Dock, activities associated with the Proposed Action would occur primarily between approximately 7.8 to 26.0 miles (12.6 to 42.0 km) inland from the Beaufort Sea coast. Furthermore, although terrestrial habitat with features suitable for denning is broadly distributed on the Arctic Coastal Plain, most dens west of the Kavik River, have occurred near the coast. Of 19 dens between the Kavik River and Utqiaġvik prior to 2009, all were within 5 miles of the coast and 95% were within 2.8 miles of the coast (with historical den sites west of Utqiaġvik too few in number to examine for spatial relationships; Durner et al. 2009).

As mentioned above, the majority of the Action Area lies outside the coastal zone where encounters with non-denning bears have historically occurred. The most comprehensive dataset of human–polar bear encounters along the coast of Alaska; records of Industry encounters during activities on the North Slope between 2014 - 2018, indicate the number of polar encounters significantly decreases with distance from the coast (Figure 7.1). Few encounters occur >1.2 miles from the coast (USFWS 2021b) and more encounters occur during the open-water season than the ice season.

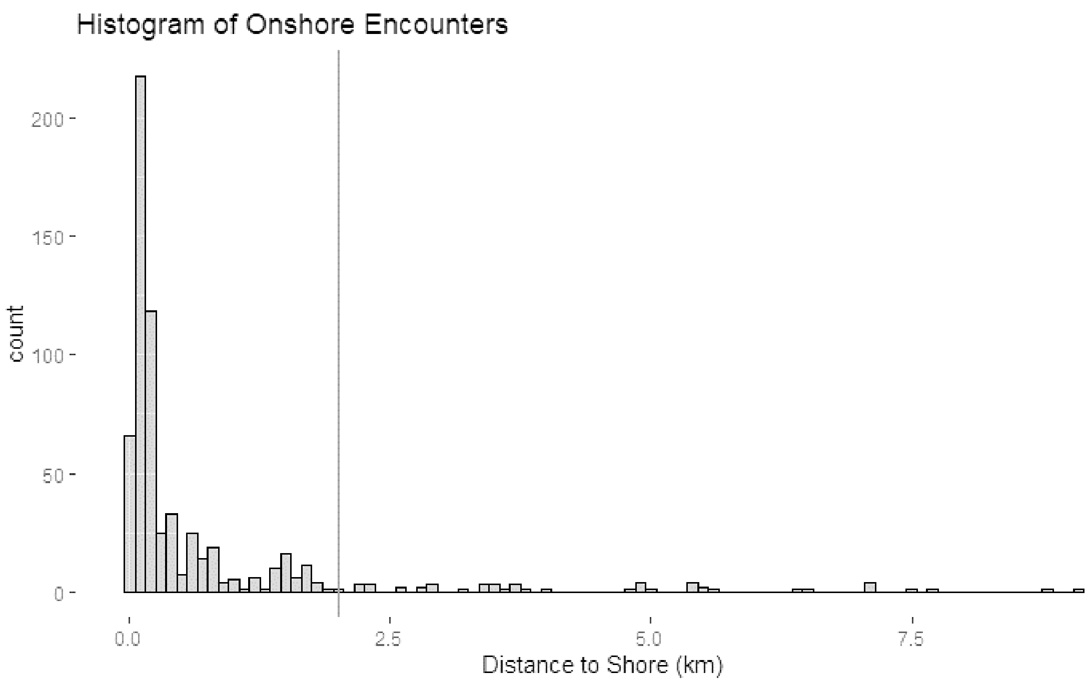


Figure 7.2. Distribution of onshore polar bear encounters on the North Slope of Alaska from 2014 to 2018 by distance to shore (km). The decrease in encounters was used to designate a “coastal” zone up to 2.0 km (1.2 mi) from shore and an “inland” zone greater than 2.0 km (1.2 mi) from shore (USFWS 2021b).

Similarly, the majority of the Action Area lies outside the boundaries of designated polar bear critical habitat, much farther inland than where polar bears typically occur, again with the exception of the facilities at Oliktok Dock and associated vehicle and vessel traffic, as well as portions of barrier islands adjacent to the marine transit route. However, the dock and road existed at the time critical habitat was designated and therefore, this infrastructure was exempted from designation (75 FR 76086). Thus, continued use and minor modifications to these preexisting, exempted facilities does not require evaluation from the standpoint of potential impacts to critical habitat, although we do evaluate these activities in relation to potential impacts to polar bears.

Project Timing
Many of the activities included in the Proposed Action would only occur during a subset of the 30-year project timeline. The Proposed Action can be divided into three phases: Construction, Drilling, and Operations. Activities and therefore disturbance to bears, would vary depending on phase. Timing, location and activity details associated with each of the three phases are outlined in the Project Description above (BLM 2022a).

Activities that would occur near the coast – barging, screeding, module storage and dock improvements around Oliktok, would occur only during the open-water season and there would be no temporal overlap with the denning period. Additionally, these activities would only take place during 4 of the 30 years projected for the Project (summers 2, 3, 4, and 6). Furthermore, these activities would be a small subset of existing operations occurring annually at the Oliktok facility, thereby reducing the potential that any impacts to polar bears in that location would be attributable to the Proposed Action. Meanwhile, the MTR used to barge Project materials from Dutch Harbor to Oliktok Dock would follow an established route, used routinely by North Slope Industry and coastal communities.

Applicant-responsible Minimization Measures
As described above in the Project Description, for the life of the proposed Project, CPAI has committed to following:

1. Measures to Avoid and Minimize Potential Polar Bear Incidental Harassment
2. Measures to Avoid and Minimize Potential Polar Bear Deterrence

These include all the mitigation measures that CPAI would typically be required to implement under MMPA authorizations for both incidental take and take by deterrence (i.e., intentional, non-lethal take). CPAI would implement these measures regardless of current or future MMPA authorization.

Other Applicable Design Features, ROPs, and LSs
CPAI would also adhere to the following Design Features, BLM-required ROPs and LSs, and other Mitigation Measures listed[6] below to reduce project impacts to polar bears and polar bear critical habitat. Further detail about how these provisions would serve to reduce impacts to polar bears in direct relation to project activities, is addressed in the following sections.

- **ROPs A-1–A-5, A-8/Design features 60 and 88:** Address management of wastes and contaminants to minimize impacts to polar bears and reduce human-polar bear interactions.

[6] These descriptions provide a general summary of each provision from the *Biological Assessment for the Willow Master Development Plan (BLM 2022a)*. For a detailed description of each provision, refer to the Project Description section above or reference *BLM 2022a and b*.

- **ROP A-8/Design Features 46 and 60**: Address polar bear interactions; describe how to reduce, react to, and report polar bear interactions.
- **ROPs C-1 and L-1/Design Feature 61**: Address minimization measures aimed to reduce impacts and disturbance to denning polar bears.
- **ROP F-1/Design Feature 45**: Address minimization measures aimed to reduce impacts and disturbance from aircraft to polar bears.
- **ROP M-1/Design Feature 66**: Prohibit vehicle disturbance to polar bears.
- **LS K-6:** Protects summer and winter shoreline habitat for polar bears through coastal setbacks.
- **ROP A-3/Design Features 91, 93, 96, 98, 99–101, 103–106:** Address practices to minimize the generation of hazardous wastes and outlines requirements of hazardous waste contingency plans.
- **ROP A-4/Design Feature 56, 92, 94–97,101, 103, 104, 108:** Address spill prevention and response.
- **ROP A-5/Design Feature 96, 97, 107:** Minimize the potential for impacts of contaminants from refueling operations.
- **ROP A-7:** Minimizes impacts to the environment from discharge of produced fluids.
- **ROP E-4/Design Feature 94, 100, 102**: Address pipeline engineering and operation techniques to best monitor for, and minimize, spills and leaks.
- **ROP E-5/Design Feature 113-115:** Address mechanisms to reduce overall project gravel footprint.

Summary of Protections Inherent in the Project Description that Minimize Effects to Polar Bears
In summary, the likelihood of encountering transient or denning polar bears in most of the Action Area is low due to distance from the coast. Furthermore, a significant reduction in activities after completion of the 8-year construction phase may further reduce the likelihood of encountering transient or denning polar bears in the last 22 years of the project. Additionally, the Proposed Action includes several non-discretionary provisions which would further reduce potential impacts to polar bears. Significant among them is CPAI's commitment to following 1) *Measures to Avoid and Minimize Potential Polar Bear Incidental Harassment*, and 2) *Measures to Avoid and Minimize Potential Polar Bear Deterrence* for the life of the proposed Project. These measures, combined with Project-specific design features, and BLM LSs and ROPs would avoid and/or reduce impacts to polar bears and designated polar bear critical habitat described in further detail below.

Effects of the Proposed Action on Polar Bears

Disturbance
We evaluated whether activities associated with the Project could potentially disturb polar bears, impacting denning and non-denning individuals. Disturbance could originate from human activities from both stationary and mobile sources. Stationary sources could include construction, maintenance, repair, operations at staging pads, production and processing facilities, gas flaring, and drilling operations. Mobile sources could include vessel and aircraft traffic, ice and gravel road construction, mine site development and operations, vehicle traffic,

movement of modules and other equipment to and from staging facilities, drilling, and dredging and screeding. Response to disturbance by denning and non-denning polar bears differs and is therefore evaluated separately below.

Impacts of disturbance to Non-denning Bears
Non-denning polar bear responses would vary by the type, duration, intensity, and location of the source of disturbance. When disturbed by noise, individual polar bears may respond behaviorally (e.g., escape response) or physiologically (e.g., increased heart rate, hormonal response) (Harms et al. 1997; Tempel and Gutierrez 2003). Affected polar bears may move away from the source of disturbance and increase vigilance. Available studies of polar bear behavior indicate that polar bears can be sensitive to noise disturbance based on previous interactions, sex, age and maternal status (Anderson and Aars 2007; Dyck and Baydack 2004). Habituation may also influence individual bear behavior. Possible impacts on transient polar bears exposed to project related disturbance potentially include disruption of normal activities, displacement from foraging and resting areas, and interruption of movement patterns.

Information on the distribution of transient (non-denning) polar bears indicates they generally remain north of the Project area. Similar to denning bears, the probability of transient bear occurrence is highest in the coastal portion of the Action Area (USFWS 2021b), especially at Oliktok Dock. Non-denning polar bears spend the majority of the year on sea ice, although when sea ice retreats in late summer and fall, polar bears occur along the coast and on barrier islands, often congregating where whale carcasses or other food is available (Miller et al. 2006; Schliebe et al. 2008). These bears may be disturbed or temporarily displaced by barges and support vessels during module deliveries, or by screeding activities in the vicinity of Oliktok Dock (Figure 6.*1*, Inset A).

As discussed in the Environmental Baseline, use of terrestrial habitat along the Beaufort Sea coast by non-denning bears is expected to increase in the future as sea ice declines (Atwood et al. 2016; Schliebe et al. 2006 and 2008). However, we would expect polar bear use of terrestrial portions of the Action Area in the future to remain concentrated near the Beaufort Sea coast, an area subject to existing disturbance from human development. Therefore, due to the inland location of the Proposed Action, additional measurable impacts of project-specific disturbance to an increased number of terrestrial non-denning bears are not anticipated.

Vessel disturbance
Vessel traffic in support of the Project would occur during the open-water season (estimated to be 85 days: July 7 through September 30). The project would include 30 barge trips using 50 supporting tugboats between Dutch Harbor and Oliktok Dock and 285 smaller support vessel trips in the Oliktok Dock vicinity. Polar bears regularly cross open water when moving from pack ice to shore, and up to 50% of polar bears encountered during barging activities between Cape Simpson and West Dock from 2005–2007 reacted to barges by moving off ice floes or swimming away (Green and Negri 2005, 2006; Green et al. 2007). Nonetheless, Industry records indicate interactions between polar bears and industry activities in open water have been relatively rare (USFWS - Marine Mammals Management Office, *pers. comm*.). Additionally, Oliktok facilities, as well as the proposed MTR from Dutch Harbor, are used by many other

North Slope operations annually. Hence, polar bears which remain in this small area are presumably exposed to regular disturbance, the Proposed Action would contribute a small subset to existing vessel-based disturbance in the area, and measurable impacts of disturbance to polar bears from Project vessels is not anticipated.

Although unlikely, if an encounter between a vessel and a swimming bear occurs, it would most likely result in a minor disturbance (e.g., the bear may change its direction or temporarily swim faster) as the vessel passes the swimming bear. Additionally, CPAI has committed to *Measures to Avoid and Minimize Potential Polar Bear Incidental Harassment* (described above in the Proposed Action and BLM 2022a and 2022b), which include the following measures directed to reduce impacts to polar bears from vessel disturbance:

- Operational and support vessels must be staffed with dedicated marine mammal observers to alert crew of the presence of polar bears and initiate adaptive mitigation responses.
- Vessel operators will maintain the maximum distance possible and take every precaution to avoid harassment of concentrations of polar bears. Vessels will reduce speed and maintain a minimum 0.5-mile (805-m) operation exclusion zone around polar bears observed on ice.
- Vessels must avoid areas of active or anticipated polar bear subsistence hunting activity as determined through community consultations.
- The USFWS may require trained marine mammal monitors on the site of the activity or on-board ships, aircraft, icebreakers, or other support vessels or vehicles to monitor the impacts of Industry's activity on polar bears.

Therefore, because 1) the probability of vessel encounters with polar bears in open-water is low, 2) these bears would likely move away from the source of disturbance, resulting in minor (i.e., not biologically significant), temporary changes in behavior with no likelihood of injury, and 3) minimization measures inherent to the Project Description would further avoid and reduce the consequences of disturbance to polar bears in the event they experience vessel disturbance; we anticipate vessel disturbance to non-denning polar bears would be insignificant.

Aircraft disturbance

Non-denning bears experience increased noise and visual stimuli when planes or helicopters fly above them, both of which may elicit a biologically significant behavioral response. Sound frequencies produced by aircraft would likely fall within the hearing range of polar bears (Nachtigall et al. 2007) and would thus be audible to animals during flyovers or when operating in proximity to polar bears. However, the frequency and level of airborne sounds typically produced by Industry is unlikely to cause temporary or permanent hearing damage unless marine mammals are very close to the sound source (USFWS 2021b) which is not likely to occur.

Observations of polar bears during fall coastal surveys, which flew at much lower altitudes than typical Industry flights indicate the reactions of non-denning polar bears typically varied but was limited to short-term changes in behavior ranging from no reaction to running away. Aircraft activities can impact bears over all seasons; however, during the summer and fall seasons, aircraft have the potential to disturb both individuals and congregations of polar bears. Onshore bears spend the majority of their time resting and limiting their movements on land. Exposure to aircraft traffic could result in changes in behavior, such as going from resting to walking or running, and these changes in behavior could be energetically costly. However, areas where significant numbers of polar bears congregate in the fall are located well outside the Action Area and would not be affected by Project-associated aircraft.

Aircraft traffic (fixed-wing and helicopter) is expected year-round at the WOC airstrip. Approximately 12,053 total fixed-wing aircraft trips and 2,437 total helicopter trips to and from the WOC and existing Alpine airstrip are estimated to occur over the life of the project. Additionally, helicopter operations associated with the proposed Project would take place during summer on undeveloped lands within the Action Area (e.g., stick picking of past season ice road routes). Because stick picking would often take place as part of ice road compliance, these activities would be expected to follow previous seasons ice road routes well inland from the coast (Figure 3.1), thereby avoiding most transient polar bears which occur more frequently much nearer the coast.

To reduce aircraft disturbance to transient polar bears, CPAI has included Design Feature 45 and BLM's ROP F-1, which aim to minimize the effects of low-flying aircraft on wildlife, by limiting the number of takeoffs and landings to support oil and gas operations to the extent possible, prohibiting wildlife hazing with aircraft, and mandating that all aircraft used as part of BLM-authorized activity along the coast and shore fast ice zone shall maintain minimum altitude of 3,000 feet (915 meters) when within 1.0 mile (1.6 km) of all listed marine mammal species.

Furthermore, included in CPAI's *Measures to Avoid and Minimize Potential Polar Bear Incidental Harassment* are the following measures intended to reduce impacts to polar bears from aircraft disturbance:

- Operators of support aircraft should conduct their activities at the maximum distance possible from concentrations of polar bears.
- Aircraft operations will maintain an altitude of 457 m (1,500 feet) within 805 m (0.5 mile) of polar bears observed on ice or land.
- Under no circumstances, other than an emergency, will aircraft operate at an altitude lower than 457 m (1,500 feet) within 805 m (0.5 mile) of polar bears observed on ice or land.
- Helicopters may not hover or circle above such areas or within 805 m (0.5 mile) of such areas. When weather conditions do not allow a 457-m (1,500-feet) flying altitude, such as during severe storms or when cloud cover is low, aircraft may be operated below this altitude. However, when weather conditions necessitate operations of aircraft at altitudes below 457 m (1,500 ft), the operator must avoid areas of known polar bear concentrations and will take precautions to avoid flying directly over or within 805 m (0.5 mile) of these areas.
- Plan all aircraft routes to minimize any potential conflict with active or anticipated polar bear hunting activity as determined through community consultations.

