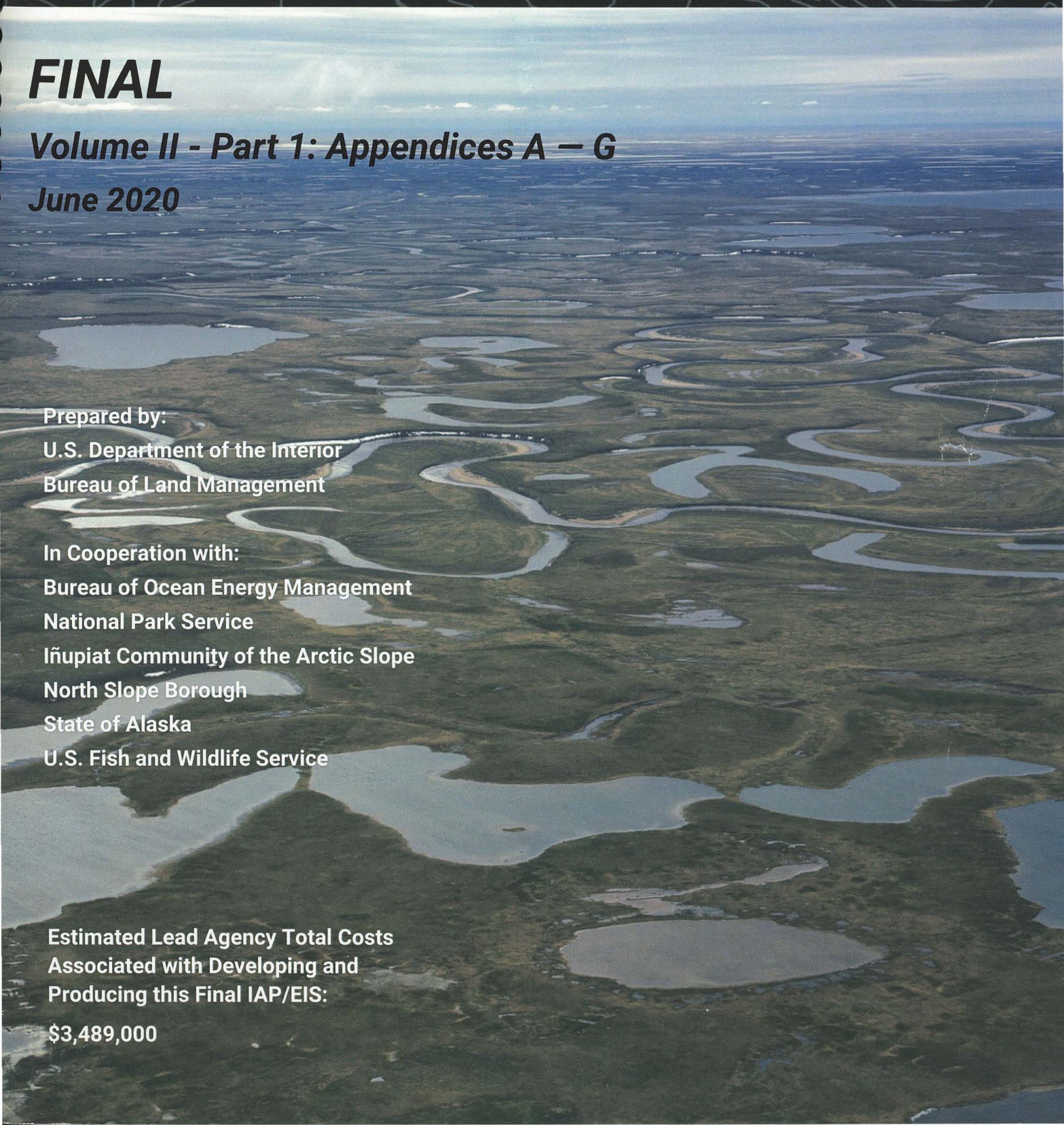
U.S. Department of the Interior
Bureau of Land Management

National Petroleum Reserve in Alaska

Integrated Activity Plan and Environmental Impact Statement



FINAL

Volume II - Part 1: Appendices A — G

June 2020

Prepared by:
U.S. Department of the Interior
Bureau of Land Management

In Cooperation with:
Bureau of Ocean Energy Management
National Park Service
Iñupiat Community of the Arctic Slope
North Slope Borough
State of Alaska
U.S. Fish and Wildlife Service

Estimated Lead Agency Total Costs Associated with Developing and Producing this Final IAP/EIS:

$3,489,000

Mission

To sustain the health, diversity, and productivity of the public lands for the use and enjoyment of present and future generations.

Cover Photo: Northeast National Petroleum Reserve in Alaska.
Photo by Bob Wick (BLM).

DOI-BLM-AK-R000-2019-0001-EIS

BLM/AK/PL-20/018+1610+F010

National Petroleum Reserve in Alaska

Integrated Activity Plan and Environmental Impact Statement

Volume II—Part 1: Appendices A — G

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$3,489,000

APPENDICES

Appendix A
Maps

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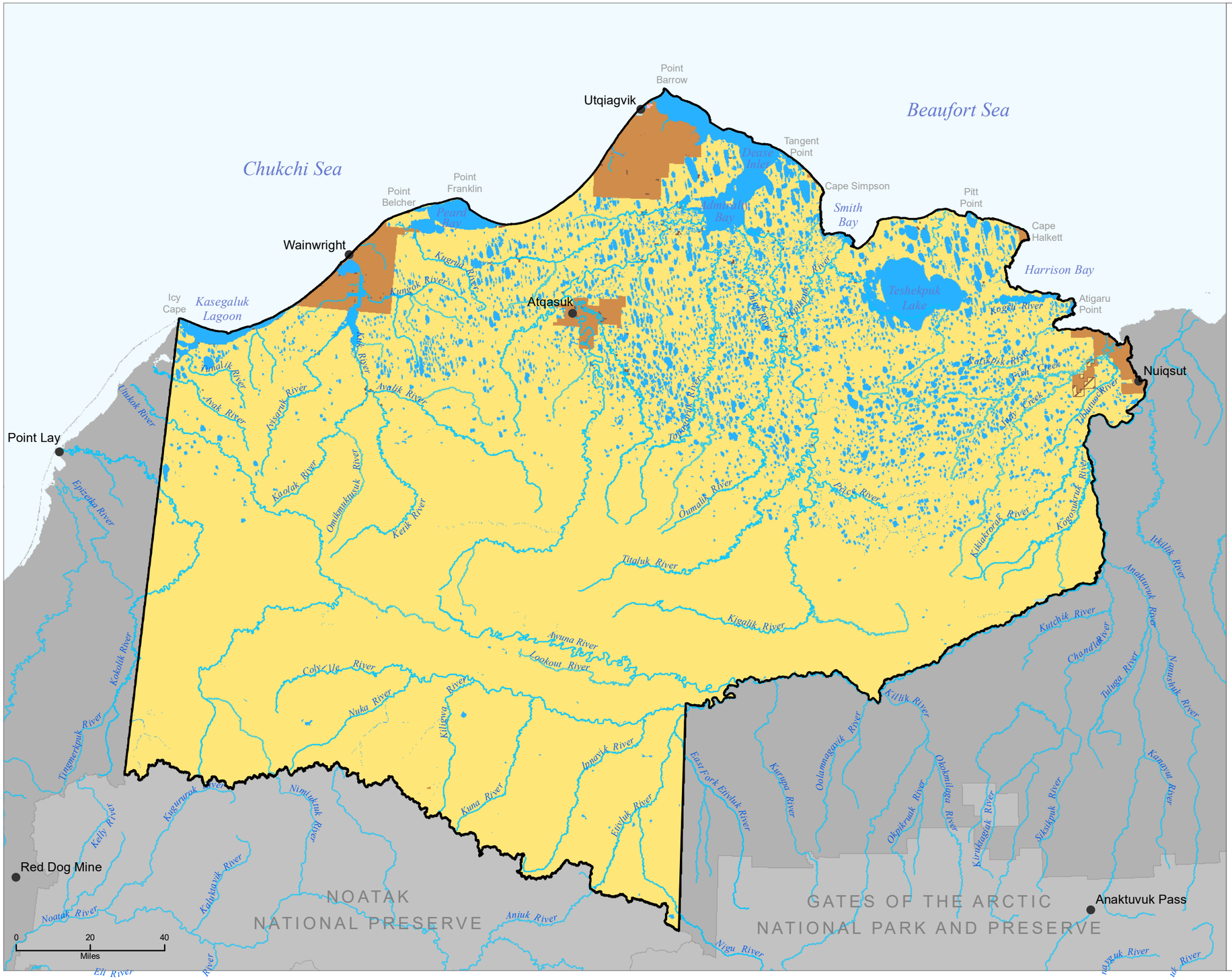
Appendix A. Maps

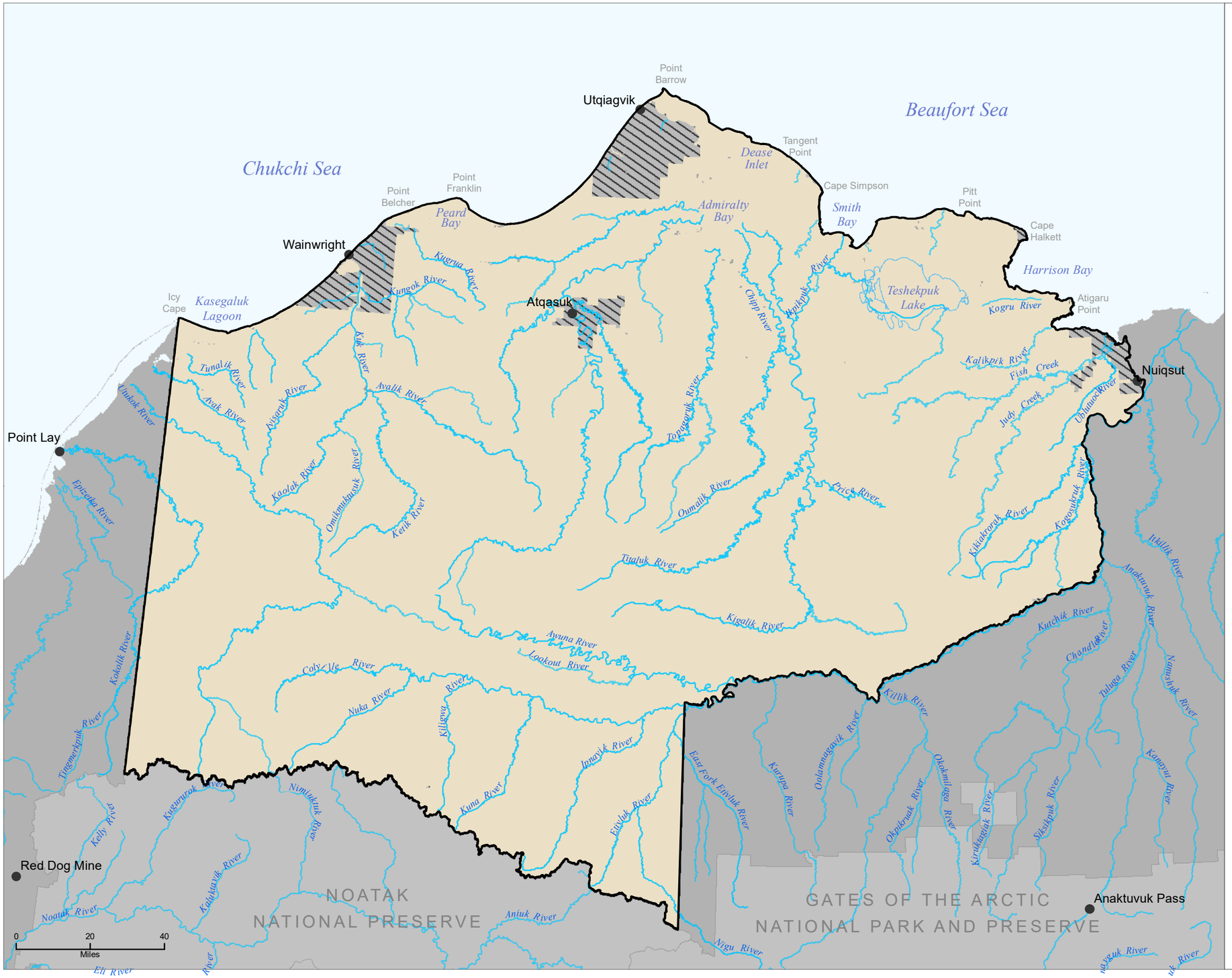


- Bureau of Land Management (BLM)
- Native-selected
- Water (inside the planning area, administered by BLM)
- Alaska Native land, including Alaska Native Claims Settlement Act (ANCSA) regional or village corporations
- Native allotment owned by a private individual
- Navy
- State

- National Petroleum Reserve-Alaska

Data source: BLM GIS 2019
Print date: 06/10/2020

Map 1-1



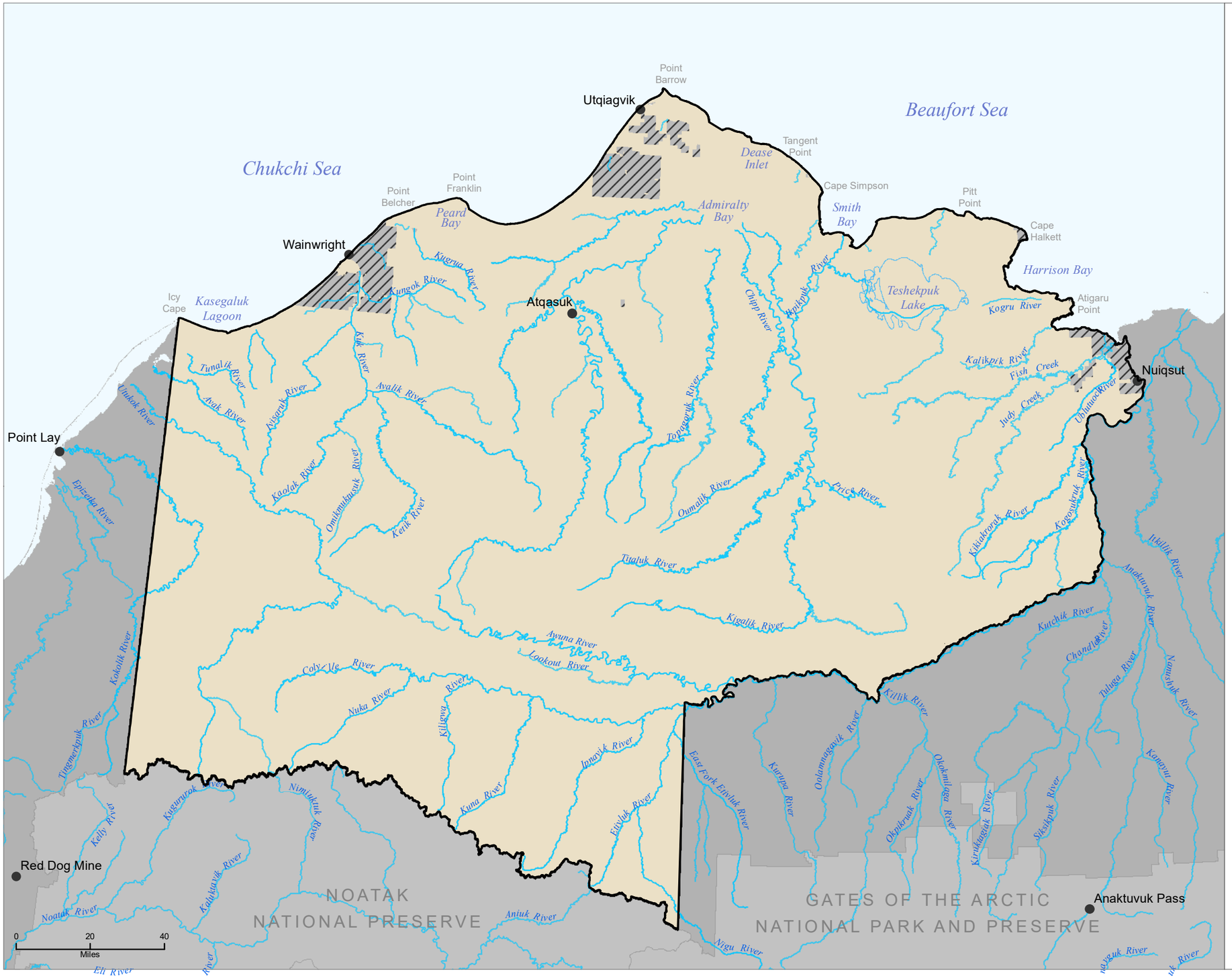
Bureau of Land Management (BLM), within BLM's surface authority

Outside the BLM's surface authority

National Petroleum Reserve-Alaska

Data source: BLM GIS 2019
Print date: 05/07/2020

Map 1-2



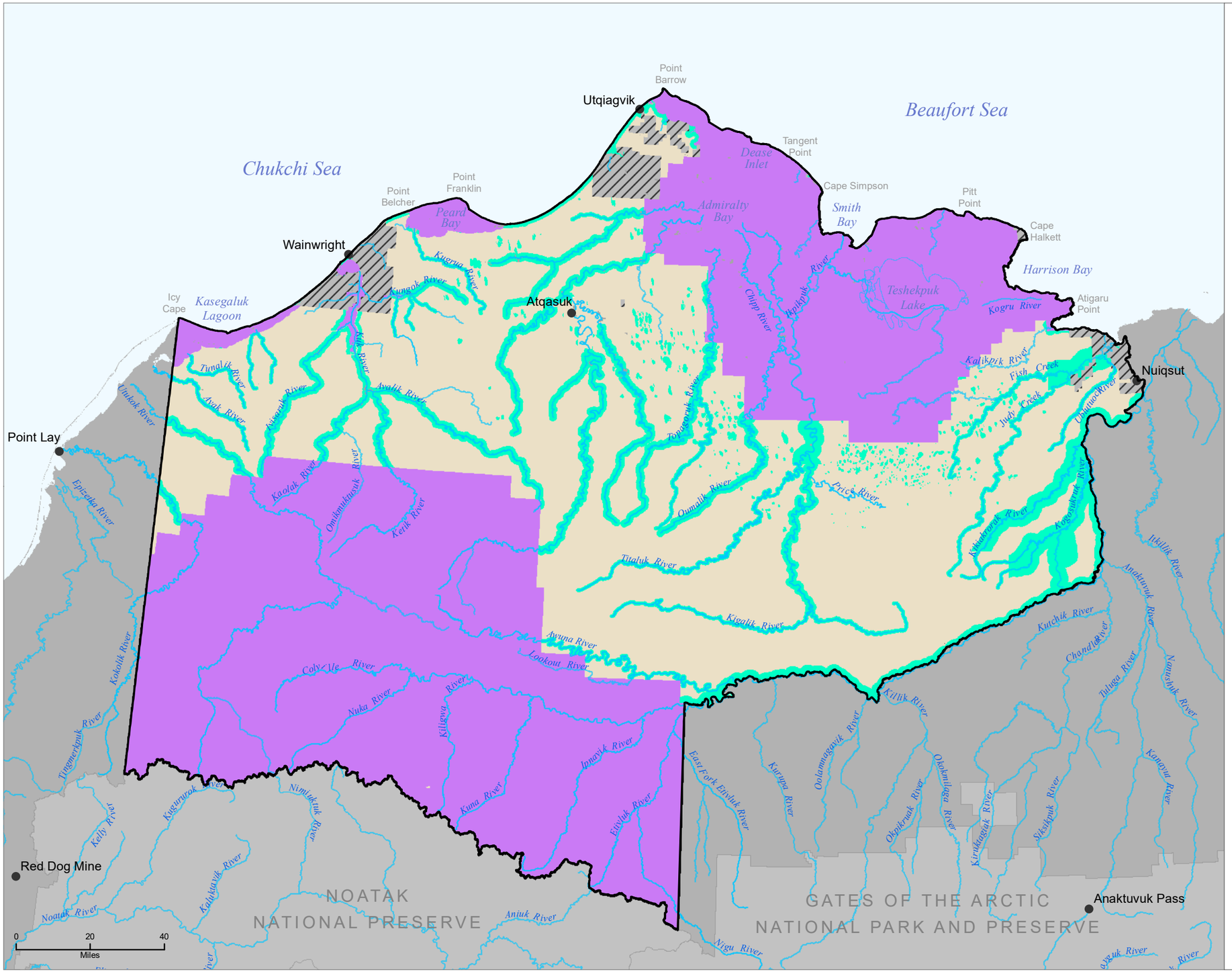
Bureau of Land Management (BLM), within BLM's subsurface authority

Outside the BLM's subsurface authority

National Petroleum Reserve-Alaska

Data source: BLM GIS 2019
Print date: 05/07/2020

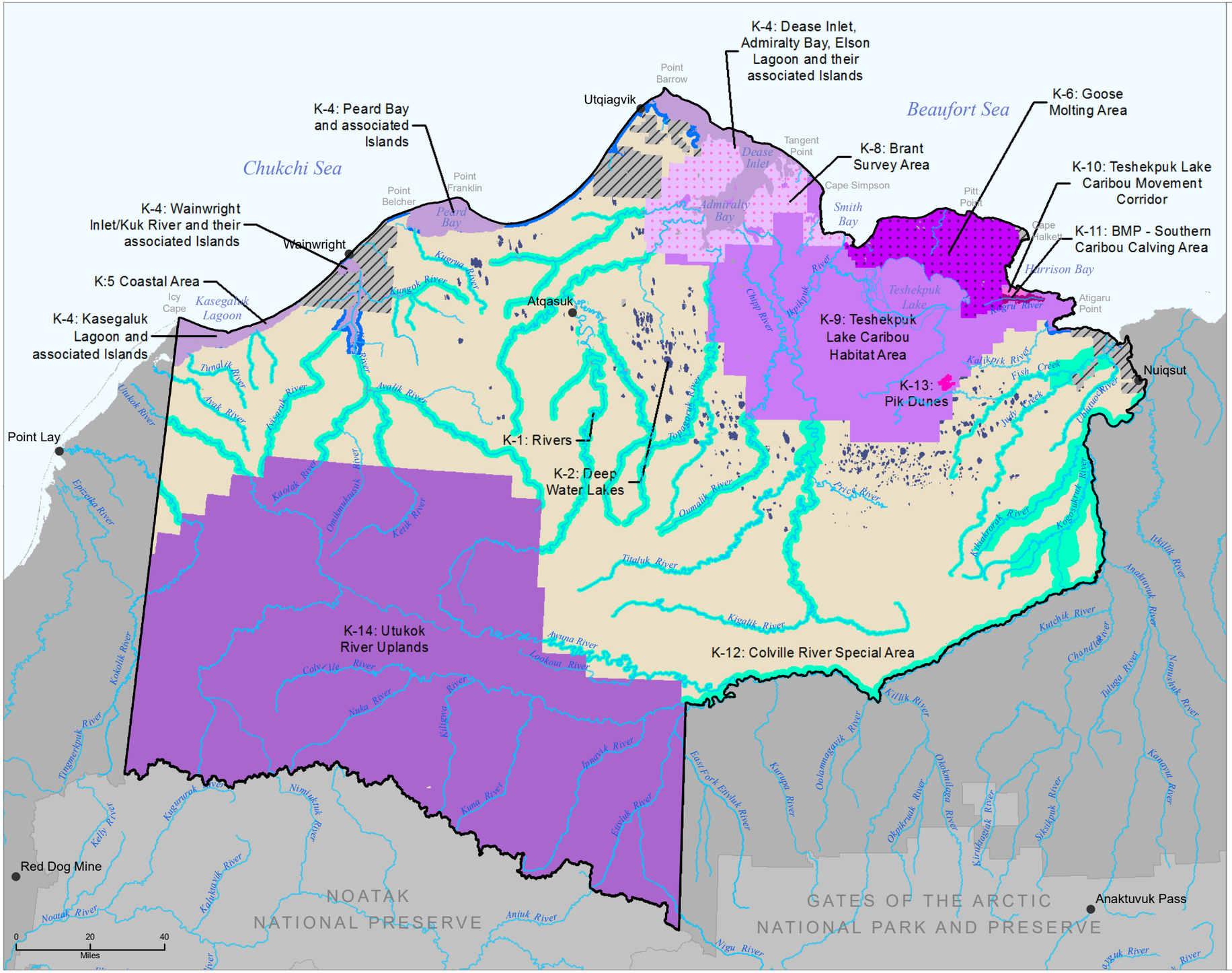
Map 1-3



- Closed to fluid mineral leasing
- Open to fluid mineral leasing, subject to no surface occupancy
- Open to fluid mineral leasing, subject to controlled surface use (none)
- Open to fluid mineral leasing, subject to a timing limitation (none)
- Open to fluid mineral leasing, subject to only standard terms and conditions
- National Petroleum Reserve-Alaska
- Outside the BLM's subsurface authority

Data source: BLM GIS 2019
Print date: 06/10/2020

Map 2-1



Closed to fluid mineral leasing

- K-4: lagoons, inlets, and associated islands
- K-6: goose molting area
- K-8: brant survey area
- K-9: Teshekpuk Lake caribou habitat area
- K-10: Teshekpuk Lake caribou movement corridor
- K-11: southern caribou calving area
- K-13: Pik Dunes
- K-14: Utukok River Uplands

Open to fluid mineral leasing, subject to no surface occupancy

- K-1: river setbacks
- K-2: deep water lakes
- K-5: coastal area

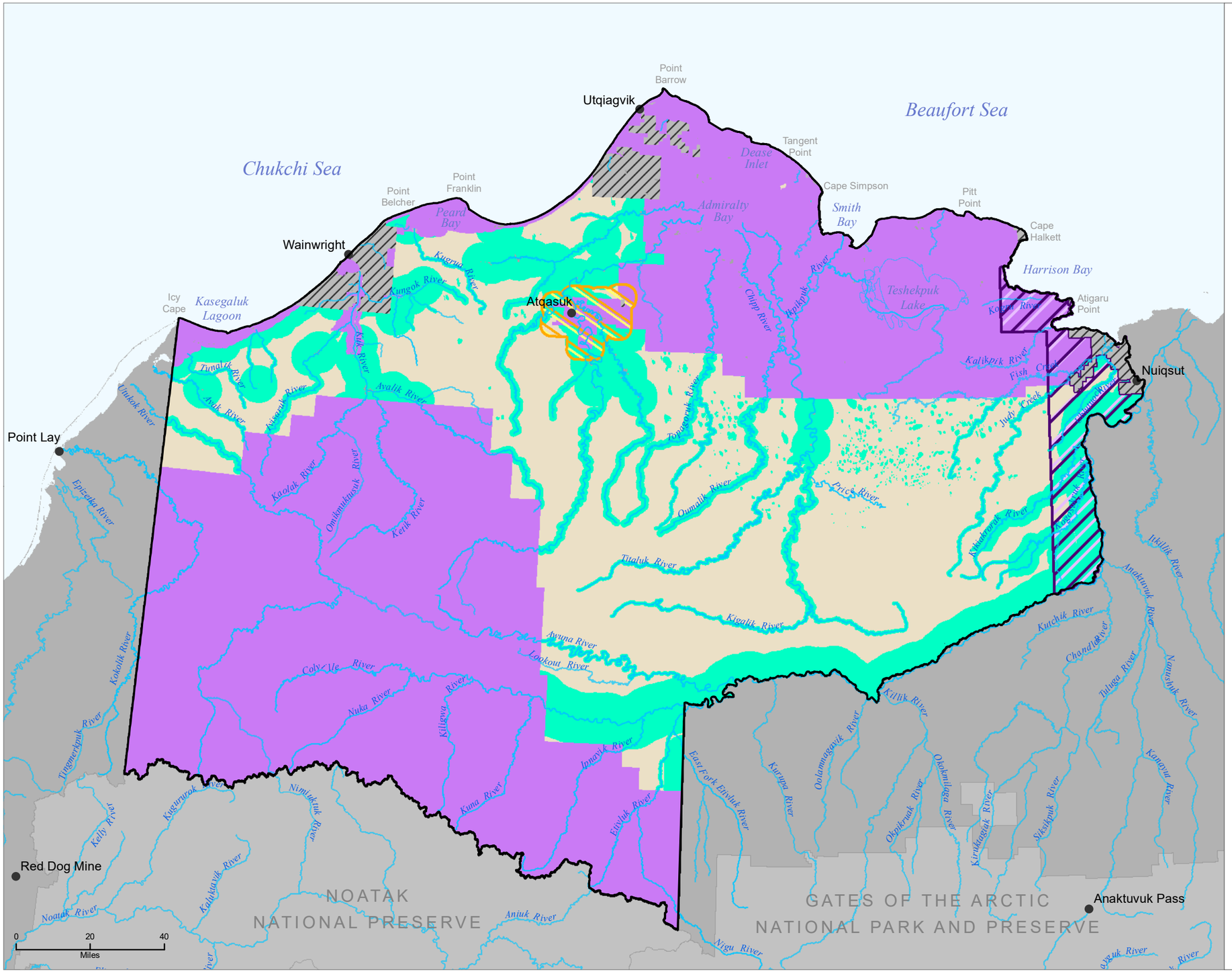
Open to fluid mineral leasing, subject to only standard terms and conditions

National Petroleum Reserve-Alaska

Outside the BLM's subsurface authority

Data source: BLM GIS 2019
Print date: 06/10/2020

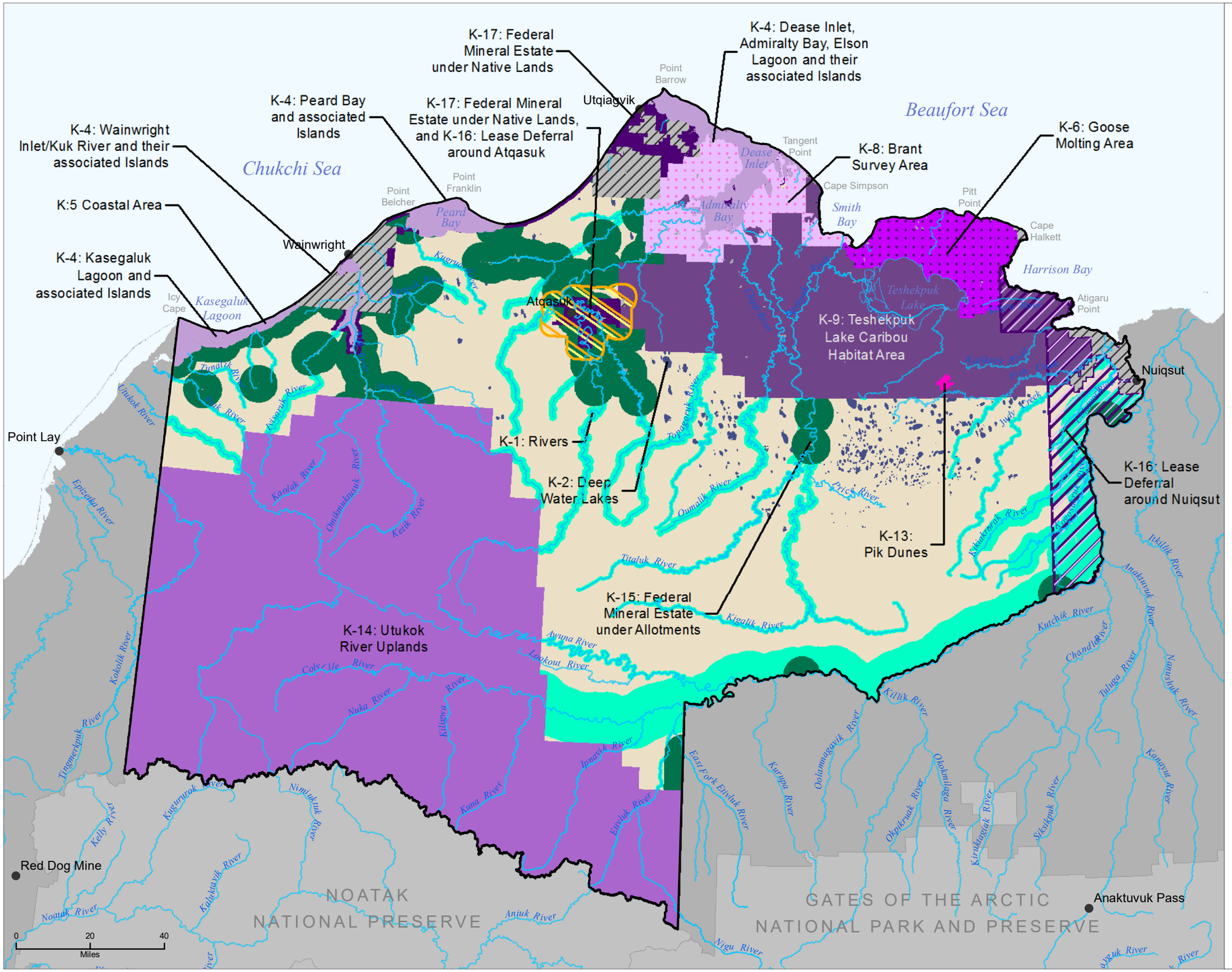
Map 2-2



- Closed to fluid mineral leasing
- Open to fluid mineral leasing, subject to no surface occupancy
- Open to fluid mineral leasing, subject to controlled surface use (none)
- Open to fluid mineral leasing, subject to a timing limitation (none)
- Open to fluid mineral leasing, subject to only standard terms and conditions
- Lease deferral around Nuiqsut, no leasing for 10 years
- Lease deferral around Atqasuk, no leasing for 5 years
- National Petroleum Reserve-Alaska
- Outside the BLM's subsurface authority