Therefore, although small numbers of non-denning polar bears could be disturbed by aircraft operations associated with the proposed Project, measurable effects or injury would be unlikely because 1) polar bears occur at low density in the Action Area, 2) transient bears can move away from disturbance if necessary, and this level of disturbance is expected to be minor and temporary without the likelihood of injury, 3) most activities requiring summer helicopter operations would take place along winter routes well inland from the coast, and 4) adherence to minimization measures, such as maintaining a flight altitude of 1,500 feet (ROP F-1) would minimize impacts of disturbance to non-denning bears.

Other Project Associated Disturbance
Construction and operation of facilities would produce localized disturbance. Although some disturbance would continue for the life of the project (e.g., routine operations and maintenance activities on gravel pads and roads) we expect the greatest levels of disturbance would take place during the construction phase of the Project. Specifically, winter-based Tiŋmiaqsiuġvik mine blasting activities and pile driving of bridge abutments would be the loudest noise sources during construction, and could disturb transient polar bears.

Disturbance from vehicle use would occur throughout the life of the Project but would also be greatest during the Construction Phase. Ground traffic rates would be highest in winter and spring from Year 1 through Year 10, when there would be up to 150.1 vehicles per hour (assuming traffic is equally distributed over each 24-hour period throughout the season). Vehicle traffic volume would slow substantially from year 11-30, to 3.7 to 9.4 vehicles per hour year-round.

Because the area around Oliktok Dock, including road between DS-2P and Oliktok, and the proposed offshore screeding area, is currently heavily used by existing Industry operators, we do not expect the increased noise and activity associated with the Proposed Action would result in measurable project-specific disturbance to bears transiting these areas.

To reduce project-specific disturbance to transient polar bears, CPAI has included Design Features 46, 60, 66, 81 and BLM's ROPs A-8 and M-1, which aim to avoid and minimize the effects of disturbance to polar bears and prohibit harassment of wildlife with vehicles. Furthermore, CPAI has committed to implement *Measures to Avoid and Minimize Potential Polar Bear Incidental Harassment* (BLM 2022a and 2022b) to further reduce impacts to polar bears from disturbance associated with the proposed Project:

Therefore, although small numbers of non-denning polar bears could be disturbed by activities associated with the proposed Project, project-specific disturbance would not result in injury to these bears because 1) polar bears occur at low density in the Action Area, 2) transient bears can move away from disturbance if necessary, such that disturbance would be limited to short-term changes in behavior that would not be biologically significant, 3) following the construction phase, most activities would take place well inland from the coast where polar bears are less likely to occur, and 4) existing coastal infrastructure most likely to be encountered by polar bears is subject to on-going existing levels of human activities and disturbance, and 5) CPAI's adherence to minimization measures, such as ROPs A-8, M-1 and Design features 46, 60,66, and 81 would minimize impacts of disturbance to non-denning bears.

Impacts of Disturbance to Denning Bears

Proposed Project activities could affect denning polar bears by obstructing or altering movements of pregnant females as they prospect for den sites; by disturbing females at den sites before cubs are born, which could force the female to search for an alternate site; or, by causing premature den or den site abandonment after cubs are born, which could cause the imminent death of cubs or reduced probability of their survival over time.

Various studies have evaluated the effects of anthropogenic disturbance on maternal denning polar bears. Amstrup (1993) reported that 10 of 12 denning polar bears tolerated exposure to a variety of disturbance stimuli near dens with no apparent change in productivity (survival of cubs). Two females denned successfully (produced young) on the south shore of a barrier island within 1.7 mi of an active oil processing facility and others denned successfully after a variety of human disturbances near their dens. Similarly, during winter 2000–2001, two females denned successfully within 1,320 feet and 2,640 feet of remediation activities being conducted on Flaxman Island (MacGillivray et al. 2003). In contrast, Amstrup (1993) found that several females responded to disturbance early in the denning period by moving to other sites, suggesting that females may be more likely to abandon dens in response to disturbance early in the denning period, rather than later. Initiating intensive human activities during the period when female polar bears seek den sites (October–November) would presumably, give them the opportunity to choose sites in less-disturbed locations (Amstrup 1993), at least in areas where oilfield activity occurs consistently throughout the year.

Due to the timing of den initiation and winter activities, dens in undeveloped areas subject to winter activities (e.g., construction and use of ice roads and pads), are likely to be established and occupied before winter Industry activities commence, raising the risk of den disturbance and abandonment. Although disturbance to denning bears can be costly at any stage in the denning process, consequences in early denning can be especially high because of the vulnerability of cubs early in their development (Elowe and Dodge 1989, Amstrup and Gardner 1994, Rode et al. 2018). If a female leaves a den during the early denning period, cub mortality is likely to occur due to a variety of factors including susceptibility to cold temperatures (Blix and Lentfer 1979, Hansson and Thomassen 1983, Van de Velde et al. 2003), predation (Derocher and Wiig 1999, Amstrup et al. 2006) and mobility limitations (Lentfer 1975). If disturbance occurs during late denning, the consequences may be less severe as cubs can potentially survive outside the den after reaching approximately 60 days of age. However, because survival increases with time spent in the den during late denning, and near the den post-emergence, disturbance that contributes to: (1) early emergence during late denning and/or (2) premature post-emergence abandonment of the den site, is likely to have negative impacts on cub survival.

Because proposed activities at Oliktok dock (barging, lightering, and screeding) would be limited to open-water periods, we anticipate impacts to denning polar bears associated with activities at Oliktok Dock would be discountable due to lack of temporal overlap with the denning period.

However, several other aspects of the Project could result in disturbance of denning polar bears (e.g., mine site operations [blasting and excavation], pile driving for bridges, and aircraft operations).

The majority of the Action Area is farther inland than where most polar bear dens occur, with the exception of the coastal area near Oliktok Dock (Figure 6.1). Durner et al. (2009b) reported that in northern Alaska, west of the Kavik River, 95% of all historical confirmed and probable dens occurred within 4.5 km (2.8 mi) of the Beaufort Sea coast. The majority of the proposed Project infrastructure would be greater than 10 km from the coast. For example, BT2, the closest permanent Project infrastructure to the coast would be roughly 21 km inland. The Tiŋmiaqsiuġvik mine site would also be roughly 15 km from the coast, and the mine and associated access ice road would only be utilized over five years during the construction phase (BLM 2022a). Additionally, the proposed WOC landing strip would be approximately 20 miles (32.2 km) inland, and the nearest suitable denning habitat (i.e., topography capable of forming drifted snow), occurs along Judy Creek, roughly 2.6 km (1.6 m) from the airstrip, and outside the zone where denning polar bears would be expected to experience disturbance from WOC aircraft traffic (Figure 6.*1*). The airstrip would also be oriented parallel to, rather than perpendicular, the general course of Judy Creek, such that approaching and departing aircraft would be unlikely to fly within 1,500 ft of denning habitat.

Nonetheless, small numbers of dens have been documented within or just beyond the discrete boundary of the Action Area within the last 100 years; almost all were concentrated in coastal areas, near Oliktok Dock, and nearby barrier islands (Figure 6.*1*). This history suggests that it is possible that one or more polar bears could attempt to den within the Action Area over the 30-year life of the project.

BLM ROP C-1 and Design Feature 61 require den detection surveys prior to initiating winter operations and the establishment of a 1-mile operational exclusion zone around any detected dens[7]. Additionally, as described in *Measures to Avoid and Minimize Potential Polar Bear Incidental Harassment*, CPAI has committed to conduct two aerial infrared (AIR) polar bear den detection surveys of all denning habitat within 1.0 mile (1.6 km) of human activity prior to initiating winter activities. AIR surveys are used to detect body heat emitted by polar bears beneath the snow which is, in turn, used to determine potential den locations. These measures and ROPs reduce the probability of impacts, but AIR surveys do not detect 100% of dens present. Therefore, we evaluated the probability that a den (or family group newly emerged from a den) that was not detected may be exposed to disturbance from the proposed activities.

Using a model which uses den simulations based on habitat and the location of project activities (Wilson and Durner 2020), we derived an estimate of the number of dens that may be disturbed and hence the number of cubs that could experience potential injury or mortality because of this disturbance. A complete description of the methodologies and assumptions used in the analysis, and type and frequency of impacts to polar bears is provided in Appendix B. The referenced model was developed primarily to inform the Service's evaluation of MMPA incidental take

[7] Unless protective measures are approved by the BLM AO and are consistent with the Service's Marine Mammals and ESA programs recommendations

requests (i.e., Incidental Take Regulations and Incidental Harassment Authorizations) and as such the results of this model speak to various forms of "take" as defined under the MMPA as opposed to the ESA. A more detailed explanation of key similarities and differences between MMPA and ESA "take" definitions and a summary of how the Service utilized MMPA-focused modelling results to inform its estimates of anticipated ESA take is provided in the Incidental Take Statement. Here, in the Effects section, the Service focuses on the nature and frequency of estimated impacts rather than the application of various "take" definitions.

Because geographic location of activities, and activity type duration, would vary over the life of the Project, we evaluated potential impacts to denning or post-emergence bears in relation to these factors. During the 8-year construction phase, years 1–4 would have the most activity including: development of the Tiŋmiaqsiuġvik mine site, single and multi-year ice infrastructure, pipeline construction, and construction of permanent gravel infrastructure. Between years 6–8, construction would continue. Additionally, Tiŋmiaqsiuġvik mine operations would be complete by the end of year 7. By the start of year 9, construction would be finished, and the following 21 years would consist of drilling and operation activities on permanent infrastructure, presumably at reduced potential for impact to polar bears.

The model estimated the numbers of denning or post-emergence polar bear cubs that could experience Level A harassment (an MMPA term that encompasses acts with the potential to cause injury or mortality) as a result of disturbance associated with the Proposed Action. During the first eight years of the Project, an estimated median 0.00 (mean = 0.03; 95% CI: 0.00 – 0.00; Table B.2) cubs could experience potential injury or mortality annually. During years 9-30 an estimated median of 0.00 (mean = 0.02; 95% CI: 0.00 – 0.00; Table B.2) cubs could experience potential injury or mortality annually. During the 30-year life of the Project, the model estimated the cumulative median number of cubs that could experience potential injury or mortality at 0.00 (mean = 0.70; 95% CI: 0.00 – 4.00; Table B.2).

The model also estimated the probability of one or more potential injuries or mortalities accruing to polar bear cubs over the 30-year life of the Project. The estimated cumulative probability of > 0 potential injuries or mortalities occurring is 0.30 (i.e., there is a 70% probability of 0 potential injuries or mortalities to denning polar bears over the 30-year life of the Project; Table B.2).

The median numbers (rather than the mean) are in this case most representative of what is anticipated to occur. This is due to the non-normal and heavily skewed distributions reported by the model, as indicated by the marked difference (>50%) between mean and median values. In cases such as this, the median numbers are more reflective of the most common modelling results and thus what can be anticipated to occur. By comparison, the mean numbers are more strongly influenced by outliers associated with a small number of the model's 10,000 iterations, thus less indicative of the most common modelling results, and less representative of what is anticipated to occur.

Finally, as discussed in the Environmental Baseline, use of terrestrial habitat along the Beaufort Sea coast by denning bears is expected to increase in the future as sea ice declines (Olson et al. 2017; Rode et al. 2018). However, similar to transient bears, we would expect denning polar bear use of terrestrial portions of the Action Area in the future to remain concentrated near the Beaufort Sea coast. Therefore, due to the inland location of the vast majority of Project infrastructure and activities (> 10 km from the coast), and the fact that Project-related activities occurring closer to shore would utilize existing infrastructure already subject to disturbance, additional measurable impacts of project-specific disturbance to an increased number of terrestrially denning bears are not anticipated.

Summary of Results

Across all years of the Project, the model estimates: 1) the number of potential injuries or mortalities occurring, and 2) the probability of potential injuries or mortalities occurring. These estimates indicate the annual likelihood of such impacts occurring is extremely low. Likewise, the cumulative mean and median estimates (0.70 and 0.00, respectively) and the cumulative probability (0.30) of potential injuries or mortalities occurring over the life of the Project are also low. The median estimate of 0.00 potential injuries or mortalities best represents the number of potential injuries or mortalities that can be anticipated to occur over the 30-year life of the Project.

Human-Polar Bear Interactions

In addition to potential impacts from disturbance discussed above, the proposed activities could result in potentially harmful interactions between humans and polar bears, specifically: collisions with vehicles on winter routes or gravel roads, collapse of undetected dens caused by winter equipment movements, attraction of bears to facilities or human activities, and deterrence actions, which could result in injury or death of polar bears in defense of human life.

Polar bears are typically distributed in offshore areas associated with multiyear pack ice from mid-November to mid-July. From mid-July to mid-November, polar bears can be found in large numbers and high densities on barrier islands, along the coastline, and in the nearshore waters of the Beaufort Sea, particularly on and around Barter and Cross Islands. This distribution leads to a significantly higher number of human-polar bear encounters on land and at off-shore structures during the open-water period than other times of the year.

Vehicles

Traffic on ice roads (and presumably gravel roads) could pose a collision risk to polar bears. However, polar bears generally occur at low density within most of the trafficked Project area. Furthermore, ROP M-1 and Design Feature 66 specifically address minimizing disturbance and hindrance of wildlife or alteration of wildlife movement from vehicles, and prohibit the harassment of wildlife with vehicles. Additionally, activities are generally tightly regulated in industry developments, including speed limits on in-field thoroughfares. Therefore, although conceivable, we conclude that vehicle-polar bear collisions would be extremely unlikely.

Tracked or low-ground pressure vehicles moving over snow in winter could encounter and collapse undetected dens. Although vehicles used on snow are designed to distribute weight over a larger area, dens in drifted snow would be unlikely to withstand any considerable additional weight. Therefore, if equipment were to encounter an undetected den, the den would likely collapse, resulting in injury or death of the cubs and/or female. The likelihood of one or more such events would be proportional to 1) the density of dens in the Action Area, and 2) the area impacted by winter tundra travel.

However, as described above, denning polar bears occur at very low density in the Action Area. Additionally, all ice road-based activities including Tiŋmiaqsiuġvik mine site operations are located at least 15 km inland, where denning polar bear dens are unlikely to occur. These factors, combined with CPAI's commitment to implement *Measures to Avoid and Minimize Potential Polar Bear Incidental Harassment* (BLM 2022a and 2022b), including den detection surveys and exclusion zones around detected dens (also included in ROP C-1) would minimize the already very low probability of encounters with denning polar bears during winter equipment moves. Therefore, the probability that winter equipment moves would encounter or destroy any polar bear dens is discountable.

Facilities and Human Activities
Facilities and human activities, including industry and non-industry activities (e.g., coastal camps used for research or recreation), occasionally attract polar bears, which may be motivated by hunger or curiosity. Sightings of polar bears at industrial sites in the Beaufort Sea region of Alaska have increased in recent years, consistent with increasing use of coastal habitats as summer sea-ice cover has diminished (Schliebe et al. 2008; USFWS 2008; 76 FR 47010: 3 August 2011; 86 FR 42982; 5 August 2021). As sea-ice cover continues to diminish, the number of encounters between humans and nutritionally stressed bears is expected to increase, raising the likelihood of potentially dangerous encounters (Wilder et al. 2017).

However, to date, the incidence of human/bear encounters and harassment by deterrence (hazing), remains relatively low. From 2010 through 2016, industry reported under Letters of Authorization (LOAs) issued under Incidental Take Regulations (ITRs) that 395 of 2,373 polar bears (16.6 percent) observed near industrial sites in the North Slope oilfields were disturbed either unintentionally or by intentional deterrence (Miller et al. 2018). The percentage of reported intentional deterrence events decreased over time from a high of 39 percent of the bears observed in 2005 to 14 percent during 2010–2014 (81 FR 52276; 5 August 2016). This decrease in deterrence events is attributed to increased polar bear safety and awareness training of industry personnel, as well as ongoing deterrence education, training, and monitoring programs (76 FR 47010: 3 August 2011; 81 FR 52276; 5 August 2016).

Most Industry–polar bear observations occur within 2 km (1.2 mi) of the coastline. Therefore, the inland location of the Proposed Action would reduce the probability of encounters. Encounters in the Action Area would be most likely to occur on and near the coastline as bears move through in late summer and fall (August–October) and as pregnant females search for den locations in autumn and early winter (October–November). In addition, females with dependent young departing in late winter (March–April) may also encounter Project activities on the coast (e.g., moving of sealift modules by road), although these family groups are not likely to be attracted to industrial facilities because of their greater sensitivity to disturbance.

This Proposed Action includes several ROPs which would further decrease the probability of human-polar bear encounters and minimize the risk that rare encounters would adversely affect polar bears. Specifically, ROP A-1 which manages solid waste; A-2 which requires specific management for garbage and putrescible waste; Design Feature 60 and ROPs A-3 through A-7 which govern hazardous materials and fuels all of which could be attractants to polar bears. ROP A-8 specifically addresses human-polar bear conflicts and requires CPAI prepare and implement bear-interaction plans to minimize conflicts between bears and humans. These plans include CPAI's *Polar Bear Avoidance and Interaction Plan* (June 2021; BLM 2022a) which includes measures to:

- Minimize attraction of bears to the drill sites.
- Organize layout of buildings and work sites to minimize human/bear interactions.
- Warn personnel of bears near or on work sites and identify proper procedures to be followed.
- Establish procedures, if authorized, to discourage bears from approaching the worksite.
- Provide contingencies in the event bears do not leave the site or cannot be discouraged by authorized personnel.
- Discuss proper storage and disposal of materials that may be toxic to bears.
- Provide, annually, a systematic record of bears on the work site and in the immediate area.

Furthermore, CPAI will implement *Measures to Avoid and Minimize Potential Polar Bear Incidental Harassment* (BLM 2022a and 2022b), including the following measures requiring site-specific interaction plans which outline the following:

- An approved polar bear safety, awareness, and interaction plan on file with the USFWS and onsite (i.e., CPAI's *Polar Bear Avoidance and Interaction Plan* (June 2021; BLM 2022a). This plan includes:
- The type of activity and where and when the activity will occur (*i.e.,* a plan of operation);
- A food, waste, and other ''bear attractants'' management plan;
- Personnel training policies, procedures, and materials;
- Site-specific polar bear interaction risk evaluation and mitigation measures;
- Polar bear avoidance and encounter procedures; and
- Polar bear observation and reporting procedures.

Despite the protective measures described above, human polar bear interactions associated with the proposed Project and consequences to polar bears from those interactions are possible. Operators on the North Slope, including CPAI, that receive MMPA Intentional Take LOAs are instructed by the Service to only use direct-contact projectiles (i.e., pepper balls, bean bags, or rubber bullets) when other deterrence methods have failed. Thus, the use of these methods during polar bear deterrence away from human activity is extremely rare. On the North Slope from 2014-2018, oil and gas entities reported 1,308 encounters with polar bears. Of these encounters, 112 ended with the bear or bears being hazed. However, the hazing methods used in most of these encounters were limited to vehicle positioning, horns, sirens, and cracker shells (i.e., passive deterrence), resulting in minor behavior response and area avoidance. Only 15 encounters in a five-year period ended in the use of direct-contact projectiles, constituting 13.4% of hazing events, and 1.2% of total encounters. Additionally, provision 7 of CPAI's *Measures to Avoid and Minimize Potential Polar Bear Deterrence* stipulates that when conducting a deterrence activity, project personnel will "Begin with the lowest level of force or intensity that is effective and increase the force or intensity of the technique, or use additional techniques, only as necessary to achieve the desired result," and "Shout at the polar bear before using projectiles or other techniques." Given, 1) records of projectile use by Industry are historically uncommon and 2) the minimization measures described above; we anticipate deterrence of polar bears with projectiles associated with the Proposed Action would be rare.

An analysis of polar bear encounter rates developed for the Beaufort Sea ITRs (86 FR 42982) were 0.005 bears/km^2 per season in the open water season (July 19-November 11) in areas > 2 km from the coast, and 0.004 bears/ km^2 per season in the ice season (November 12-July 18) in areas greater than 2 km from the coast. To calculate the area of impact to polar bears resulting from the proposed Project, we assume bears may be impacted up to 1.6 km (1 mi) from human activity (see 86 FR 42982 for justification). The Project footprint would include ice roads and pads that would not be present in the open water season, leading to a smaller footprint (581 km^2) in the open water season than the ice season (871 km^2). Using an extremely conservative (i.e., worst case) assumption that the entire project footprint would be impacted 24 hours a day, we estimate 3 polar bears would be encountered each year in the open water season, and 4 polar bears would be encountered each year in the ice season. Given the 1.2% rate of direct-contact projectile hazing described above, the vast majority of these bears would not be hazed with projectile contact rounds. However, we anticipate up to 4 bears may be hazed with projectile contact rounds over the 30-year Project life (MMM pers comm). We expect bears hazed with direct-contact projectiles would experience short-term pain and minor injuries such as bruising. It is also conceivable that a small subset of direct-contact hazing incidents could result in more serious injury or death of a bear, however, these incidents have historically been very rare.

Analytical data is limited for assessing the likelihood of this type of event, but between 1992 and 2019, LOAs for polar bear deterrence were issued in 24 out of 28 years and only two lethal takes due to hazing with direct-contact projectiles have occurred, one each in Industry and in North Slope Borough (NSB) bear patrols. The use of direct-contact projectiles has since declined in Industry activities. Additionally, and subsequent to these events, the Service worked with Industry and the NSB to greatly minimize the likelihood of such mistaken use re-occurring. Based on historical incidents, we anticipate the probability that misuse of projectiles could cause severe injury or death of a polar bear to be 0.08 per year (2 ÷ 24 = 0.083; USFWS 2020b). Therefore, because 1) the proposed Project would represent a small subset of North Slope Industry operations, 2) use of direct-contact projectiles has declined over time and we expect that trend to continue, and 3) provisions included in CPAI's *Measures to Avoid and Minimize Potential Polar Bear Deterrence* further reduce the likelihood that direct-contact projectiles would be used, or misused; we do not anticipate hazing of polar bears associated with the proposed Project would result in severe injury or death of any bears.

In addition to infrequent deterrence with direct-contact projectiles, based on historical encounter rates, incidents of passive deterrence would be likely during the Proposed Action. However, polar bear response to these techniques would be limited to minor short-term behavioral response that result in bears leaving the area without the likelihood of injury.

In summary, although we estimate up to 4 bears could be hazed with direct-contact projectiles over the life of the project, given 1) declining use of direct contact projectiles by Industry, 2) proactive measures adopted by CPAI to further minimize encounters with, and impacts to, polar bears, and 3) the low probability of serious injury or death resulting from such incidents; we do not anticipate any serious injury or death resulting from hazing.

Spills of oil and other contaminants and petroleum products

Accidental spills of produced water, seawater, produced or refined oil, other petroleum products, or hazardous materials could occur during all phases of the Project originating from the WPF, WOC, airstrip, satellite pads, Tiŋmiaqsiuġvik mine site, terrestrial pipelines, vehicles, and heavy equipment operating in the Action Area. We evaluated whether spilled contaminants could reach the marine habitat of polar bears (including sea ice) and coastlines (including barrier islands) from vessel spills in marine waters, or spills in terrestrial areas being transported downstream to marine waters. Because these types of spills would be very unlikely (BLM 2022a and 2022b), impacts on polar bears from spills of this nature are unlikely to occur.

Exposure to oil could impact polar bears in several ways, depending on the volume, location, and timing of a spill, and the severity and manner of exposure. Polar bears could make direct contact with spilled oil or ingest it through grooming fouled fur, nursing, ingesting contaminated prey, or inhaling vapors (Engelhardt 1983). Consequences could include irritation to eyes, mouth, and mucus membranes, irritation and damage to respiratory organs from inhalation, kidney and liver damage from ingestion of contaminated prey (Øritsland et al. 1981), loss of ability to thermoregulate, hair loss, anemia, anorexia, increased metabolic rate, elevated skin temperatures, and stress response (Derocher and Stirling 1991; St. Aubin 1990). Exposure could range from short-term, sub-lethal impacts to long-term impacts on health including death, depending on the substances contacted, the magnitude and duration of exposure, and the health of exposed individuals. In addition to consequences from direct contact with spills and other contaminants, polar bears could be subject to disturbance and human-polar bear interactions during spill response activities.

We considered records of polar bears encountering spilled oil or other toxic substances in Alaska to evaluate whether exposure would be possible from the Proposed Action and determined the probability of such an event would be very low. Since 1993, the Service has interacted with the oil and gas industry in northern Alaska to evaluate, regulate, and monitor effects of oil and gas exploration, production, and processing on polar bears. In this interval, large oil spills impacting polar bears have not occurred. One polar bear died in 1988 following exposure to ethylene glycol and dye (Amstrup et al. 1989), and two bears died in 2012 after chemical exposure including Rhodamine B (81 FR 52297). Although this compound is used by the oil and gas industry, it is also used by others on the North Slope, so those events cannot be attributed to Industry (81 FR 52297). Between July 1, 2009, and June 30, 2014, spills averaging about 59,000 gallons per year were reported by industry on the North Slope, with approximately 5.6% of the volume comprised of crude oil (81 FR 52299). None of these spills were documented to have injured or killed polar bears.

Spills during construction – Consequences of spills during construction would be avoided and minimized by compliance with BLM's ROPs A-3–A-5, CPAI's Design Features 56, 60, 88, 91-108, and appropriate project-specific spill prevention and response plans (e.g., the ODPCP, SPCCP, and FRP; BLM 2022a and 2022b). As described in the *Effects to Spectacled Eiders* above, during the construction phase, BLM expects the likelihood of very small to small terrestrial spills of refined petroleum products (< 10 to < 99.9 gallons) would be low to medium (e.g., during fuel transfers; BLM 2022a and 2022b). Small spills would be localized, likely of short duration, and be quickly contained and remediated (BLM 2022a). The likelihood of medium to medium-large spills (100 to 9,999.9 gallons e.g., tanker truck accident) would be very low. A spill of this size would also be expected to be mostly localized, of short duration, and be quickly contained. The likelihood of large spills (10,000 to 100,000 gallons; e.g., complete loss from a bulk tanker) would be very low. The spatial extent of a large spill would vary with the season and circumstances, but could affect up to 0.5 acres of adjacent habitat (BLM 2022a). Very large spills (> 100,000 gallons) during construction would be very unlikely (BLM 2022a). Therefore, impacts on polar bears from very large spills during construction would be discountable.

Spills during drilling and operations – During the drilling and operations phases, BLM expects the likelihood of wellhead spills would be low to very low. Although unlikely, the size of a wellhead spill could range from very small to large but would likely be contained within the boundaries of gravel infrastructure (BLM 2022a).

Pipeline spills – Spills from facility piping (i.e., infield and on-pad pipelines) could be very small to very large in size, although the likelihood of spills in these categories ranges from very high to very low, respectively (BLM 2022a). A very small spill would be expected to be contained within a small area in the immediate vicinity of the spill; however, large spills that go undetected for a period of time could affect an area a few acres in size before the spill is contained (BLM 2022a)

Spills from other pipelines (e.g., production, seawater, and export pipelines) could range from very small to medium large, and the duration could be very short or prolonged (e.g., days or weeks) depending on the type of spill or location. However, the likelihood of spills from pipelines is expected to be low to very low (BLM 2022a). Very small spills would be localized and quickly contained, although large spills could impact a few acres of adjacent tundra (BLM 2022a). The location and timing of a pipeline spill would also influence the spatial extent of the spill; a larger spill during snow free periods could reach freshwater systems and impact a larger area downstream. For example, a pipeline spill at a stream crossing could reach the channels of Uvlutuuq Creek or the Kalikpik River, particularly during periods of flooding. However, if spilled material were to enter freshwater lakes or streams, the relatively low flow and convoluted nature of streams in the area would preclude most spilled material from reaching the Beaufort Sea coast. Furthermore, in the unlikely event of a large spill, staged spill response equipment and pre-deployed containment boom at key stream locations would reduce the duration and extent of a petroleum product spill (BLM 2022a). Finally, because the likelihood of very large pipeline spills would be very low (BLM 2022a), impacts from spills of this nature on polar bears would be discountable.

Aboveground storage tanks (ASTs) – Due to volume of ASTs, spills originating from these structures could range from very small to very large, although the likelihood of any spill from an AST would be low to very low (BLM 2022a). Furthermore, due to required secondary containment, in the unlikely event of a complete AST failure, spilled material would be expected to be contained by the secondary containment, or at the worst, within the boundaries of gravel infrastructure, and would not impact adjacent tundra (BLM 2022a).

Very large oil spills (VLOS) – Similar to spills during construction, the consequences of spills during drilling and operations would be avoided and minimized by compliance with BLM's ROPs A-3–A-5, CPAI's Design Features 56, 60, 88, 91-108, and appropriate project-specific spill prevention and response plans.

The likelihood of a VLOS (e.g., from a shallow-gas or well blowout) would be very low (i.e., approaching zero; BLM 2022a), although an unlikely event, such a spill would have a longer duration compared to other spills and could impact up to 25 acres of surrounding tundra habitat (BLM 2022a). If released oil were to enter adjacent freshwater streams or channels during snow-free periods, the impacts could occur over a broader spatial scale. However, oil from a very large spill such as a blowout would be unlikely to reach Beaufort Sea coast due to the inland location of Project satellite pads and production infrastructure. For example, BT2, the closest satellite pad to the coast, would be approximately 13 miles overland from the coast, 3 miles east of the Kalikpik River and roughly 1 mile west of Iqalliqpik Creek (Figure 3.1). Because freshwater systems in the Action Area are highly convoluted, spilled oil would likely spread slowly, become stranded along streambanks and be recovered. Similar to pipeline spills, in the unlikely event of a VLOS, staged spill response equipment and pre-deployed containment boom at key stream locations would reduce the duration and extent of a VLOS (BLM 2022a). Finally, because the likelihood of a VLOS would be very low, impacts on polar bears from a spill of this nature would be discountable.

Hazardous materials spills – In addition to potential oil and other spills discussed above, spills of hazardous materials could occur during Project drilling and operations. Hazardous materials associated with the proposed Project would include, but not be limited to, biocides (within the seawater system to kill micro-organisms which cause corrosion), corrosion inhibitors, methanol, antifreeze, other glycols, acids, lube oils, used oil, and hydraulic fluids. These materials would be stored inside buildings, or in ASTs within secondary containment.

Hazardous material spills could range from small to medium, and based on historical North Slope industry data, the likelihood of a hazardous material spill occurring during the 30-year project life would be very high (BLM 2022a). However, potential hazardous materials spills would be expected to be very small (< 10 gallons) with localized impacts, and be identified and responded to quickly, in compliance with the project-specific *Hazardous Substance Contingency*

Plan (HSCP; ROP A-3), ODPCP, SPCCP, and FRP. Required secondary containment would also be expected to contain a spill to the immediate area, and hazardous materials spills would not be expected to extend beyond gravel or ice infrastructure (BLM 2022a).

Spills in the MTR – BLM (2022a) expects most spills during sealift operations in the MTR would be very small to small (< 10 to 99.9 gallons), limited to refined products (e.g., diesel fuel that would degrade more quickly than crude oil), and be localized and of short duration. Given spill prevention and response measures in place, the likelihood of small spills in the MTR would be very low to low and these spills would be limited to the vicinities of Dutch Harbor (e.g., during fuel transfers) and Oliktok Dock (e.g., during module delivery).

A medium to very large spill would be conceivable if a tug or barge were to run aground, sink, or have its compartments breached. The duration and spatial extent of this type of spill could range from one to several days depending on the location, sea state, and proximity to shore-based response. However, given that all vessels associated with the Project would follow established shipping routes, the likelihood of such an accident would be very low (BLM 2022a). Furthermore, given that the duration and frequency of vessel traffic in the MTR would be limited (i.e., sealift operations would take place during a 4-year subset of the construction phase), the likelihood of a spill of this nature would be very low. Therefore, impacts on polar bears from a medium to very large spill in the MTR would be discountable.

Impacts to polar bears in the MTR would likely be limited to the vicinity of Oliktok Dock, and bears in this area could conceivably be impacted by small spills during vessel operations and module delivery. However, the BLM has indicated spills during these operations would be uncommon, localized and of short duration (BLM 2022a). Therefore, we anticipate impacts to polar bears from small spills would be minor. Furthermore, because larger spills (>100 gallons) resulting from the limited vessel operations would be extremely unlikely, impacts from large spills on polar bears in the MTR would be discountable.

Throughout the broader Action Area, polar bears generally occur at low density, although an average of 140 polar bears (up to 15% of the SBS subpopulation) occur in late summer and fall along the Beaufort Sea coast between Utqiaġvik and the Canada border. The only areas with significant concentrations occur at or near Kaktovik, Cross Island, and Utqiaġvik, none of which are within or near the Action Area. Therefore, although it is possible some polar bears could be exposed to spilled contaminants, either in terrestrial, freshwater, or marine environments, based on the limited number and low volume of predicted spills, the distance of most potential spill sources from the coast, and BLMs required spill prevention and response measures; the potential for exposure of polar bears to spilled contaminants would be discountable.

Spill effects summary
Due to the low density of polar bears in the Action Area, particularly inland from the coast where most development and activities associated with the Project would take place, we expect the likelihood of polar bears encountering contaminants from terrestrial or marine spills in the Action Area would be low. Small spills would be more likely to occur than medium or large spills, but we expect small spills would occur on production pads, be confined to a small area,

and be remediated quickly. Furthermore, compliance with BLM's ROPs A-3, A-4, A-5 (including requirements for immediate response and notification of Federal agencies), CPAI's Design Features 56, 60, 88, 91-108, and project-specific ODPCP, SPCCP, HSCP, and FRP, would avoid or reduce most impacts to polar bears from potential spills. Although disturbance of polar bears could occur during spill response efforts, this disturbance is expected to be minor (i.e., limited to changes in behavior that would not be biologically significant or entail any likelihood for injury) and temporary as bears would be expected to move away to a safe distance.

Given historical North Slope spill data (ADEC 2019), some spills would be likely during the proposed Project despite continued improvements in engineering design and greater emphasis on prevention and response. However, 1) spills are expected to be uncommon and most would be low volume, 2) polar bear density in the Action Area is low, 3) because most spills would be low volume, impacts would be localized, and spilled material would be contained and remediated quickly, 4) transient polar bears would likely avoid disturbance associated with areas of active response, and 5) material handling, spill prevention, and response measures required by BLM's ROPs, CPAI's Design Features, and respective spill prevention response and contingency plans include numerous measures to minimize impacts to polar bears in the event of a spill. Additionally, a polar bear-specific response plan has been developed to guide response efforts in the event that a spill with potential to affect polar bears does occur. Therefore, we do not anticipate any polar bears would come into contact with spills of oil or other contaminants and we anticipate that collective effects to polar bears from spills (including response efforts) resulting from the Proposed Action would be insignificant.