Data source: BLM GIS 2019
Print date: 06/10/2020

Map 2-3



Closed to fluid mineral leasing

- K-4: lagoons, inlets, and associated islands
- K-6: goose molting area
- K-8: brant survey area
- K-9: Teshekpuk Lake caribou habitat area
- K-13: Pik Dunes
- K-14: Utukok River Uplands
- K-16: lease deferral around Nuiqsut, no leasing for 10 years
- Lease deferral around Atqasuk, no leasing for 5 years
- K-17: federal mineral estate under Native lands

Open to fluid mineral leasing, subject to no surface occupancy

- K-1: river setbacks
- K-2: deep water lakes
- K-5: coastal area
- K-15: federal mineral estate under allotments

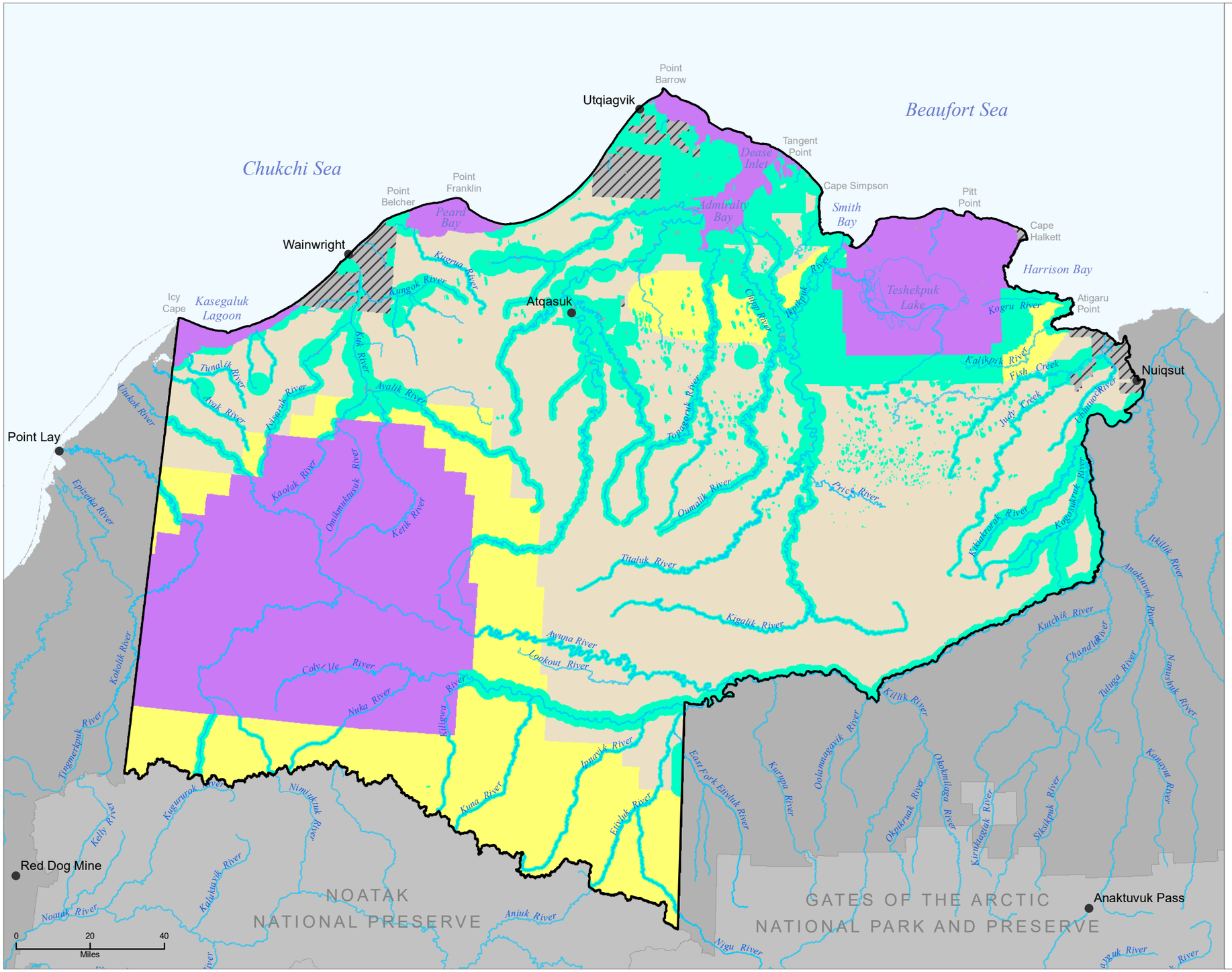
Open to fluid mineral leasing, subject to only standard terms and conditions

National Petroleum Reserve-Alaska

Outside the BLM's subsurface authority

Data source: BLM GIS 2019
Print date: 06/10/2020

Map 2-4

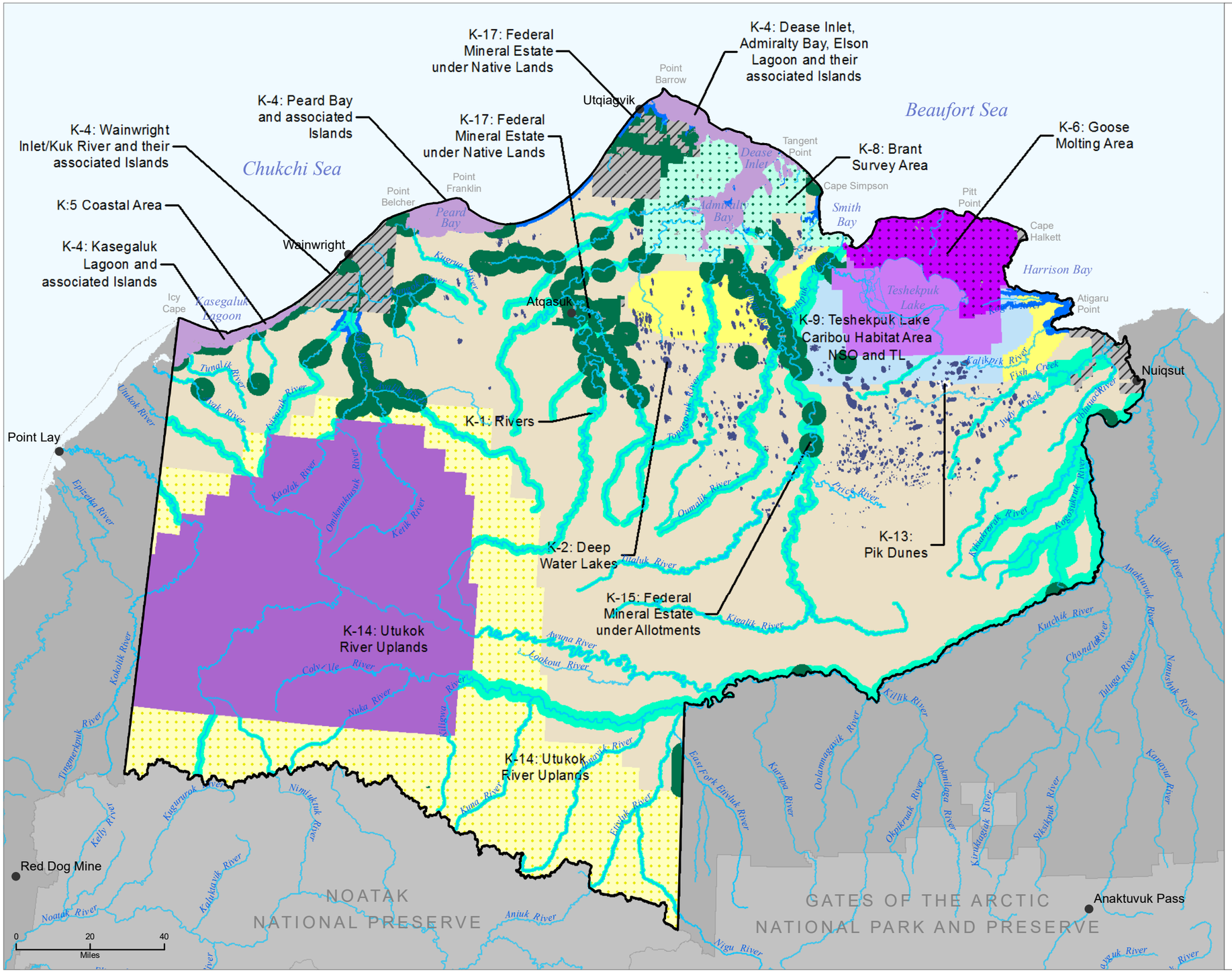


- Closed to fluid mineral leasing
- Open to fluid mineral leasing, subject to no surface occupancy
- Open to fluid mineral leasing, subject to controlled surface use (none)
- Open to fluid mineral leasing, subject to a timing limitation
- Open to fluid mineral leasing, subject to only standard terms and conditions

- National Petroleum Reserve-Alaska
- Outside the BLM's subsurface authority

Data source: BLM GIS 2019
Print date: 06/10/2020

Map 2-5



Closed to fluid mineral leasing

- K-4: lagoons, inlets, and associated islands
- K-6: goose molting area
- K-9: Teshekpuk Lake caribou habitat area
- K-13: Pik Dunes
- K-14: Utukok River Uplands

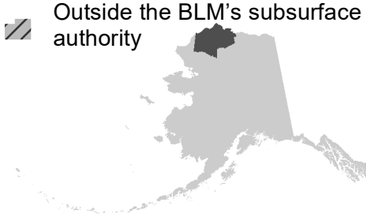
Open to fluid mineral leasing, subject to no surface occupancy (NSO)

- K-1: river setbacks
- K-2: deep water lakes
- K-5: coastal area
- K-8: brant survey area
- K-9: Teshekpuk Lake caribou habitat area
- K-15: federal mineral estate under allotments
- K-17: federal mineral estate under Native lands

Open to fluid mineral leasing, subject to a timing limitation (TL)

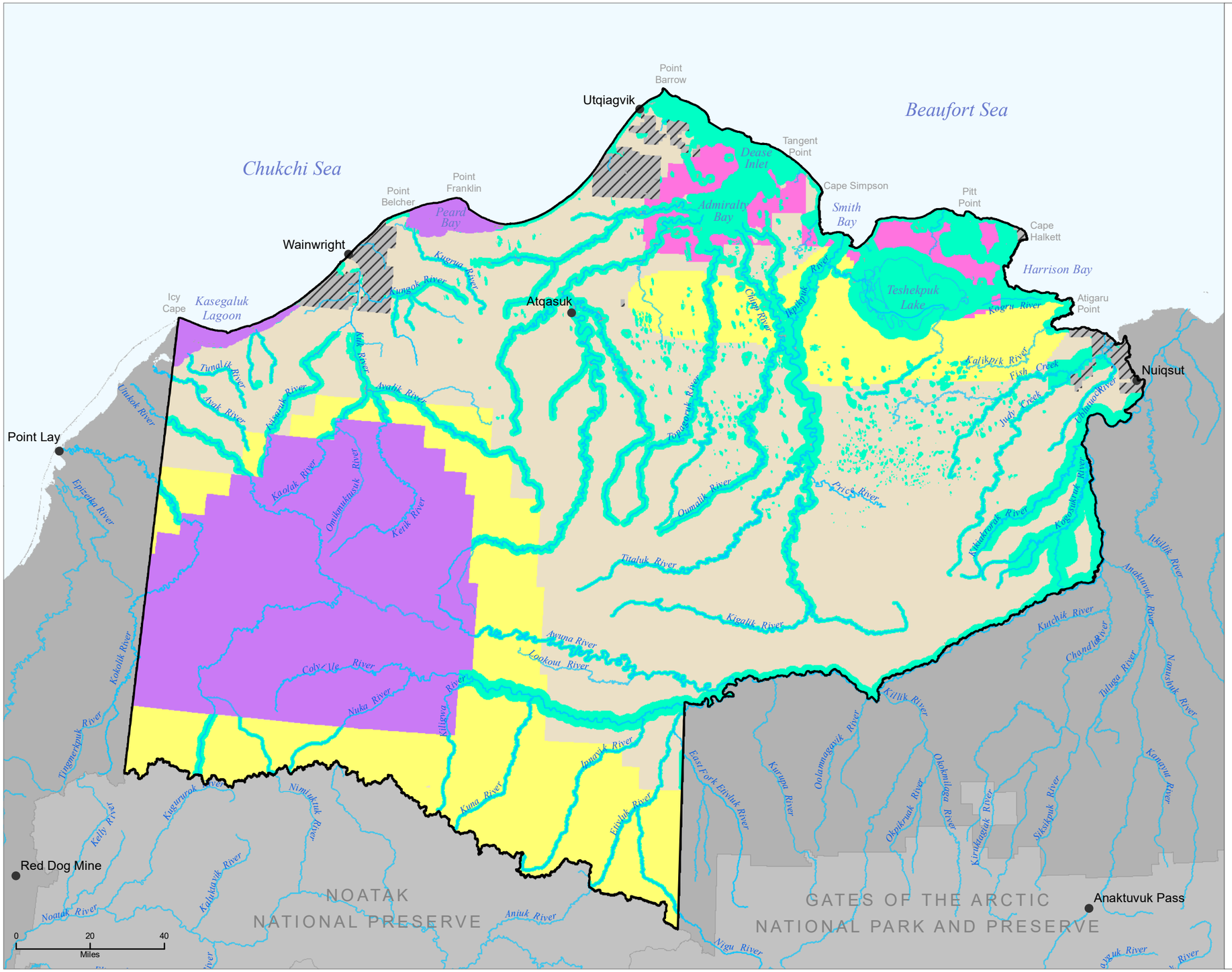
- K-9: Teshekpuk Lake caribou habitat area
- K-14: Utukok River Uplands Special Area

- Open to fluid mineral leasing, subject to only standard terms and conditions
- National Petroleum Reserve-Alaska
- Outside the BLM's subsurface authority



Data source: BLM GIS 2019
Print date: 06/10/2020

Map 2-6



- Closed to fluid mineral leasing
- Open to fluid mineral leasing, subject to no surface occupancy
- Open to fluid mineral leasing, subject to controlled surface use
- Open to fluid mineral leasing, subject to a timing limitation
- Open to fluid mineral leasing, subject to only standard terms and conditions

- National Petroleum Reserve-Alaska
- Outside the BLM's subsurface authority

Data source: BLM GIS 2019
Print date: 06/10/2020

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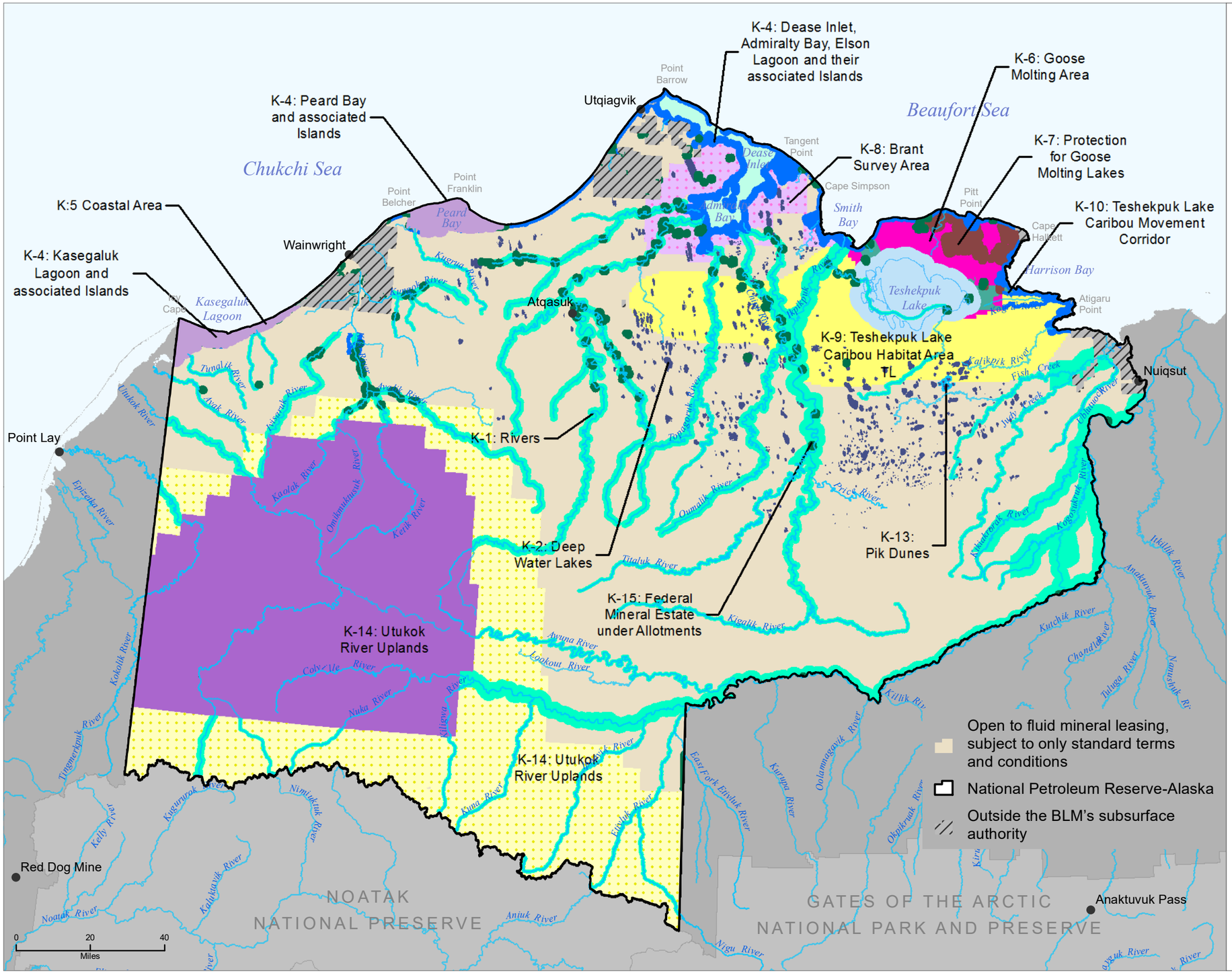
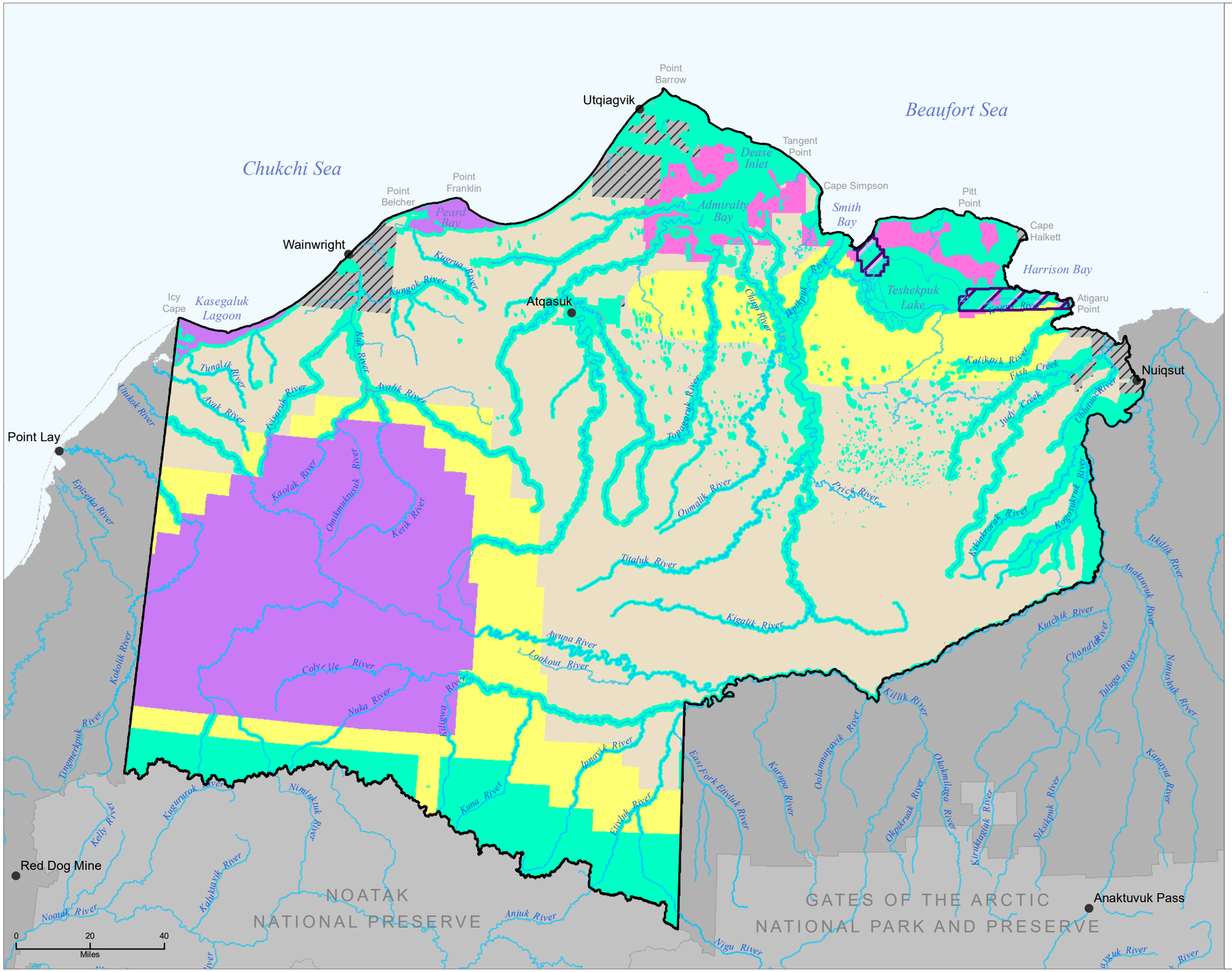
Map 2-7



Data source: BLM GIS 2019
Print date: 06/10/2020

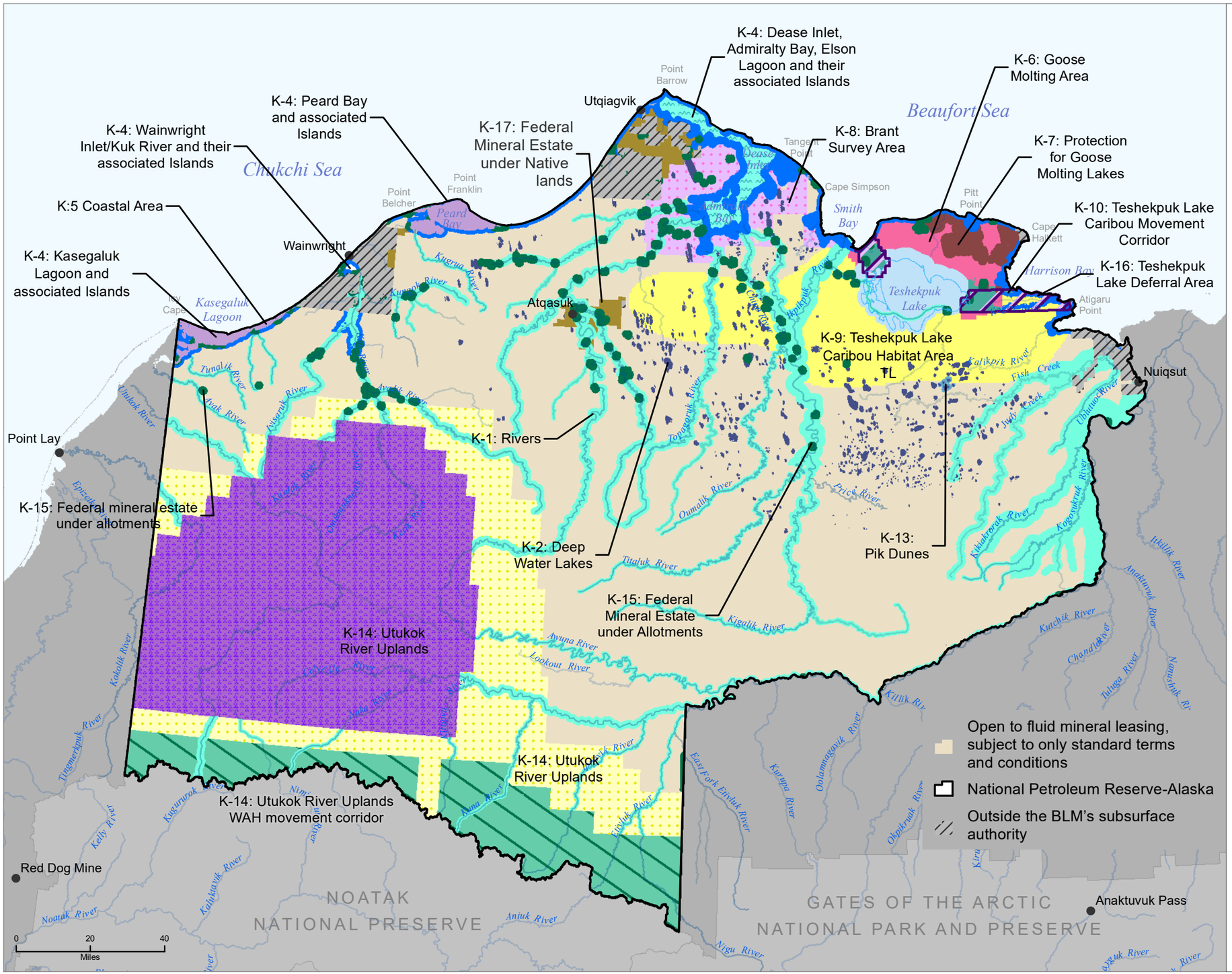
Map 2-8



- Closed to fluid mineral leasing
- Open to fluid mineral leasing, subject to no surface occupancy
- Open to fluid mineral leasing, subject to controlled surface use
- Open to fluid mineral leasing, subject to a timing limitation
- Open to fluid mineral leasing, subject to only standard terms and conditions
- Teshekpuk Lake Deferral Area, no leasing for 10 years
- National Petroleum Reserve-Alaska
- Outside the BLM's subsurface authority

Data source: BLM GIS 2019
Print date: 06/10/2020

Map 2-9



Closed to fluid mineral leasing

- K-4: lagoons, inlets, and associated islands
- K-14: Utukok River Uplands
- K-16: Teshekpuk Lake Deferral Area, no leasing for 10 years

Open to fluid mineral leasing, subject to no surface occupancy (NSO)

- K-1: river setbacks
- K-2: deep water lakes
- K-4: lagoons, inlets, and associated islands
- K-5: coastal area
- K-7: protection for goose molting lakes
- K-9: Teshekpuk Lake caribou habitat area
- K-10: Teshekpuk Lake caribou movement corridor
- K-13: Pik Dunes
- K-14: Utukok River Uplands Western Arctic Caribou Herd movement corridor
- K-15: federal mineral estate under allotments
- K-17: federal mineral estate under Native lands

Open to fluid mineral leasing, subject to controlled surface use

- K-6: goose molting area
- K-8: brant survey area

Open to fluid mineral leasing, subject to only standard terms and conditions

National Petroleum Reserve-Alaska

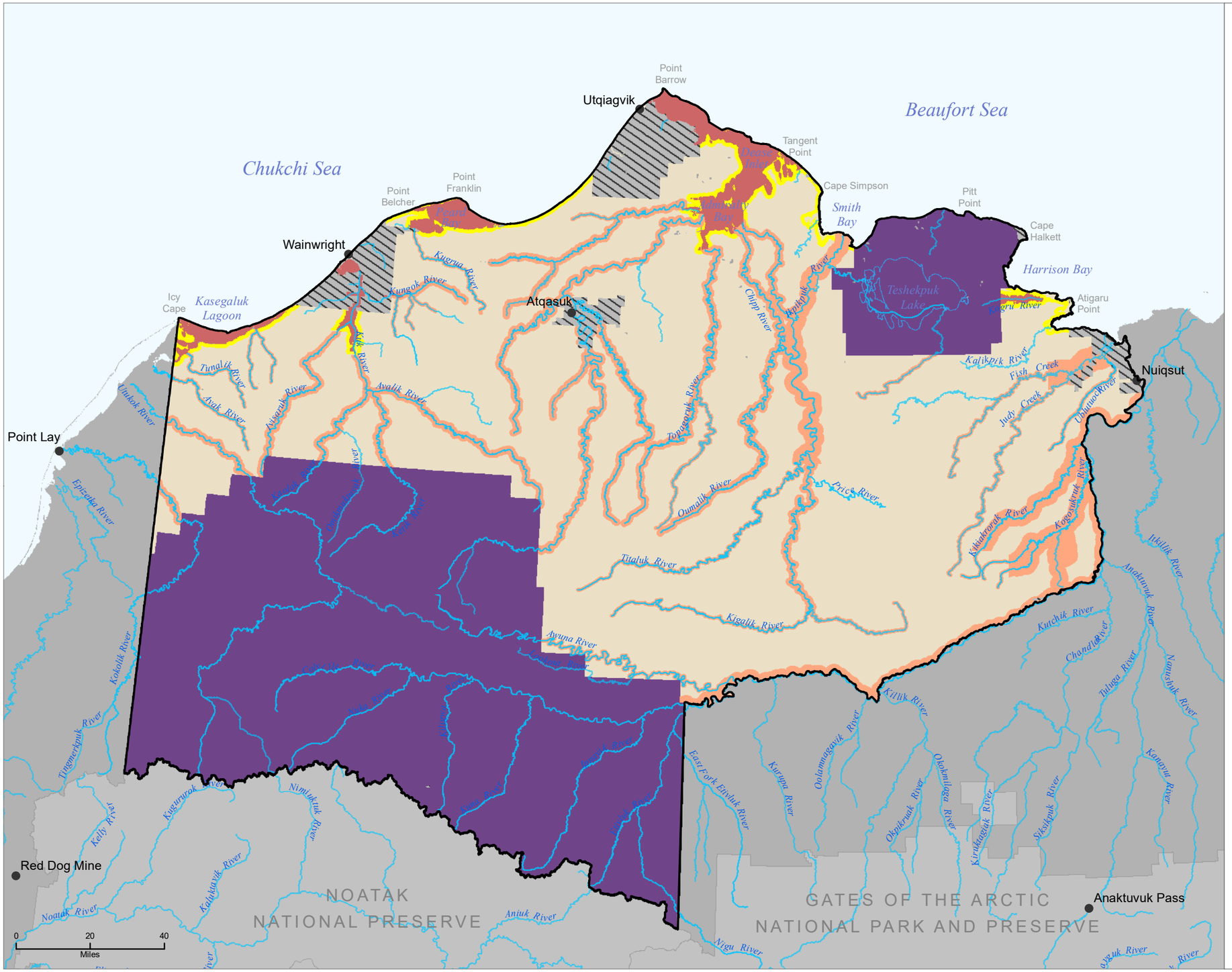
Outside the BLM's subsurface authority

Open to fluid mineral leasing, subject to a timing limitation (TL)

- K-9: Teshekpuk Lake caribou habitat area
- K-14: Utukok River Uplands Special Area

Data source: BLM GIS 2019
Print date: 06/10/2020

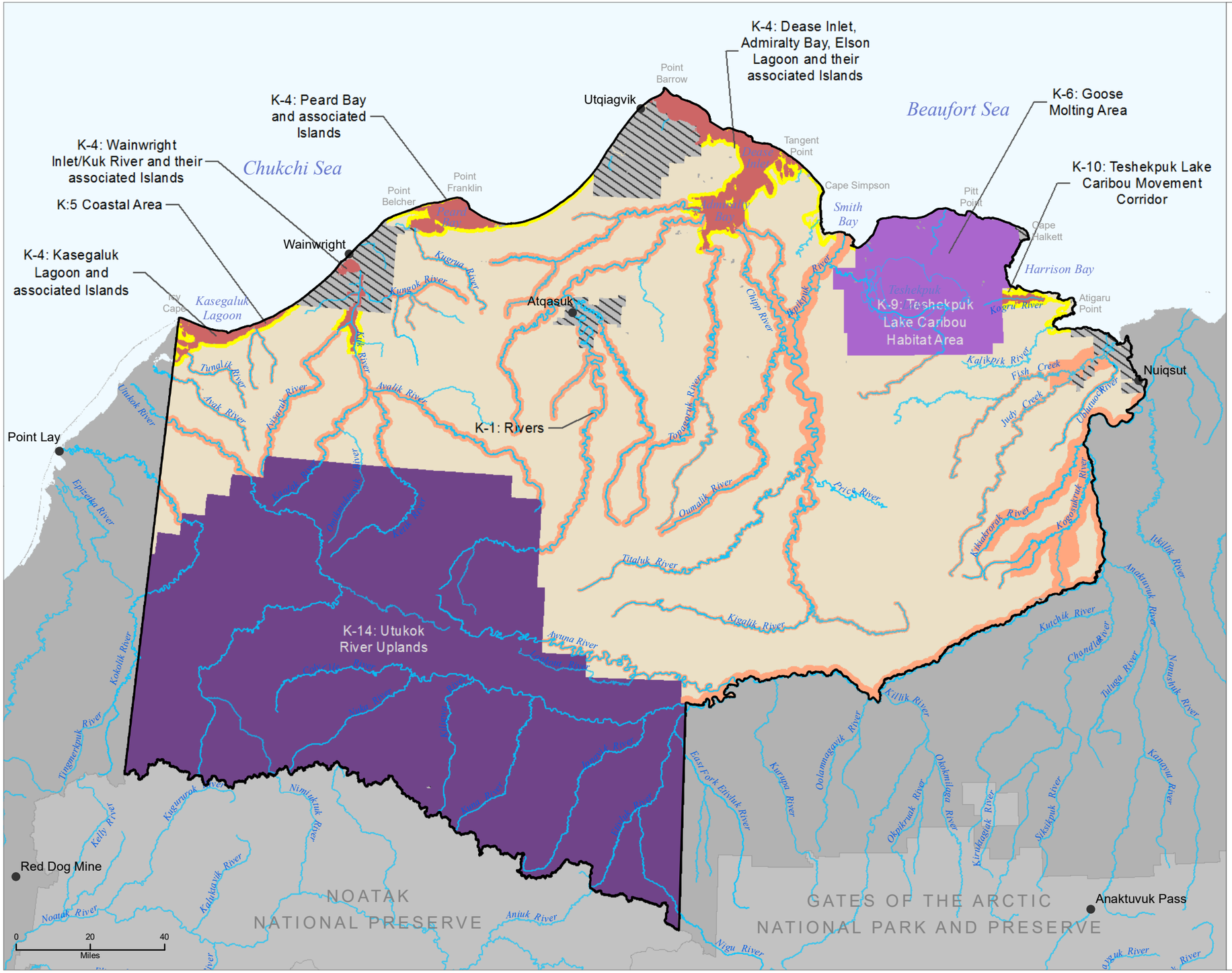
Map 2-10



- Unavailable for new infrastructure
- Unavailable for new infrastructure, except for essential pipeline crossings
- Unavailable for new infrastructure, except for essential roads and pipeline crossings
- Unavailable for new infrastructure, except for essential coastal infrastructure
- Available for new infrastructure
- National Petroleum Reserve-Alaska
- Outside the BLM's surface authority

Data source: BLM GIS 2019
Print date: 06/10/2020

Map 2-11



Unavailable for new infrastructure

- K-9: Teshekpuk Lake caribou habitat area
- K-14: Utukok River Uplands

Unavailable for new infrastructure, except for essential pipeline crossings

- K-4: lagoons, inlets, and associated islands

Unavailable for new infrastructure, except for essential roads and pipeline crossings

- K-1: river setbacks

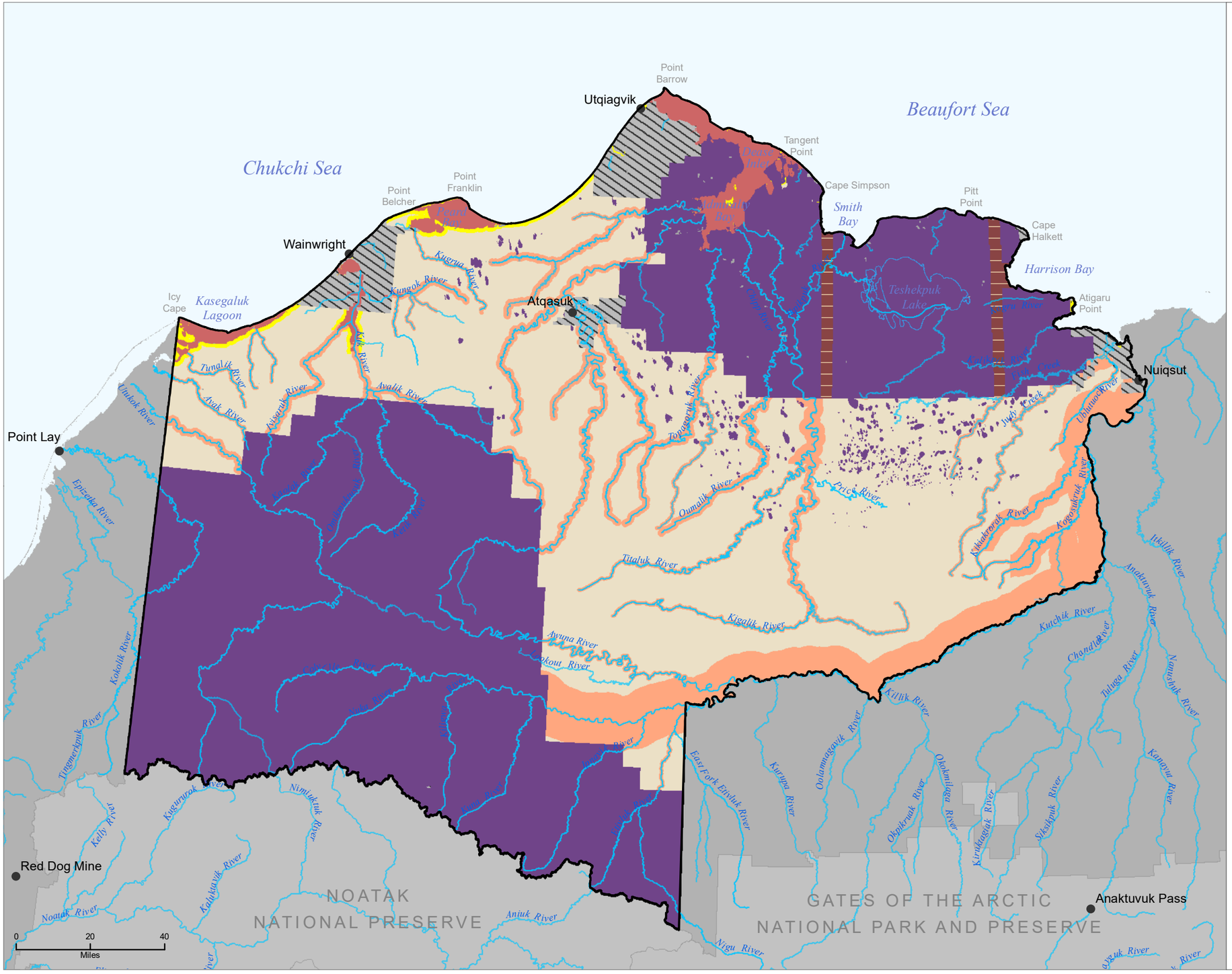
Unavailable for new infrastructure, except for essential coastal infrastructure

- K-5: coastal area
- Available for new infrastructure

- National Petroleum Reserve-Alaska
- Outside the BLM's surface authority

Data source: BLM GIS 2019
Print date: 06/10/2020

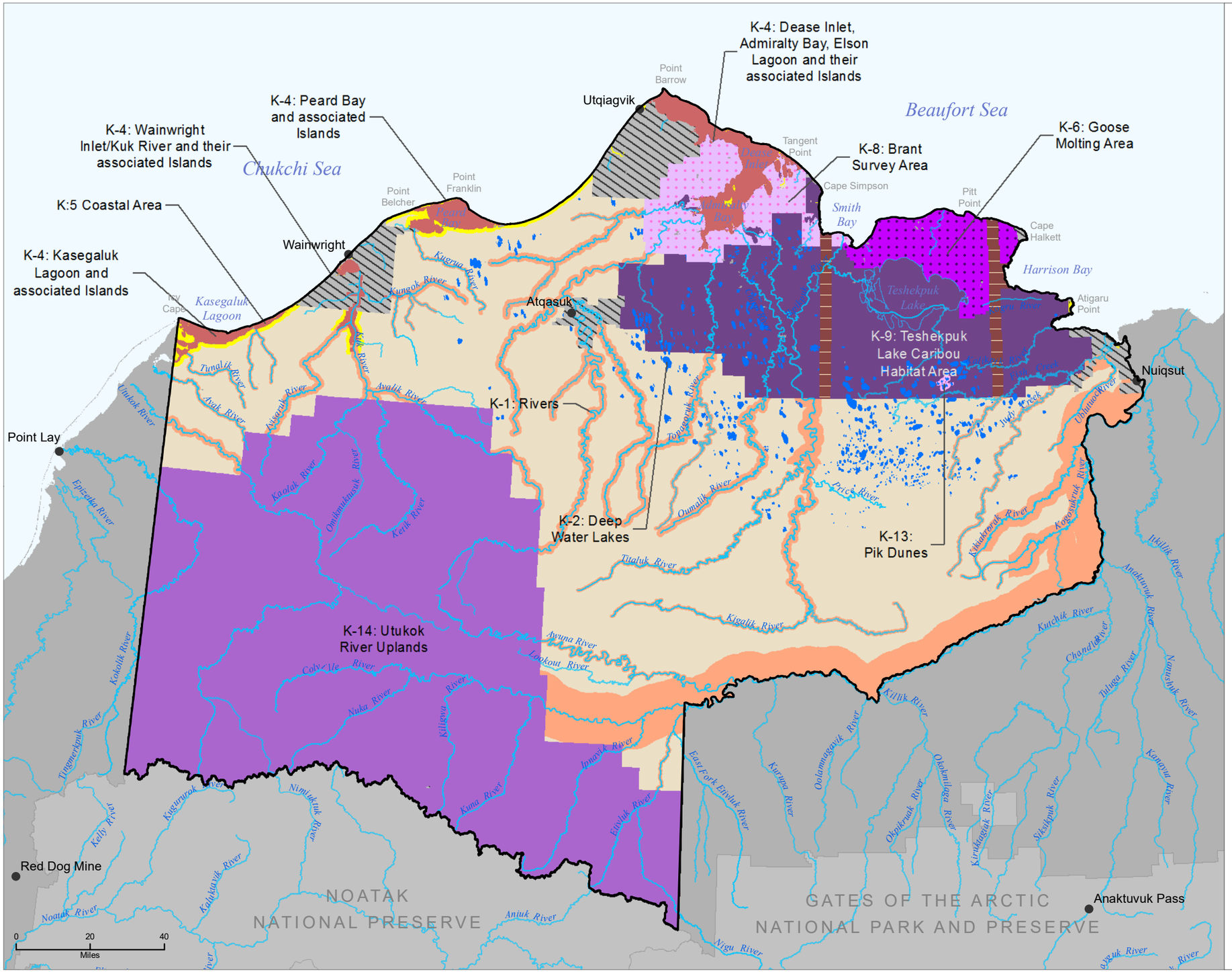
Map 2-12



- Unavailable for new infrastructure
- Unavailable for new infrastructure, except for essential pipeline crossings
- Unavailable for new infrastructure, except for essential roads and pipeline crossings
- Unavailable for new infrastructure, except for essential coastal infrastructure
- Available for new infrastructure
- Pipeline corridor: for representational purposes only, specific corridor locations would be developed in subsequent National Environmental Policy Act analyses
- National Petroleum Reserve-Alaska
- Outside the BLM's surface authority

Data source: BLM GIS 2019
Print date: 06/10/2020

Map 2-13



Unavailable for new infrastructure

- K-2: deep water lakes
- K-6: goose molting area
- K-8: brant survey area
- K-9: Teshekpuk Lake caribou habitat area
- K-13: Pik Dunes
- K-14: Utukok River Uplands

Unavailable for new infrastructure, except for essential pipeline crossings

- K-4: lagoons, inlets, and associated islands

Unavailable for new infrastructure, except for essential roads and pipeline crossings

- K-1: river setbacks

Unavailable for new infrastructure, except for essential coastal infrastructure

- K-5: coastal area

Available for new infrastructure

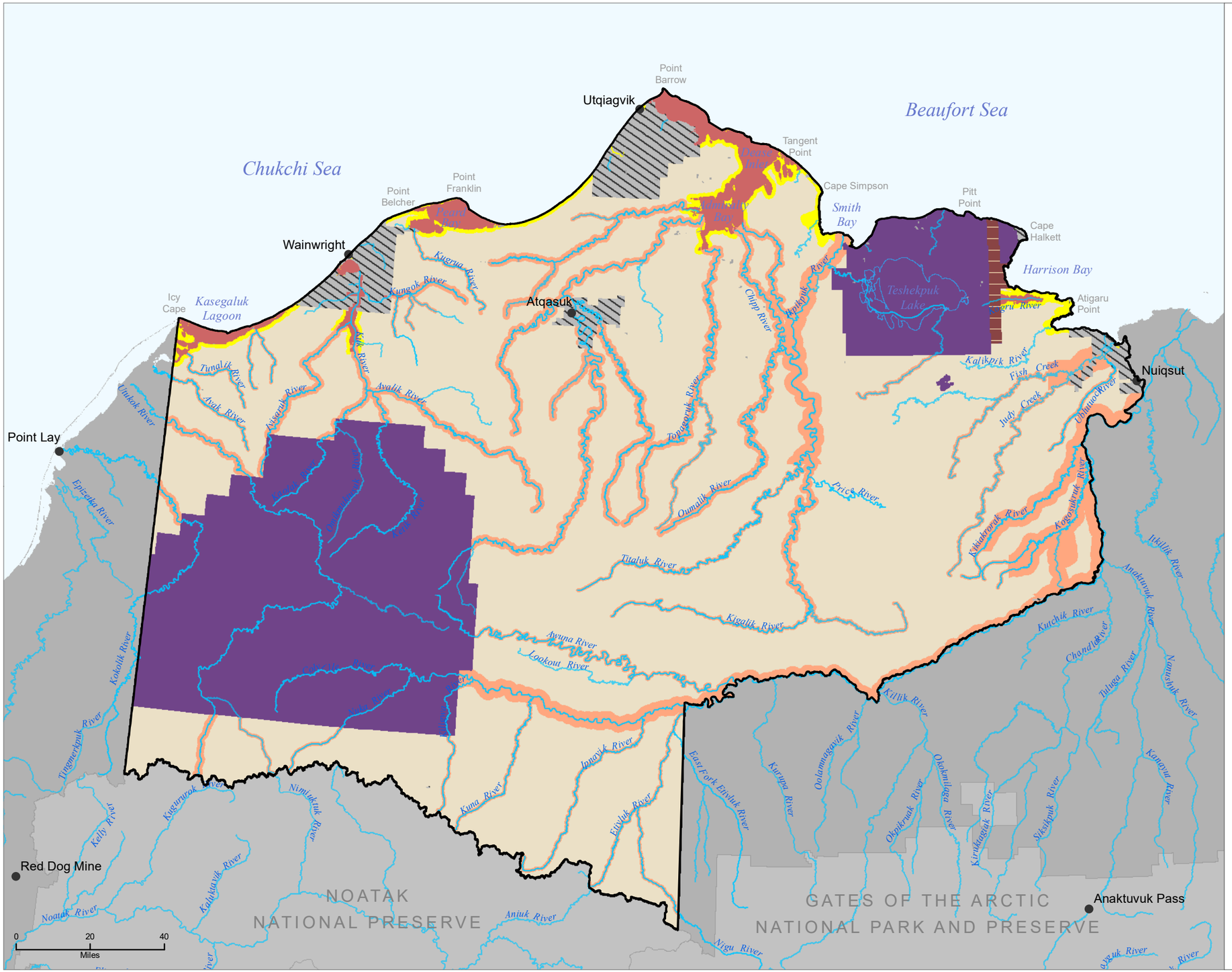
Pipeline corridor: for representational purposes only, specific corridor locations would be developed in subsequent National Environmental Policy Act analyses

National Petroleum Reserve-Alaska

Outside the BLM's surface authority

Data source: BLM GIS 2019
Print date: 06/10/2020

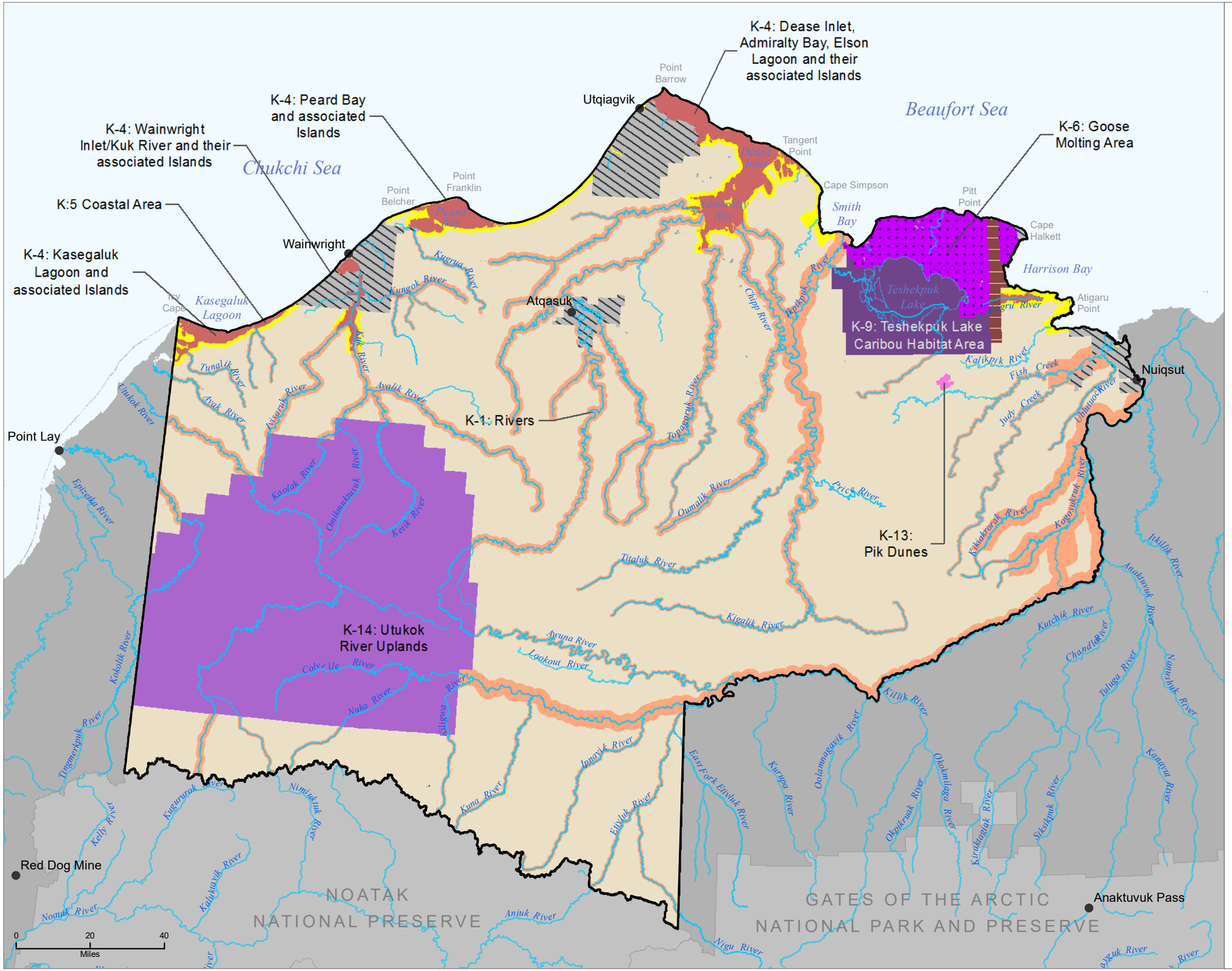
Map 2-14



- Unavailable for new infrastructure
- Unavailable for new infrastructure, except for essential pipeline crossings
- Unavailable for new infrastructure, except for essential roads and pipeline crossings
- Unavailable for new infrastructure, except for essential coastal infrastructure
- Available for new infrastructure
- Pipeline corridor: for representational purposes only, specific corridor locations would be developed in subsequent National Environmental Policy Act analyses
- National Petroleum Reserve-Alaska
- Outside the BLM's surface authority

Data source: BLM GIS 2019
Print date: 06/10/2020

Map 2-15



Unavailable for new infrastructure

- K-6: goose molting area
- K-9: Teshekpuk Lake caribou habitat area
- K-13: Pik Dunes
- K-14: Utukok River Uplands

Unavailable for new infrastructure, except for essential pipeline crossings

- K-4: lagoons, inlets, and associated islands

Unavailable for new infrastructure, except for essential roads and pipeline crossings

- K-1: river setbacks

Unavailable for new infrastructure, except for essential coastal infrastructure

- K-5: coastal area

Available for new infrastructure

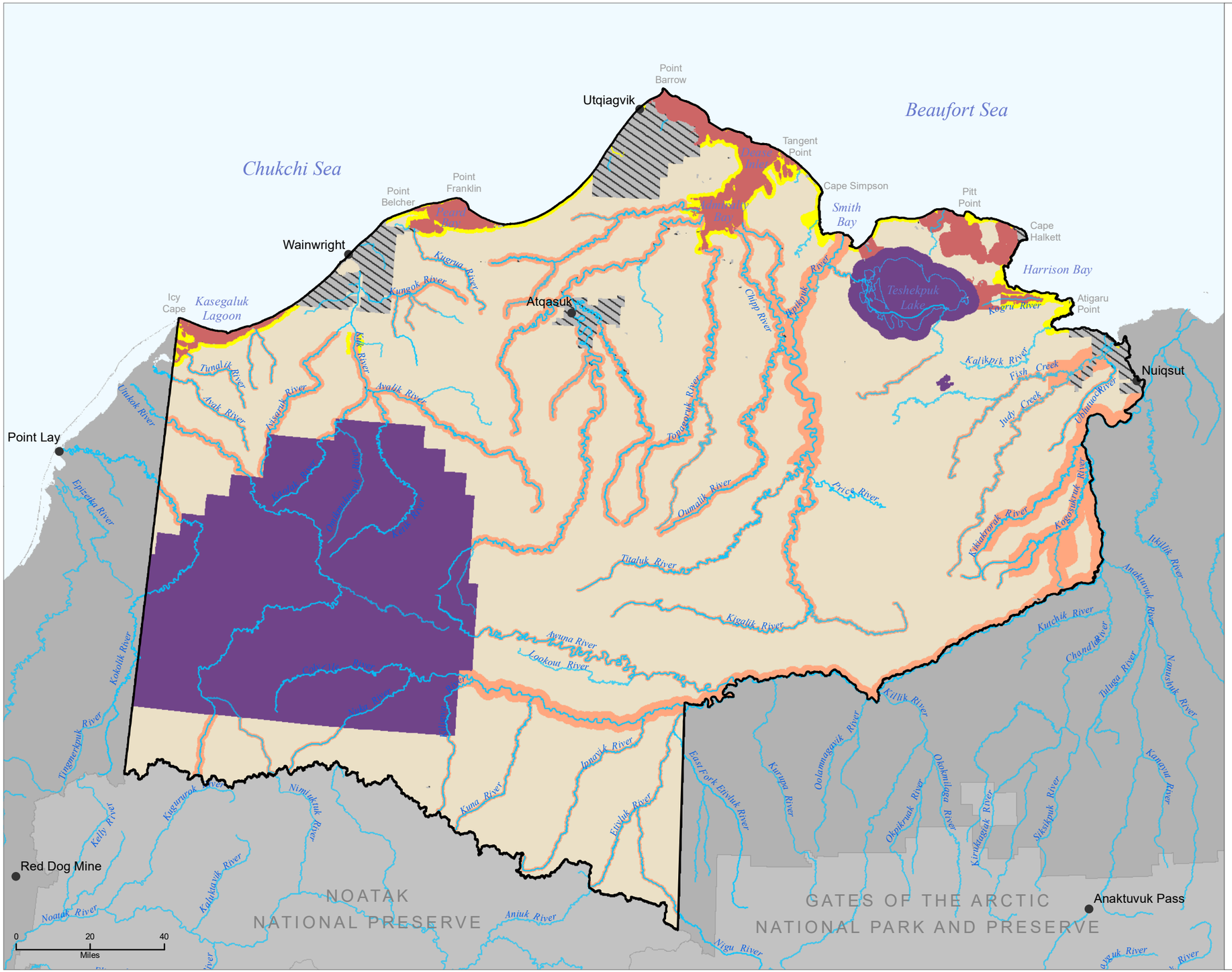
Pipeline corridor: for representational purposes only, specific corridor locations would be developed in subsequent National Environmental Policy Act analyses

National Petroleum Reserve-Alaska

Outside the BLM's surface authority

Data source: BLM GIS 2019
Print date: 06/10/2020

Map 2-16

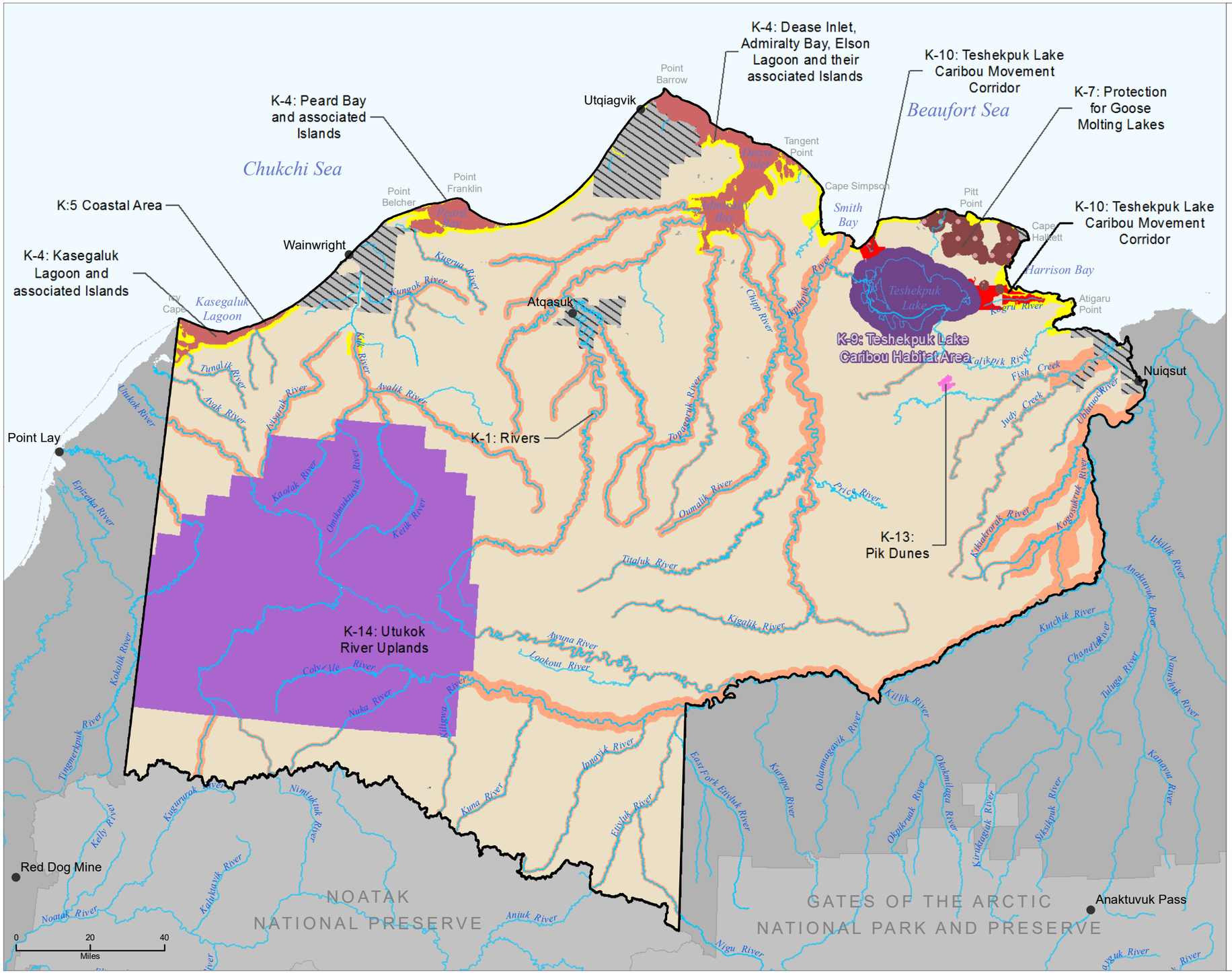


- Unavailable for new infrastructure
- Unavailable for new infrastructure, except for essential pipeline crossings
- Unavailable for new infrastructure, except for essential roads and pipeline crossings
- Unavailable for new infrastructure, except for essential coastal infrastructure
- Available for new infrastructure
- Pipeline corridor (none)

- National Petroleum Reserve-Alaska
- Outside the BLM's surface authority

Data source: BLM GIS 2019
Print date: 06/10/2020

Map 2-17



Unavailable for new infrastructure

- K-9: Teshekpuk Lake caribou habitat area
- K-13: Pik Dunes
- K-14: Utukok River Uplands

Unavailable for new infrastructure, except for essential pipeline crossings

- K-4: lagoons, inlets, and associated islands
- K-7: protection for goose molting lakes
- K-10: Teshekpuk Lake caribou movement corridor

Unavailable for new infrastructure, except for essential roads and pipeline crossings

- K-1: river setbacks

Unavailable for new infrastructure, except for essential coastal infrastructure

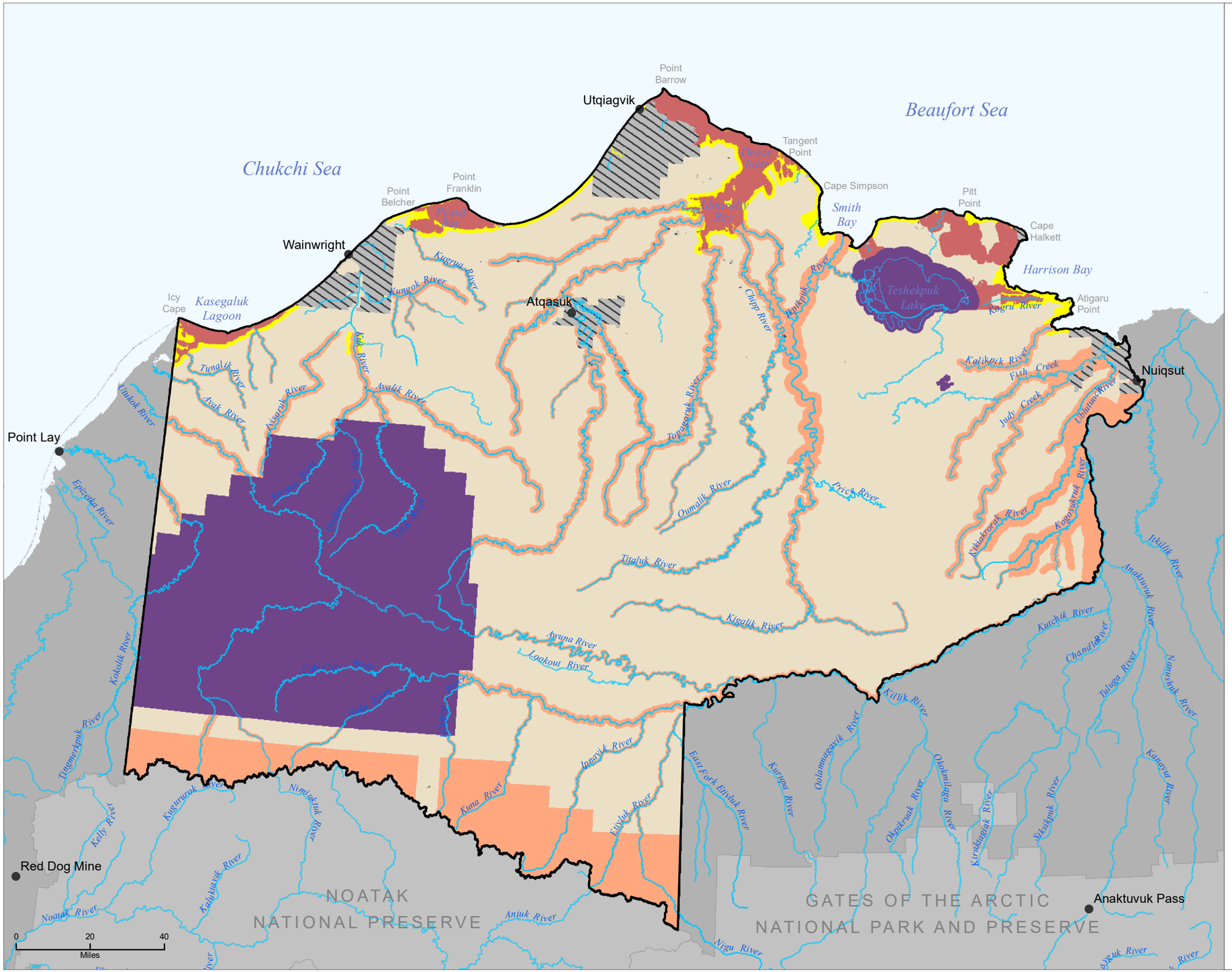
- K-5: coastal area

- Available for new infrastructure
- Pipeline corridor (none)