Effects to Polar Bear Prey Species

The fecundity or survival rates of polar bears could be affected if the Proposed Action affects polar bear prey populations. Polar bears are top predators in the Arctic marine ecosystem, and in marine portions of the Action Area, they prey primarily on ringed, and to a lesser extent, bearded seals, although other food sources, including beach-cast and subsistence-harvested marine mammal carcasses are occasionally important (USFWS 2016). The NMFS manages ringed and bearded seals under the authorities of the MMPA and ESA, and analyzed the effects of BLM's 2022 proposed IAP for NPR-A, which includes the Action Area (NMFS 2022).

In their analysis, NMFS (2022) noted that exposure to vessel noise and small oil spills may occur, but effects to pinnipeds from small spills would not be expected, and that vessel strikes with pinnipeds were extremely unlikely to occur. They described how activities permitted under the 2022 IAP could expose seals to either in-air or in-water noise, depending on where the activity took place and during what season. However, NMFS concluded that the effects of vessel noise are likely to be temporary and transient (NMFS 2022). Therefore, exposure to vessel noise is not likely to reduce the abundance, reproduction rates, or growth rates of the populations of prey species those individuals represent.

The effects of barging, screeding and dock improvements associated with the proposed Project could displace polar bear prey species. Seals may respond to noise associated with such activities or be temporarily displaced from habitat. However, as described above, these disturbances would have minor, short-term, and temporary effects (NMFS 2022) and would not significantly reduce the availability of polar bear prey. Furthermore, because activities at Oliktok Dock would only occur in the summer, there would be no effects on ice habitat for prey species (e.g., pupping lairs, haulouts, or breathing holes).

The best available data on abundance estimates indicates the ringed seal population in the Chukchi and Beaufort seas to be at least 300,000 individuals, while the Beringia DPS of bearded seas is estimated at 155,000 individuals (NMFS 2022). Only an extremely small subset of these populations would be affected by activities which may result from the proposed Project, and as described above NMFS concluded impacts of activities under the 2022 IAP, including the proposed Project, would not be likely to adversely affect listed ringed and bearded seals (NMFS 2022), and hence, we conclude impacts to polar bears would be insignificant.

Effects from Subsistent Harvest

Because the Project Description includes construction of roadway turnouts with ramps aimed to improve subsistence access to surrounding undeveloped areas, polar bears would be subject to potential increased subsistence harvest. However, due to 1) the low density of polar bears in the Action Area, and 2) because the proposed infrastructure, including subsistence ramps and access points, would be directed inland from the coast, where polar bears occur even less frequently; we anticipate potential subsistence harvest of polar bears throughout the Action Area would be low.

Furthermore, given conservation practices afforded through the 1973 Polar Bear Agreement and Inuvialuit-Inupiat Polar Bear Management Agreement, which established quotas and recommendations concerning protection of denning females, family groups, and methods of harvest, we anticipate increased polar bear harvest due to enhanced subsistence access would be unlikely. Therefore, an appreciable increase in polar bear harvest facilitated by subsistence access ramps associated with the Proposed Action is not anticipated.

Effects Summary

We identify five primary mechanisms by which the Proposed Action could affect polar bears: disturbance, human-polar bear interactions, spills of oil, contaminants and other petroleum products, effects to prey species, and effects from subsistence practices. We also identify aspects of the proposed project that would serve to limit potential impacts to polar bears: requirements for den detection surveys prior to initiating winter work, most new infrastructure would be located a significant distance from the coast, and CPAI would follow management plans to minimize human-polar bear interactions and disturbance of dens. Taking these aspects of the Proposed Action into consideration, we expect some polar bears may experience consequences resulting from the Proposed Action. Some transient polar bears would experience incidental disturbance associated with the Proposed Project, but resulting impacts would be limited to minor and short-term behavioral changes, that do not result in a likelihood of injury. Based on the best available information (i.e., den simulation modelling), we find that impacts to denning or post-emergence polar bear cubs are not anticipated or reasonably certain to occur over the 30-year life of the Project (i.e., cumulative probability of 0 MMPA Level A + lethal takes = 70%; Appendix B, Table B.2). Finally, although we do not anticipate measurable effects to transient bears from passive deterrence, we estimate that up to four bears may experience hazing through direct-contact projectiles over the 30-year life of the Project. Although we expect these incidents would be limited to short-term pain and minor injury (e.g., bruising), and changes in behavior, we do not anticipate such incidents would result in serious injury or death of any polar bears.

Effects to Polar Bear Critical Habitat

As described above, critical habitat for polar bears includes three units: Unit 1, Sea Ice Habitat; Unit 2, Terrestrial Denning Habitat; and Unit 3, Barrier Island Habitat (75 FR 76086 – 76137). The Action Area includes 1) a subset of the Terrestrial Denning unit 2) transport of materials on barges within the boundaries of the Sea Ice unit (although during the open water season, when sea ice is likely to be absent or broken), and 3) actions (barge transport) that could affect the Barrier Island unit, in the event of contaminant spills into the marine environment. Therefore, we separately consider the Sea Ice, Terrestrial Denning Habitat, and Barrier Island units. For each unit, we consider potential impacts to the physical and biological features (PBFs) of the habitat that were identified within the designation.

Unit 1, Sea Ice Habitat

The Project Description indicates vessel traffic transporting modules and materials through the MTR to Oliktok Dock would pass through marine waters designated as sea ice critical habitat. Sea ice critical habitat was determined to be: "sea ice that moves or forms over the shallower waters of the continental shelf (300 meters (982.2 feet) or less) and that contains adequate prey resources (primarily ringed and bearded seals) to support polar bears." (75 FR 76112). Sea ice is an essential physical feature for polar bears in the southern Beaufort, Chukchi, and Bering seas for food and physiological requirements (75 FR 76086 – 76137). Because vessel traffic would be limited to the open water season, no direct effects to sea ice would occur, but we identify that the Proposed Action could affect this essential physical feature through two mechanisms: 1) spills of oil or other contaminants into marine waters that form ice, or 2) impacts to ringed and bearded seals, caused by disturbance or spills of oil or other petroleum products.

It is plausible that oil or other spilled petroleum products could be spilled by vessels using the MTR within the boundaries of the sea ice unit during summer, when ice is absent or broken. If spills were incompletely remediated, oil or other petroleum products could contaminate sea ice after freeze in fall/winter. Spilled products could also affect ice seals, which are an identified component of sea ice habitat for polar bears. Last, spills in terrestrial and freshwater fluvial environments could be transported downstream to the marine system. BLM (2022b) expects most spills during sealift operations in the MTR would be very small to small (< 10 to 99.9 gallons), limited to refined products (e.g., diesel fuel, which degrades much faster than crude oil), and be localized and of short duration. Given spill prevention and response measures in place, the likelihood of small spills in the MTR impacting sea ice habitat would be low.

A medium to very large spill would be conceivable if a tug or barge were to run aground, sink, or have its compartments breached. However, given that all vessels associated with the proposed Project would follow established shipping routes, the likelihood of such an accident would be very low. Furthermore, given that the duration and frequency of project-specific vessel traffic through the MTR would be limited to a 4-year subset of the construction phase, the likelihood of a spill of this nature impacting sea ice habitat would be very low.

Several measures included in the Project Description would reduce the likelihood of spills occurring, the magnitude of spills in the event that one or more do occur, and the likelihood of spills in or near wetlands, where they could be transported to the marine environment. To minimize the potential for an inadvertent spill, CPAI would comply with BLM's ROPs A-3‒A-5 (including requirements for prevention, immediate response, and notification of Federal agencies), as well as CPAI's Design Features 56, 60, 88, 91-108, and project-specific ODPCP, SPCCP, HSCP, and FRP which include numerous measures to prevent spills. If a spill should occur, adherence to the measures listed above would decrease the response time for containment and remediation, and thereby avoid or minimize effects of a spill on sea ice critical habitat.

Unit 2, Terrestrial Denning Habitat

Terrestrial Denning Habitat comprises roughly 3,620,558 total acres (14,652 km^2). The Action Area overlaps a very small subset of this total, and the area of overlap is limited to the vicinity of Oliktok Dock and the existing road (Figure 6.1). The dock and road existed at the time critical habitat was designated and are therefore not part of critical habitat. Nonetheless, the surrounding habitat, which was not exempt from designation, would be subject to some level of disturbance from increased vehicle traffic associated with the proposed Project. Additionally, small gravel expansions are proposed for the existing road (i.e., placement of up to 5.1 total acres [0.0204 km^2] of fill for curve widening and increased road thickness), and an extremely small subset of these modifications would overlap designated terrestrial habitat within 8 km of the coast (Figure 6.1). Given that (1) this area is subject to existing levels of disturbance from vehicle traffic and (2) this disturbance would occur within a very small subset of available terrestrial denning habitat, we would expect this disturbance to be insignificant. Additionally, because the gravel expansions would occur within an extremely small subset of terrestrial denning habitat (i.e., > 0.02 km^2 of 14,652 km^2) we would not expect measurable effects to the PBFs of designated terrestrial denning habitat. Therefore, appreciable impacts to designated terrestrial denning critical habitat from the proposed Project are not anticipated.

Unit 3, Barrier Islands

When designating critical habitat for polar bears, the Service identified barrier islands as a "physical feature essential to the conservation of polar bears in the United States." The unit was described as "barrier island habitat used for denning, refuge from human disturbance, and movements along the coast to access maternal den and optimal feeding habitat, which includes all barrier islands along the Alaska coast, and their associated spits, within the range of the polar bear in the United States, and the water, ice, and terrestrial habitat within 1.6 kilometers (1 mile) of these islands (no-disturbance zone)" (75 FR 76086 – 76137).

Based on the description of barrier islands at designation, we consider the physical features of barrier islands to include the physical characteristics of islands, accompanied by refuge from disturbance necessary for denning, resting, and unimpeded movements. In this light, we consider the Proposed Action could affect barrier islands through disturbance, and potential spills of oil or other petroleum products reaching barrier islands.

The Action Area overlaps a small portion of designated barrier island critical habitat (i.e., the 1.6-km disturbance zone associated with the MTR overlaps with a single barrier island; Figure

6.1), and we evaluated whether project-specific vessel disturbance could appreciably diminish the value of barrier island critical habitat for polar bears. Given that 1) vessel presence in proximity to this barrier island would be infrequent and short-term, 2) this portion of the Action Area is an established MTR that experiences continuous vessel traffic during the open water season, 3) project-specific vessel operations would be limited to 4 years during construction, and 4) the affected area is an extremely small proportion of available barrier island critical habitat (approximately 10,575 km^2 total; 75 FR 76086); we expect disturbance within this unit would be minor and temporary, such that the value of barrier island critical habitat as a refuge from disturbance would not be appreciably reduced.

We find that the same factors we used to evaluate the risk of spills affecting the Sea Ice Unit pertain to the risk of spills affecting barrier islands. Several measures included in the Project Description would reduce the likelihood and magnitude of spills in the event that one or more do occur, and the likelihood of spills in or near wetlands, where they could be transported to the marine environment. To minimize the potential for an inadvertent spill, CPAI would comply with BLM's ROPs A-3–A-5 (including requirements for prevention, immediate response, and notification of Federal agencies), as well as CPAI's Design Features 56, 60, 88, 91-108, and project-specific ODPCP, SPCCP, HSCP, and FRP which include numerous measures to prevent spills. If a spill should occur, adherence to the measures listed above would decrease the response time for containment and remediation, and thereby avoid or minimize effects of a spill on barrier island critical habitat.

8. CUMULATIVE EFFECTS

Under the ESA, cumulative effects are the effects of future State or private activities, not including Federal activities, that are reasonably certain to occur within the Action Area considered in this BO (50 CFR §402.02). Effects from future Federal activities (i.e., activities that require Federal approval, funding, permits or other form of authorization) do not constitute cumulative effects for the purposes of this BO, but would be analyzed in separate consultation under the ESA. The subsections below identify types of activities that may occur in the Action Area in the future, and discusses their potential to cause cumulative effects.

Oil and gas activities

Future oil and gas activities, and associated mechanisms of impact (i.e., habitat loss, disturbance, listed eider collision risk, increased predators, human-polar bear interactions etc.), whether in Federal or State waters or in the terrestrial environment on State, private, Native-owned, or Federal lands, would require Federal permits (e.g., project approval by BLM or BOEM, section 404 of the Clean Water Act authorization from the U.S. Army Corps of Engineers [USACE], and National Pollution Discharge Elimination System permits from the Environmental Protection Agency). Therefore, effects from these actions are not considered cumulative effects for the purposes of this Biological Opinion.

Infrastructure expansion

Often, as industry and private sector developments expand so does associated infrastructure (e.g., gravel and ice roads, powerlines, communication towers, landfills, and gravel pits). The scale of potential adverse impacts would depend not only on the amount of growth, but the location as it relates to listed eider nesting habitat or coastal areas frequented by polar bears. Here, the terrestrial Action Area within the range of ESA-listed species is classified as wetlands (https://www.fws.gov/wetlands/data/mapper.html). Therefore, a section 404 permit from the USACE would be necessary for any infrastructure expansion projects. The issuance of these permits would also trigger consultation under the ESA. Smaller private sector projects may not require a Federal permit, but would also likely result in smaller, if any, impact to listed eiders, polar bears, or their habitat. No such projects are proposed for or reasonably certain to occur in the Action Area.

Increased marine traffic

As the extent of Arctic sea ice in the summer has declined, and the duration of ice free periods has increased, interest in shipping within and through arctic waters has increased (Brigham and Ellis 2004). Increased shipping along the Northern Sea Route (part of the Northeast Passage that follows Norway and Russia’s coast down into the Chukchi and Bering seas), and the Northwest Passage (which follows Canada’s eastern coast north along Canada and Alaska’s Beaufort Sea coast) could result in increased fragmentation of sea ice habitat and disturbance/injury to marine mammals, increased human-bear encounters, and the introduction of waste/litter, and toxic pollutants, including spilled oil (PBRS 2015). All of these threats could potentially affect polar bears, listed eiders, and/or designated critical habitat for these species.

The Arctic Council conducted a comprehensive Arctic marine shipping assessment for the Arctic Ocean, focusing on potential impacts of humans and the arctic environment (AMSA; Arctic Council 2009). The AMSA Report includes a comprehensive estimate of the number of ships (excluding naval vessels) operated in the Arctic by year, and identified Arctic natural resource development and regional trade as the key drivers of future Arctic marine activity. The release of oil was identified as one of the most significant environmental threats related to shipping. The report specifically recommended that Arctic countries address impacts on marine mammals from shipping, and work with the International Maritime Organization (IMO) to develop and implement mitigation strategies.

Since then, significant advances have been made in implementing recommendations set forth in the AMSA Report. For example, several reports that identify Arctic marine areas of special ecological and cultural importance have been published (Smith et al. 2010), and voluntary guidelines to reduce underwater noise to avoid adverse impacts on marine biota have been developed (PAME 2015). Additionally, vessel routing and speed restrictions have been recognized as effective measures to mitigate impacts on marine mammals (Brigham and Sfraga 2010). In 2015, the IMO adopted the environmental provisions of the Polar Code, which include standardized safety procedures addressing design, construction, equipment, operational, training, environmental protection standards, and use of designated shipping lanes. The Polar Code was entered into force on January 1, 2017 (IMO 2019).

The majority of marine shipping activities in the Action Area are regulated by the U.S. Coast Guard (USCG). The Service is working with USCG to develop programmatic consultations to address existing and future shipping operations. Effects from shipping considered in these separate consultations would not be considered cumulative effects for the purposes of this BO. The extent of other future shipping activities (i.e., those falling outside the scope of separate consultations) is difficult to project going forward. It is possible, though not reasonably certain, that these activities will increase in the future. The effects of such activities would be comparable to current shipping impacts, that is, minor changes in spectacled eider and polar bear behavior that are not biologically significant, collisions impacting small numbers of spectacled eiders, localized fragmentation of sea ice habitat, and spills that are small, infrequent, and quickly remediated. As such, vessel traffic is anticipated to pose only intermittent and minor cumulative effects on spectacled eiders, polar bears, and their designated critical habitat over the course of this Proposed Action.

Reduction in the extent and duration of sea ice may also increase the potential for commercial fishing within the MTR portion of the Action Area, but the likelihood and magnitude of these activities are unknown at this time, and these activities are not reasonably certain to occur. Future commercial fisheries within the MTR portion of the Action Area would likely be managed by the National Marine Fisheries Service, and the issuance of regulations would require section 7 consultations, and effects from such activities are therefore not considered cumulative effects for the purposes of this BO.