- National Petroleum Reserve-Alaska
- Outside the BLM's surface authority

Data source: BLM GIS 2019
Print date: 06/10/2020

Map 2-18

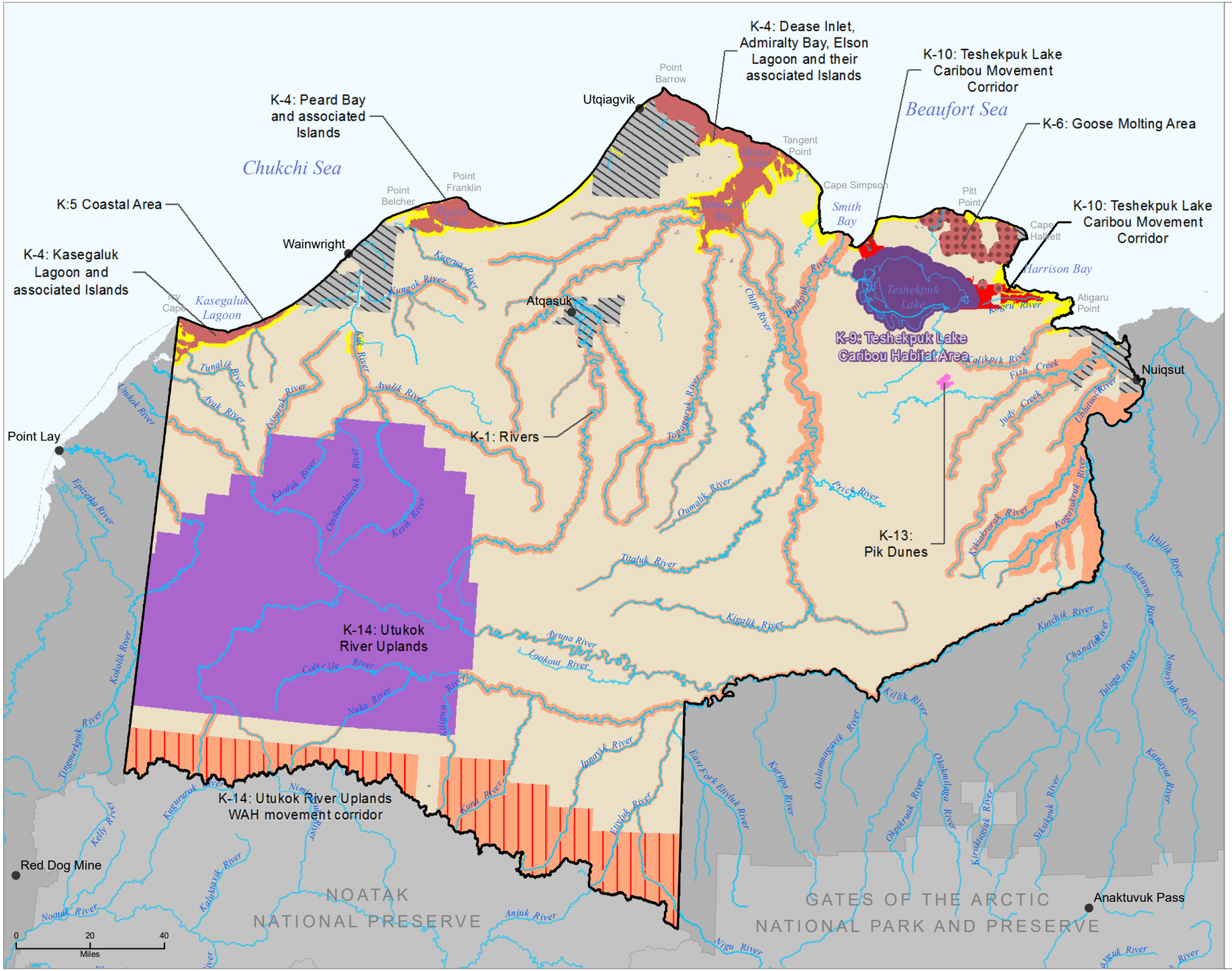


- Unavailable for new infrastructure
- Unavailable for new infrastructure, except for essential pipeline crossings
- Unavailable for new infrastructure, except for essential roads and pipeline crossings
- Unavailable for new infrastructure, except for essential coastal infrastructure
- Available for new infrastructure
- Pipeline corridor (none)

- National Petroleum Reserve-Alaska
- Outside the BLM's surface authority

Data source: BLM GIS 2019
Print date: 06/10/2020

Map 2-19



Unavailable for new infrastructure

- K-9: Teshekpuk Lake caribou habitat area
- K-13: Pik Dunes
- K-14: Utukok River Uplands

Unavailable for new infrastructure, except for essential pipeline crossings

- K-4: lagoons, inlets, and associated islands
- K-6: goose molting area
- K-10: Teshekpuk Lake caribou movement corridor

Unavailable for new infrastructure, except for essential roads and pipeline crossings

- K-1: river setbacks
- K-14: Utukok River Uplands, Western Arctic Caribou Herd (WAH) movement corridor

Unavailable for new infrastructure, except for essential coastal infrastructure

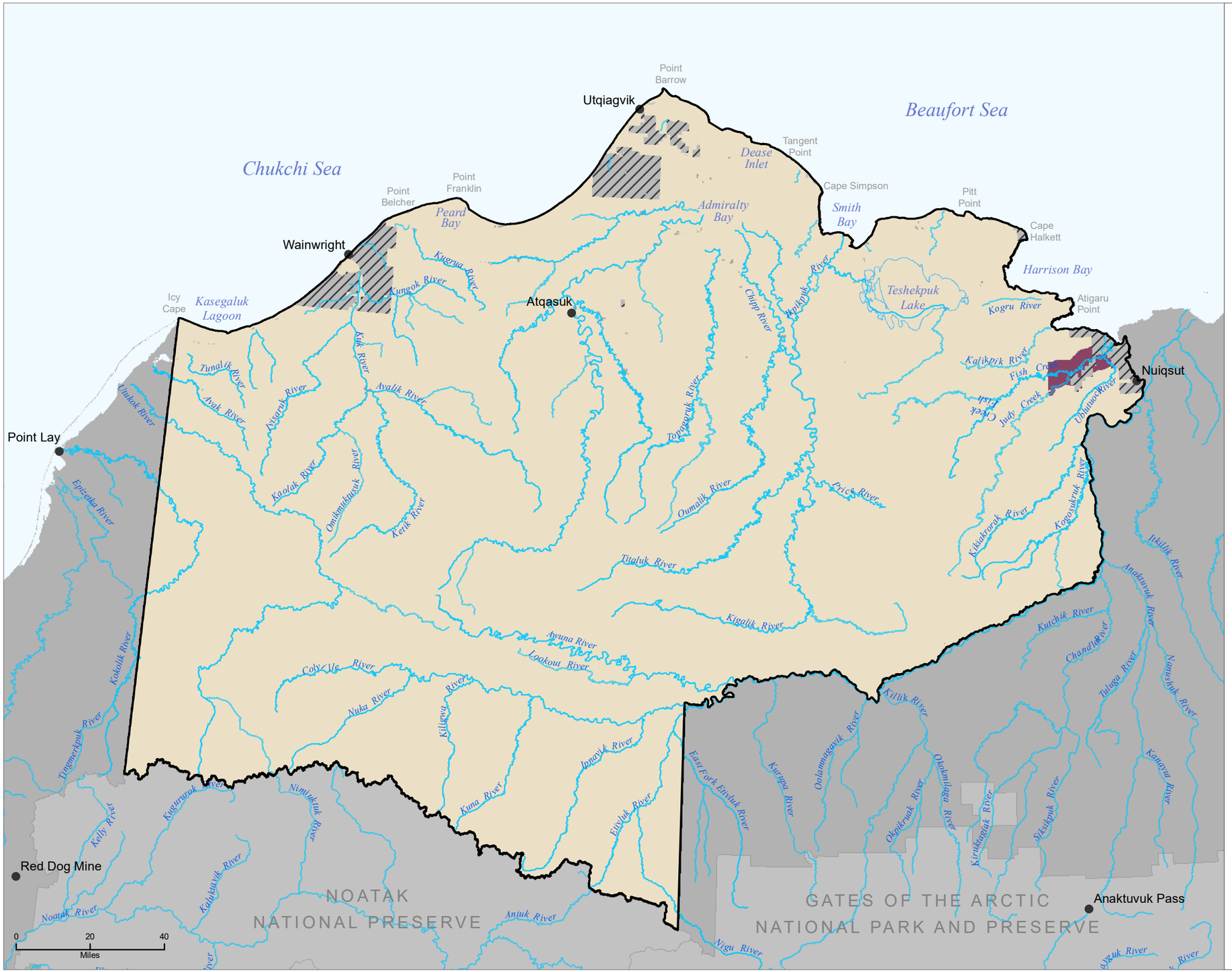
- K-5: coastal area

- Available for new infrastructure
- Pipeline corridor (none)

- National Petroleum Reserve-Alaska
- Outside the BLM's surface authority

Data source: BLM GIS 2019
Print date: 06/10/2020

Map 2-20



Prohibit sand and gravel mining (mineral materials disposal)

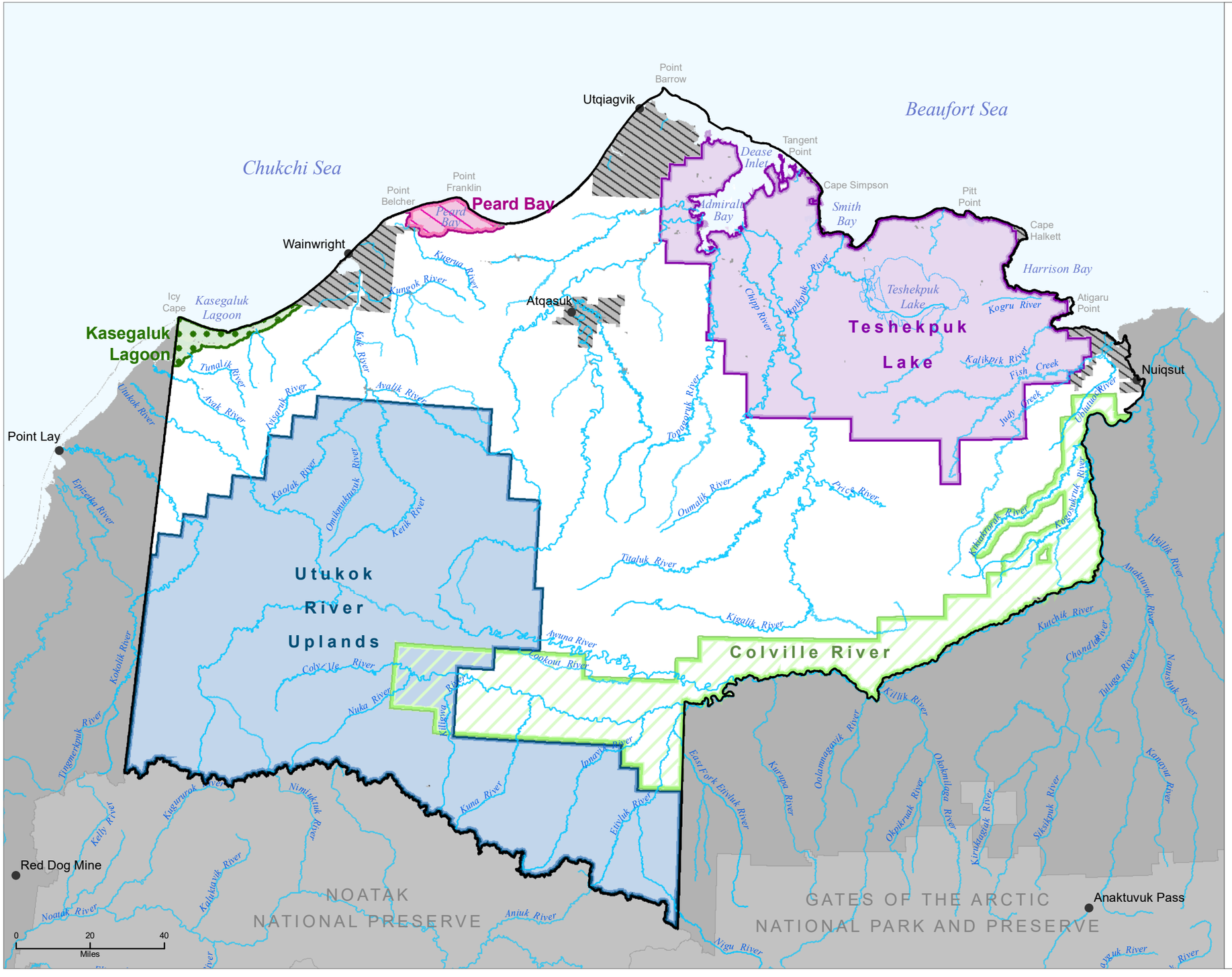
Authorize sand and gravel mining through the normal review process

National Petroleum Reserve-Alaska

Outside the BLM's subsurface authority

Data source: BLM GIS 2019
Print date: 06/10/2020

Map 2-21



Special Areas

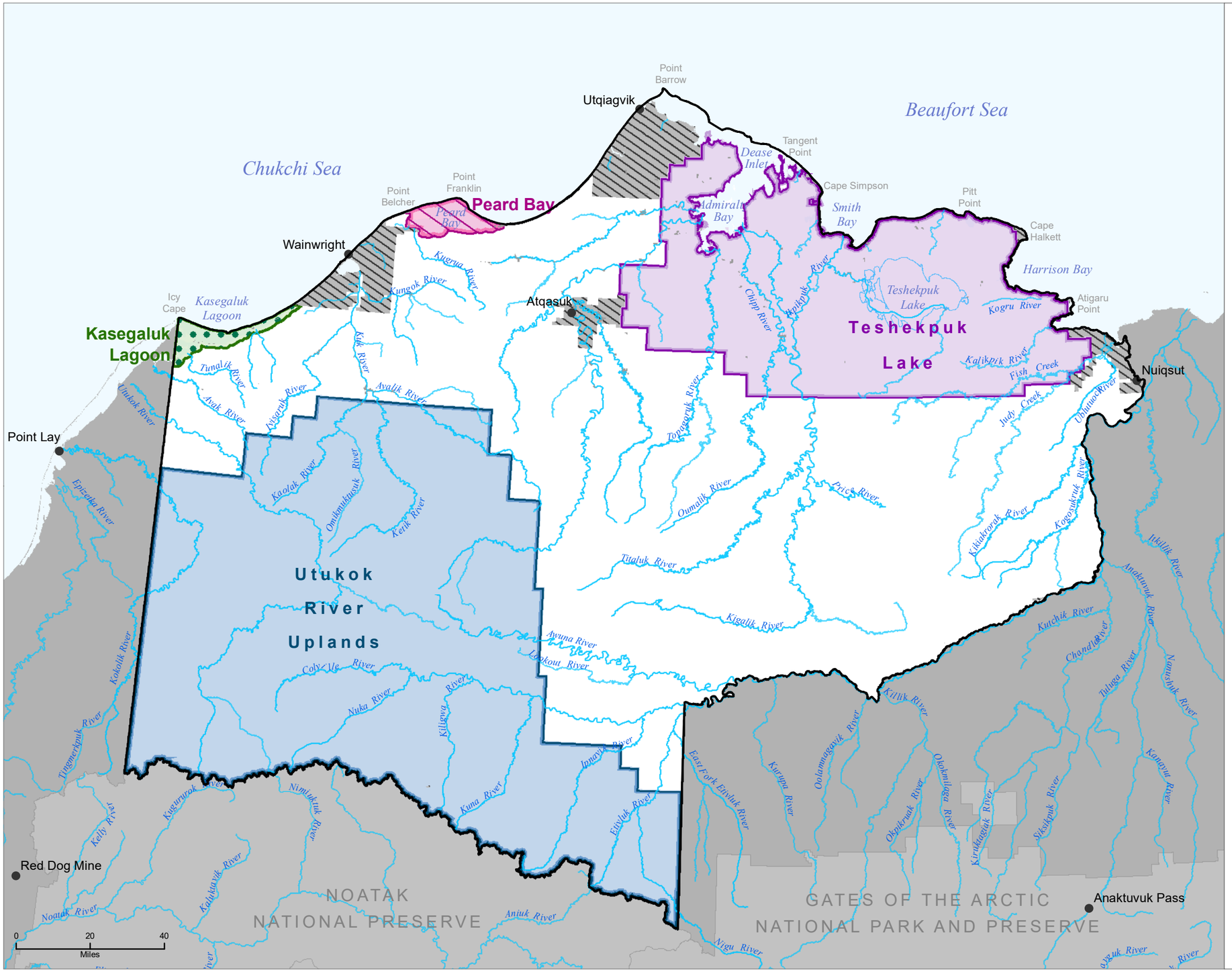
- Colville River
- Kasegaluk Lagoon
- Peard Bay
- Teshekpuk Lake
- Utukok River Uplands
- Colville River and Utukok River Uplands

Special Areas denote areas with significant surface values. See Chapter 2 for specific protections that apply to these areas.

- National Petroleum Reserve-Alaska
- Outside the BLM's surface authority

Data source: BLM GIS 2019
Print date: 06/10/2020

Map 2-22



Special Areas

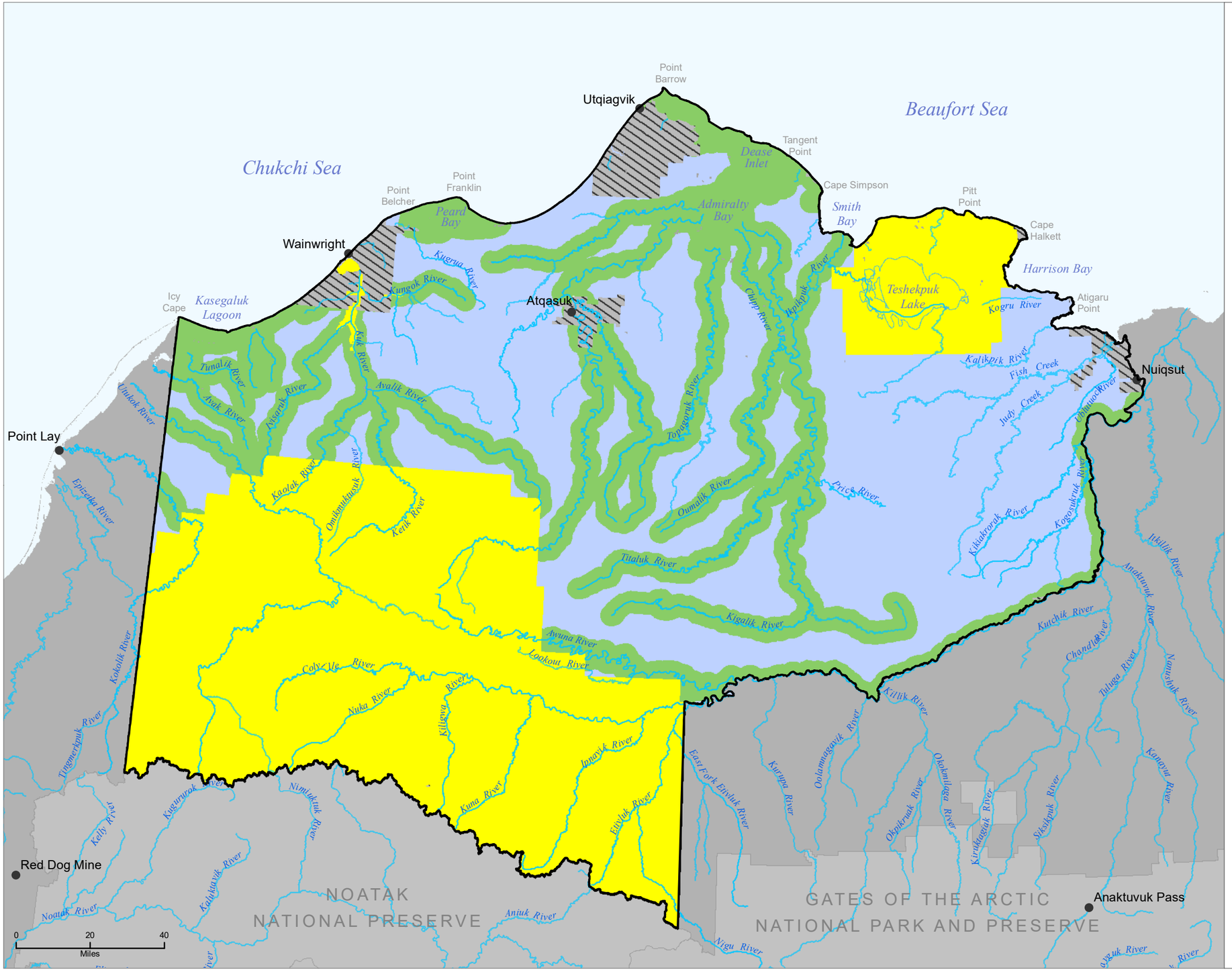
- Kasegaluk Lagoon
- Peard Bay
- Teshekpuk Lake
- Utukok River Uplands

Special Areas denote areas with significant surface values. See Chapter 2 for specific protections that apply to these areas.