Increased Scientific Research

Scientific research across the Arctic is increasing as concern about effects of climate change in the Arctic grows. While research is often conducted by universities and private institutions, these activities frequently entail permit authorizations or funding from the National Science Foundation (NSF) or other Federal agencies (e.g., BLM for research in NPR-A) if scientific activities are related to industry development. No research activities that do not require Federal authorization are reasonably certain to occur in the Action Area. Large scale projects that may overlap the MTR are generally funded by the NSF or operate off USCG ice breaking vessels. These activities have been and/or will be considered in separate section 7 consultations.

Recreation

Effects from purely private activities within the Action Area meet the definition of cumulative effects under the ESA. Private party use of the Action Area, or users of nearby private lands could disturb a few individual listed eiders or polar bears each year. However, these species occur at such low density, and with increasing scarcity inland from the coast that we expect the likelihood of private party encounters or resulting impacts to listed species would be very low. In the unlikely event a private party encounters listed species, we would expect effects to be limited to minor disturbance that would result in short-term changes in behavior that would not be biologically significant.

Conclusion

In summary, we anticipate the scope and scale of industry development, infrastructure expansion, marine traffic, scientific activities, and recreation in the Action Area will continue, and may increase in the future. Most notably, activities with the potential to affect significant numbers of individuals of listed species (such as industry development and infrastructure expansion) are expected to require consultation under the ESA; whereas those that may not require consultation (e.g., small private sector projects) would be anticipated have, at most, minor impacts to listed species and their habitat.

9. CONCLUSION

Regulations (51 CFR 19958) that implement section 7(a)(2) of the ESA define "jeopardize the continued existence of" as "to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species." We note that we determined the Proposed Action is not likely to adversely affect Alaska-breeding Steller's eiders, the southwest Alaska DPS of northern sea otters, or critical habitat for these two species. Therefore, we do not revisit or provide additional conclusions for sea otters, Steller's eiders, or critical habitat for these two species here.

Spectacled eiders

We identified loss of nesting habitat (direct loss and that associated with disturbance) and collision with project structures or vessels as factors with potential to adversely affect spectacled eiders.

Some habitat would be completely and permanently lost when structures or fill render the habitat unusable. Additionally, the capability of immediately adjacent habitat to support eiders may be completely or partially compromised by nearby structures and associated human activity, which could disturb nesting eiders or prevent them from nesting or rearing broods nearby. The full extent of the area affected by disturbance remains unknown, and it is also unknown whether eiders would simply be displaced from this habitat (possibly with reduced productivity) or continue to use it, possibly with reduced fitness. We have determined that habitat loss and disturbance within the adjacent 200-m zone of influence around Project facilities may adversely affect listed eiders, causing functional loss of 70.58 km^2 of nesting habitat. We estimate this would result in the loss of production from 40 spectacled eider nests over the 30-year life of the project. We also estimate up to a total of 11 adult or fledged juvenile spectacled eiders would be injured or killed in collisions with structures in the terrestrial environment (4) and vessels transporting materials through the marine environment (6).

Thus, collectively, we estimate effects of the Proposed Action would cause the loss of production of up to 40 spectacled eider nests and collisions causing injury or death of 11 adult or fledged juvenile spectacled eiders. Again, the predicted loss in production (i.e., nests) is a conservative estimate, as not all nests would naturally survive to hatching in the absence of disturbance, and not all nests subjected to project-specific disturbance would be expected to fail. Furthermore, the loss in reproductive potential (i.e., adults and fledged juveniles) due to collisions is an extremely small proportion of the North Slope breeding population (i.e., 0.17% of 6,401 eiders [95% CRI = 3,766–9,750] Dunham et. al. 2021). Because these collective impacts would occur over a 30-

year interval we would not anticipate population level responses to result. Therefore, the Service concludes effects of the Proposed Action, considered together with cumulative effects and in the context of the status of the species and environmental baseline, are not reasonably likely to jeopardize the continued existence of spectacled eiders by reducing appreciably the likelihood of survival and recovery of the species in the wild by reducing their reproduction, numbers, or distribution.

Spectacled eider critical habitat

Effects to spectacled eider critical habitat would be limited to designated marine units (i.e., LBCHU) and there would be very little overlap with the MTR. We identified disturbance or spills from vessels as potential mechanisms of impact to spectacled eider critical habitat.

We do not anticipate a few vessels rarely passing through the LBCHU would affect the physical or biological features for which critical habitat was designated. Furthermore, given the size of LBCHU and the expected rarity of vessels passing through, we do not anticipate vessel traffic associated with the proposed Project would appreciably affect spectacled eider access to, or use of, LBCHU such that the function and conservation value of the LBCHU for spectacled eiders would be reduced.

Accidental spills during sealift operations would likely be limited to small spills originating from fuel transfers in the vicinities of Dutch Harbor and Oliktok Dock. Wintering habitat south of St. Lawrence Island, the nearest critical habitat unit to Dutch Harbor, is 800 km away. Furthermore, sealift operations would not take place from October through April when the wintering area is used by spectacled eiders (BLM 2022a). Therefore, it is extremely unlikely that any oil from re-fueling spills would be carried into designated critical habitat, and we do not anticipate adverse impacts to spectacled eider critical habitat from small spills. Although conceivable, larger spills from vessels operating in the MTR would be very unlikely and are not considered reasonably certain to occur.

Because 1) impacts to terrestrial critical habitat from the Proposed Action are not expected, 2) impacts to the physical and biological features of the LBCHU are not expected from rare incursions by vessels *en route* to Oliktok Dock, 3) disturbance to eiders within designated marine critical habitat is expected to be infrequent and limited to minor short-term disturbance, and 4) due to geographic and temporal separation, impacts from spills during refueling of vessels are not anticipated; collective impacts to spectacled eider critical habitat from the Proposed Action are expected to be insignificant. Therefore, the Service concludes the Proposed Action, considered together with cumulative effects and in the context of the status and environmental baseline of critical habitat, is not likely to result in the destruction or adverse modification of any unit of designated spectacled eider critical habitat.

Polar bears

In evaluating impacts of the proposed project to polar bears, we have identified potential adverse effects from disturbance to denning polar bears and human-polar bear interactions.

We find that a host of construction and production activities associated with the Proposed Action would intermittently incidentally expose small numbers of polar bears of the SBS stock to disturbance, and that effects from these exposures would be limited to temporary changes in behavior that would not be biologically significant. We acknowledge the Proposed Action could affect an increasingly higher proportion of the SBS stock of polar bear in the future (due to polar bears' increased use of terrestrial areas as sea ice decreases, a decline in the SBS stock population, or other factors). We also acknowledge that polar bears in the Action Area could become increasingly sensitive to disturbance or other impacts due to food stress or other factors indirectly associated with climate change. However, we do not have sufficient data to reliably predict how the effects of the proposed Action may or may not contribute to increased sensitivity. Regardless, we anticipate that activities authorized under the proposed Project would continue to impact small numbers of individual polar bears within the SBS stock and would not appreciably affect the survival and recovery of the polar bear species as a whole. When considering effects from the Proposed Action in combination with cumulative effects, we arrive at this same conclusion because any future activities in the Action Area (which is largely Federally-managed land and almost entirely comprised of jurisdictional wetlands) with the potential for significant effects would have a federal nexus and therefore would require separate section 7 consultation. Other smaller scale activities, which may not have a federal nexus, would likely have smaller impacts and therefore would not contribute significantly to cumulative effects.

Our analysis also finds that aspects of the Proposed Action would serve to limit the potential for associated gas development actions and activities to impact polar bears. Most new infrastructure would be located a significant distance from the coast and would be directly adjacent to existing infrastructure, and BLM's stipulations and ROPS, as well as CPAI's proactive design features and minimization measures would serve to minimize human-polar bear interactions and disturbance to dens. In consideration of these factors, although we do not anticipate measurable effects to transient bears from passive deterrence, we estimate that up to four polar bears may be hazed with direct-contact projectiles resulting in short-term pain, minor injury (e.g., bruising), and/or minor changes in behavior without a likelihood of serious injury or death during activities over the 30-year life of the Proposed Action. Additionally, incidental disturbance to non-denning (i.e., transient) polar bears is not anticipated to create a "likelihood of injury" to any polar bears, and thus incidental disturbance would not "harass" non-denning polar bears per the ESA. *See* 50 CFR § 17.3. Finally, using the best available science, we estimate that no denning or post-emergence polar bear cubs would be injured or killed due to disturbance of undetected dens over the 30-year life of the Project.

Because we estimate the impacts described above (i.e., minor and temporary effects of incidental disturbance to transient bears and up to four polar bears hazed with direct-contact rounds) would occur over a 30-year interval, and be imposed upon a SBS subpopulation estimated to include 900 individuals (Bromaghin et al. 2015) of which, 565 individuals occur in Alaska (Bromaghin et al. 2021), we do not anticipate population level responses within the SBS stock, much less the species which numbers approximately 26,000 individuals.

Therefore, based on these factors, and after reviewing the current status of polar bears, the environmental baseline for the Action Area in which the effects of current on-going actions are evaluated, the effects of the proposed action, and the cumulative effects, it is the Service's biological opinion that the Action, as proposed, is not likely to jeopardize the continued existence of polar bears by reducing appreciably the likelihood of survival and recovery in the wild by reducing reproduction, numbers, or distribution of this species

Polar bear critical habitat

Unit 1, Sea Ice

We determined that vessel traffic associated with transporting modules and materials through marine waters designated as sea ice critical habitat could potentially affect sea ice habitat through 1) spills of oil or other petroleum products into marine waters that form ice, or 2) impacts to ringed and bearded seals, caused by disturbance or spills of oil or other petroleum products. More specifically, incompletely remediated spills of oil or other petroleum products could contaminate sea ice after freeze up in fall/winter, spilled products could affect ice seals (an identified component of sea ice habitat), and spills in onshore environments could be transported downstream to the marine system.

However, several measures included in the Project Description would reduce the likelihood of spills occurring in the marine environment (or areas of the terrestrial environment from which spills could be transported to the marine environment), and the magnitude of such spills in the event that one or more do occur. To minimize the potential for an inadvertent spill, CPAI would comply with BLM's ROPs A-3–A-5, CPAI's Design Features 56, 60, 88, 91-108, and appropriate project-specific spill prevention and response plans (e.g., the ODPCP, SPCCP, and FRP), which include numerous measures to prevent spills. If a spill should occur, adherence to the measures listed above would decrease both the area impacted and response time for containment and remediation, and thereby avoid or minimize effects of a spill on sea ice critical habitat. Therefore, we do not anticipate the proposed Action would result in direct or indirect alteration that appreciably diminishes the value of sea ice critical habitat as a whole for the survival and recovery of polar bears.

Unit 2, Terrestrial Denning Habitat

A very small subset of the Action Area overlaps terrestrial denning habitat. However, as described above in *Effects to Polar Bear Critical Habitat*, the area of overlap is limited to the vicinity of Oliktok Dock, the existing road and associated small gravel expansion areas, and disturbance associated with these facilities. Given that (1) this area is subject to existing levels of disturbance from vehicle traffic and (2) this disturbance would occur within an extremely small subset of available terrestrial denning habitat which totals roughly 3.6 million acres, we would expect disturbance and any effects to the PBFs to be insignificant. Therefore, we do not anticipate the proposed Action would result in direct or indirect alteration that appreciably diminishes the value of terrestrial denning critical habitat as a whole for the survival and recovery of polar bears.

Unit 3, Barrier Islands
We evaluated whether the Proposed Action could affect barrier islands through disturbance, and potential spills of oil or other petroleum products reaching barrier islands. However, we expect disturbance would be limited to occasional vessel passage adjacent to a single barrier island (Figure 6.1). Given that 1) vessel presence in proximity to this barrier island would be infrequent and short-term, 2) project-specific vessel operations would be limited to 4 years during construction, and 3) the affected area is an extremely small proportion of available barrier island critical habitat (approximately 10,575 km^2 total; 75 FR 76086); we expect disturbance within this unit would be minor and temporary, such that the value of barrier island critical habitat as a refuge from disturbance would not be appreciably reduced.

Furthermore, we find several measures included in the Project Description would reduce the likelihood of spills occurring, the magnitude of spills in the event that one or more do occur, and the likelihood of spills in or near wetlands, where they could be transported to the marine environment. To minimize the potential for an inadvertent spill, CPAI would comply with BLM's ROPs A-3–A-5, CPAI's Design Features 56, 60, 88, 91-108, and appropriate project-specific spill prevention and response plans (e.g., the ODPCP, SPCCP, and FRP), which include numerous measures to prevent spills. If a spill should occur, adherence to the measures listed above would decrease both the area impacted and the response time for containment and remediation, and thereby avoid or minimize effects of a spill on barrier island critical habitat. Therefore, we do not anticipate the proposed Action would result in direct or indirect alteration that appreciably diminishes the value of barrier island critical habitat as a whole for the survival and recovery of polar bears.

Determination
In conclusion, we find that the proposed Project contains protective measures that provide significant conservation benefits for polar bear critical habitat by effectively limiting the capacity of Project-related activities to cause adverse effects. Based on these factors, and after reviewing the current status of polar bear critical habitat, the environmental baseline for the action area, the effects of the Proposed Action, and Cumulative Effects, it is the Service's Biological Opinion that the Action, as proposed, is not likely to result in the destruction or adverse modification of any unit of designated critical habitat for the polar bear.

10. INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or attempt to engage in any such conduct. "Harm" is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. "Harass" is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed species by annoying them to such an extent as to significantly disrupt normal behavior patterns that include, but are not limited to, breeding, feeding or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action, is not considered a prohibited taking provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement (ITS).

BLM has a continuing duty to regulate the activity covered by this ITS. If BLM (1) fails to assume and implement the terms and conditions or (2) fails to require any applicant to adhere to the terms and conditions of the ITS through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, BLM or CPAI, must report the progress of the Proposed Action and its impact on the species to the Service as specified in the incidental take statement. [50 CFR §402.14(i)(3)]

Spectacled eiders

The activities described and assessed in this BO may adversely affect spectacled eiders through loss of nesting habitat and collisions with Project structures and/or vessels. Methods used to estimate spectacled eider take from habitat loss and collisions are described in the *Effects of the Action* section. Based on these analyses, the Service *estimates loss of production from up to 40 spectacled eider nests, and injury or mortality of up to 11 adults or fledged juveniles attributed to collisions* resulting from the Proposed Action.

Polar bears

The Service does not anticipate the proposed action would result in any incidental take of polar bears. A polar bear section is nevertheless provided in this ITS to further explain and contextualize this finding and to address the relationship between this Biological Opinion and take authorizations issued under the MMPA.

MMPA take versus ESA take

We first recognize that there are several important differences in how various forms of “take” are defined under the MMPA and ESA, and that in many instances MMPA take does not equate to any form of ESA take. This is largely due to different standards concerning both the probability and the extent of impacts. Whereas acts causing a “potential to disturb” or “potential to injure” a marine mammal could qualify as MMPA “Level B harassment” or MMPA “Level A harassment”, respectively, no ESA take can occur unless the act creates a “likelihood of injury” (an element of “harass” under the ESA) or “actually kills or injures” a marine mammal (an element of “harm” under the ESA). *See* 16 USC § 1362(18), 50 CFR § 17.3.

MMPA “Level A harassment” is suggestive of ESA “harm” in that both concepts use a common metric to express the extent of impact, *i.e.*, injury. But as noted above, these separate terms differ greatly in terms of the requisite probability of impacts; whereas MMPA “Level A harassment” contemplates acts with the “potential to injure” a marine mammal, ESA “harm” contemplates only those acts that “actually” injure (or kill) a marine mammal. Therefore, it follows that not all instances of MMPA “Level A harassment” rise to the level of ESA “harm.”

Incidental disturbance of non-denning bears

The Service does not anticipate any incidental disturbances resulting from the proposed action would "harass" any polar bears per the applicable definition of that term. Two concepts separately and independently support this finding. First, for the reasons explained in the Effects section, none of the incidental disturbances to non-denning (i.e., transient) polar bears anticipated to result from this proposed action would create a "likelihood of injury" to any polar bears, and thus none of these incidental disturbances would "harass" any polar bears per the ESA. *See* 50 CFR § 17.3. Second, incidental disturbances resulting from this proposed action would not occur intentionally or negligently. As explained in the Preamble to the Service's rulemaking the defined various forms of "take" under the ESA,

> "Harass" in the ESA-definition of "take" means an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding or sheltering.
>
> Under this definition two elements must be shown before a finding of harassment can be made: 1) likelihood of injury to wildlife, and 2) some degree of fault, either intentional or negligent. Because the definition contains an element of fault, it will not result in criminal liability for habitat modifications unless it is shown that the defendant knew or reasonably should have known that his actions would be likely to injure wildlife. Thus, a private landowner who wishes to develop land that serves as habitat for an endangered species may do so if reasonable measures are taken to avoid injury to wildlife. 46 Fed. Reg. 29490, 29491 (quoting Associate Solicitor opinion issued to the Service).

Here, the proposed action is the development and production of oil and gas resources pursuant to valid leases held by the applicant, a situation closely analogous to the example of a private landowner who wishes to develop land that serves as habitat for a listed species. The applicant's activities (except hazing, which is accounted below) would be conducted with the intent of developing and producing oil and gas and without any intent to annoy, disturb, or harass polar bears. The applicant's activities would be conducted in accordance with a host of lease stipulations and Required Operating Procedures developed by BLM in consultation with the Service to protect polar bears (BLM 2022b). The applicant would also conduct activities in accordance with numerous additional minimization measures proactively incorporated into its Project Description to further protect polar bears. These additional measures include, for the life of the Proposed Action, all of the minimization measures included by the Service in its most recent MMPA incidental take regulations for oil and gas activities in the region, in which the Service prescribes minimization measures necessary to ensure that oil and gas operations on the North Slope have the least practicable adverse impact on polar bears (USFWS 2021b). The development of each suite of applicable minimization measures was based on decades of Industry experience operating on the North Slope and on decades of Federal management of polar bears and regulation of Industry activities on the North Slope. Collectively, these protective measures constitute a reasonable and robust standard of care for the responsible conduct of oil and gas development and production activities in areas utilized by polar bears. Therefore, it follows that the applicant's activities would be conducted in accordance with "reasonable measures to avoid injury to" to polar bears and that any incidental (*i.e.*, not intentional) disturbance of polar bears that nevertheless results from the proposed action would not entail any "degree of fault, either intentional or negligent", and thus would not constitute "harassment" as that term is defined in long-standing regulations interpreting the ESA 50 CFR § 17.3. "Harass in the definition of take in the (ESA) means an *intentional or negligent* act or omission that creates the likelihood of injury to wildlife" through certain mechanisms) (emphasis added).

The Service acknowledges that it has not consistently given effect to the "intentional or negligent" language of its ESA definition of "harass" when developing biological opinions for polar bears. It does so here to give proper effect to all elements of the definition of "harass," reflect the comprehensiveness of mitigation measures already incorporated into this Proposed Action, provide a more precise estimate of the amount or extent of ESA take anticipated to result from this proposed action, and better satisfy its responsibilities under the ESA.

Incidental disturbance of denning polar bears
Denning polar bears are more susceptible to injury from incidental disturbance than are non-denning bears. As explained in the Effects section and Appendix B, the Service used a predictive model to analyze the potential for impacts to denning polar bears. While this model estimates the probability and frequency of MMPA take as opposed to ESA take, its outputs represent the best available scientific information concerning potential impacts and thus shed light on the potential for ESA take.

Here, the anticipated number of all MMPA Level A Harassments (even when combined with the anticipated number of lethal takes) is zero. This supports the Service's conclusion that no incidental ESA take of denning bears is anticipated to result from the Proposed Action.

Hazing
As explained in the Effects section, the Service anticipates that hazing associated with the Proposed Action will result in up to four ESA "harm" takes over the life of the Project. While most instances of hazing would utilize only passive deterrence methods and would not entail a likelihood of injury and would not "harass" or otherwise take any polar bears under the ESA, up to four instances of hazing would entail use of direct contact rounds that would injure and thus "harm" individual polar bears. The extent of these injuries is anticipated to be limited to minor bruising. Take caused by hazing is directed and intentional take, rather than incidental take, because the purpose of the act is to alter the behavior of polar bears.

The Service acknowledges that its recent BOs concerning polar bears have not consistently clarified and given proper effect to this distinction between intentional take and incidental take. For instance, the BO for a prior version of the Willow MDP included an ITS that acknowledged anticipated impacts from hazing without clarifying the distinction between incidental take and intentional take. This lack of clarity contributed to an appearance that the Service was treating hazing-related take as incidental take, which in turn contributed to the reviewing court finding a legal error in that BO. *See* SILA v. BLM, 555 F.Supp.3d 739, 802-803 (D. Alaska, 2021). The Service's BO concerning the Liberty project also lacked clarifying discussion and appeared to treat hazing take as incidental take, which similarly contributed to a finding of legal error. *See* CBD v. Bernhardt, 982 F.3d 723, 751 (9^{th} Cir., 2020). The Service's 2017 BO concerning

BOEM Lease Sale 193 more clearly described take from hazing as intentional take but nevertheless drew a connection between intentional take and certain ESA provisions that concern impacts from incidental take.

Here, the Service makes clear that the take anticipated to result from hazing is intentional take as opposed to incidental take. The purpose of hazing is to alter the behavior of polar bears, which distinguishes acts of hazing from acts encompassed by the definition of "incidental take" provided by Service regulations implementing section 7 of the ESA. *See* 50 CFR § 402.02. Treating hazing take as incidental take would also result in misapplications of the incidental take provisions of section 7(b)(4) of the ESA and the Service's implementing regulations at 50 CFR § 402.14(i). Where marine mammals such as polar bears are concerned, these provisions require the Service to provide an ITS only when the anticipated taking is authorized pursuant to Section 101(a)(5) of the MMPA. Those MMPA provisions address "incidental, and not intentional, taking" and, as the Service has long recognized, do not facilitate the authorization of take resulting from intentional acts such as hazing. 16 USC § 1371(a)(5)(A)(i) and (D)(i); *see also* 50 CFR § 18.34 and explanatory discussion at 75 Fed. Reg. 61631, 61633 as well as the Preamble to the Service's polar bear 4(d) rule at 78 Fed. Reg. 11766-11788. Since intentional take from hazing cannot be authorized under Section 101(a)(5) of the MMPA, it falls outside the purview of section 7(b)(4) and 50 CFR § 402.14(i)(1) and does not support the inclusion of certain required ITS components, *i.e.*, reasonable and prudent measures, terms and conditions, and measures to comply with Section 101(a)(5) of the MMPA. Treating hazing take as intentional take, and not incidental take, gives proper effect to the ESA and its implementing regulations and preserves consistency in the meaning of "incidental take" under the ESA and MMPA.

We note that this BO includes a reinitiation provision specific to intentional take via hazing. This provision implements 50 CFR § 402.16(a)(2) and should not be misconstrued as an application of 50 CFR § 402.14(i)(4) or 50 CFR § 402.16(a)(1), which pertain to incidental take.

In this Biological Opinion, the Service determined that the intentional take of up to four polar bears is not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat.

Authorization of MMPA take

The Service cannot authorize the ESA incidental take of any marine mammals unless that take is first authorized pursuant to the MMPA. 16 USC 1536(b)(4)(C). Here, no ESA incidental take is anticipated. However, the relationship between MMPA take authorizations and this Biological Opinion warrants further discussion.

Incidental Take - The Service can authorize MMPA incidental take through two mechanisms provided within section 101(a)(5) of the MMPA. The first is through promulgation of incidental take regulations (ITRs) and associated Letters of Authorization. *See* 16 USC § 1371(a)(5)(A), 50 CFR § 18.27(f). The second is through issuance of Incidental Harassment Authorizations. *See* 16 USC § 1371(a)(5)(D). The MMPA prescribes a 5-year limit for ITRs (and, by extension, associated LOAs) and a 1-year limit for IHAs. *See* 16 USC 1371(a)(5)(A)(i)(I) and (D)(i), respectively. Thus, it is not possible for the Service to issue an MMPA incidental take authorization applicable to the entirety of this 30-year Proposed Action. When the Service updated its ESA section 7 consultation regulations to implement amendments to the MMPA which provided a mechanism for allowing certain taking of ESA-listed species, it offered "options on how to handle the timing discrepancies between the two Acts." 54 Fed. Reg. at 40,346. The Ninth Circuit Court of Appeals has summarized these options as follows:

> First, the action agency may consider initiating the MMPA process in advance of the ESA section 7 process. The MMPA requirements can then be incorporated into the ESA incidental take statement when the biological opinion is issued and subsequent revisions would not be necessary. Second, FWS and the Action Agency may together agree to extend the section 7 consultation under the ESA to accommodate completion of the MMPA regulations. Or, third, the Action Agency may begin early consultation with the ESA, and request a preliminary biological opinion. Once the MMPA process is completed, the opinion would be reviewed and the ... incidental take statement amended or added, as appropriate. *Center for Biological Diversity v. Bernhardt*, 982 F.3d 723, footnote 8 (9th Cir. 2020) (internal quotations and citations omitted).

The 30-year duration of this Proposed Action precludes resolution of the timing discrepancy using Option 2. Meanwhile, the applicant has already requested and received from the Service an LOA issued pursuant to the 2021-2026 Beaufort Sea ITR (under which LOAs are issued for no more than 1 year) for a period spanning August 7, 2022, through August 6, 2023. This LOA (22-INC-10) authorizes the incidental MMPA Level B harassment of polar bears during the conduct of project activities during that timeframe. Consistent with Option 1 and 50 CFR § 402.14(i)(1)(iii), the measures necessary to comply with the existing LOA are hereby incorporated into this ITS.

Since MMPA incidental take authorization does not yet exist for this Proposed Action past the expiration date of the existing incidental take LOA, the Service will address MMPA incidental take authorizations issued for subsequent years of the proposed project using an approach consistent with Option 3. More specifically, the Service will review this Biological Opinion and amend its contents, as appropriate, in light of the findings made and requirements imposed by each subsequent MMPA incidental take authorization process concerning this proposed Project.

Intentional Take – Take resulting from any hazing conducted during the Proposed Action cannot be authorized under section 101(a)(5) of the MMPA because authorizations issued under that provision are limited to "incidental, but not intentional, taking" and hazing take is intentional take. 16 USC § 1371(a)(5). Hazing take is therefore outside the scope of what must be addressed or authorized in this ITS. *See* 16 USC § 1536(b)(4), 50 CFR § 402.14(i).

We further note that take resulting from hazing would not constitute a prohibited action under the MMPA in the first place because it would be exempt from the MMPA's take prohibition by virtue of one or more other MMPA provisions. Specifically, 16 USC § 1371(c) exempts taking that is "imminently necessary in self-defense or to save the life of a person in immediate danger" while 16 USC § 1371(a)(4)(A) exempts taking caused by certain individuals to deter marine mammals from, *inter alia*, "endangering personal safety" or "damaging private property" so long as the deterrence measures do not result in the death or serious injury of a marine mammal. Service implementing regulations provides guidelines for safely deterring polar bears consistent with this latter statutory provision. *See* 50 CFR § 18.34. Hazing conducted in a manner consistent with these guidelines is not prohibited by the MMPA. The Service has reviewed relevant materials integrated into this proposed action, to include CPAI's *Polar Bear Avoidance and Interaction Plan* (June 2021) and determined that the deterrence practices described therein are consistent with the Service's guidelines and thus the hazing take anticipated to result from the proposed action would not be prohibited take under the MMPA.

The Service has issued to the applicant an LOA (23-INT-01) for "Level B non-lethal harassment (deterrence) of polar bears" that may occur via the applicant's North Slope activities (including activities associated with this Proposed Action) from January 14, 2023, to January 13, 2024. The Service issued this LOA in accordance with 16 USC § 1371(a)(4)(A) as well as 16 USC § 1379(h) and 16 USC § 1381(c), which are additional MMPA provisions through which the Service can designate non-governmental employees as parties whose taking of marine mammals for certain purposes (*i.e*., for the protection or welfare of the mammal, the protection of the public health and welfare, or the nonlethal removal of nuisance animals) are exempted from the MMPA's take prohibition. Given that hazing resulting from the proposed action would already be exempt from the MMPA's take prohibition, this LOA (and/or future similar LOAs) is not necessary to authorize the applicant's anticipated hazing activities under the MMPA. This LOA instead provides additional regulatory certainty to the applicant and makes applicable to the applicant's employees the additional MMPA exemptions at 16 USC § 1379(h).

Exemption of ESA take

The ESA prohibits the take of endangered species of wildlife but not threatened species of wildlife such as the polar bear. See 16 USC § 1538(a)(1). The Service's implementing regulations extend the ESA's take prohibition to threatened species of wildlife except as provided by subsequent, species-specific provisions. *See* 50 CFR § 17.31 et seq. One such provision (referred to as a "special rule") applies to polar bears and provides in relevant part that:

> None of the prohibitions in § 17.31 of this part apply to any activity that is authorized or exempted under the Marine Mammal Protection Act (MMPA)…, provided that the person carrying out the activity has complied with all terms and conditions that apply to that activity under the provisions of the MMPA and [its] implementing regulations. 50 CFR § 17.40(q)(2).

As discussed above, the applicant has received from the Service an MMPA incidental take authorization (LOA 22-INC-10) concerning project-related activities conducted from August 7, 2022 through August 6, 2023. The requirements of this one-year LOA are hereby incorporated into this ITS. Incidental take from activities conducted subsequent to that timeframe is not yet authorized under the MMPA but will be accounted for during the future processes described above whereby the Service will review this BO and make any appropriate amendments.

Meanwhile, the take that is anticipated to result from hazing cannot be authorized under section 101(a)(5) of the MMPA but is exempted under various other provisions of the MMPA and thus, per 50 CFR § 17.40(q)(2), not prohibited by the ESA, which further precludes the need for (or ability of) this ITS to authorize such take under the ESA. Regulations implementing the ESA also clarify more generally that takes of wildlife in defense of human life are not prohibited under the ESA. *See* 50 CFR § 17.21(c)(2).

Summary
In summary, the Service believes that no more than 40 spectacled eider nests and 11 spectacled eiders would be incidentally taken over the life of the Project as a result of the Proposed Action. The Service does not anticipate any polar bears would be incidentally taken over the life of the Project as a result of the Proposed Action.

The RPMs and their implementing T&Cs below are designed to minimize the impact of incidental take that might otherwise result from the Proposed Action. If, during the Action, this level of incidental take is exceeded, such incidental take represents new information requiring reinitiation of consultation and review of the Reasonable and Prudent Measures provided. The Federal agency must immediately provide an explanation of the causes of the taking and review with the Service the need for possible modification of the RPMs and their implementing T&Cs.

11. REASONABLE AND PRUDENT MEASURES

This RPM and its implementing terms and conditions aim to minimize the incidental take anticipated from activities described in this BO. As described in the *Effects of the Action* and *Incidental Take Statement*, activities authorized by BLM or USACE are anticipated to lead to incidental take of spectacled eiders through long-term habitat loss and collisions.

RPM 1: Contribute to improved understanding of spectacled eider collision risk with Project infrastructure, facilities, and/or vessels.

12. TERMS AND CONDITIONS

To be exempt from the prohibitions of Section 9 of the Act, BLM, USACE, and their agents must comply with the following terms and conditions, which implement the RPM described above. These terms and conditions are non-discretionary.

T&C 1 – Observations of collision events in which one or more listed eider, or 3 or more birds of any species[8], appear to have collided with oil and gas infrastructure (i.e., wires, towers, or buildings), or vessels shall be recorded and reported to the USFWS, Northern Alaska Field Office[9] and BLM, Arctic District Office[10] in an annual report due by December 31, unless listed eider collisions exceed the number exempted by the ITS, in which case, the collision event shall be reported within 48 hours. Reports should include: the date, time of day, weather conditions, number and species of birds involved, and other factors considered to be relevant by the observer, and should include photos of dead

[8] Reporting collisions of non-listed species may be valuable as surrogates in assessing the frequency of collision events, and factors contributing to their occurrence.
[9] U.S. Fish and Wildlife Service - Northern Alaska Field Office
101 12th Avenue, Room 110, Fairbanks, Alaska, 99701
[10]Bureau of Land Management - Arctic District Office
222 University Avenue, Fairbanks, Alaska, 99709

birds, top and bottom view, with wings spread, and with the bill and feet visible if possible.

13. CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. We recommend the following action be implemented:

1. Implement lighting controls to turn off exterior lighting at satellite pads and other unoccupied facilities when personnel are not present, between August 1 and October 31.
2. Continue den detection, mapping, behavioral, and habitat work in polar bear habitat in the United States.
3. Minimize development and disturbance on barrier islands (where denning habitat is most limited). Where development occurs in polar bear habitat within the United States, work collaboratively to mitigate loss of denning habitat.
4. Update existing oil spill modeling and scenarios; anticipate potential overlap with seasonal polar bear movements, aggregations, and important habitats within the United States.

We request notification of the implementation of any conservation recommendations by BLM or USACE to keep the Service informed of actions minimizing or avoiding adverse effects or benefiting listed species and their habitats.

14. REINITIATION NOTICE

This concludes formal consultation for the Proposed Action. As provided in 50 CFR 402.16, re-initiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law), and if:

1. The amount or extent of *incidental* take for listed species is exceeded over the life of the project;

    a. More than 40 spectacled eider nests lost due to disturbance;

    b. More than 11 adult and/or fledged juvenile spectacled eider attributed to collisions with Project structures or vessels;

    c. Any ESA incidental take of polar bears;

2. The amount or extent of estimated *intentional* take of polar bears is exceeded over the life of the project:

a. If human-polar bear interactions result in deterrence by direct-contact projectiles of more than four polar bears over the life of the Project; or

b. Direct-contact projectiles cause severe injury or death to any polar bears.

3. New information reveals effects of the action that may affect listed species in a manner or to an extent not considered in this opinion (e.g., if observations in the Action Area indicate levels of human-polar bear interactions, especially the need for hazing, is increasing significantly over time, or is resulting in chronic or repeated interference with normal polar bear behavior).

4. The agency action is subsequently modified in a manner that causes an effect to listed species or critical habitat not considered in this opinion; or

5. A new species is listed or critical habitat is designated that may be affected by the action.

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APPENDIX A

Below we provide the approach and calculations used to estimate impacts to listed eiders resulting from disturbance from aircraft landings and on-tundra activities, and collisions with barges associated with the Proposed Action.