- National Petroleum Reserve-Alaska
- Outside the BLM's surface authority

Data source: BLM GIS 2019
Print date: 06/10/2020

Map 2-23



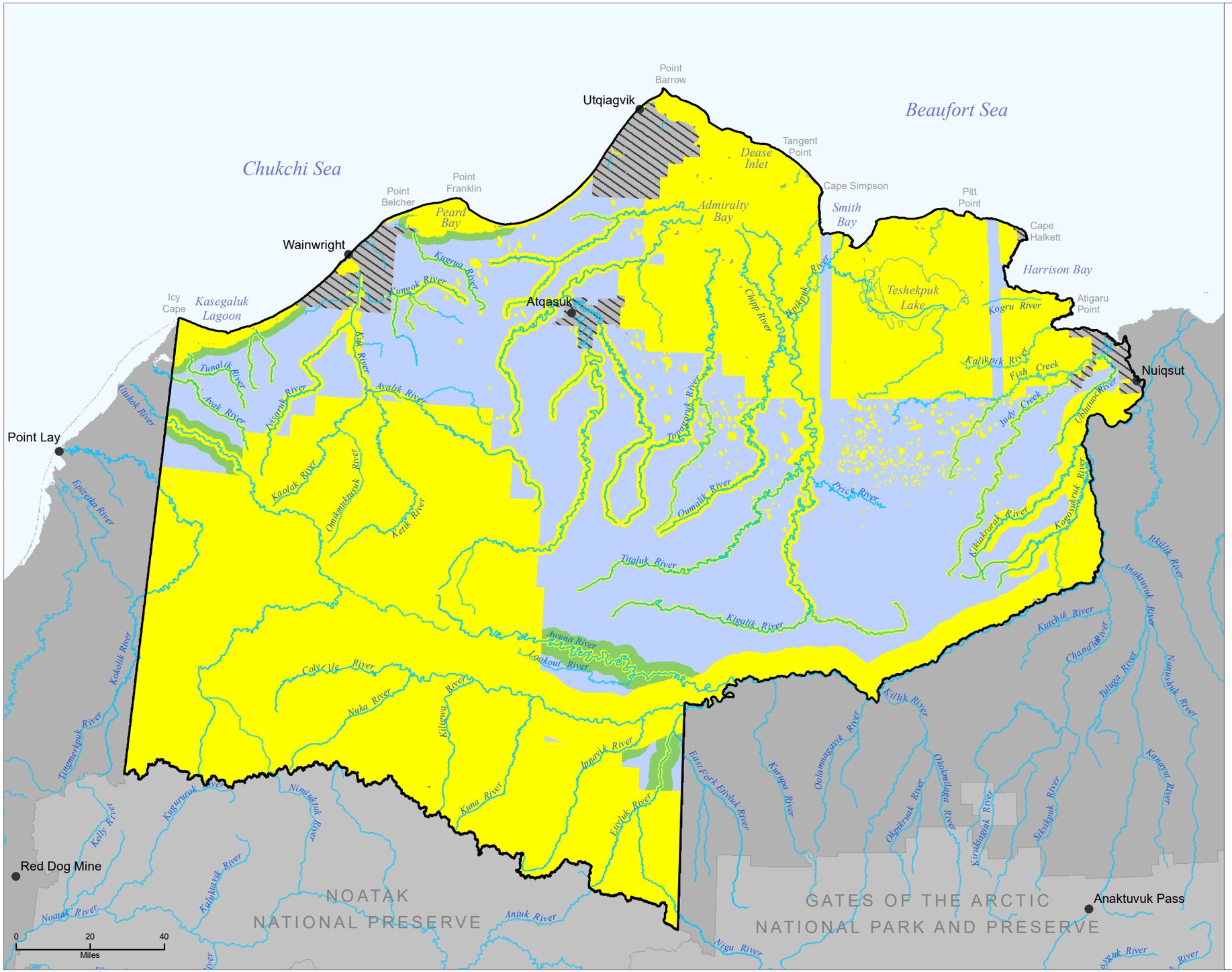
Visual resource management

- Class I (none)
- Class II
- Class III
- Class IV

- National Petroleum Reserve-Alaska
- Outside the BLM's surface authority

Data source: BLM GIS 2019
Print date: 06/10/2020

Map 2-24



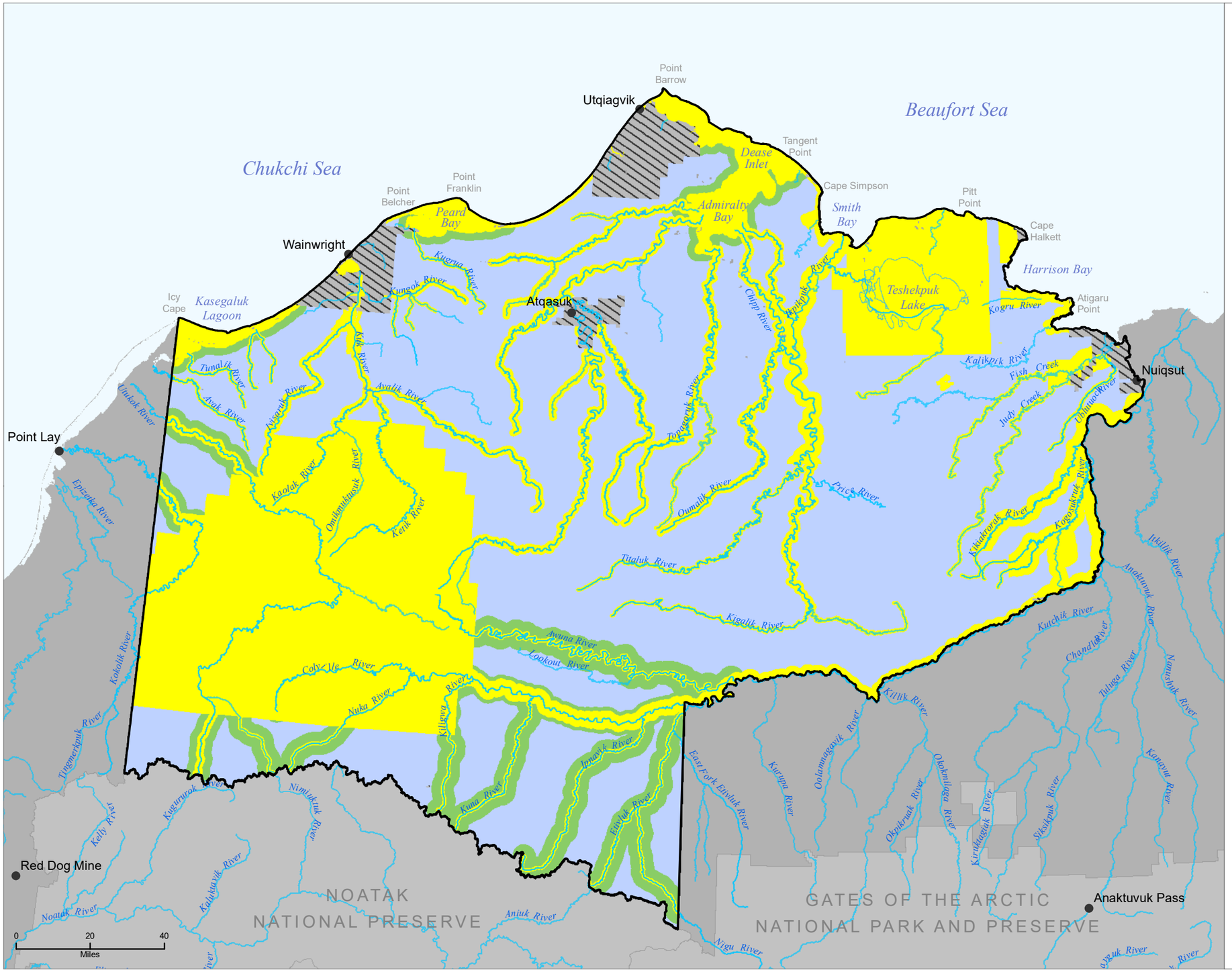
Visual resource management

- Class I (none)
- Class II
- Class III
- Class IV

- National Petroleum Reserve-Alaska
- Outside the BLM's surface authority

Data source: BLM GIS 2019
Print date: 06/10/2020

Map 2-25



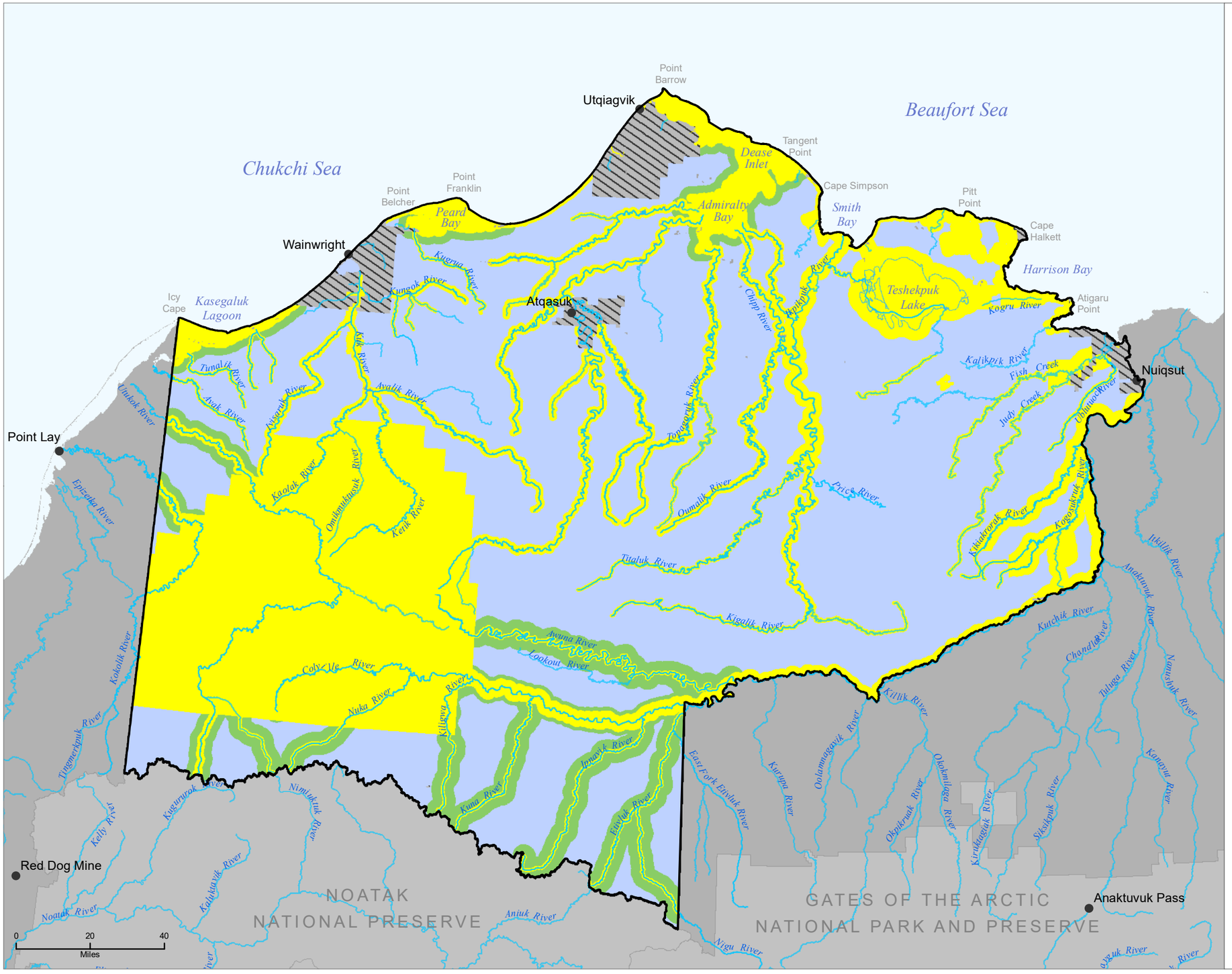
Visual resource management

- Class I (none)
- Class II
- Class III
- Class IV

- National Petroleum Reserve-Alaska
- Outside the BLM's surface authority

Data source: BLM GIS 2019
Print date: 06/10/2020

Map 2-26



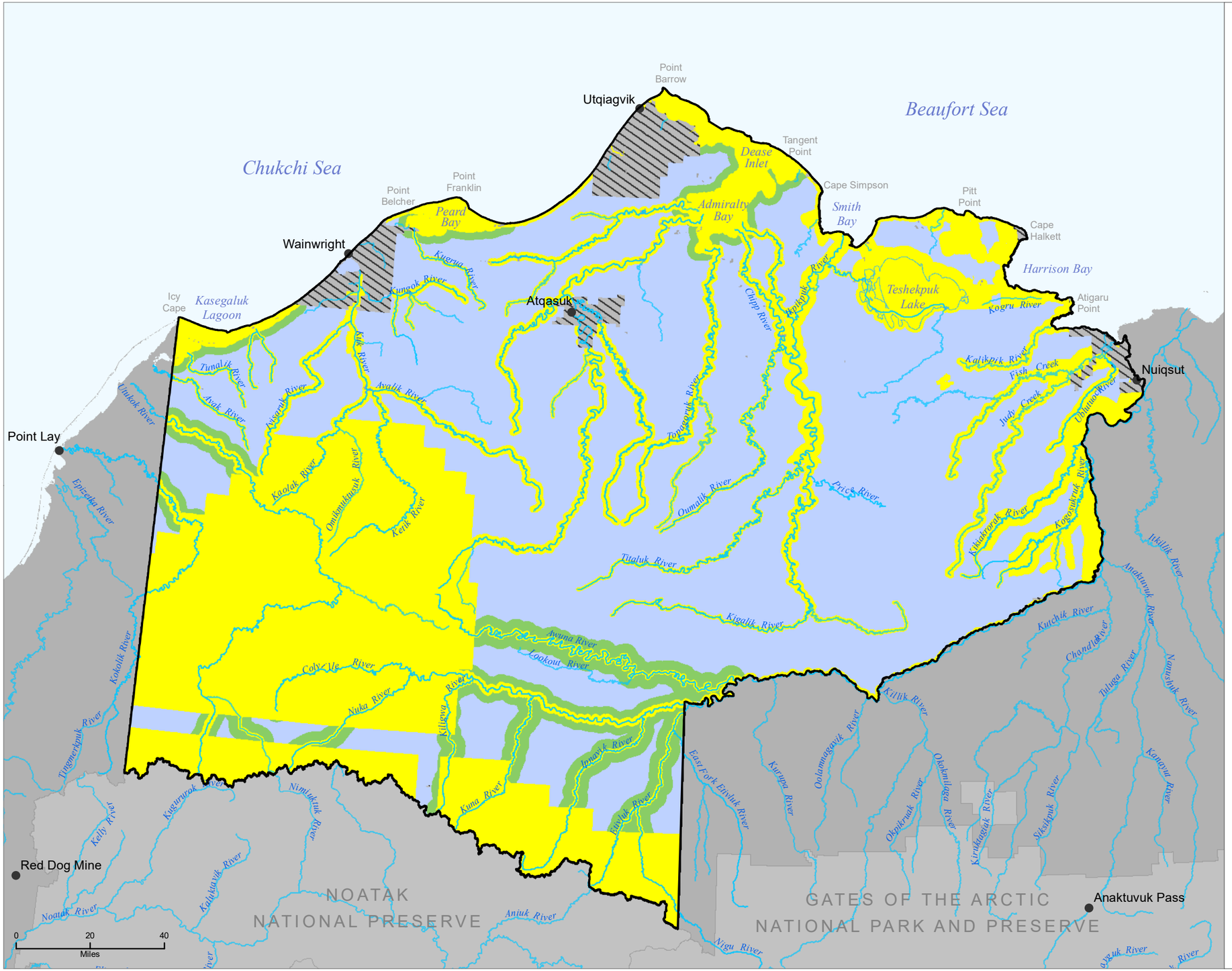
Visual resource management

- Class I (none)
- Class II
- Class III
- Class IV

- National Petroleum Reserve-Alaska
- Outside the BLM's surface authority

Data source: BLM GIS 2019
Print date: 06/10/2020

Map 2-27



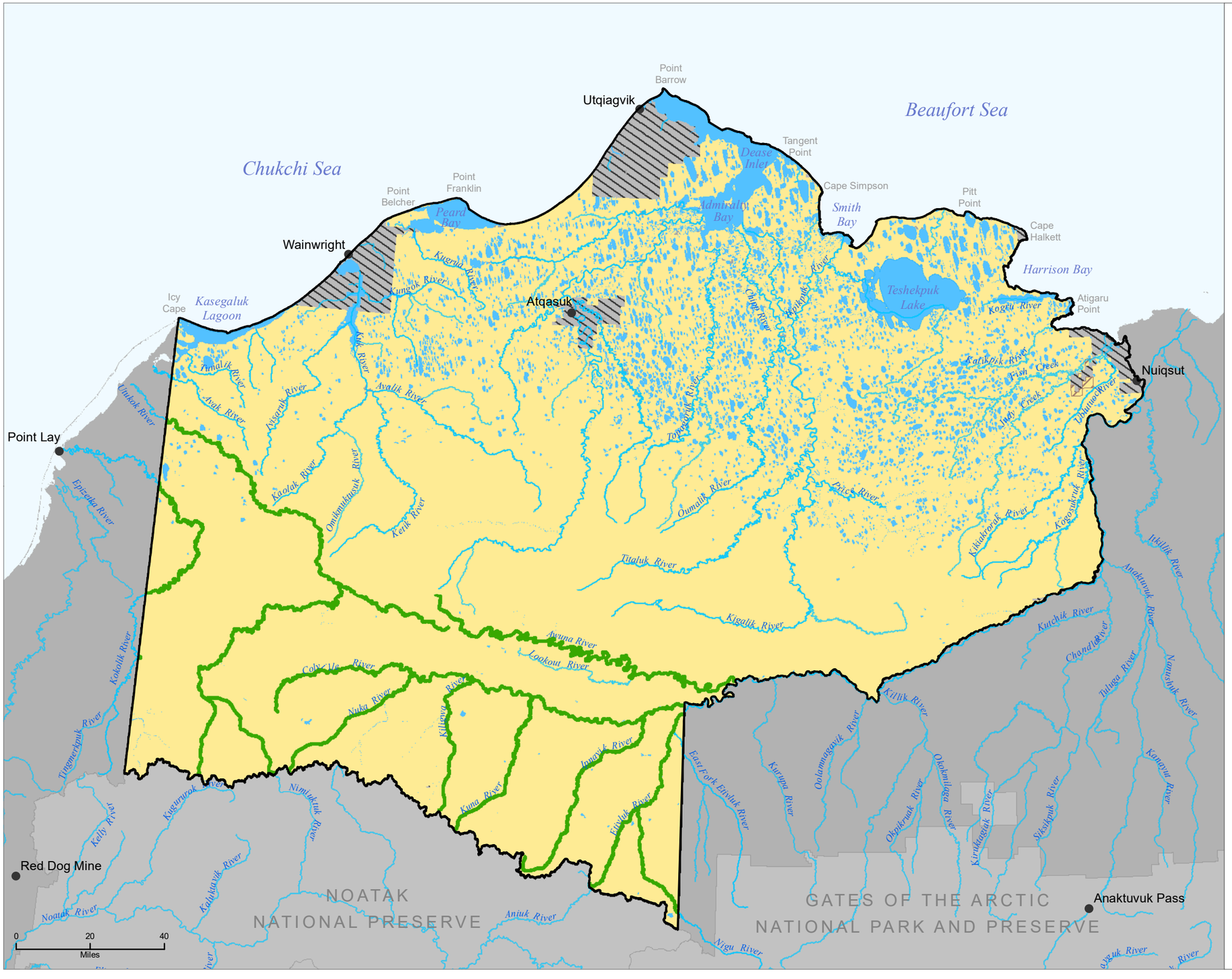
Visual resource management

- Class I (none)
- Class II
- Class III
- Class IV

- National Petroleum Reserve-Alaska
- Outside the BLM's surface authority

Data source: BLM GIS 2019
Print date: 06/10/2020

Map 2-28



Suitable wild and scenic river segments recommended for designation

Suitable wild and scenic river segments are not recommended for designation in Alternatives A, C, D, and E

Bureau of Land Management (BLM)

Native-selected

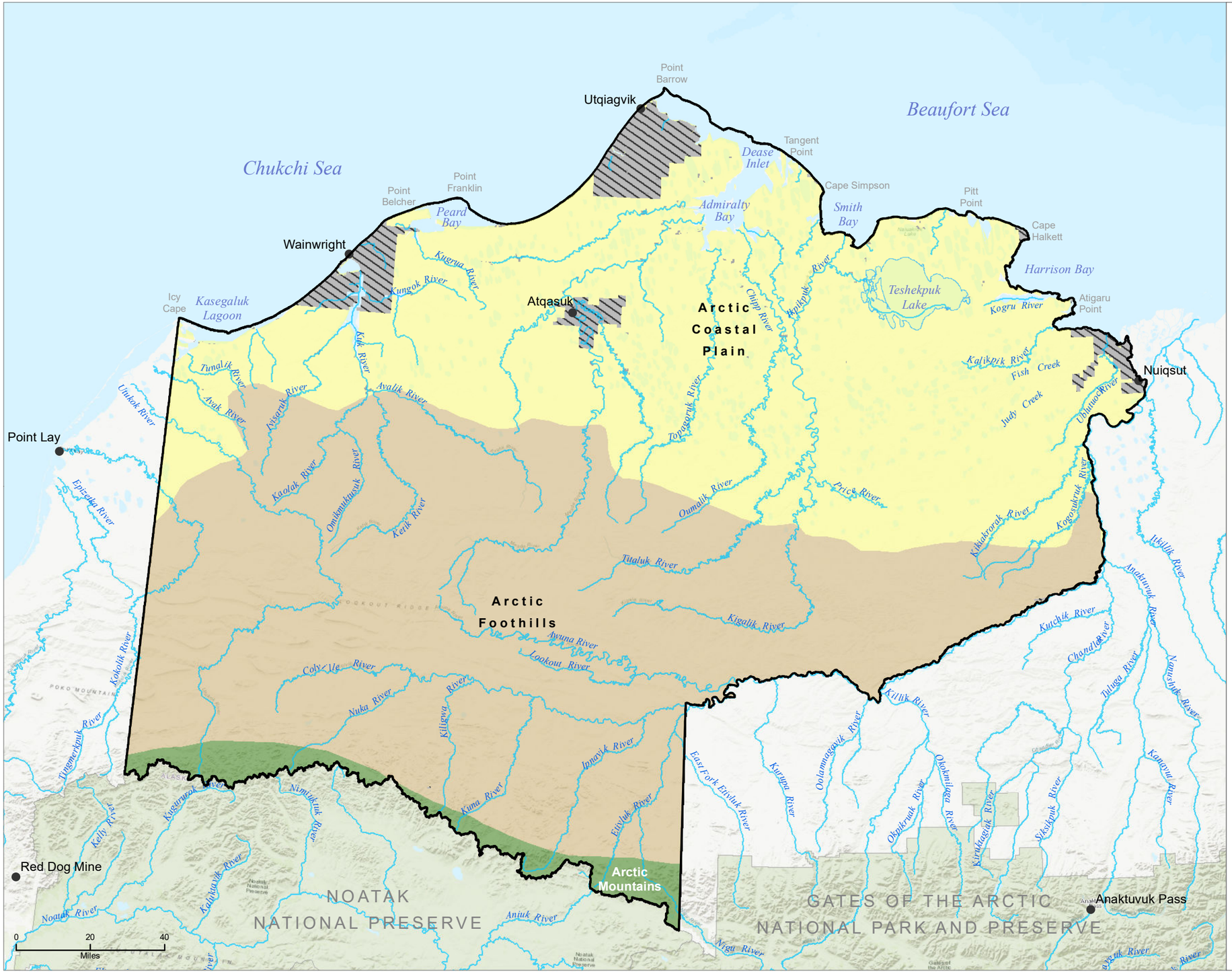
Water (inside the planning area, administered by BLM)

National Petroleum Reserve-Alaska

Outside the BLM's surface authority

Data source: BLM GIS 2019
Print date: 06/10/2020

Map 2-29



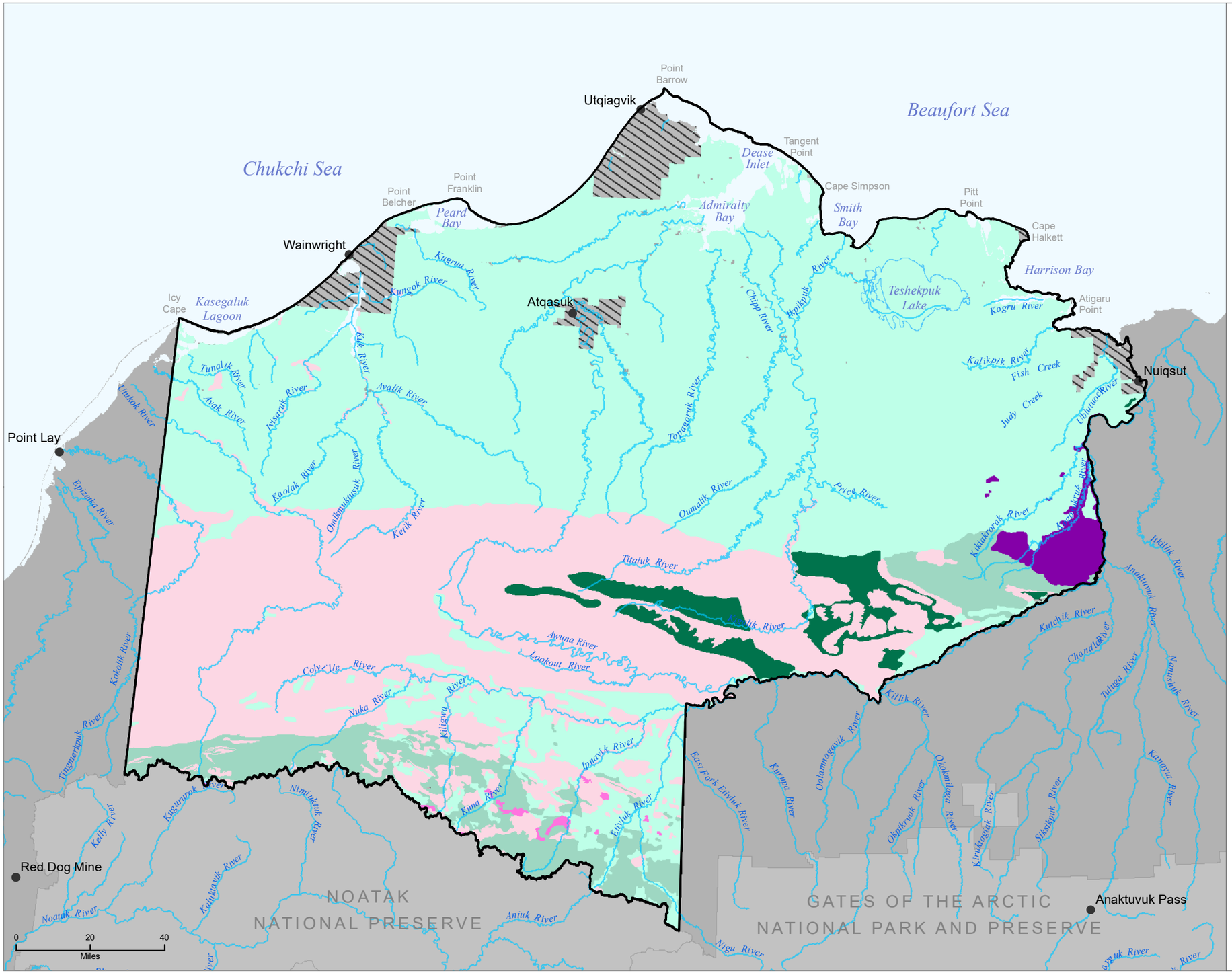
Physiographic divisions of Alaska

- Arctic Coastal Plain
- Arctic Foothills
- Arctic Mountains

- National Petroleum Reserve-Alaska
- Outside the BLM's surface authority

Data source: Wahrhaftig GIS 1965, BLM GIS 2019
Print date: 06/10/2020

Map 3-1



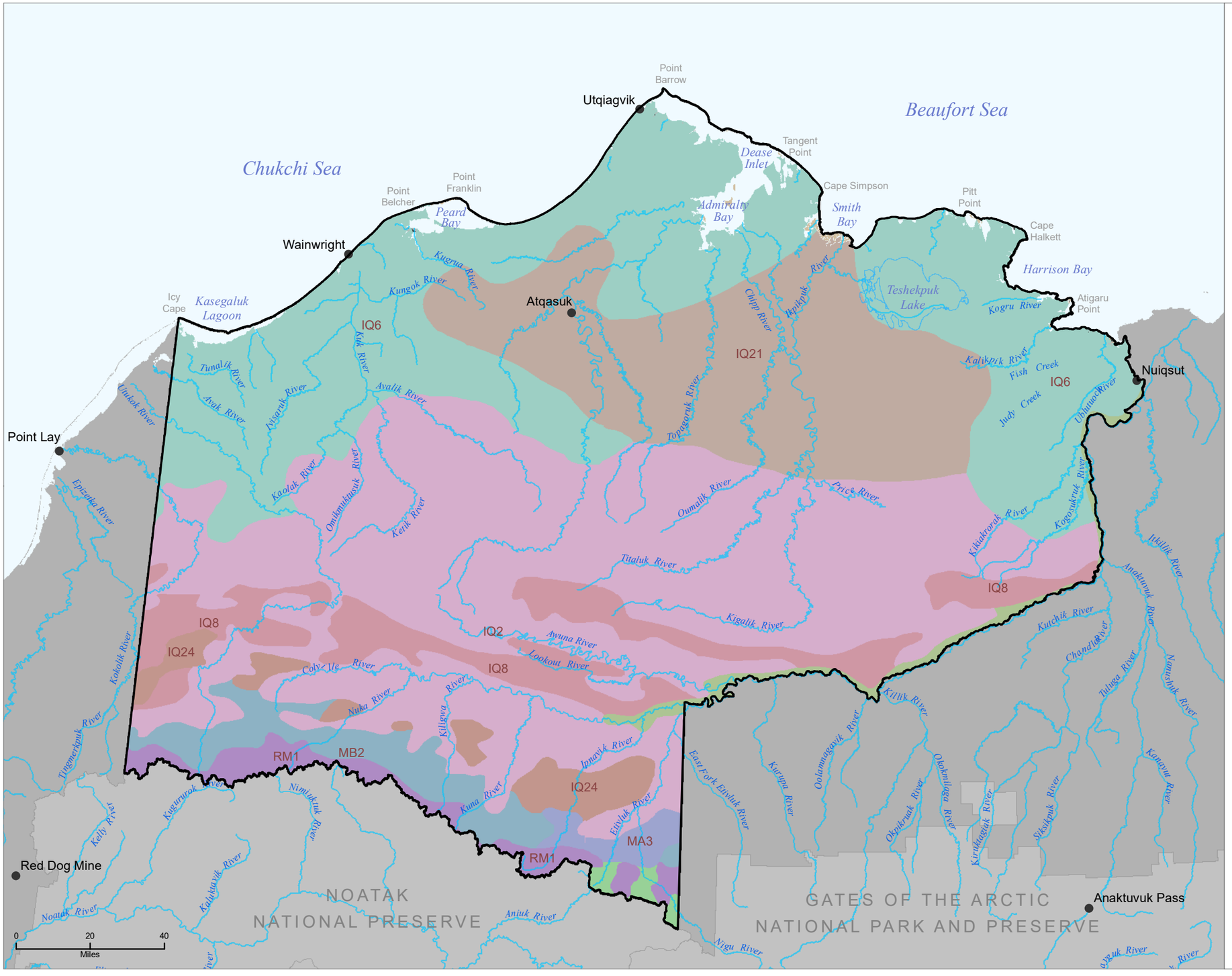
Potential fossil yield classification

- 1
- 2
- 3
- 4
- 5
- Unknown

- National Petroleum Reserve-Alaska
- Outside the BLM's surface authority

Data source: USGS GIS 2015, BLM GIS 2019
Print date: 06/10/2020

Map 3-2



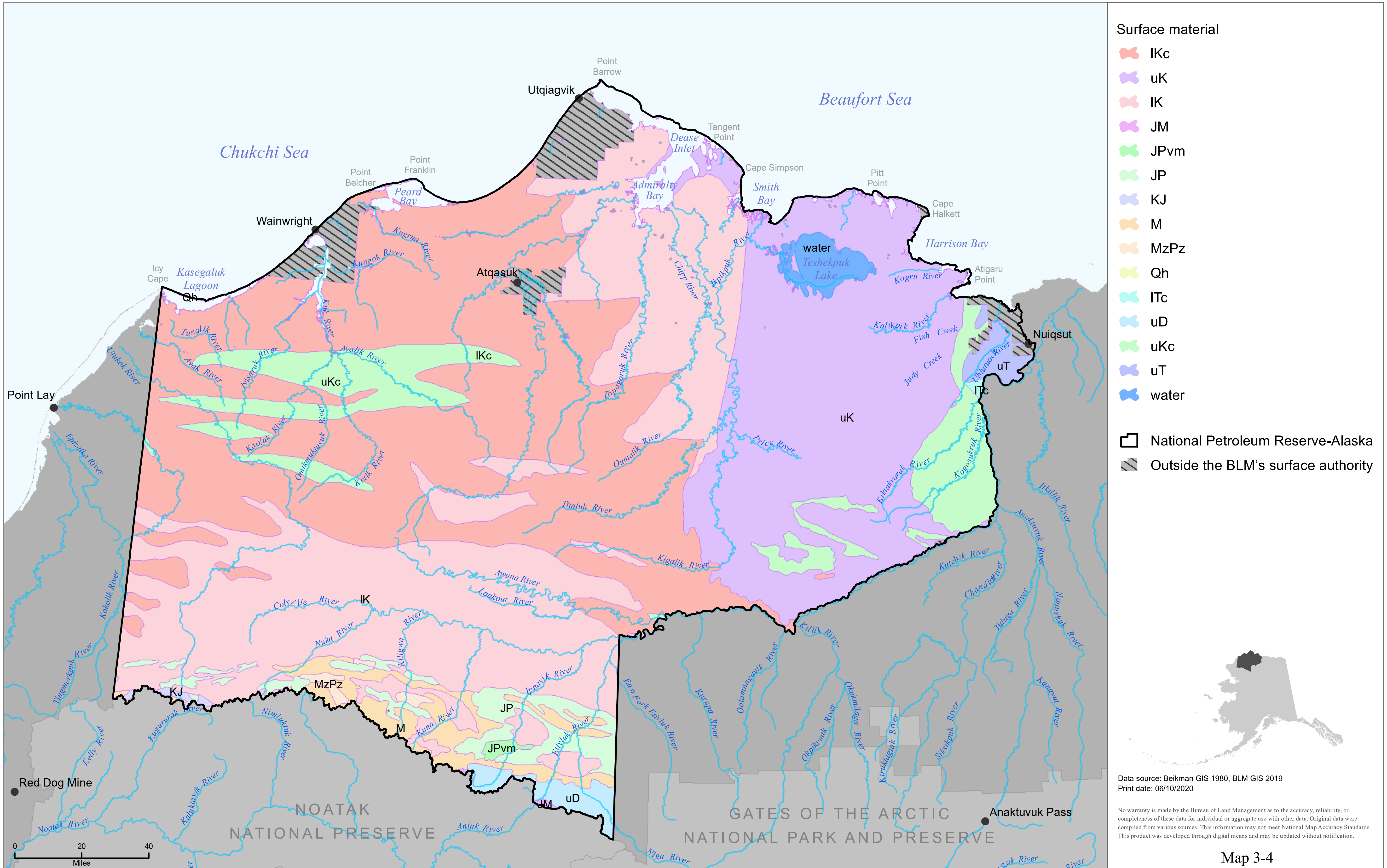
Major soil resources

- IQ2
- IQ21
- IQ22
- IQ24
- IQ6
- IQ8
- MA3
- MA3-2
- MB2
- RM1
- Other

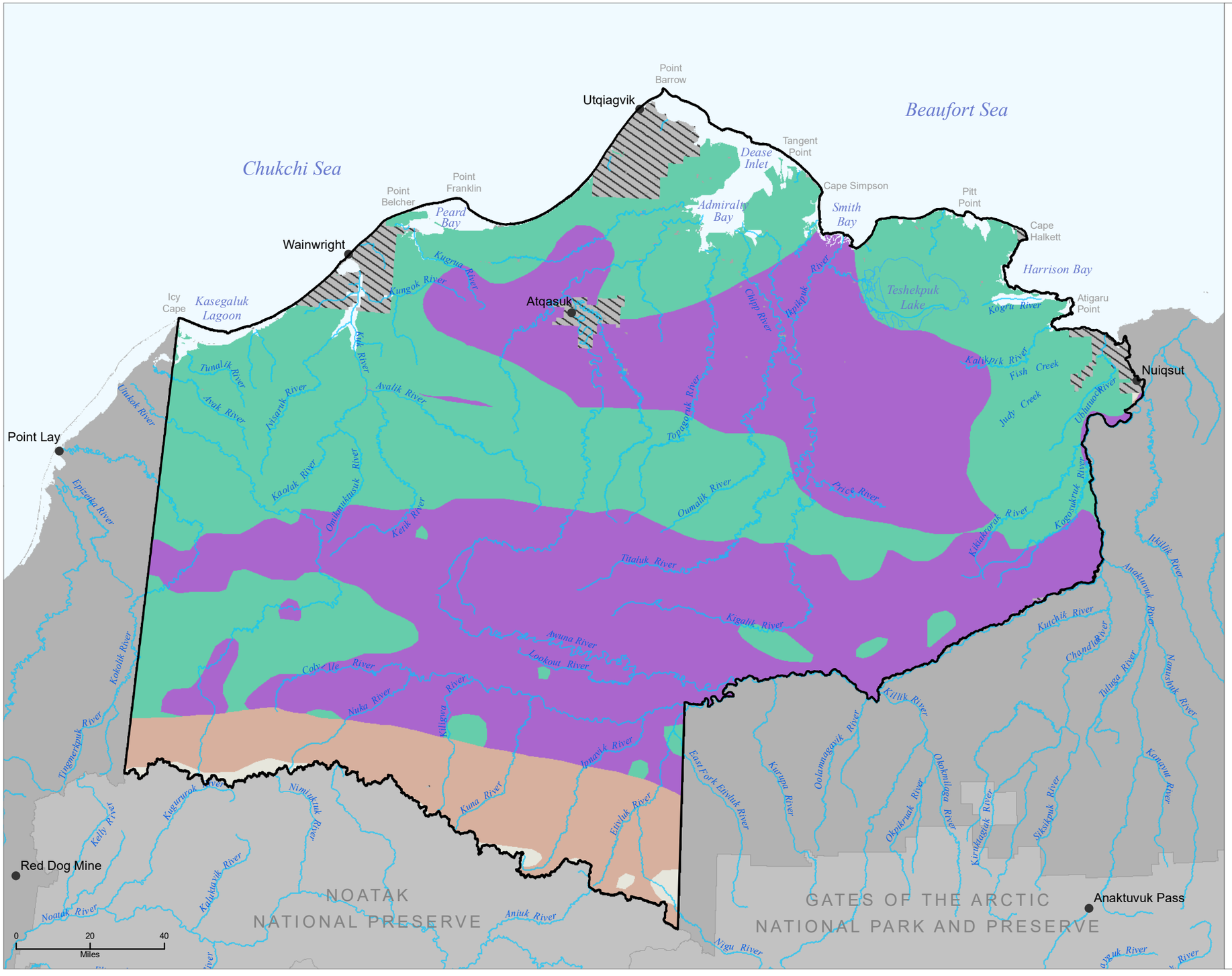
- National Petroleum Reserve-Alaska
- Outside the BLM's surface authority

Data source: BLM GIS 2019
Print date: 06/10/2020

Map 3-3


Surface material
lKc
uK
lK
JM
JPvm
JP
KJ
M
MzPz
Qh
lTc
uD
uKc
uT
water
National Petroleum Reserve-Alaska
Outside the BLM's surface authority
Beaufort Sea
Chukchi Sea
Utqiagvik
Point Barrow
Wainwright
Atqasuk
Nuiqsut
Point Lay
Red Dog Mine
Anaktuvuk Pass
Teshekpuk Lake
NOATAK NATIONAL PRESERVE
GATES OF THE ARCTIC NATIONAL PARK AND PRESERVE
0 20 40
Miles
Data source: Beikman GIS 1980, BLM GIS 2019
Print date: 06/10/2020
No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual or aggregate use with other data. Original data were compiled from various sources. This information may not meet National Map Accuracy Standards. This product was developed through digital means and may be updated without notification.

Map 3-4



Hillslope thermokarst terrain coverage

- High
- Moderate
- Low
- None

- National Petroleum Reserve-Alaska
- Outside the BLM's surface authority

Data source: BLM GIS 2019
Print date: 06/10/2020

Map 3-5

Percent of the map area for which the depth to permafrost is ≤ to 100 centimeters

High : 98

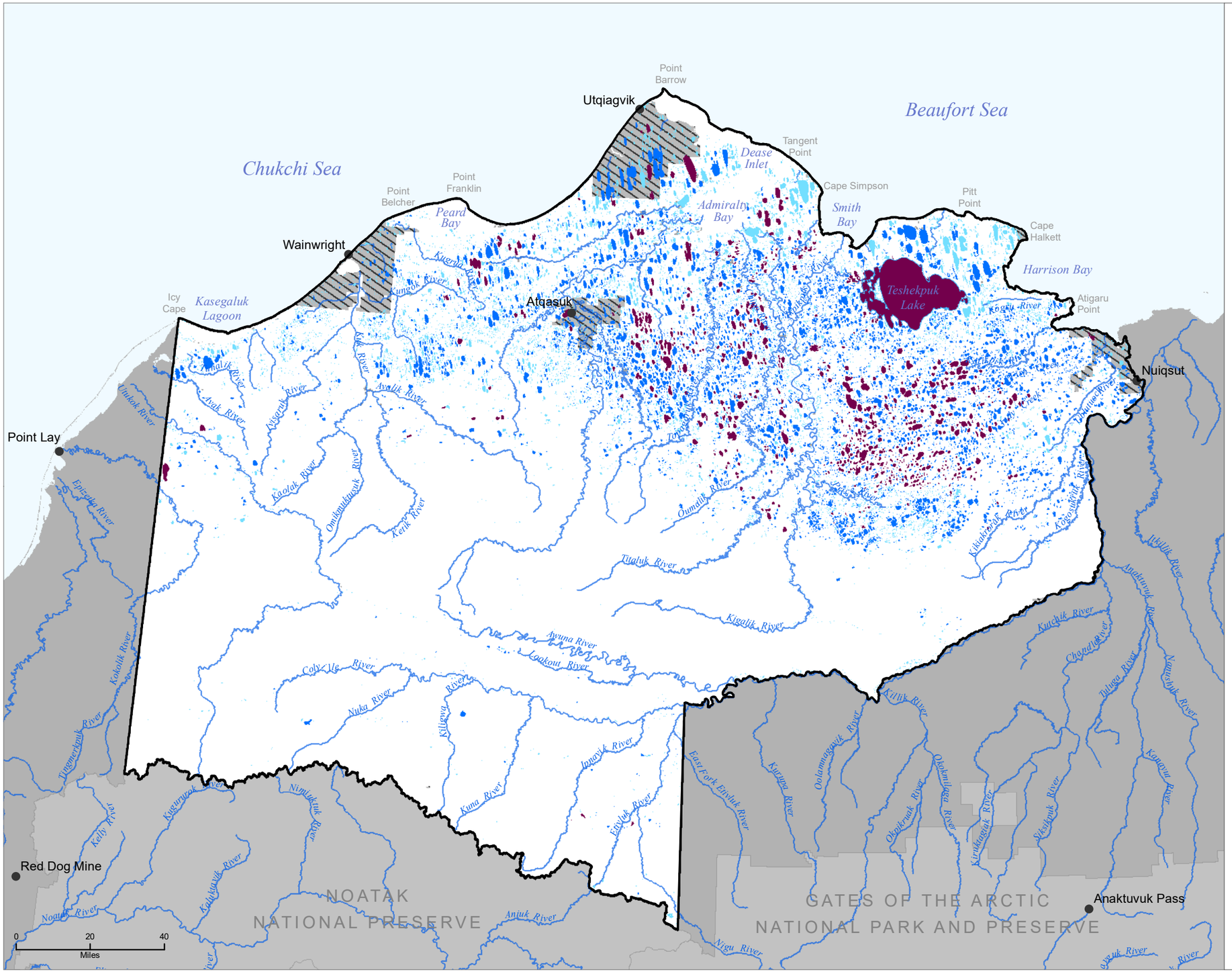
Low : 0

National Petroleum Reserve-Alaska

Outside the BLM's surface authority

Data source: SNAP GIS 2019
Print date: 06/10/2020

Map 3-6



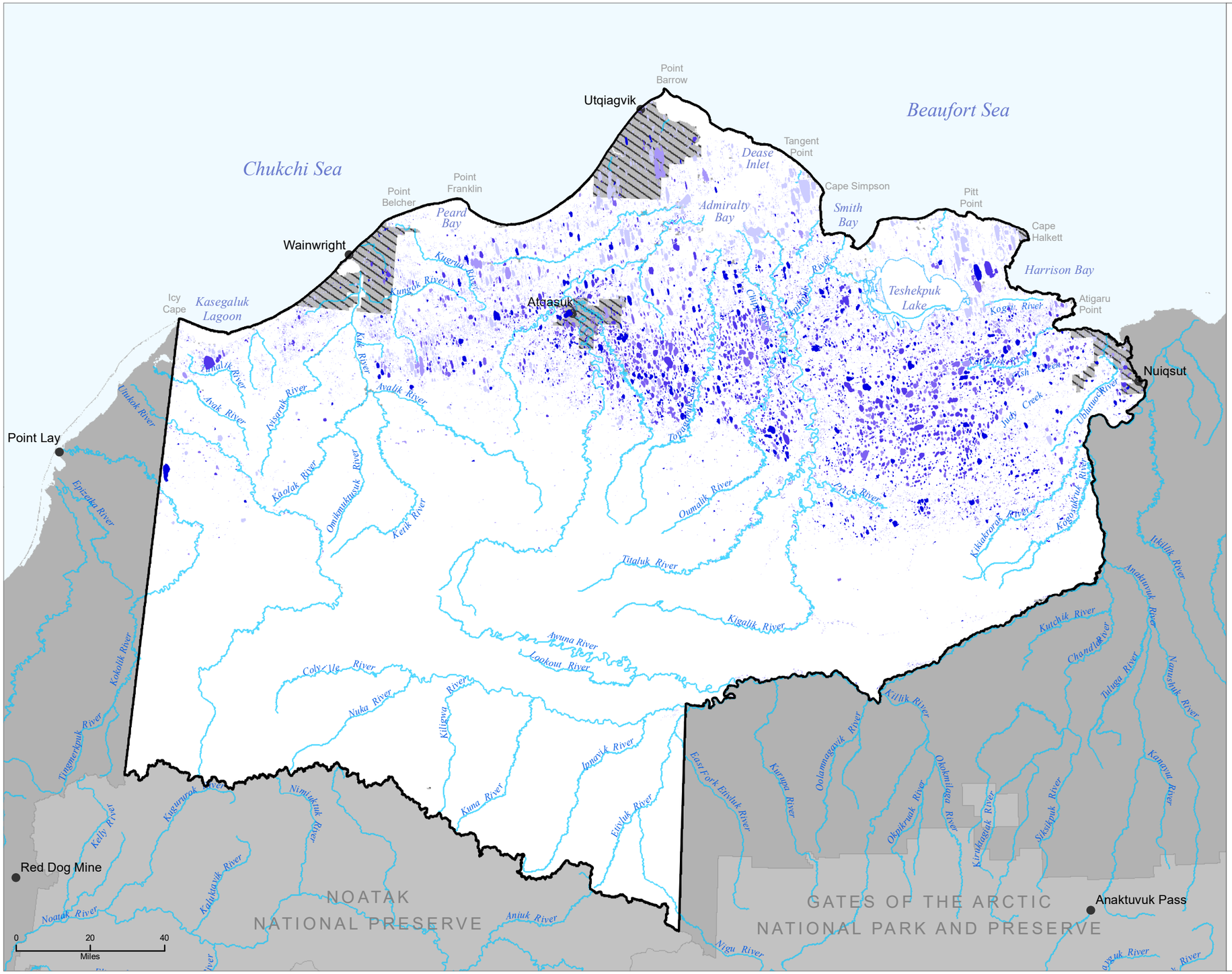
Lake depth

- >4 meters
- 1.6-4 meters
- 0-1.6 meters

- National Petroleum Reserve-Alaska
- Outside the BLM's surface authority

Data source: Mellor GIS 1985, BLM GIS 2019
Print date: 06/10/2020

Map 3-7



Percent of lake with liquid water below ice

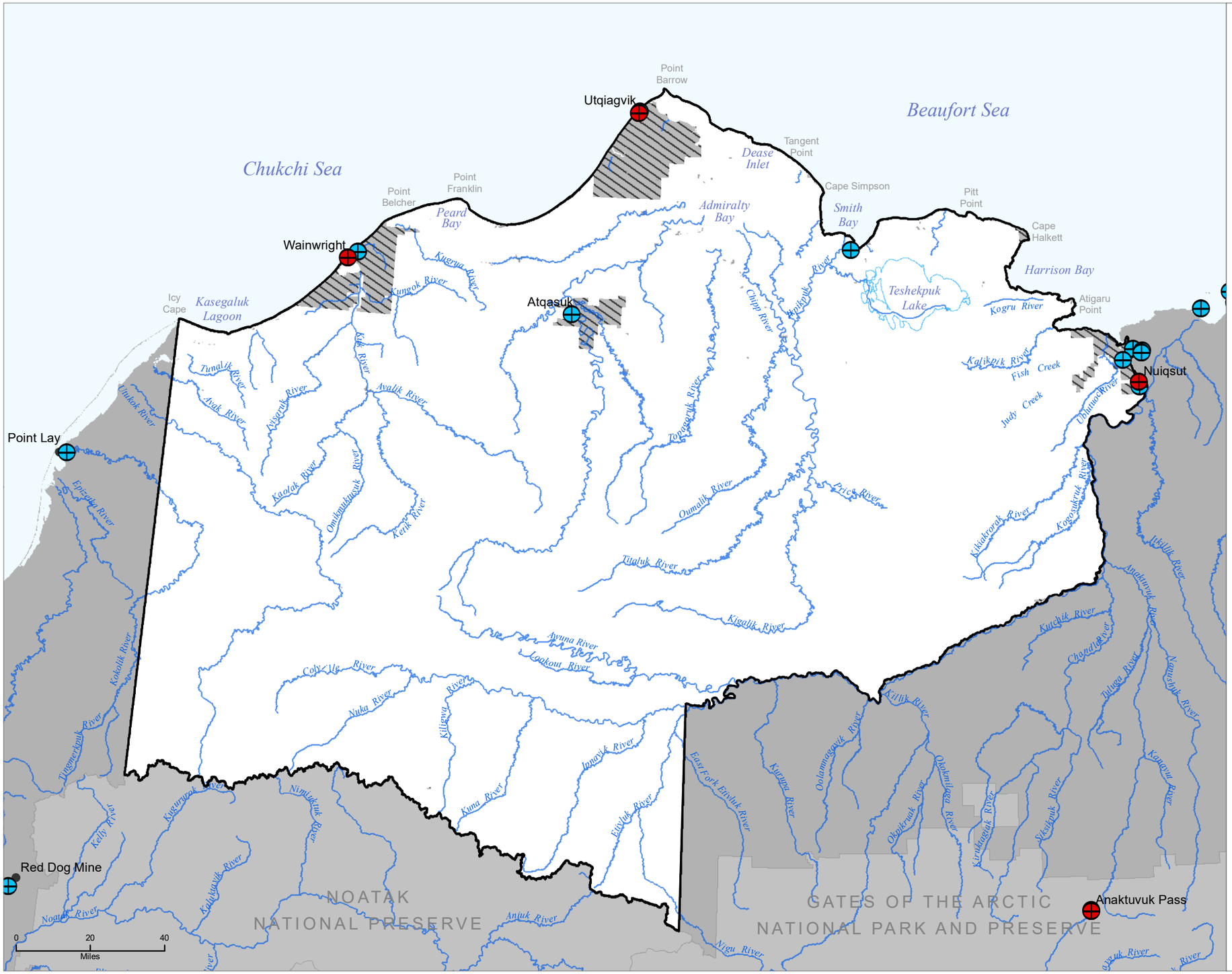
- 0-19
- 19-36
- 36-50
- 50-62
- 62-73

National Petroleum Reserve-Alaska

Outside the BLM's surface authority

Data source: BLM GIS 2019
Print date: 06/10/2020

Map 3-8



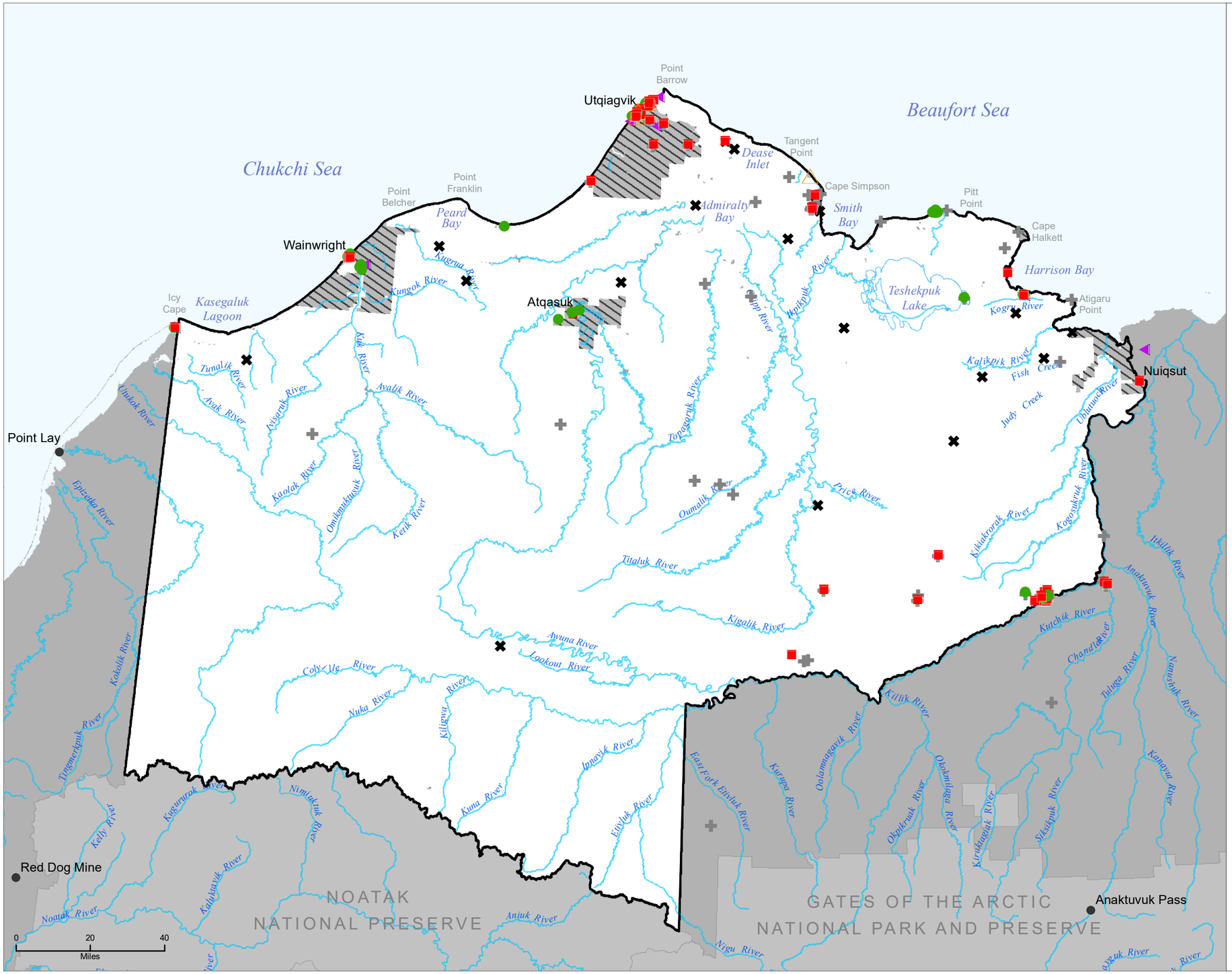
Water withdrawal

- Private
- Public

- National Petroleum Reserve-Alaska
- Outside the BLM's surface authority

Data source: ADEC GIS 2020, BLM GIS 2019
Print date: 06/10/2020

Map 3-9



Contaminated site status

- Cleanup complete
- Cleanup complete with institutional controls
- Active

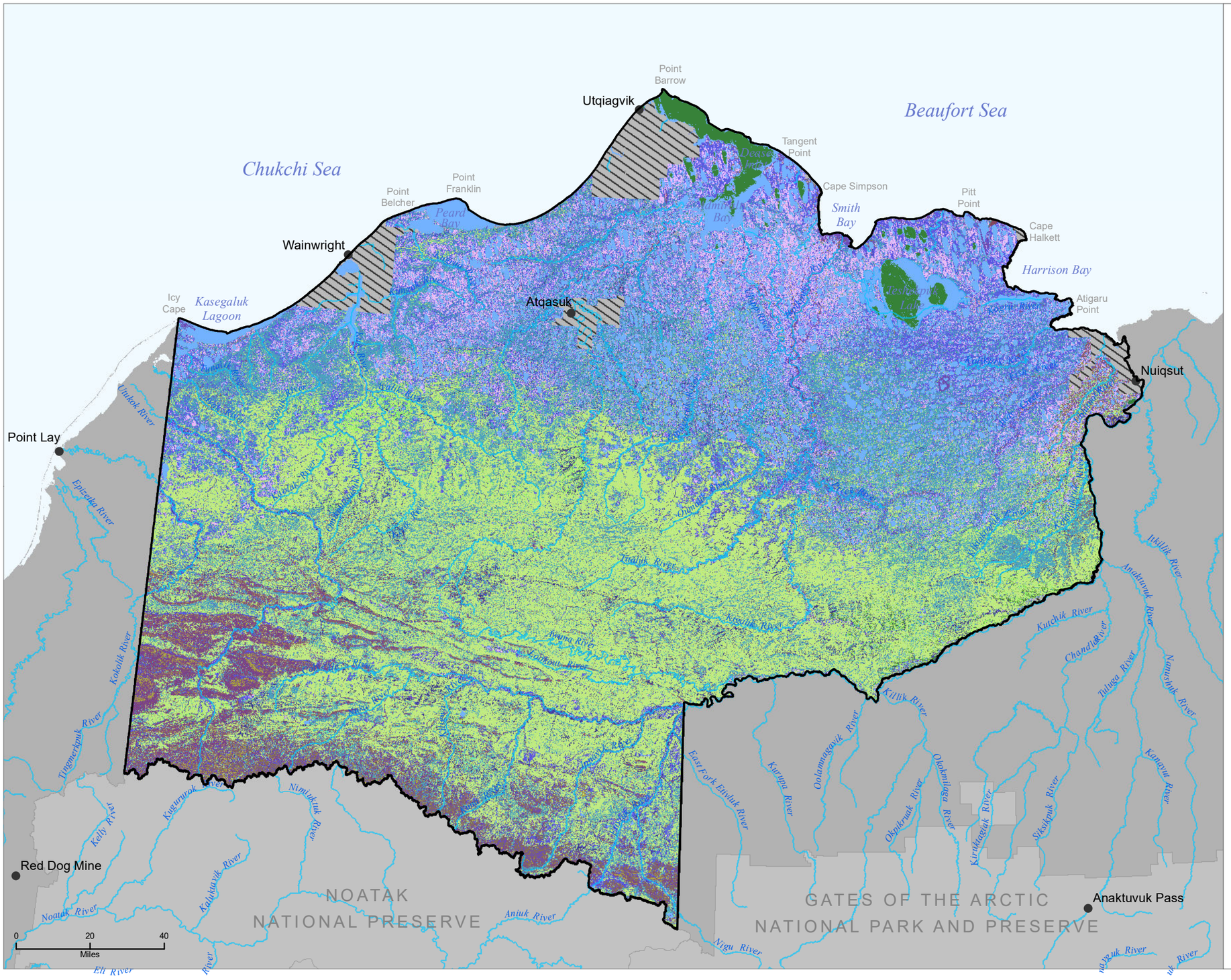
Legacy wells

- Legacy well
- Legacy well with reserve pit

- Resource Conservation and Recovery Act site
- National Petroleum Reserve-Alaska
- Outside the BLM's surface authority

Data source: ADEC GIS 2020, EPA GIS 2018, BLM GIS 2019
Print date: 06/10/2020

Map 3-10



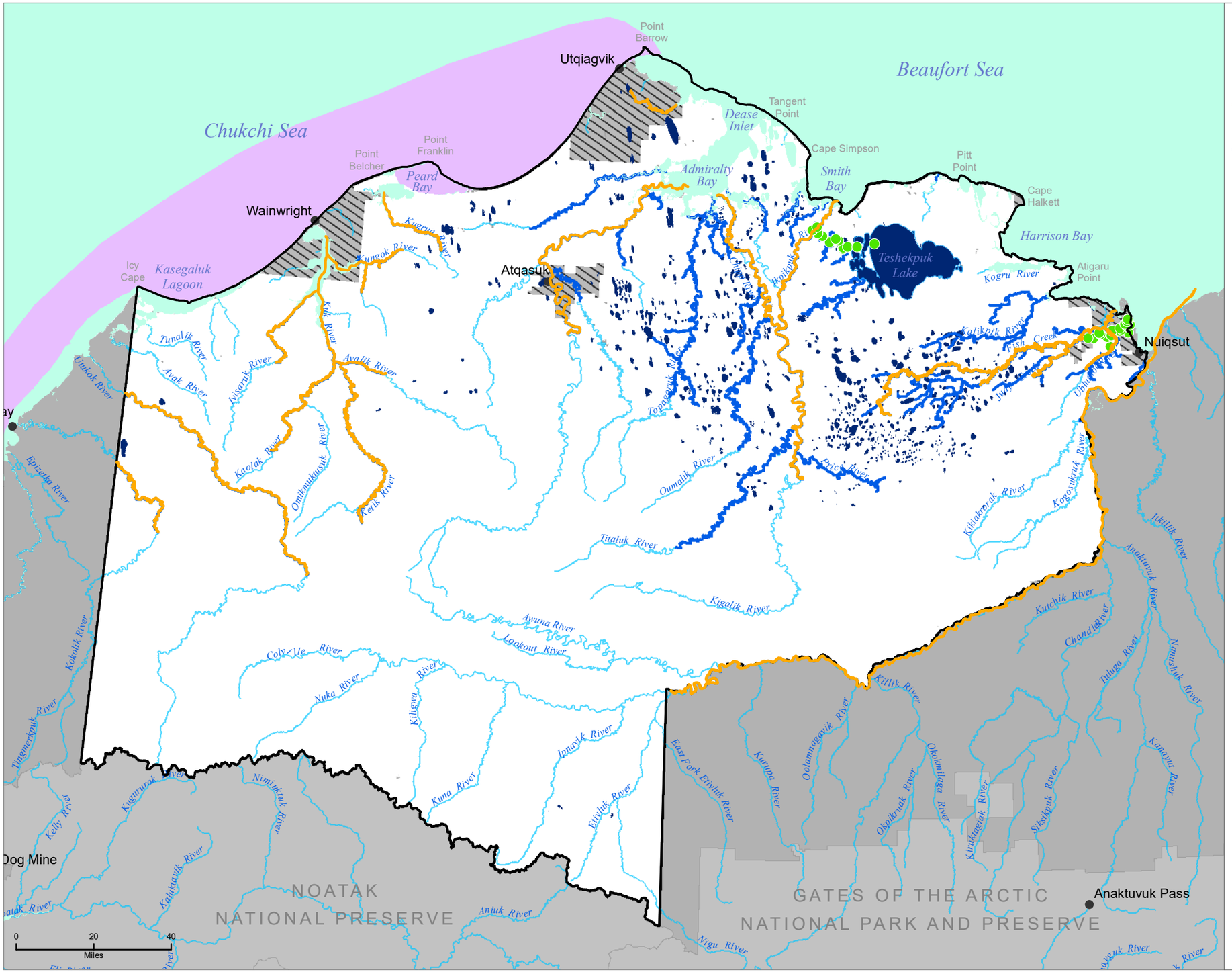
Vegetation Class

- Open water
- Marine beach/beach meadow
- Coastal marsh
- Freshwater marsh-Arctophila fulva
- Freshwater marsh-Carex aquatillis
- Wet sedge
- Wet sedge-Sphagnum
- Mesic herbaceous
- Mesic sedge-Dwarf shrub tundra
- Tussock tundra
- Tussock shrub tundra
- Dwarf shrub
- Birch ericaceous low shrub
- Low-Tall willow
- Alder
- Dryas dwarf shrub
- Bare ground
- Sparsely vegetated
- Unclassified
- Ice/snow
- Burned area

- National Petroleum Reserve-Alaska
- Outside the BLM's surface authority

Data source: NSSI Landcover
GIS 2019, BLM GIS 2019
Print date: 06/10/2020

Map 3-11



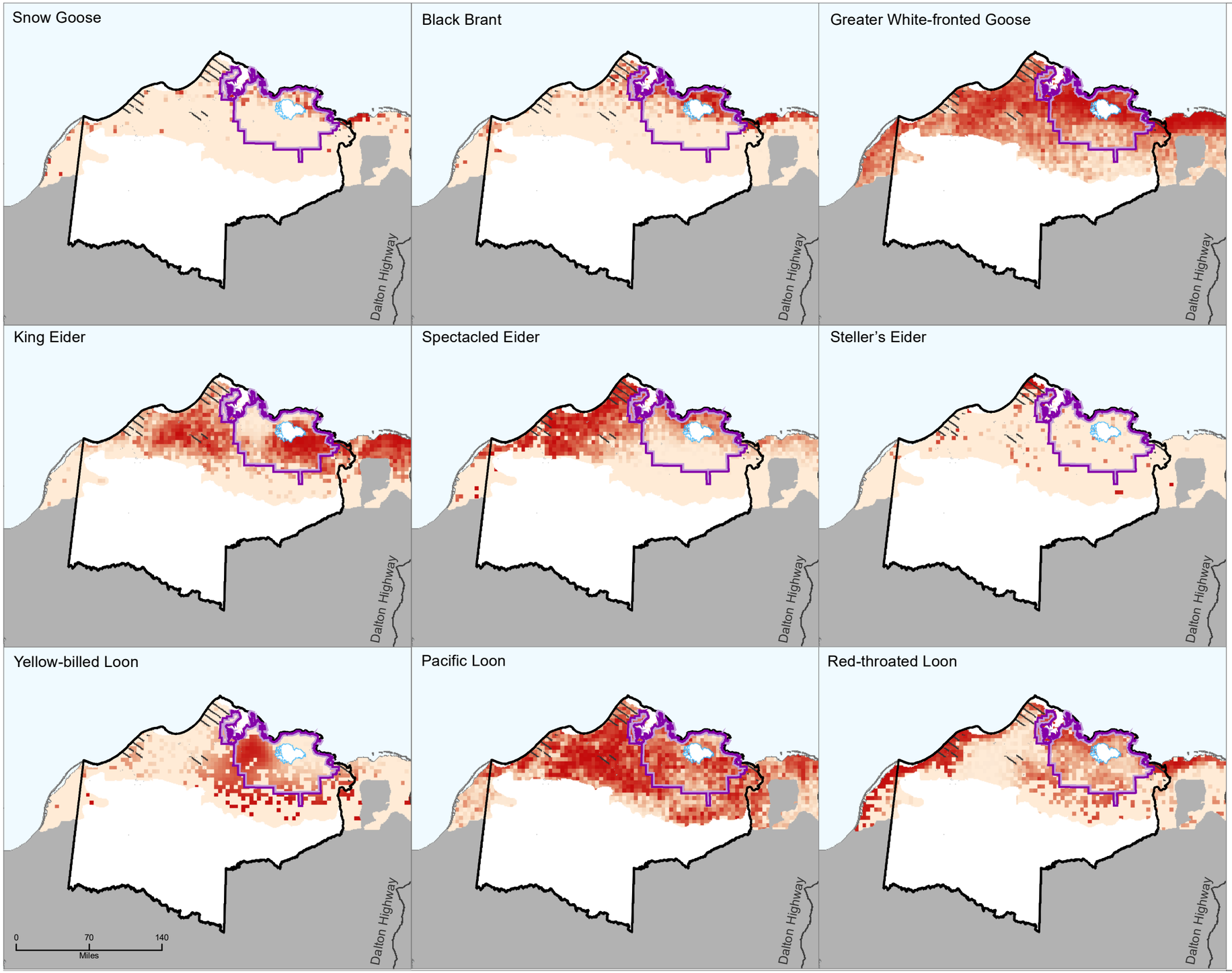
Fish habitat

- Alaska Freshwater Fish Inventory
- Anadromous Waters Catalog (chum and pacific salmon)
- Anadromous Waters Catalog (all species)
- Saffron and Arctic Cod essential fish habitat
- Arctic Cod essential fish habitat
- Lake depth >4 meters

- National Petroleum Reserve-Alaska
- Outside the BLM's surface authority

Data source: BLM GIS 2019, ADFG GIS 2019
Print date: 06/10/2020

Map 3-12



Bird density
- High
- Medium
- Low

Teshekpuk Lake Special Area

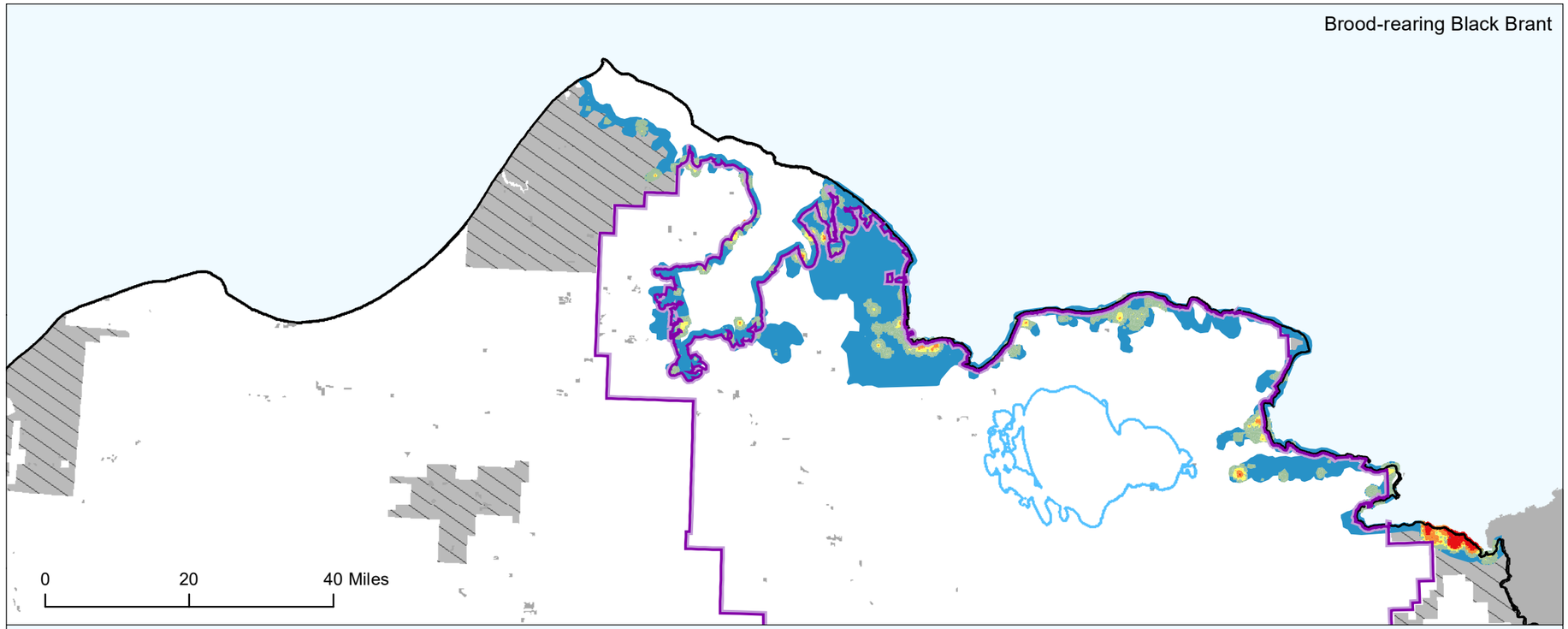
National Petroleum Reserve-Alaska

Outside the BLM's surface authority

The bird area of analysis includes all terrestrial areas within the NPR-A borders and 5 miles off shore to include the sand spits, lagoons, nearshore islands.

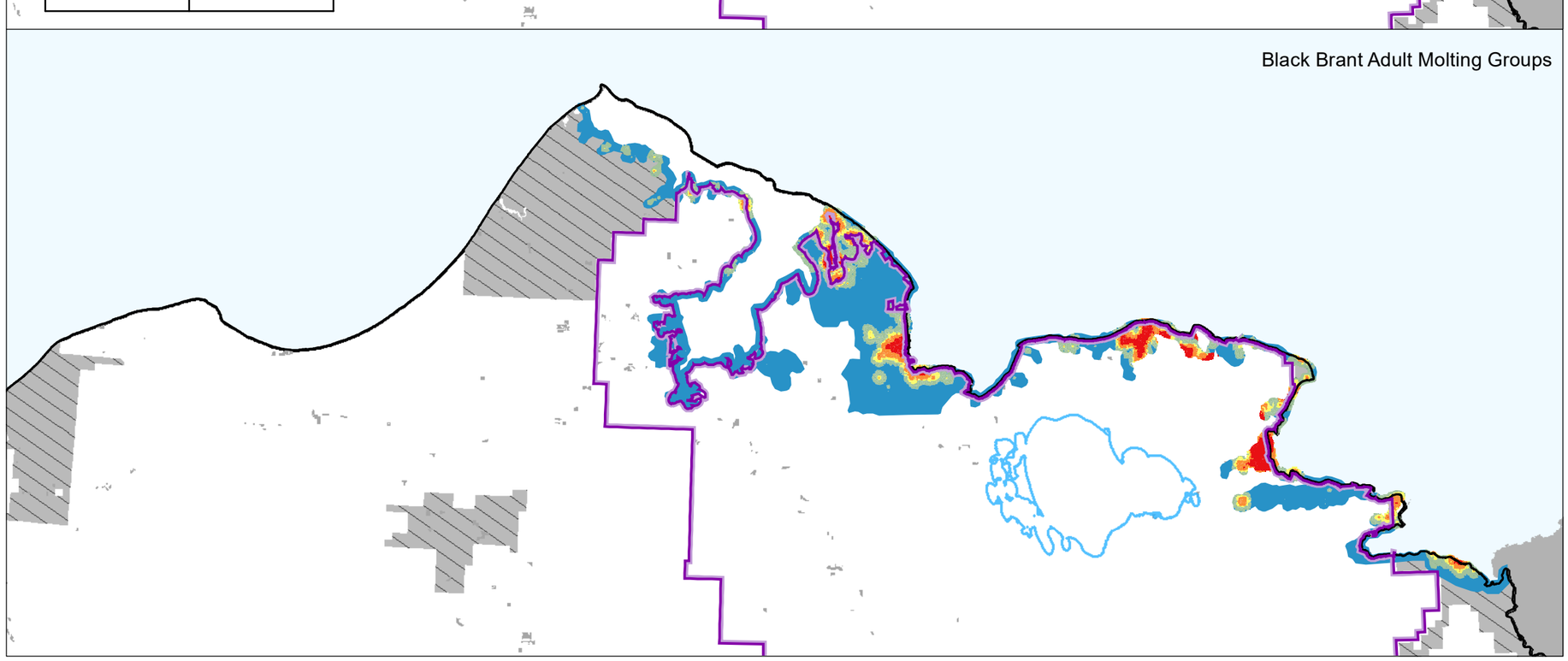
Data source: BLM GIS 2019, Amundson et al. 2019
Print Date: 06/10/2020

Map 3-13



Birds/km²/year
0
1 - 5
6 - 10
11 - 25
26 - 186
Teshekpuk Lake Special Area

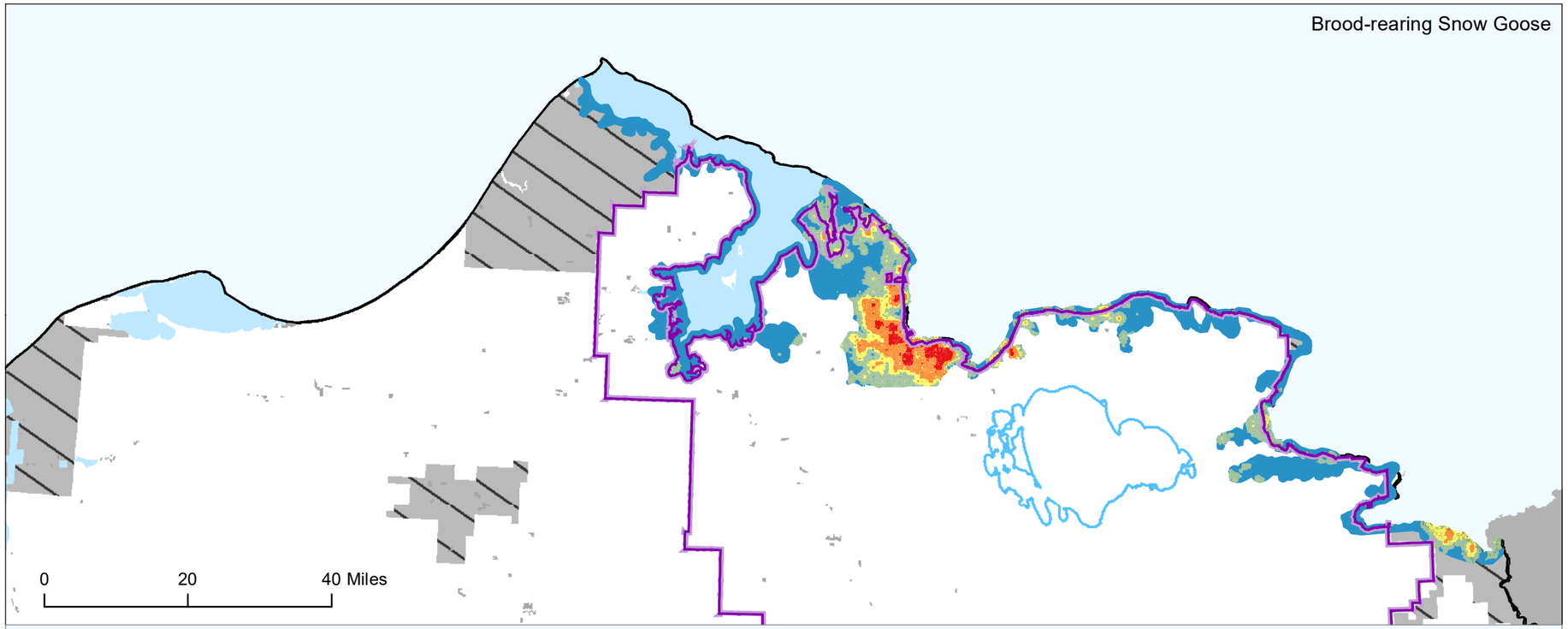
National Petroleum Reserve-Alaska
Outside the BLM's surface authority