Aircraft landings and on-tundra activities

An absence of empirical data makes it difficult to estimate the effect of aircraft landings and tundra-based activities upon nesting and brood-rearing listed eiders. Our estimates are therefore based on a series of assumptions. Landing close to a nest would likely flush the incubating female and prevent her from returning for as long as the aircraft and associated human activity remain near the nest. We assume that all hens within a 600-m radius of a landing site will be flushed, and nests will subsequently be at increased risk of abandonment or depredation. The likelihood of a nesting hen flushing, and her reluctance to return to the nest, is assumed to decrease as distance from human activity increases. We assume no effects to nesting hens outside of this 600-m radius. We also assume the 600-m radius centered on the landing site would encompass the area affected by associated on-tundra activities. After landing, project personnel would conduct work over an unspecified area.

Effects of disturbance associated with the proposed activities could result in reduced production of listed eiders, and we estimate effects of proposed activities on listed eider production using the following multi-step process:

1. Using the assumptions described above, we estimate potential effects of aircraft and human disturbance on eider nest success would occur within a 600-m radius, or 1.13 km^2 area, at each landing site, and multiply this area of impact by the total number of sites expected annually.
2. We then use our assumption regarding distance over which take-offs/landings may affect eider nests, combined with estimates of eider density, to estimate the number of nests potentially subject to disturbance each year.
3. Finally, because not all nests subjected to disturbance would be expected to fail, we multiply the estimated reduction in nest success by the number of nests potentially disturbed, calculated in Step 3, to estimate the total number of nest failures that could result from aircraft activities associated with the proposed Project.

The applicant estimates up to 90 on-tundra helicopter landings each year during the spectacled eider nesting period (i.e., up to 82 flights originating from the WOC and 8 originating from Alpine in a given year; BLM 2022a). The number of listed eider nests potentially disturbed near landing sites was estimated by multiplying the area impacted at each site (600-m radius, area of 1.13 km^2) by the maximum number of landings proposed each year: 90, and estimated average nest density for spectacled eiders in the Action Area as follows:

$1.13\ km^2 \times 90$ sites = $101.7\ km^2$ affected,

0.015 spectacled eider nests/$km^2 \times 107.7\ km^2 = 1.53$ spectacled eider nests potentially disturbed annually, and

1.53 nests disturbed/year × 30 years = 45.77 spectacled eider nests disturbed over the project life

Using Mayfield methods, Bowman and Stehn (2003) estimated nest survival for spectacled eiders on the Y-K Delta in 1994–2002 to be 0.678. At Utqiaġvik, nest survival calculated using Mayfield methods has ranged from 0.20 (95% CI: 0.05–0.42) to 0.62 (95% CI: 0.28–0.83) between 2013 and 2017 (Safine 2011; Graff 2018). Therefore, it is clear that not all nests will survive to hatching and survival rates vary among years and areas.

We would not expect all nests from which females flush to be abandoned or depredated. For example, a site visit including one helicopter landing and human presence lasting 15 minutes would presumably result in lower risk of nest abandonment than a site visit requiring several landings and 8-10 hours of on-tundra activity; however, the difference is difficult to quantify. Human disturbance at spectacled eider nests on the Yukon-Kuskokwim Delta (Y-K Delta) reportedly reduced nest success by a mean of 9.9% (Grand and Flint 1997; Bowman and Stehn 2003). Although the likelihood of nest abandonment or depredation resulting from aircraft landings and on-tundra activities would presumably vary with the number, frequency, and duration of landings, and the type of activities at each site, we assume effects of disturbance on nest success reported on the Y-K Delta would roughly approximate the effects of on-tundra helicopter researcher disturbance from on-tundra helicopter landings associated with the Project. Therefore, we assume one disturbance event (e.g., a hen is flushed once during landing and does not return before takeoff) could reduce nest success by 9.9% (rounded to 10%). However, in situations where the hen is flushed twice (i.e., the hen is flushed during landing, returns to the nest, and is flushed again during takeoff) we assume the effects would be roughly double, or 19.8% (rounded to 20%). Assuming a worst-case or most impactful scenario, we apply the latter scenario here because the duration of on-tundra activities between landing and takeoff is unknown and may allow sufficient time for the hen to return, potentially resulting in a second flush from the nest.

45.77 spectacled eider nests potentially disturbed × 0.20 = 9.15 spectacled eider nests lost due to disturbance

Biases in assumptions

Our assumptions in this analysis contain a number of biases, likely contributing to an inflated (i.e., conservative) estimate of loss of production due to disturbance associated with the proposed activities.

1. Our estimate of the number of nests within a 600-m radius ($1.13\ km^2$) of aircraft landing sites, is based on the assumption each listed eider pair sighted during the ACP aerial

surveys subsequently nests; however, an unknown proportion of these pairs may not nest. Thus, our initial estimate of nest density may be biased high.

2. The area impacted by helicopter sites may be smaller than the 1.13 km^2 zone of influence used in the effects analysis. We assume the 1.13 km^2 zone of influence includes potential nest disturbance from on-tundra activities beyond the discrete location of the landing site, although this area may be smaller if activities take place within a smaller footprint. Therefore, it is possible that helicopter landings/takeoffs would disturb nesting hens within a much smaller zone of influence around the landing site (although the radius of this zone is unclear and likely varies among sites). Thus, our calculations may overestimate the number of nests potentially disturbed.
3. We base our estimates of the magnitude to which disturbance may decrease nest success on studies in which researchers intentionally flushed eiders from nests, whereas in the proposed action, project personnel would not deliberately flush hens.
4. We are unable to separate activities into those that occur during the nesting, brood-rearing, and post-fledging periods based on the information available to us; therefore, we have assumed that all activities have similar impacts on nest success regardless of timing.

For these reasons, we have likely overestimated impacts of disturbance associated with the proposed activities on nest success. Nonetheless, these estimates are based on the best information available. Using this process, we estimate loss of production from a total of nine spectacled eider nests due to disturbance associated with on-tundra aircraft landings over the life of the project.

Collisions with vessels

As discussed in the *Environmental Baseline*, migratory birds suffer considerable mortality from collisions with anthropogenic objects. Spectacled and Steller's eiders migrating east during spring and west during summer/fall would be at risk of colliding with vessels in the MTR (Figure 3.2). Using the best available information, we provide an estimate of collision risk for listed eiders from barge traffic associated with the proposed Project. We first calculate the *per capita* risk of collision per vessel operating during a single season in the Chukchi and Beaufort seas, using observations of vessel collisions collected by biological observers in a structured monitoring and reporting effort during Royal Dutch Shell's (Shell) 2012 Exploratory Program. Observers on ten vessels operating in the Chukchi Sea for 108 days recorded 131 total bird-vessel encounters, 17 of which were fatal collisions between eiders (13 king and 4 common eiders) and vessels (M. Schroeder, BOEM, unpubl. obs, pers.comm.). Of these 17 collisions, two involved mobile offshore drilling units, while the other 15 involved support vessels, which are reasonably similar to the barges currently planned for use in the Project. Considering that 10 vessels were involved in 15 fatal eider collisions, we estimate average collision rate per vessel to be 1.5 (i.e., 15 ÷ 10 = 1.5 collisions/vessel) over a 108-day season.

These rates are based on reported collisions for king and common eiders during a single shortened industry season in the Chukchi Sea. Listed eiders were not among the sea duck collisions recorded in 2012; however, spectacled and Steller's eiders moving through the

Bering, Chukchi, and Beaufort seas during barging operations for the Project would also be at risk of colliding with the proposed barges, presumably in proportion to their relative abundance in sea duck populations. Assuming spectacled and Steller's eiders are roughly as vulnerable to collisions as king and common eiders (and we have no basis to assume otherwise), we believe information on *per capita* collision rates of much more abundant king and common eiders can be used to reasonably approximate collision rates for less abundant spectacled and Steller's eiders. To do this, we considered the number of observed collisions for eiders during Shell's 2012 exploratory season in the Chukchi Sea, combined with the estimated number of eiders migrating through the region, which were theoretically exposed to collision risk.

Based on a total of 705,380 eiders (529,271 king and 176,109 common eiders) recorded during migration counts near Utqiaġvik in late summer and fall of 2002 (Quakenbush et al. 2004)[11], we very roughly estimate the *per capita risk* of collision for each vessel operating offshore in the Chukchi Sea to be:

> 1.5 collisions per vessel per season ÷ 705,380 eiders = 0.0000021 collisions per eider-vessel- season

We then estimate the risk of collision for spectacled and Steller's eiders migrating through the Bering, Chukchi, and Beaufort seas, by multiplying the collision rate per eider (described above), by the estimated abundance of spectacled and Steller's eiders from pre-nesting aerial survey data for the North Slope. The most recent estimate of the number of spectacled eiders breeding on the ACP, in 2019, is 6,401 eiders (95% CRI = 3,766–9,750; Dunham et. al. 2021), and the most recent estimate for Steller's eiders on the ACP is 308 (95% CI = 216 – 422; E. Osnas and C. Frost, USFWS, pers. comm).

We can then roughly estimate the risk of collision for spectacled and Steller's eiders migrating through the Bering, Chukchi, and Beaufort seas, by multiplying the individual eider collision rate (described above), by the estimated total number of spectacled eiders on the ACP:

> 6,401 spectacled eiders × 0.0000021 collisions per vessel per season = 0.013 spectacled eiders per vessel per season

and

> 308 Steller's eiders × 0.0000021 collisions per vessel per season = 0.0006 Steller's eiders per vessel per season

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[11] This survey was based on observed counts from a fixed location. It employed a subset of time intervals and extrapolated the data to account for intervals during which no observations were made. Because the majority of king and common eiders nest in Northern Canada, we believe these counts reasonably estimate the number of king and common eiders passing through Arctic Alaska. Listed eiders were not detected during these migration counts, presumably due to the comparative scarcity and identification challenges for spectacled and Steller's eiders.

If these figures represent the number of collisions expected per vessel moving through the Bering, Beaufort, and Chukchi seas, we can then approximate collision exposure from approximately 365 and 80 vessel trips[12] for spectacled and Steller's eiders, respectively, over the life of the project:

> 0.013 spectacled eiders per vessel season × 365 vessel trips = 4.91 spectacled eiders

and

> 0.0006 Steller's eiders per vessel per season × 80 vessel trips = 0.05 Steller's eiders

We then make a final adjustment to this estimate. The estimate above was derived from a 108-day season during Shell's 2012 exploration campaign, whereas a typical open-water season, in which marine vessels could potentially operate, is approximately 150 days. Although we expect the proposed barging operations (i.e., vessel trips) would be of shorter duration (likely much shorter) than the length of a typical open-water season, we also acknowledge the timing of barge operations would be difficult to estimate with precision due to a number of factors including seasonal variation in sea ice conditions and marine forecasts. Therefore, lacking greater certainty in barge operation timing, we conservatively extrapolated our estimate to cover a full open-water season. We believe this significantly overestimates the number of days that vessels would be underway and present in waters where listed eiders occur, and therefore represents a substantial overestimation of collision risk to listed eiders.

Nonetheless, the adjusted calculations to estimate collisions over approximately 150-days of a typical open-water season are as follows:

> 4.91 spectacled eider collisions ÷ 108 days = 0.045 collisions per day; therefore,

> 0.045 collisions per day × 150 days = 6.81 spectacled eider collisions

and

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[12] The applicant estimates 30 barges and 50 ocean-going tugs would operate in the MTR within the range of spectacled and Alaska-breeding Steller's eiders during 4 years of construction. Additionally, 285 support vessel trips (e.g., support vessels, screeding barges, etc.) would take place near Oliktok Dock. Because Steller's eiders occur at such low numbers in northeastern NPR-A, we anticipate only spectacled eiders would be exposed to additional collision risk from support vessel operations. Therefore, species-specific collision risk is expected to be:

> 30 barges + 50 ocean-going tugs + 285 Oliktok support vessels = collision exposure from 365 vessel trips for spectacled eiders; and
>
> 30 barges + 50 ocean-going tugs = collision exposure from 80 vessel trips for Steller's eiders.

0.05 Steller's eider collisions ÷ 108 days = 0.00047 collisions per day; therefore,

0.00047 collisions per day × 150 days = 0.07 Steller's eider collisions

The reliability of these estimates may be limited by several factors. For example, 1) collisions are often episodic, and those resulting from light attraction in inclement weather may be particularly so, such that observations collected on a few structures/vessels in a single year may not be representative of collision rates in general, 2) monitoring for collisions is difficult and an unknown number of collisions may go undetected, even by trained bird observers, and 3) low visibility often coincides with increased collisions (Ronconi et al. 2015), which may increase the number of undetected collisions. We also note that assuming vessels transits would persist for the entire 150-day open-water season likely results in a substantial overestimate of collision risk. However, these estimates are based on the best information available.

APPENDIX B

Below we provide a complete description and results of the polar bear den simulation model used to assess impacts to denning polar bears from disturbance associated with all phases of the Proposed Action. This model was developed by the Service to inform analyses conducted pursuant to certain MMPA provisions and thus the estimates this model produces speak to various forms of take as defined by the MMPA. As explained in the foregoing Biological Opinion, there are key differences in how various forms of take are defined under the MMPA versus the ESA, and not all instances of MMPA take constitute take under the ESA. The model nevertheless constitutes the best available tool for estimating the probability and frequency of effects that in certain cases rise to the level of ESA take.

Den simulation

We simulated dens across the entire north slope of Alaska, ranging from the areas identified as denning habitat (Durner et al. 2006a, 2013) contained within the National Petroleum Reserve-Alaska (NRPA) in the west to the Canadian border in the east. To simulate dens on the landscape, we relied on the estimated number of dens in three different regions of northern Alaska provided by Atwood et al. (2020). These included the NPRA, the area between the Colville and Canning rivers (CC), and ANWR. The mean estimated number of dens in each region during a given winter were as follows: 12 dens (95% CI : 3-26) in the NPRA, 26 dens (11-48) in the CC region, and 14 dens (5-30) in ANWR (Atwood et al. 2020). For each iteration of the model (described below), we drew a random sample from a gamma distribution for each of the regions based on the above parameter estimates which allowed uncertainty in the number of dens in each area to be perpetuated through the modeling process. Specifically, we used the method of moments (Hobbs and Hooten 2015) to develop the shape and rate parameters for the gamma distributions as follows: NPRA ($12^2/5.8^2$,$12/5.8^2$), CC ($26^2/9.5^2$,$26/9.5^2$), and ANWR ($14^2/6.3^2$,$14/6.3^2$).

Because not all areas in northern Alaska are equally-used for denning and some areas do not contain the requisite topographic attributes required for sufficient snow accumulation for den excavation, we did not simply randomly place dens on the landscape. Instead, we followed a similar approach to that used by Wilson and Durner (2020) with some additional modifications to account for the differences in denning ecology in the CC region related to a preference to den on barrier island and a general (but not complete) avoidance of actively used industrial infrastructure. Using the USGS polar bear den catalogue (Durner et al. 2020), we identified polar bear dens that occurred on land in the CC region and that were identified either by GPS-collared bears or through systematic surveys for denning bears (Durner et al. 2020). This resulted in a sample of 37 dens of which 22 (i.e., 60%) occurred on barrier islands. For each iteration of the model, we then determined how many of the estimated dens in the CC region occurred on barrier islands versus the mainland. To accomplish this, we first took a random sample from a binomial distribution to determine the expected number of dens from the den catalog (Durner et al. 2020) that should occur on barrier islands in the CC region during that given model iteration; $n_{barrier}$~Binomial(37, 22/37), where 37 represents the total number of dens in the den catalogue (Durner et al. 2020) in the CC region suitable for use (as described above) and 22/37 represents the observed proportion of dens in the CC region that occurred on barrier islands. We then divided $n_{barrier}$ by the total number of dens in the CC region suitable for use (i.e., 37) to determine the proportion of dens in the CC region that should occur on barrier islands (i.e., $p_{barrier}$). We then multiplied $p_{barrier}$ with the simulated number of dens in the CC region (rounded to the nearest whole number) to determine how many dens were simulated to occur on barrier islands in the region.

In the NPRA, the den catalogue (Durner et al. 2020) data indicated that two dens occurred outside of defined denning habitat (Durner et al. 2013), so we took a similar approach as with the barrier islands to estimate how many dens occur in areas of the NPRA with the den habitat layer during each iteration of the model; $n_{habitat}$~Binomial(15, 13/15), where 15 represents the total number of dens in NPRA from the den catalogue (Durner et al. 2020) suitable for use (as described above), and 13/15 represents the observed proportion of dens in NPRA that occurred in the region with den habitat coverage (Durner et al. 2013). We then divided $n_{habitat}$ by the total number of dens in NPRA from the den catalogue (i.e., 15) to determine proportion of dens in the NPRA region that occurred in the region of the den habitat layer ($p_{habitat}$). We then multiplied $p_{habitat}$ with the simulated number of dens in NPRA (rounded to the nearest whole number) to determine the number of dens in NPRA that occurred in the region with the den habitat layer. Because no infrastructure exists and no activities are proposed to occur in the area of NPRA without the den habitat layer, we only considered the potential impacts of activity to those dens simulated to occur in the region with denning habitat identified (Durner et al. 2013).