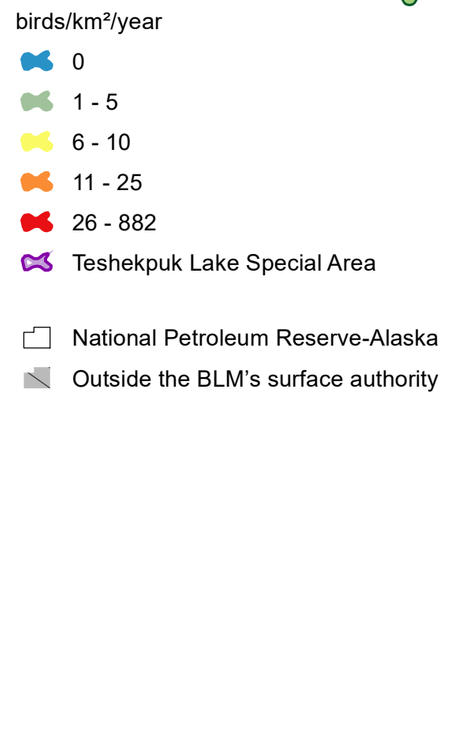


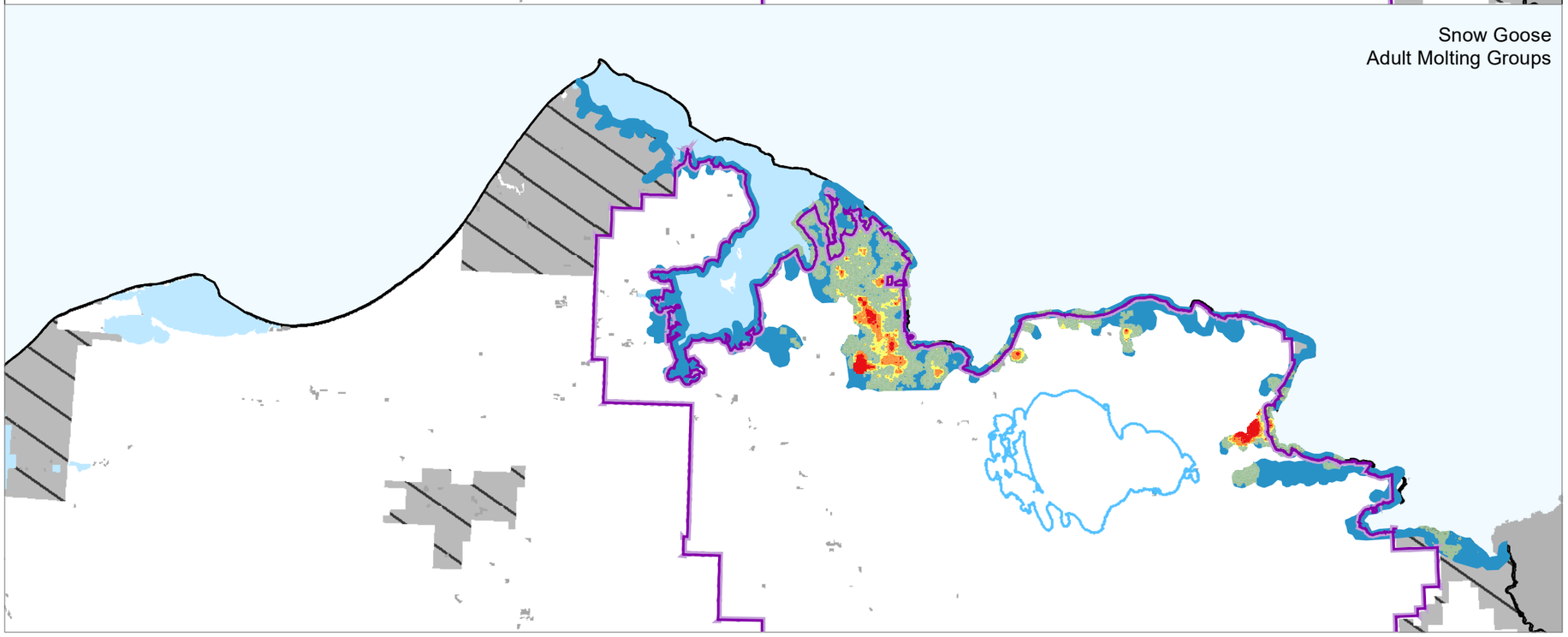
Birds/km²/year
0
1 - 5
6 - 10
11 - 25
26 - 2,357

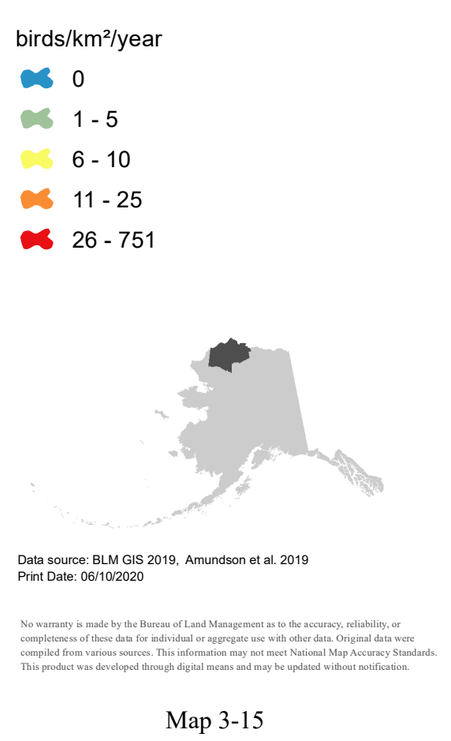
Data source: BLM GIS 2019, Amundson et al. 2019 (sponsored by North Slope Borough Division of Wildlife Management)
Print Date: 06/10/2020

Map 3-14



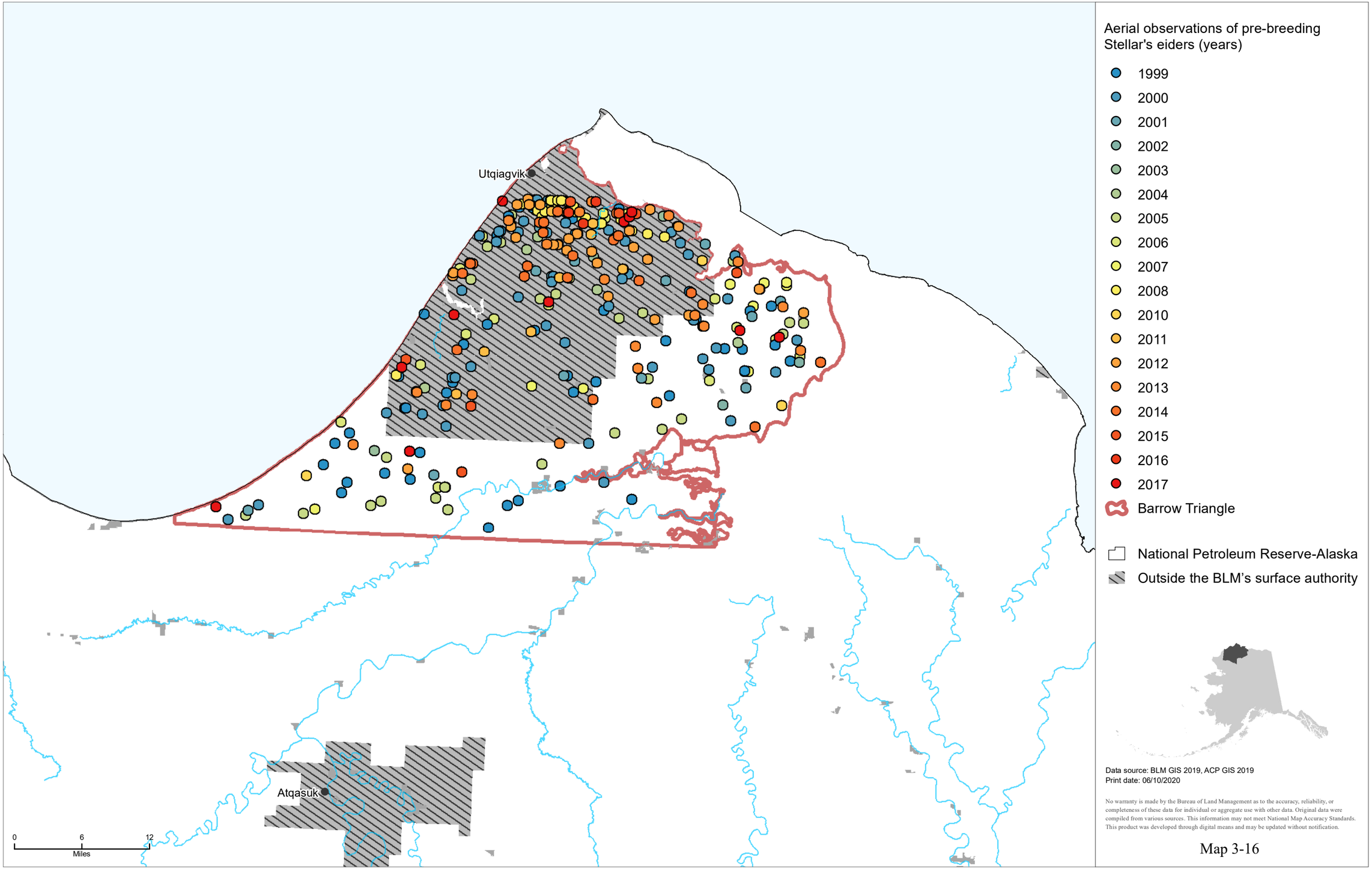




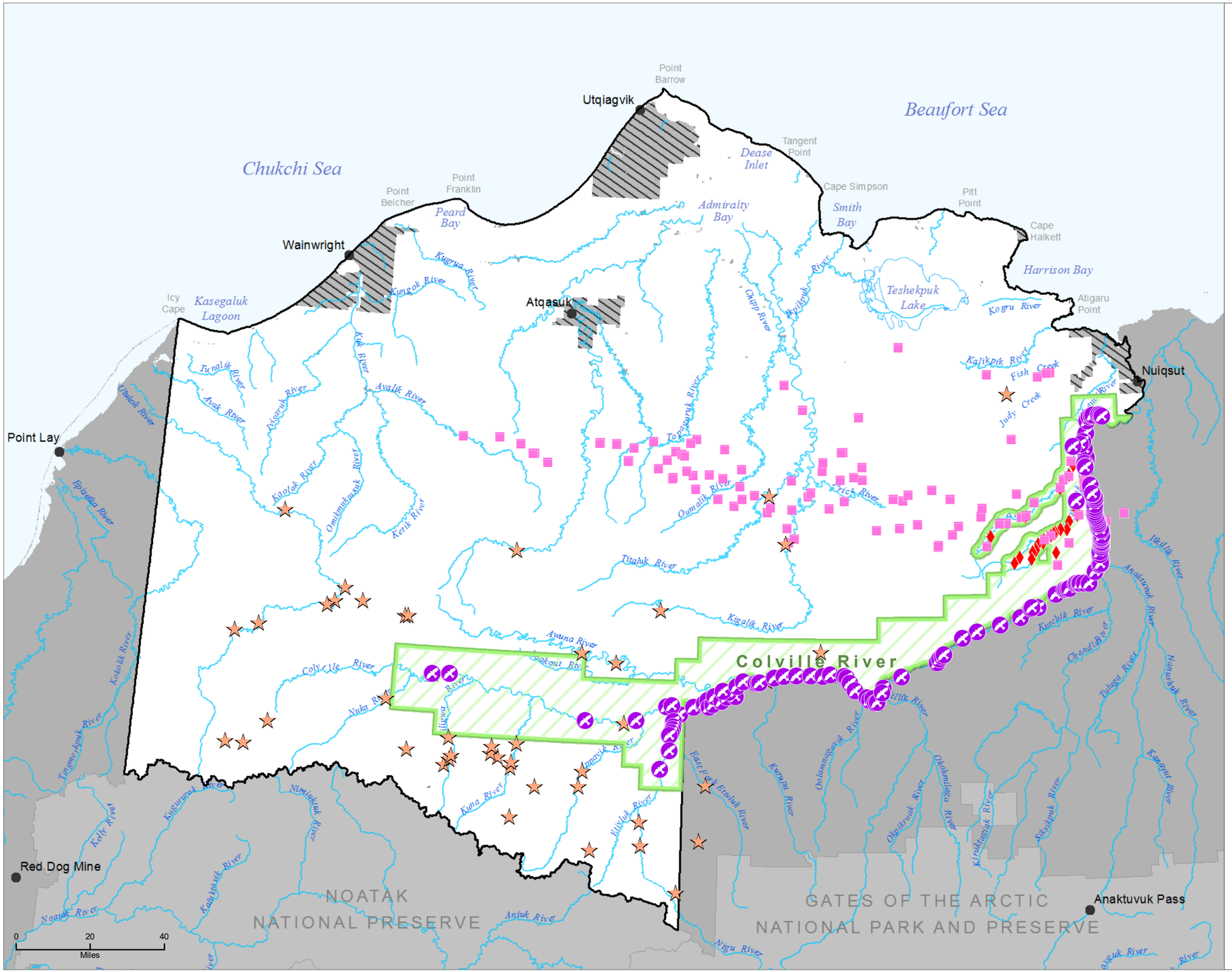


Data source: BLM GIS 2019, Amundson et al. 2019
Print Date: 06/10/2020

Map 3-15


Utqiagvik
Atqasuk
0
6
12
Miles
Aerial observations of pre-breeding Stellar's eiders (years)
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2010
2011
2012
2013
2014
2015
2016
2017
Barrow Triangle
National Petroleum Reserve-Alaska
Outside the BLM's surface authority
Data source: BLM GIS 2019, ACP GIS 2019
Print date: 06/10/2020
No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual or aggregate use with other data. Original data were compiled from various sources. This information may not meet National Map Accuracy Standards. This product was developed through digital means and may be updated without notification.

Map 3-16



Peregrine falcon nest site locations, detected in the Colville River Special Area, over 20 years

Gyrfalcon nest site locations, detected from aerial surveys, sampled from 1997–2006

Peregrine falcon and Gyrfalcon nest sites, sampled from 2012–2017

Peregrine falcon nest sites, aerial survey, sampled in 1997

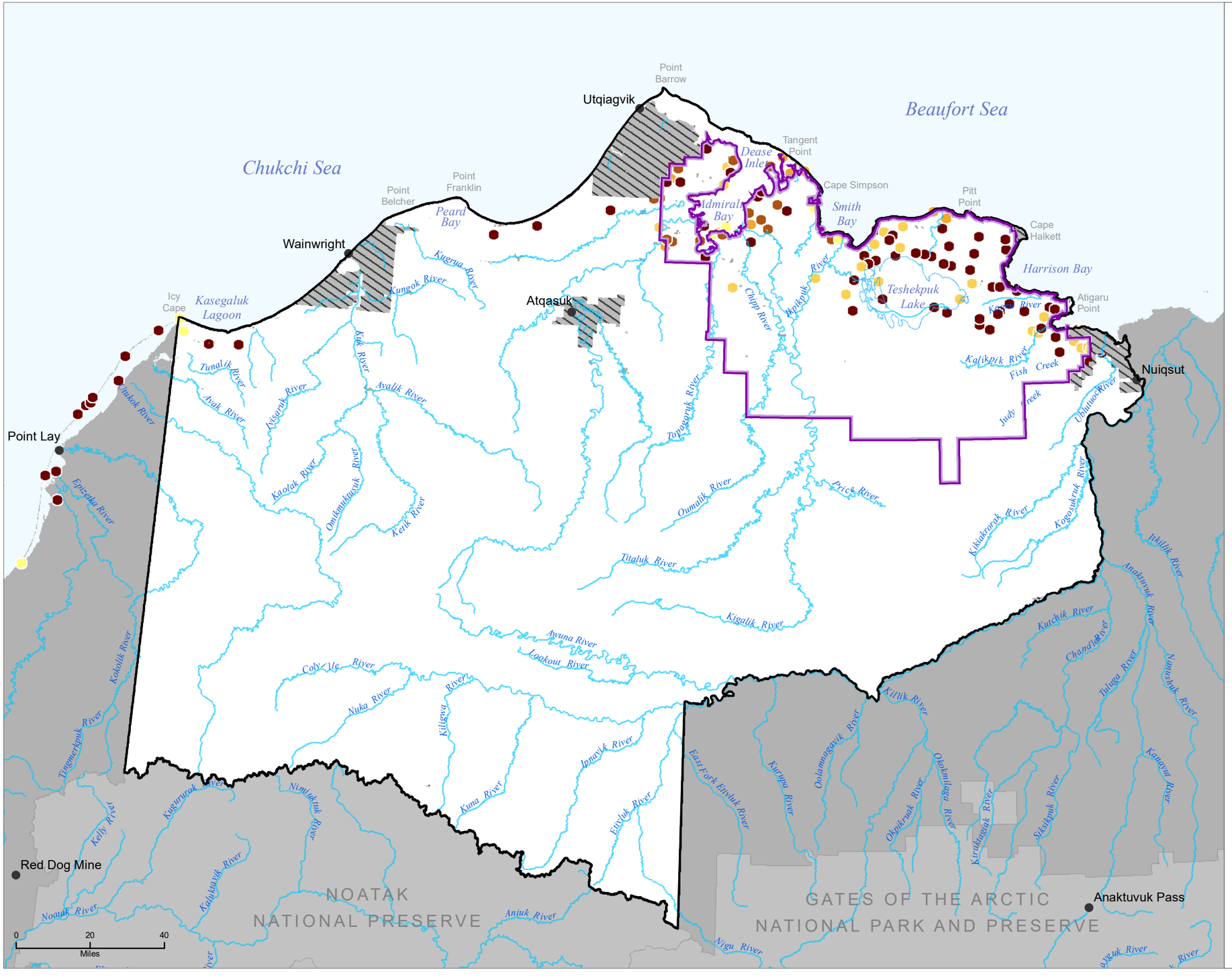
Colville River Special Area

National Petroleum Reserve-Alaska

Outside the BLM's surface authority

Data source: BLM GIS 2019
Print date: 06/10/2020

Map 3-17



Brant colonies:
percent of years occupied
(1994–2018)

- 0 - 25
- 26 - 57
- 58 - 71
- 72 - 88
- 89 - 100

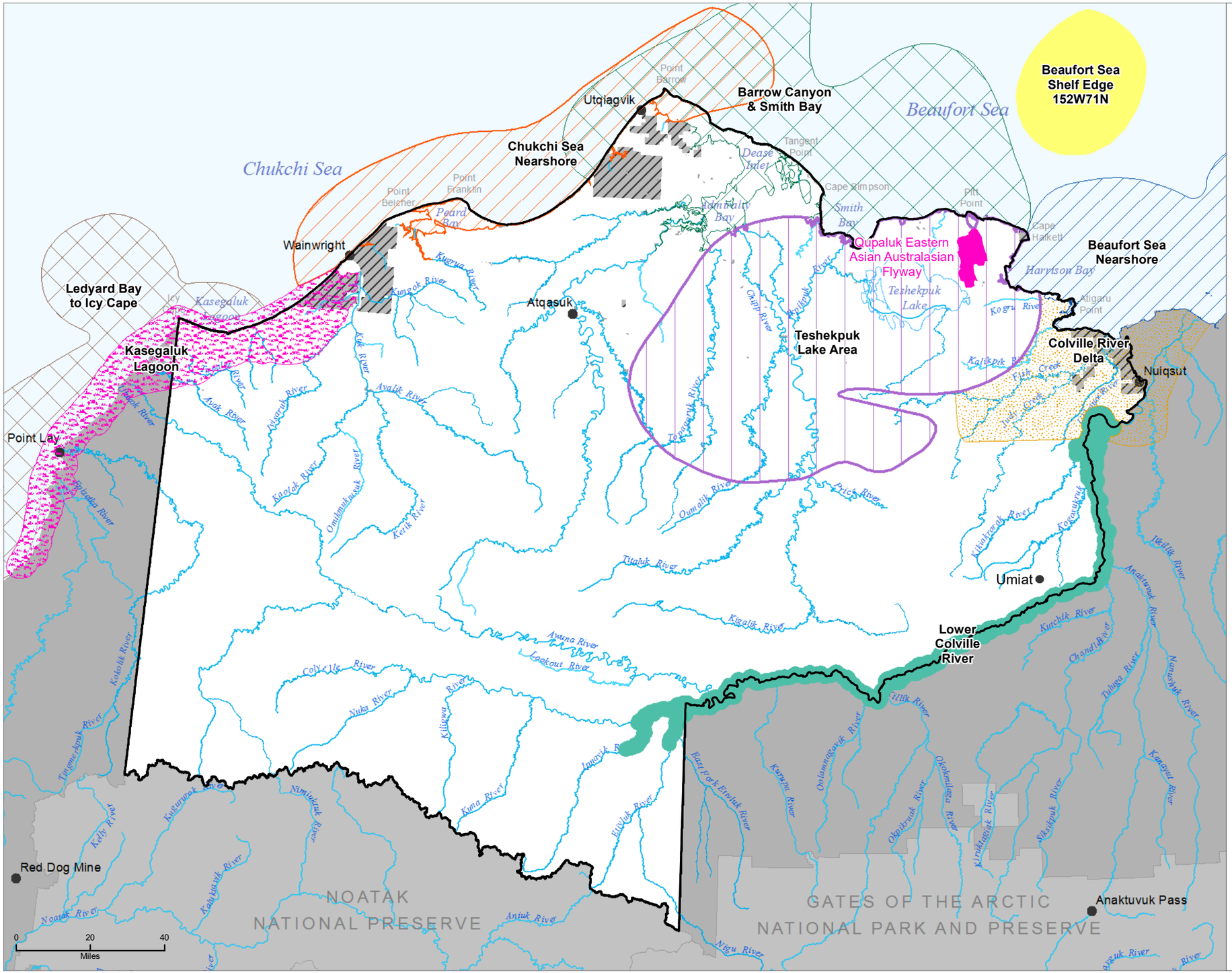
Teshekpuk Lake Special Area

National Petroleum Reserve-Alaska

Outside the BLM's surface authority

Data source: BLM GIS 2019, USGS GIS 2019 (sponsored by North Slope Borough Division of Wildlife Management)

Map 3-18



Important bird areas

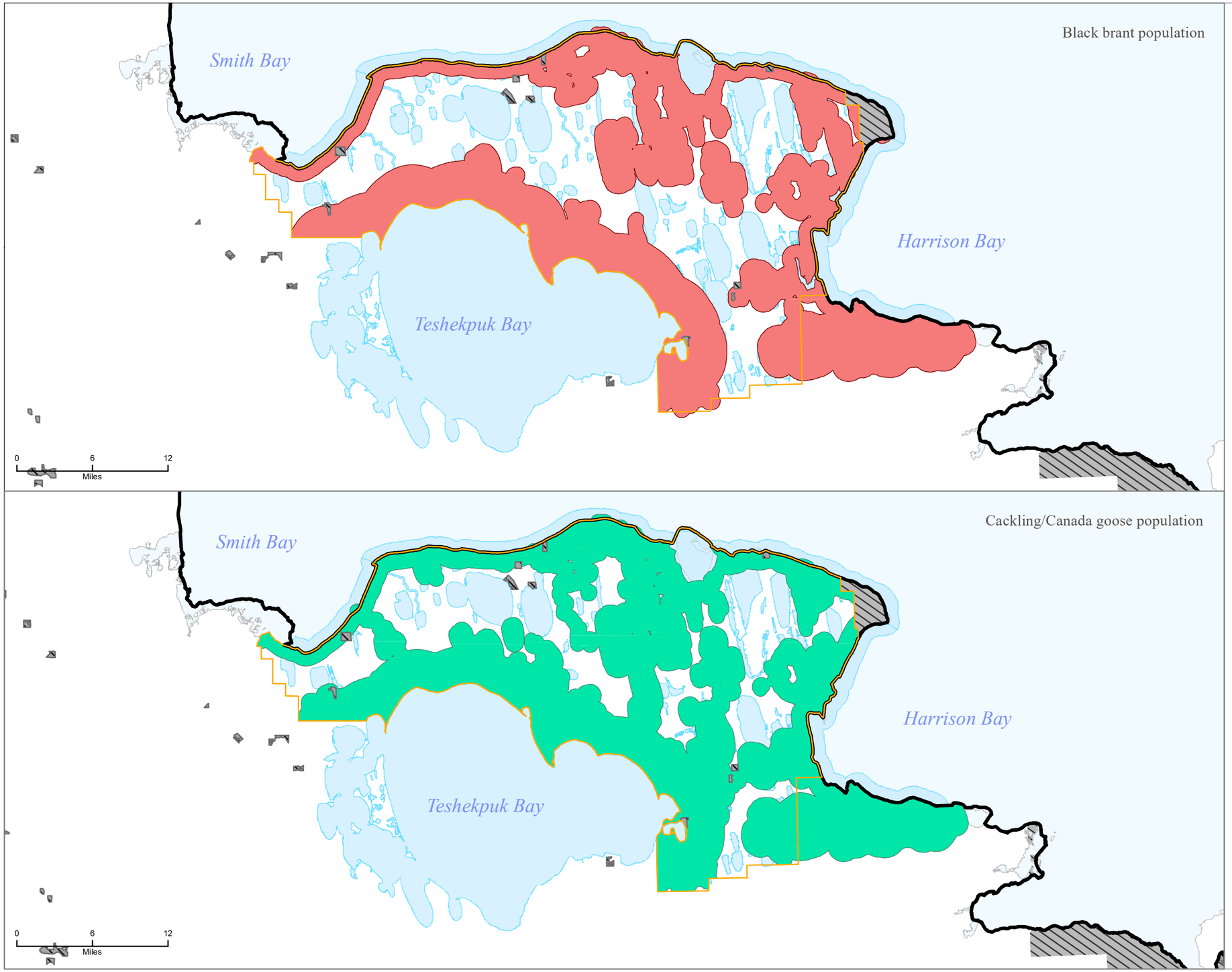
- Barrow Canyon & Smith Bay
- Beaufort Sea Nearshore
- Beaufort Sea Shelf Edge 152W71N
- Chukchi Sea Nearshore
- Colville River Delta
- Kasegaluk Lagoon
- Ledyard Bay to Icy Cape
- Lower Colville River
- Teshekpuk Lake Area

- Qupaluk Eastern Asian Australasian Flyway Site

- National Petroleum Reserve-Alaska
- Outside the BLM's subsurface authority

Data source: BLM GIS 2019
Print date: 06/10/2020

Map 3-19



Goose molting area

Lakes, 0.5-mile lake buffers, 1-mile coastal buffer, and 3-mile Teshekpuk Lake buffer used by 85% of the molting black brant population within the Goose Molting Area

Additional molt units

Goose molting area

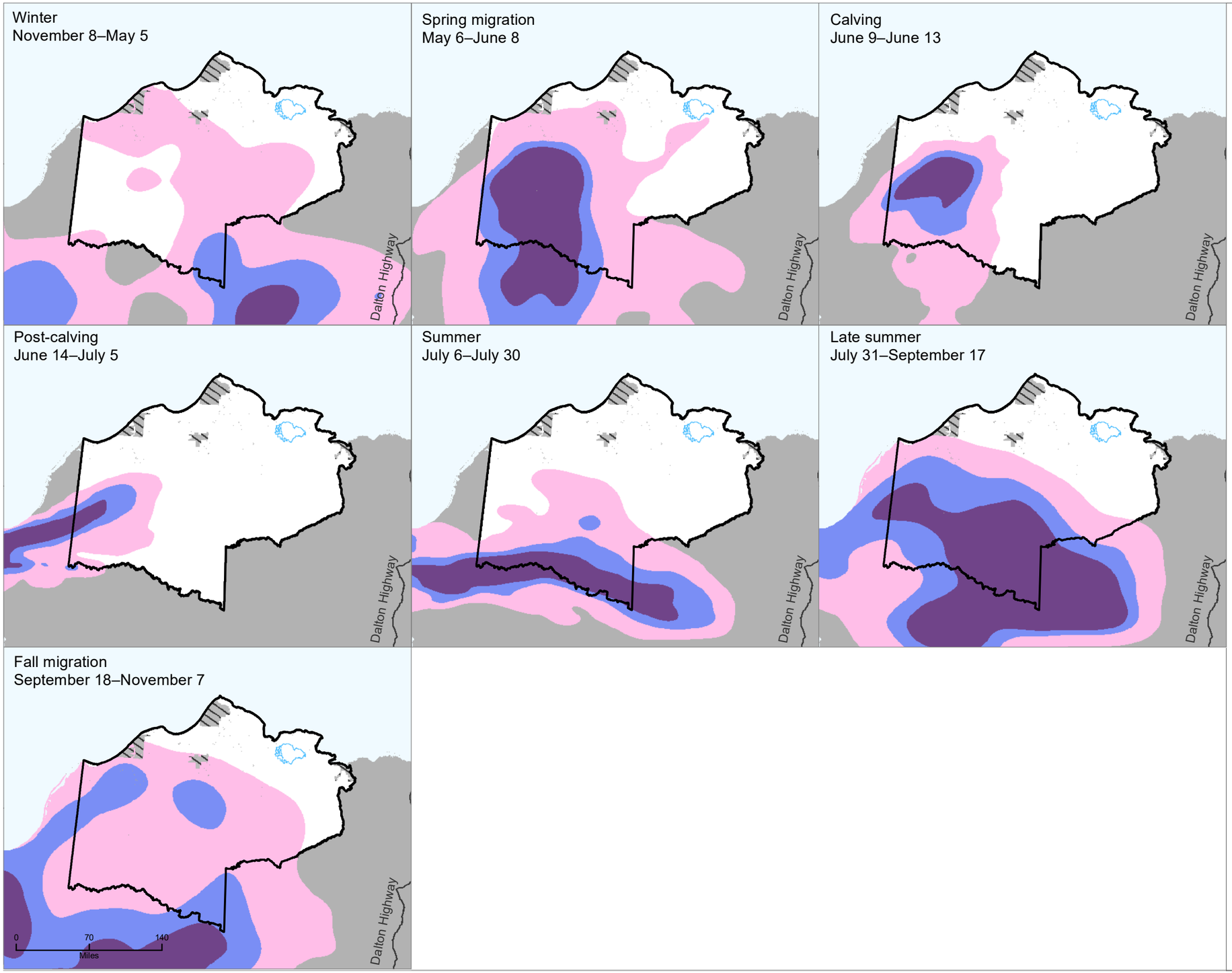
National Petroleum Reserve-Alaska

Outside the BLM's surface authority

Lakes, 0.5-mile lake buffers, 1-mile coastal buffer, and 3-mile Teshekpuk Lake buffer used by 85% of the molting cackling/Canada goose population within the Goose Molting Area

Data source: Amundson et. al 2019
Print date: 06/10/2020

Map 3-20



Kernel density isopleth

- 50% (high density)
- 75% (medium density)
- 95% (low density)

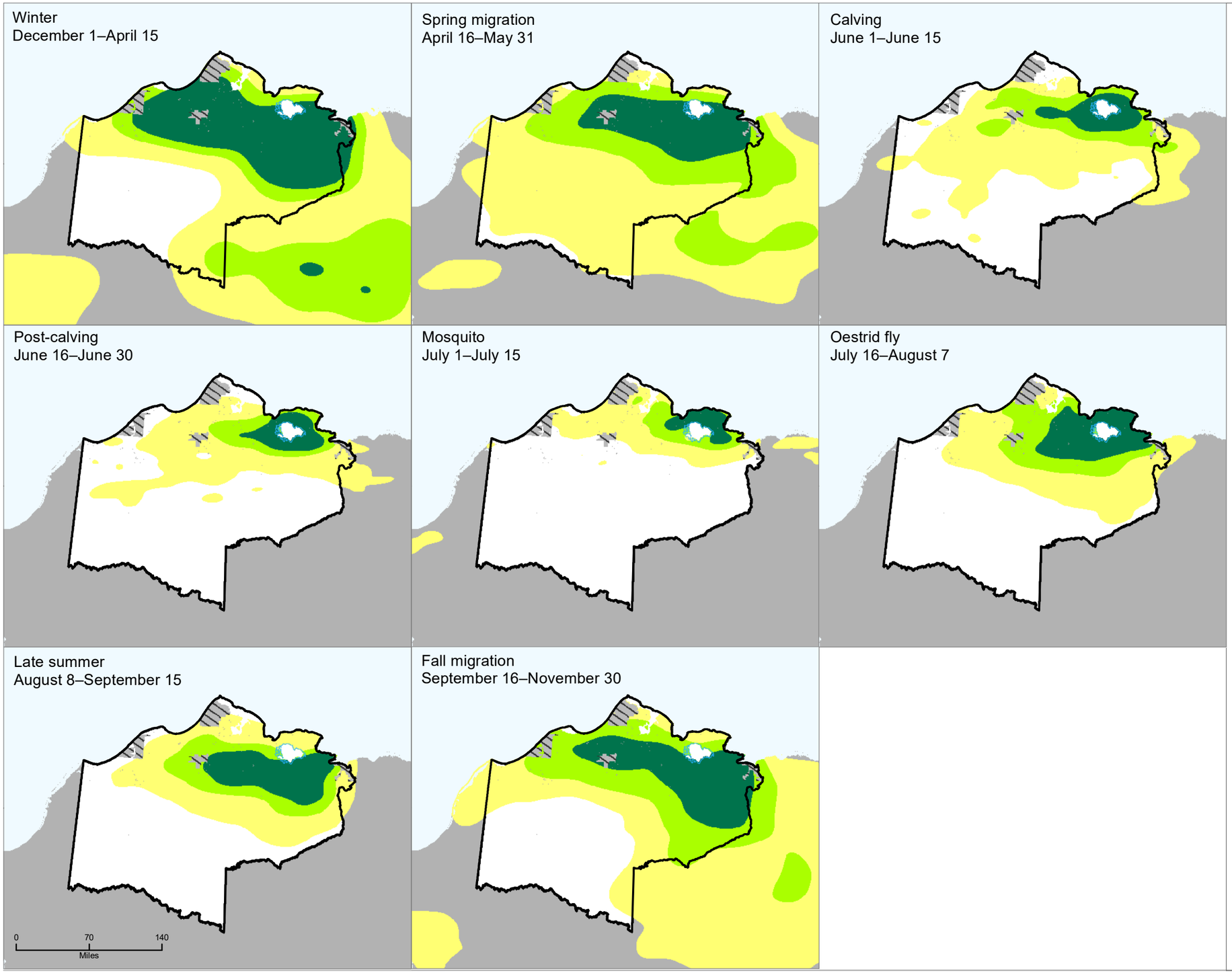
- National Petroleum Reserve-Alaska
- Outside the BLM's surface authority

Utilization distribution contours for the Western Arctic Herd were calculated using fixed-kernel density estimation analysis of locations of radio-collared female caribou (telemetry database from Alaska Department of Fish and Game [ADF&G]). Contours enclose stated percentages of all collar locations. High-, medium-, and low-density areas are the 50%, 75%, and 95% utilization distribution contours, respectively. Bandwidth calculated using the plug-in method. Final seasonal kernels were calculated as the average of kernels calculated for every 2-day period during the season to account for intra-season movements.

The study years are from 2001-2018. Funding for telemetry collars came from ADF&G and the National Park Service.