To account for the potential influence of industrial activities and infrastructure on the distribution of polar bear selection of den sites, we again relied on the subset of dens from the den catalogue (Durner et al. 2020) discussed above. We further restricted the dens to only those occurring on the mainland because no permanent infrastructure occurred on barrier islands with identified denning habitat (Durner et al. 2006). We then determined the minimum distance to permanent infrastructure that was present during the year when the den was identified. The proportion of empirical dens ≤ 5 km from infrastructure was 0.25. Thus, for the mainland portion of simulated dens in the CC region, we determined how many should be simulated to occur ≤ 5 km from infrastructure, and how many should be simulated to occur > 5 km from infrastructure at each iteration of the model. The number of mainland dens ≤ 5 km from infrastructure was modeled as $n_{\leq 5km}$~ Binomial($n_{CC\_mainland}$,0.25) where $n_{CC\_mainland}$ is the number of dens simulated to occur on the mainland portion of the CC region during one iteration of the model. The number of dens > 5km from infrastructure in the mainland portion of the CC region was calculated as:
$n_{>5km} = n_{CC\_mainland} - n_{\leq 5km}$

To inform where dens are most likely to occur on the landscape, we developed a kernel density map by using known den locations in northern Alaska identified either by GPS-collared bears or through systematic surveys for denning bears (Durner et al. 2020). The kernel density map was developed by using known den locations in northern Alaska identified either by GPS-collared bears or through systematic surveys for denning bears (Durner et al. 2020). To approximate the distribution of dens we used a scaled adaptive kernel density estimator applied to n observed den locations, which took the form $f(\mathbf{s}) \propto \frac{\theta}{n}\sum_{i}^{n} k\left(\frac{\mathbf{s}-\mathbf{s}_i}{h(\mathbf{s})}\right)$, where the adaptive bandwidth $h(\mathbf{s}) = \left(\beta_0 + \beta_1 I(\mathbf{s}_i \in \mathcal{M}) I(\mathbf{s} \in \mathcal{M})\right)\beta_2$ for the location of the i[th] den and each location $\mathbf{s}$ in the study area. The indicator functions allowed the bandwidth to vary abruptly between the mainland $\mathcal{M}$ and barrier islands. The parameters θ, β_0, β_1, β_2 were chosen so that the density estimate approximated the observed density of dens and our understanding of likely den locations in areas with low sampling effort.

To simulate dens on the landscape, we first sampled in which kernel grid cell a den would occur based on the underlying relative probability within a given region using a multinomial distribution. Once a cell was selected, the simulated den was randomly placed on the denning habitat (Blank 2013, Durner et al. 2006, 2013) located within that grid cell. For dens being simulated on mainland in the CC region, an additional step was required. We first assigned a simulated den whether it should occur near infrastructure (i.e., ≤ 5 km) or away (i.e., > 5km). We subset the kernel density grid cells that occurred ≤ 5km from infrastructure and those that occurred > 5km. We then selected a grid cell from the appropriate kernel density subset (i.e., near/far from infrastructure) based on their underlying probabilities using a multinomial distribution. Then, similar to other locations, a den was randomly placed on denning habitat within that grid cell.

For each simulated den, we assigned dates of key denning events; den entrance, birth of cubs, when cubs reached 60 days of age, den emergence, and departure from the den site after emergence. These represent the chronology of each den under undisturbed conditions. We selected the entrance date for each den from a normal distribution parameterized by entrance dates of radio-collared bears in the SB subpopulation that denned on land included in Rode et al. (2018) and published in USGS (2018; *n* = 52, mean = 11 November, SD = 18 days); we truncated this distribution to ensure that all simulated dates occurred within the range of observed values (i.e., 12 Sep to 22 Dec). We selected a date of birth for each litter from a normal distribution with a mean birth date of 15 Dec and an SD of 10 days. We then restricted random samples of birth dates to occur between 1 Dec and 15 Jan; the period of time when most cubs are believed to be born (Messier et al. 1994, Van de Velde et al. 2003). We selected the emergence date as a random draw from an asymmetric Laplace distribution with parameters μ=81.0, σ=4.79, and p=0.79 estimated from the empirical emergence dates in Rode et al. (2018) and published in USGS (2018, *n*=52) of radio-collared bears in the SB subpopulation that denned on land using the mleALD function from package 'ald' (Galarzar and Lachos 2018) in program R (R Core Development Team 2022). We constrained simulated emergence dates to occur within the range of observed emergence dates (9 Jan to 9 Apr) and to not occur prior to cubs reaching an age of 60 days. Finally, we assigned the number of days each family group spent at the den site post-emergence based on values reported in three behavioral studies, Smith et al. (2007, 2010, 2013) and Robinson (2014), which monitored dens near the target area immediately after emergence (*n* = 25 dens). Specifically, we used the mean (8.0) and SD (5.5) of the dens monitored in these studies to parameterize a gamma distribution using the method of moments (Hobbs and Hooten 2015) with a shape parameter equal to $8.0^2/5.5^2$ and a rate parameter equal to $8.0/5.5^2$; we selected a post-emergence, pre-departure time for each den from this distribution. Additionally, we assigned each den a litter size by drawing the number of cubs from a multinomial distribution with probabilities derived from litter sizes (*n* = 25 litters) reported in Smith et al. (2007, 2010, 2013) and Robinson (2014). Because there is some probability that a female naturally emerges with 0 cubs, we also wanted to ensure this scenario was captured. It is difficult to parameterize the probability of litter size equal to 0 because it is rarely observed. We therefore assumed that dens in the USGS (2018) dataset that had denning durations less than the shortest den duration where a female was later observed with cubs (i.e., 79 days). There were only 3 bears in the USGS (2018) data that met this criteria, leading to an assumed probability of a litter size of 0 at emergence being 0.07. We therefore assigned the probability of 0, 1, 2 or 3 cubs as 0.07, 0.15, 0.71, and 0.07, respectively.

Infrastructure and human activities

The model developed by Wilson and Durner (2020) provides a template for estimating the level of potential impact to denning polar bears of proposed activities while also considering the natural denning ecology of polar bears in the region. The approach developed by Wilson and Durner (2020) also allows for the incorporation of uncertainty in both the metric associated with denning bears and in the timing and spatial patterns of proposed activities when precise information on those activities is unavailable. Based on information provided in the application, we overlaid proposed infrastructure with simulated dens to determine which simulated dens were potentially exposed to disturbance. We assumed any dens within 1 mile (1.6 km) from infrastructure was exposed to disturbance.

The timing and distribution of development activities and infrastructure varied during the first eight years of the proposed Project. Between years 9 and 30, the scope of activities remains constant. We therefore had to apply the model to multiple years separately to account for the differences in proposed activities. During the first winter (1 December – 31 March), gravel mining will be initiated, along with the construction of gravel pads and roads. Ice roads will also be constructed beginning in the first year of the Project (1 December – 31 March). During years 2 – 3, gravel mining would continue (1 December – 31 March), as would gravel pad and road construction, and ice road construction (1 December – 31 March). However, the pad and road construction period would occur year-round and therefore cover the entire denning period for polar bears. During years, 2 – 3 construction of new pipelines (and associated infrastructure) begins during winter and spring (1 December – 31 May). Activities during year 4 are the same as years 2 – 3, except there is the addition of the construction of the Colville River pipeline crossing using horizontal directional drilling during winter (1 December – 31 March). In year 5 and 6, there is a pause in gravel mining, but there would still be activity associated with the gravel road and pad construction (year-round). During year 7, gravel mining resumes (1 December – 31 March), along with year-round gravel road and pad construction. Pipeline construction continues (1 December -31 May) as does ice road construction (1 December – 31 March). During year 8, gravel mining ceases for the remainder of the Project, but ice roads are still constructed (1 December – 31 March), pipeline construction continues (1 December – 31 May), as well as pad and gravel road construction (year-round). Years 9 – 30 were modeled to have year-round activity associated with gravel pads and roads. No ice roads will be constructed from year 9 – 30. Similarly, pipeline construction is to be completed in year 8, so normal year-round pipeline operations were assumed to occur for the remainder of the Project.

All activities from years 1 – 8 were assumed to be frequent and regularly-occurring, so we applied the continuous disturbance probabilities (Table B1) to activities occurring during this period. Once the pipeline construction was completed, we assumed that the activity associated with the pipeline would be regularly-scheduled inspections which would occur at fixed points in time and have short intervals of disturbance. We therefore applied discrete disturbance probabilities (Table B1) to dens adjacent to the newly-constructed pipelines. Much of the proposed new pipeline construction occurs adjacent (within ~ 5 m) to existing pipelines where take of polar bear has already been accounted for. We therefore excluded from this analysis those sections of the proposed new pipeline that run adjacent to an existing pipeline.

Aerial infrared surveys

We assumed that all proposed development would have two aerial infrared (AIR) surveys flown each winter of the 30-year project period. The first survey was simulated to occur between 1 – 25 Dec, and the second between 15 Dec – 10 Jan. During each iteration of the model, each AIR survey was randomly assigned a probability of detecting dens. Whereas previous analyses have used the results of Wilson and Durner (2020) to inform this detection probability, two additional studies (Smith et al. 2020, Woodruff et al. 2022a) have been conducted since Wilson and Durner (2020) was published that require an updated approach. The study by Woodruff et al. (2022a) considered the probability of detecting heat signatures from artificial polar bear dens. They did not find a relationship between den snow depth and detection and estimated a mean detection rate of 0.24. A recent study by Smith et al. (2020) estimated that the detection rate for actual polar bear dens in northern Alaska was 0.45 and also did not report any relationship between detection and den snow depth. Because the study by Wilson and Durner (2020) reported detection probability only for dens with less than 100 cm snow depth, we needed to correct it to also include those dens with greater than 100 cm snow depth. Based on the distribution of snow depths used by Wilson and Durner (2020) derived from data in Durner et al. (2003), we determined that 24 percent of dens have snow depths greater than 100 cm. After taking these into account, the overall detection probability from Wilson and Durner (2020) including dens with snow depths greater than 100 cm was estimated to be 0.54. This led to a mean detection of 0.41 and standard deviation of 0.15 across the three studies. We used these values, and the method of moments (Hobbs and Hooten 2015), to inform a Beta distribution:

$$p \sim Beta\left(\frac{0.41^2 - 0.41^3 - 0.41 \times 0.154^2}{0.154^2}, \frac{0.41 - 2 \times 0.41^2 + 0.41^3 - 0.154^2 + 0.41 \times 0.154^2}{0.154^2}\right)$$

from which we drew a detection probability (p) for each of the simulated AIR surveys during each iteration of the model.

Model implementation

For each iteration of the model, we first determined which dens were exposed to the proposed infrastructure. We assumed that any den within 1 mile of infrastructure or human activities was exposed (MacGillivray et al. 2003, Larson et al. 2020), excluding those detected during an AIR survey. We then identified the stage in the denning cycle when the exposure occurred based on the date range of the activities the den was exposed to: den establishment (i.e., initial entrance into den until cubs are born), early denning (i.e., birth of cubs until they are 60 days old), late denning (i.e., date cubs are 60 days old until den emergence) and post-emergence (i.e., the date of den emergence until permanent departure from the den site). We then determined whether the exposure elicited a response by the denning bear based on probabilities derived from the reviewed case studies (Woodruff et al. 2022b). Specifically, for discrete and repeated exposures during each period, we divided the number of cases that documented responses associated with either an MMPA Level B harassment (i.e., has the potential to an animal by causing disruption of behavioral patterns), MMPA Level A harassment (i.e., has the potential to injure an animal), or lethal take (i.e., cub abandonment which is assumed to result in the death of the cub) of bears by the total number of cases with that combination of period and exposure type (Table B1). Level B harassment was applicable to both adults and cubs, if present, whereas Level A harassment and lethal take were only applicable to cubs. For the sake of this analysis, we primarily focused on lethal take and serious Level A harassment (i.e., where the potential injury is likely to result in mortality) of cubs during the early denning, late denning, and post-emergence periods, but also report results for all types of Level A harassment (i.e., both serious and non-serious forms of Level A harassment) plus lethal take.

For dens exposed to any form of continuous activity, we used a multinomial distribution with the probabilities of different levels of take for that period (Table B1) to determine whether a den was disturbed or not. If a Level A harassment or lethal take was simulated to occur, a den was not allowed to be disturbed again during the subsequent denning periods because the outcome of that denning event was already determined. We took a similar approach for dens exposed to discrete activity, whereby every day that a discrete exposure occurred, a random draw from a multinomial distribution was obtained for the probabilities associated with the denning period (Table B.1). For this analysis, we assumed all activity was continuous throughout the denning period, except for AIR flights, which we assumed occurred at a discrete time.

The level of MMPA take associated with a disturbance varied according to the severity and timing of the exposure (Table B.1). Exposures that resulted in abandonment of cubs (during late denning or post-emergence) or emergence from dens prior to cubs reaching 60 days of age were considered lethal takes of cubs. If a disturbance resulted in den emergence prior to the date assigned to the den in the absence of disturbance, the level of MMPA take was considered serious Level A harassment. If a post-emergence exposure resulted in bears leaving the den site prior to the non-exposure departure date, the outcome was classified as a non-serious MMPA Level A harassment (i.e., a potential injury that is unlikely to result in mortality) for each cub.Adult females received MMPA Level B harassment for any disturbance. Cubs could similarly be applied an MMPA Level B harassment during the post-emergence time period if only a behavioral response was simulated to have occurred.

We developed the code to run this model in program R (R Core Development Team 2022) and ran 10,000 iterations of the model (i.e., Monte Carlo simulation) to derive the estimated number of dens disturbed and associated levels of take. For each of the 30 years of the application, we determined the number of cubs that would experience lethal take or serious MMPA Level A harassment. The activity present during each year of the simulations was based on information contained in the application, so it varied during the first 8 years of the project period. We then calculated the total expected number of lethal take and serious Level A harassment over the entire 30-year period.

Model results

On average, we estimated 0.40 cubs (median = 0.00; 95% CI: 0.00 – 3.00; Table B2) could experience lethal take or serious MMPA Level A harassment over the 30-year period of activity. The mean number of lethal takes and all (i.e., serious or non-serious) MMPA Level A harassment during the 30-year period of activity was 0.70 (median = 0.00; 95% CI: 0.00 – 4.00; Table B2). During the first 8 years of activity, a mean of 0.02 (median = 0.00; 95% CI: 0.00 – 0.00; Table B2) cubs were expected to experience either lethal take or serious MMPA Level A harassment each year. For years 9-30, we estimated an annual mean of 0.01 (median = 0.00; 95% CI: 0.00 – 0.00; Table B.2) cubs were expected to experience either lethal take or serious MMPA Level A harassment each year.

We also used the model to assess the probability that >0 lethal takes or serious MMPA Level A harassments occurring over the entire 30-year period of activity. Over the 30-year life of the project we estimate that the probability of >0 serious Level A harassments + lethal takes occurring was 0.19 (i.e., a 19% probability of one or more such takes occurring, is thus an 81% probability that 0 such takes occur; Table B.2). We further assessed the probability of >0 Level A harassments (either serious or non-serious) or lethal takes occurring over the entire 30-year period of activities. For all types of Level A harassment plus lethal takes, the probability of >0 MMPA takes occurring was 0.30 (i.e., 70% probability that 0 MMPA takes occur; Table B2).

Table B.1. Probability that a discrete or repeated exposure elicited a response by denning polar bears that would result in MMPA take (i.e., Level B harassment, Level A harassment, or lethal take) from the Willow Project. Level B harassment was applicable to both adults and cubs, if present; Level A harassment and lethal take were applicable to cubs only and were not possible during the den establishment period, which ended with the birth of cubs. Probabilities were calculated from the analysis of 56 case studies of polar bear responses to human activity. During the early denning period, there was no Level A harassment for cubs, only lethal take or Level B harassment. Level A harassment are considered ‘serious’ when they occur during the late denning period only.

Exposure type	Period	Level B	Level A	Lethal	No Take
Discrete	den establishment	0.600	NA	NA	0.400
	early denning	NA	NA	0.000	1.000
	late denning	0.000	0.909	0.000	0.091
	post-emergence	0.000	1.000	0.000	0.000
Repeated	den establishment	0.000	NA	NA	1.000
	early denning	0.000	NA	0.200	0.800
	late denning	0.000	0.292	0.000	0.708
	post-emergence	0.267	0.733	0.000	0.000

Table B.2. Estimated amount of MMPA take occurring during different periods of the proposed Project; i.e., years 1 –8, and 9 – 30. For the two yearly periods, MMPA take is reported on an annual basis for both lethal take and serious Level A harassment (lethal + serious Level A harassment) take combined, and lethal take and all Level A harassment (lethal + all Level A harassment). The mean, median, and 95% Confidence Intervals are reported for each estimate. The probability of >0 MMPA takes occurring (P) is also reported. The cumulative levels and probabilities of MMPA take are also reported for the full 30-year period.

	Lethal + Serious Level A Harassment				Lethal + all Level A Harassment			
Years	Mean	Median	95% CI	*P*	Mean	Median	95% CI	*P*
1 – 8	0.02	0.00	0.00 – 000	0.01	0.03	0.00	0.00 – 0.00	0.02
9 – 30	0. 01	0.00	0.00 – 0.00	0.01	0.02	0.00	0.00 – 0.00	0.01
Cumulative	0.40	0.00	0.00 – 3.00	0.19	0.70	0.00	0.00 – 4.00	0.30