Data source: BLM GIS 2019, ADFG GIS 2019
Print Date: 06/10/2020

Map 3-21



Kernel density isopleth

- 50% (high density)
- 75% (medium density)
- 95% (low density)

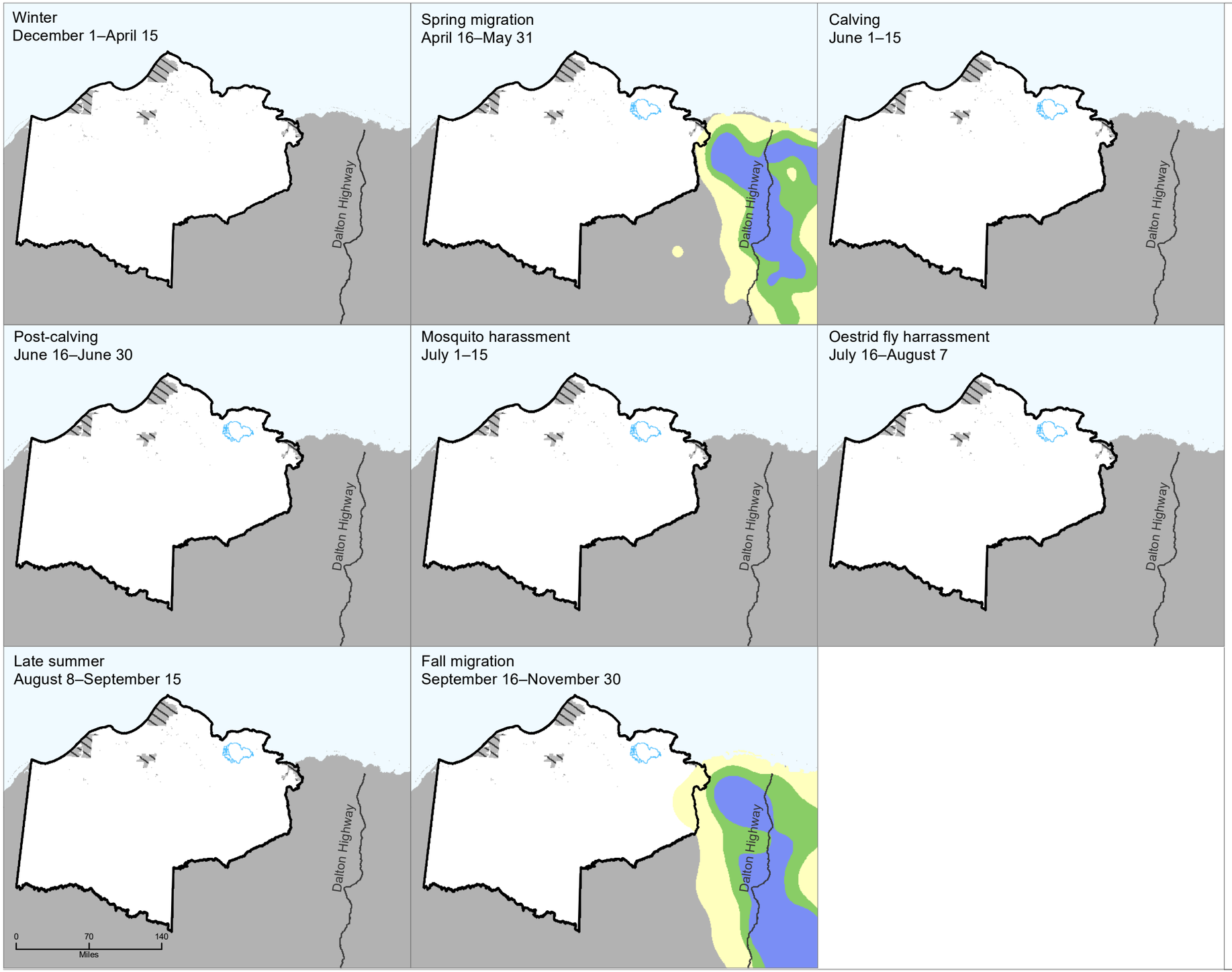
- National Petroleum Reserve-Alaska
- Outside the BLM's surface authority

Utilization distribution contours for the Teshekpuk Lake Caribou Herd were calculated using fixed-kernel density estimation analysis of locations of radio-collared female caribou (telemetry database from Alaska Department of Fish and Game [ADF&G]). Contours enclose stated percentages of all collar locations. High-, medium-, and low-density areas are the 50%, 75%, and 95% utilization distribution contours, respectively. Bandwidth calculated using the plug-in method. Final seasonal kernels were calculated as the average of kernels calculated for every 2-day period during the season to account for intra-season movements.

The study years are from 1990-2018. Funding for telemetry collars came from ADF&G, BLM, North Slope Borough, and Conoco Phillips Inc.

Data source: BLM GIS 2019, ADFG GIS 2019

Map 3-22



Kernel density isopleth

- 50% (high density)
- 75% (medium density)
- 95% (low density)

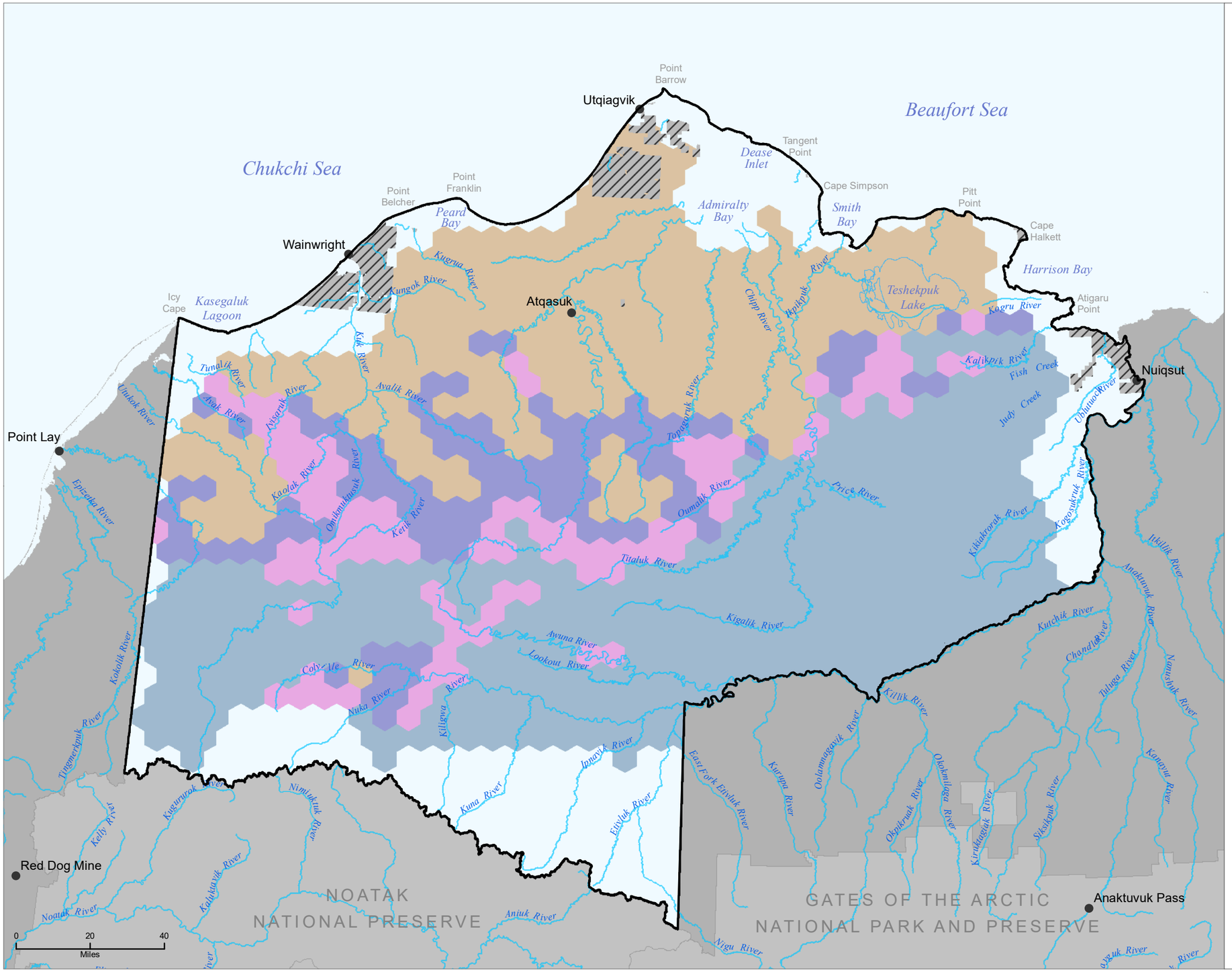
- National Petroleum Reserve-Alaska
- Outside the BLM's surface authority

Utilization distribution contours for the Central Arctic Herd were calculated using fixed-kernel density estimation analysis of locations of radio-collared female caribou (telemetry database from Alaska Department of Fish and Game [ADF&G]). Contours enclose stated percentages of all collar locations. High-, medium-, and low-density areas are the 50%, 75%, and 95% utilization distribution contours, respectively. Bandwidth calculated using the plug-in method. Final seasonal kernels were calculated as the average of kernels calculated for every 2-day period during the season to account for intra-season movements.

The study years are from 2001-2018. Funding for telemetry collars came from ADF&G and Conoco Phillips Inc.

Data source: BLM GIS 2019, ADFG GIS 2019
Print Date: 06/10/2020

Map 3-23



Wolverine habitat:
Mean occupancy estimate

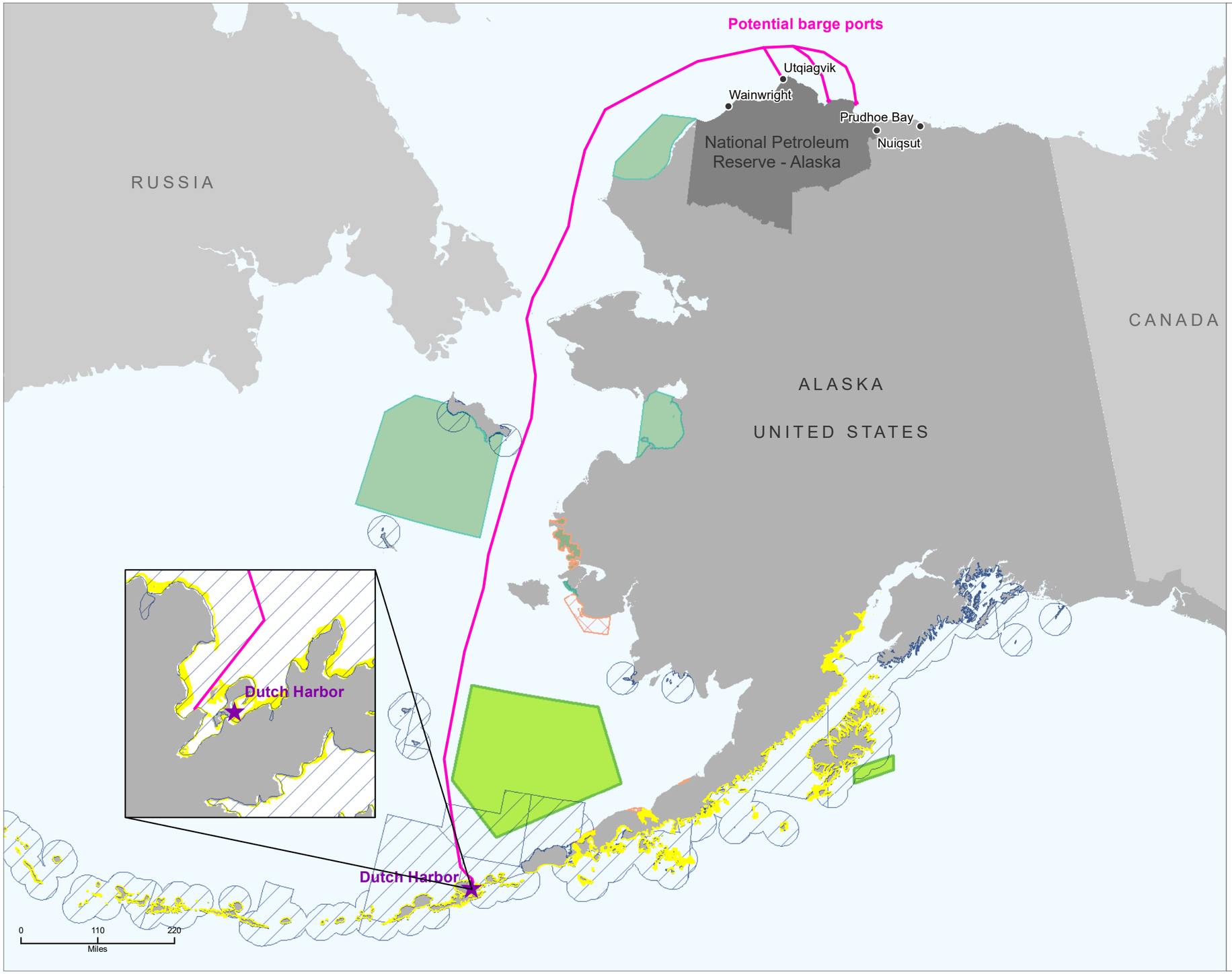
- 0-0.24
- 0.25-0.49
- 0.5-0.74
- 0.75-1.0

- National Petroleum Reserve-Alaska
- Outside the BLM's subsurface authority

Data source: Poley et al. GIS 2018, BLM GIS 2019
Print date: 06/10/2020

Map 3-24

Critical Habitat along the Potential Marine Vessel Transportation Route

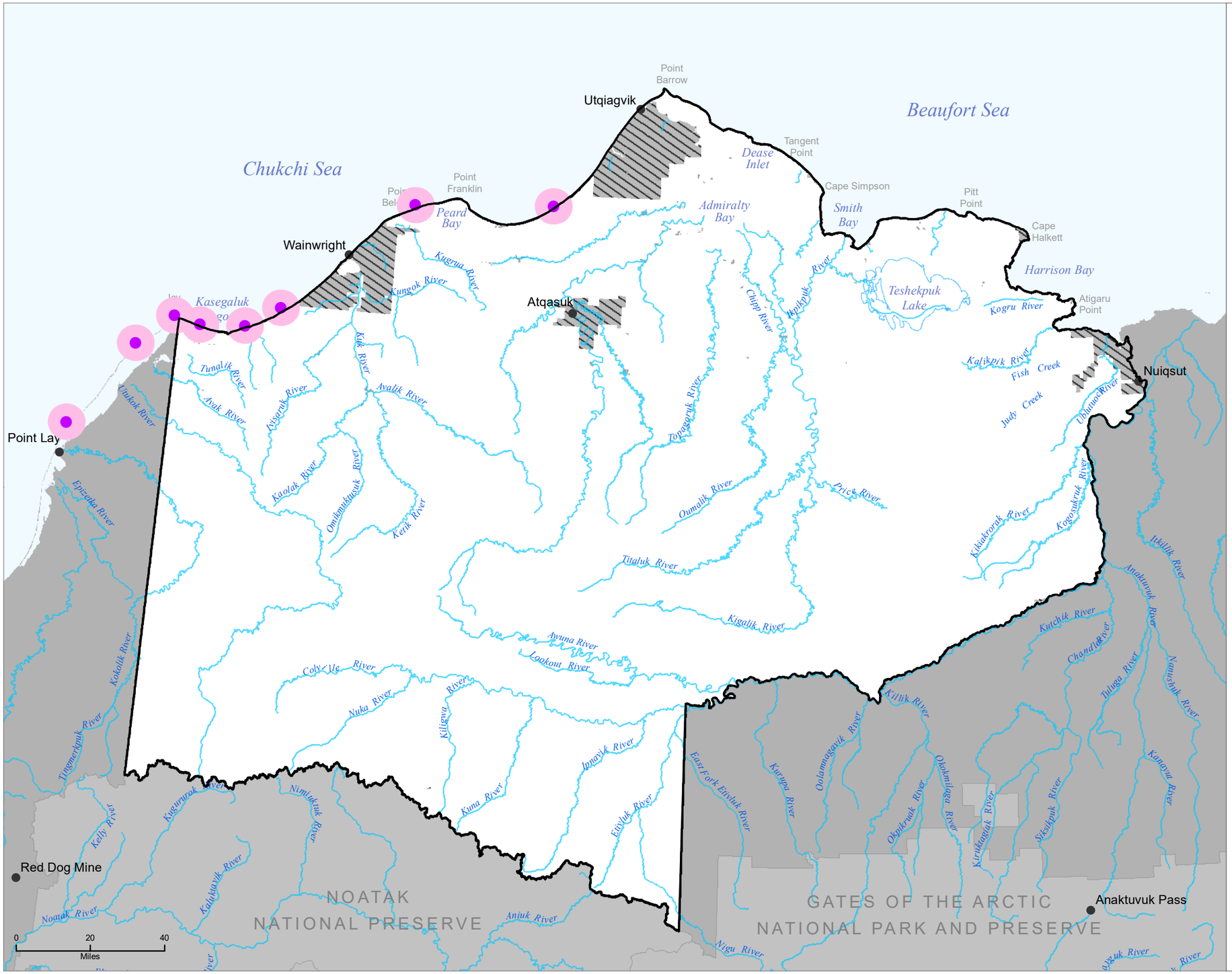


Critical habitat:
Marine transportation route

- Potential marine vessel transportation route
- Sea otter critical habitat
- Steller's sea lion critical habitat (foraging area and 20 nautical mile aquatic zone)
- Steller's eider critical habitat
- Spectacled eider critical habitat
- North pacific right whale critical habitat
- National Petroleum Reserve-Alaska

Data source: BLM GIS 2019
Print date: 06/10/2020

Map 3-25



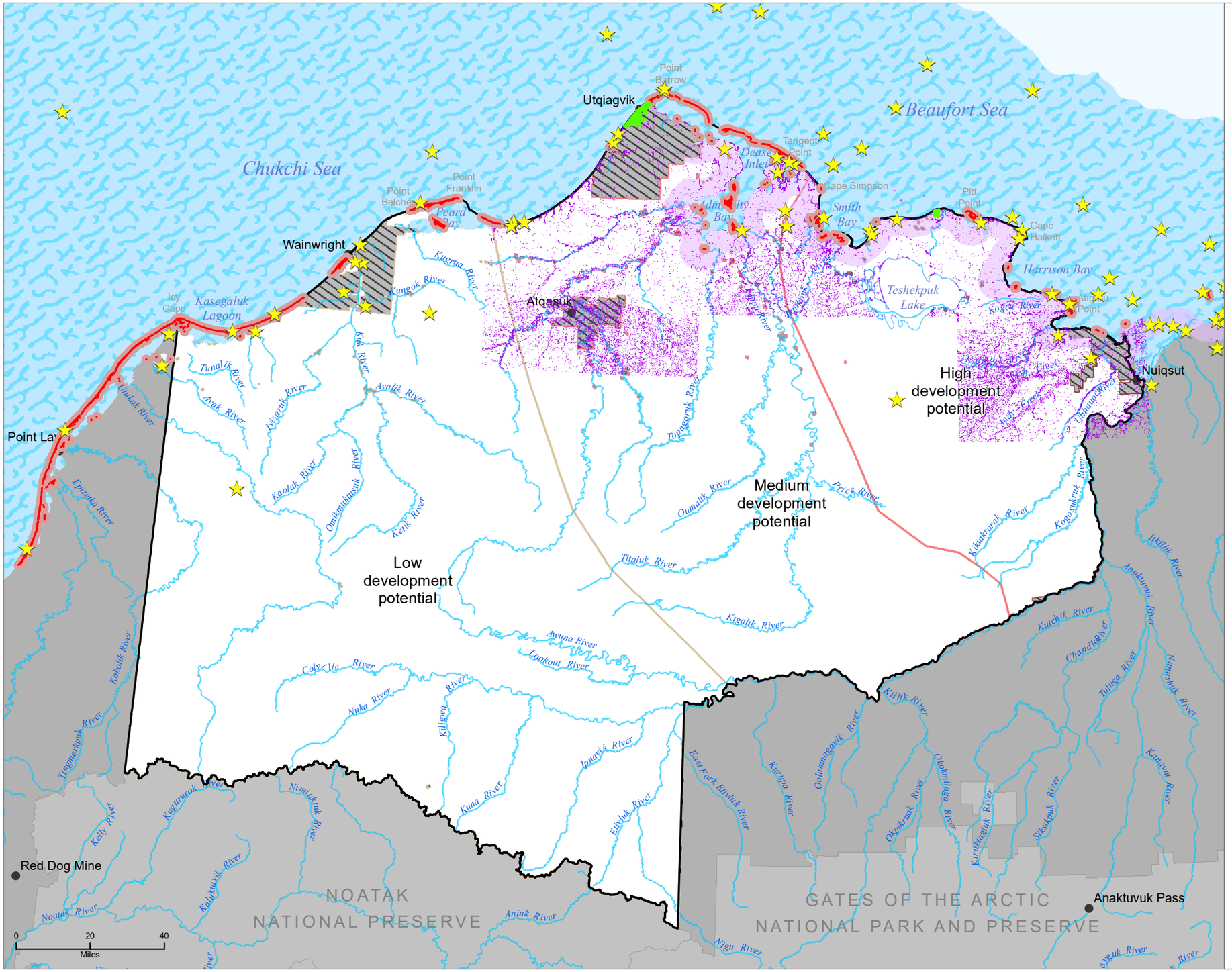
Walrus haul-outs

- Pacific walrus haul-out
- Pacific walrus haul-out 5-mile buffer

- National Petroleum Reserve-Alaska
- Outside the BLM's surface authority

Data source: ASAMM GIS 2016, BLM GIS 2019
Print date: 06/10/2020

Map 3-26



Polar bear habitat

- Polar bear maternal dens (1910-2018, Durner et al. 2020)
- Polar bear maternal den habitat (Durner et al. 2006, data are incomplete for NPR-A)

Polar bear critical habitat

- Sea ice unit
- Barrier island unit
- Barrier island no disturbance zone
- Terrestrial denning unit

- Barrow or other coastal exclusions: exclusion under Section 4(b)(2) of the Endangered Species Act

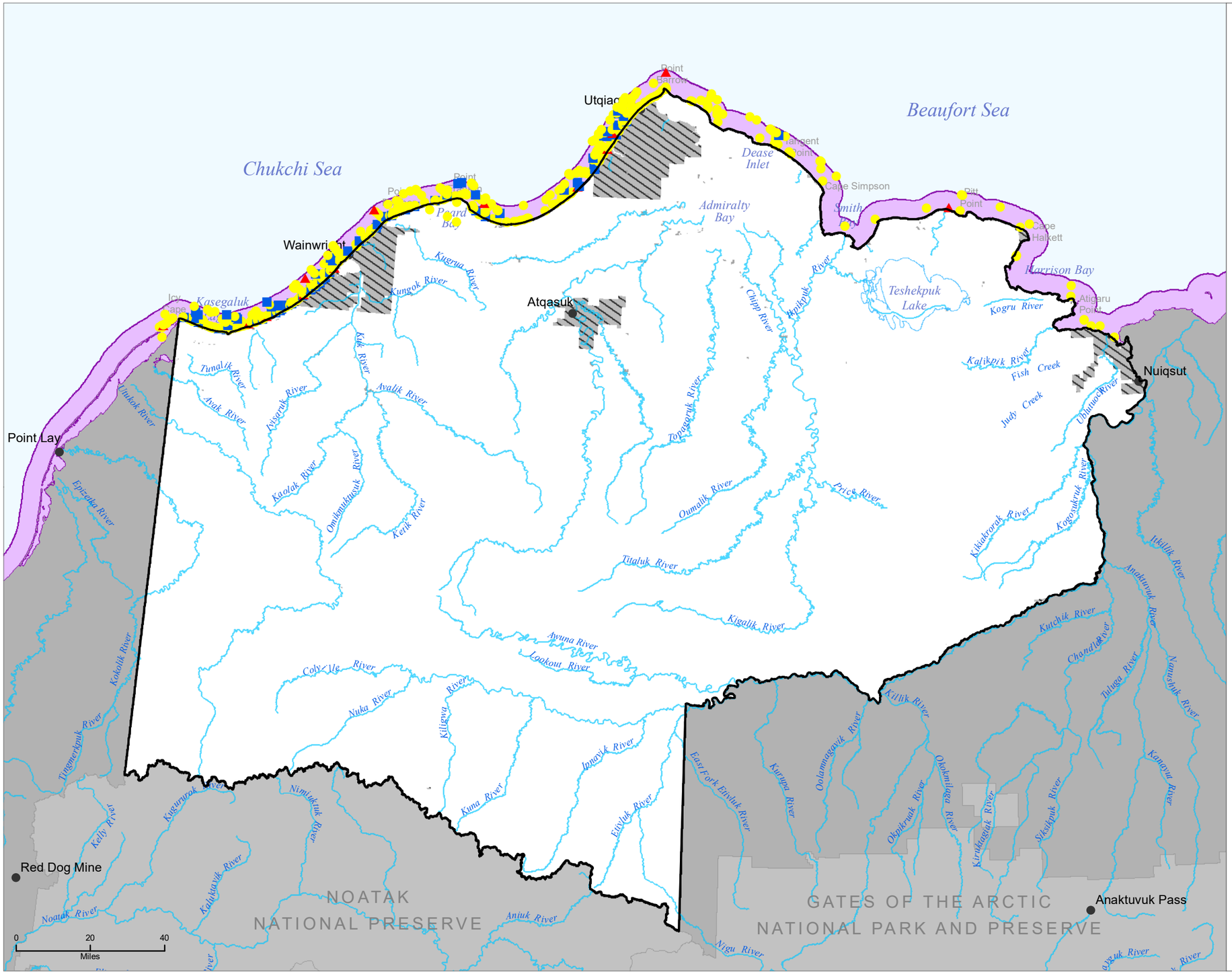
Oil and gas development potential

- High
- Medium
- Low

- National Petroleum Reserve-Alaska
- Outside the BLM's surface authority

Data source: Durner GIS 2020, USFWS GIS 2005, 2010, BLM GIS 2019
Print date: 06/10/2020

Map 3-27



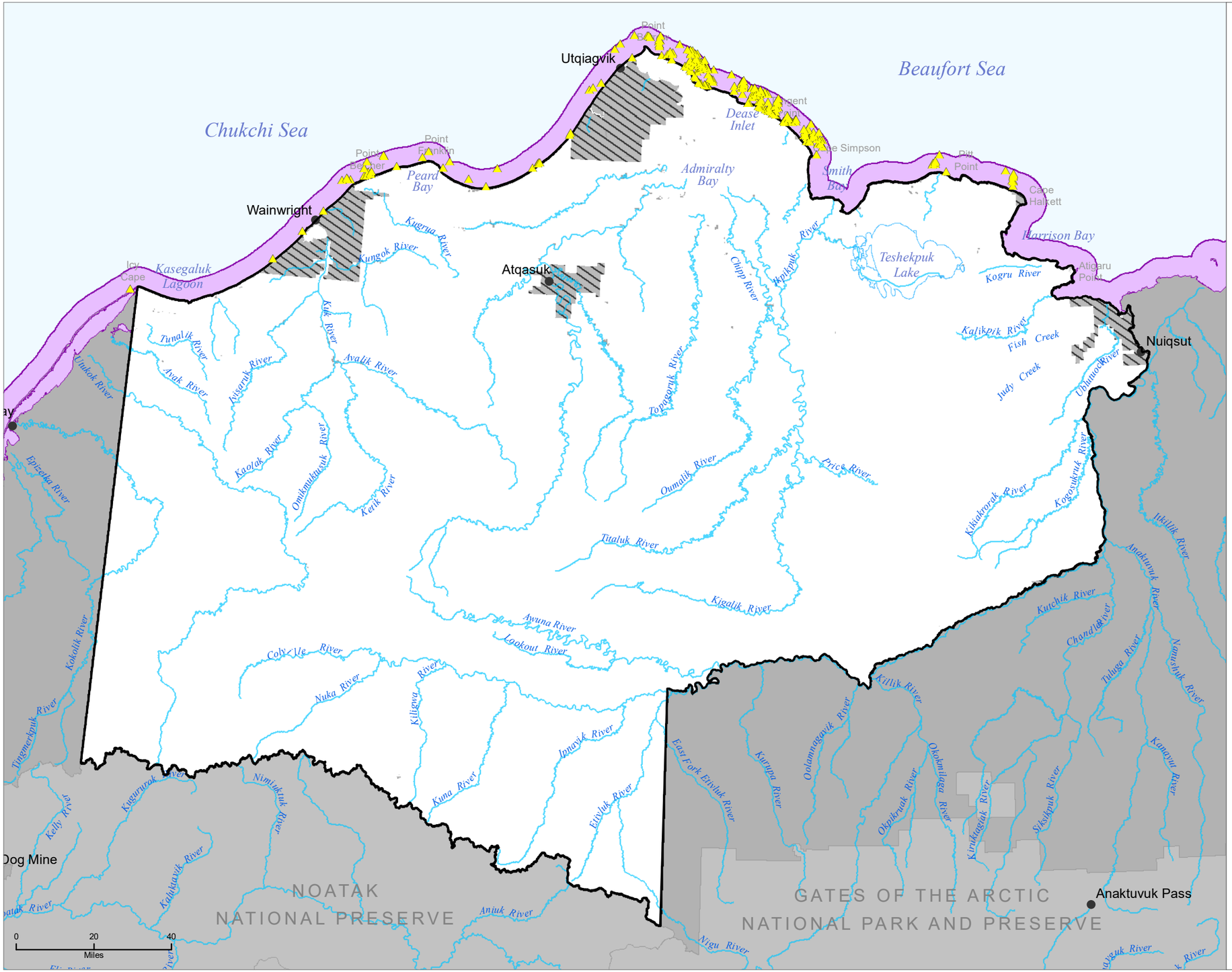
Seal sightings (2012-2018)

- Bearded seal
- Small unidentified pinniped
- Unidentified pinniped
- 5-mile coastline buffer

- National Petroleum Reserve-Alaska
- Outside the BLM's surface authority

Data source: ASAMM GIS 2018, BLM GIS 2019
Print date: 06/10/2020

Map 3-28

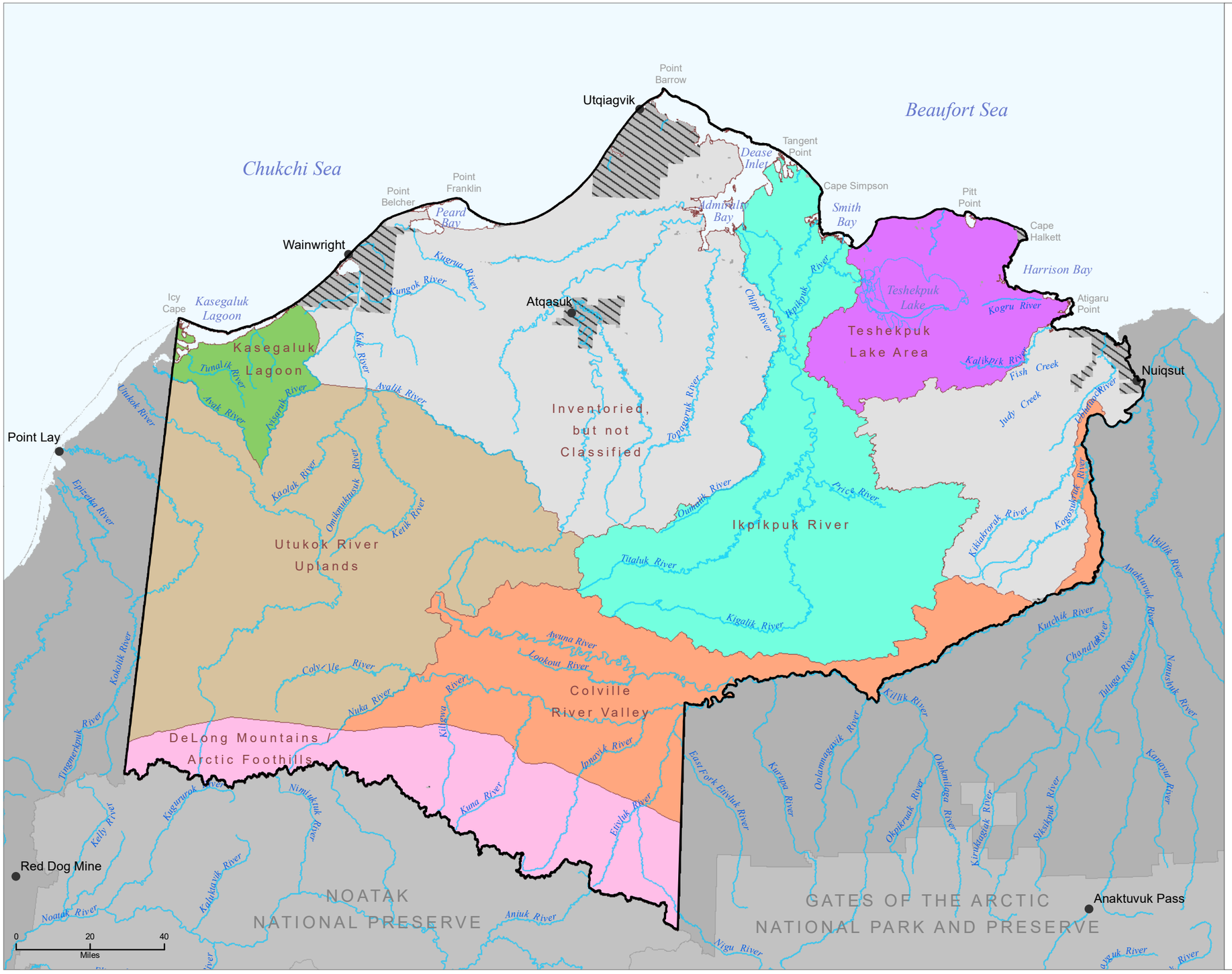


Bowhead whale sightings

- Bowhead whale sightings (2012-2018)
- 5-mile coastline buffer
- National Petroleum Reserve-Alaska
- Outside the BLM's surface authority

Data source: ASAMM GIS 2018, BLM GIS 2019
Print date: 06/10/2020

Map 3-29



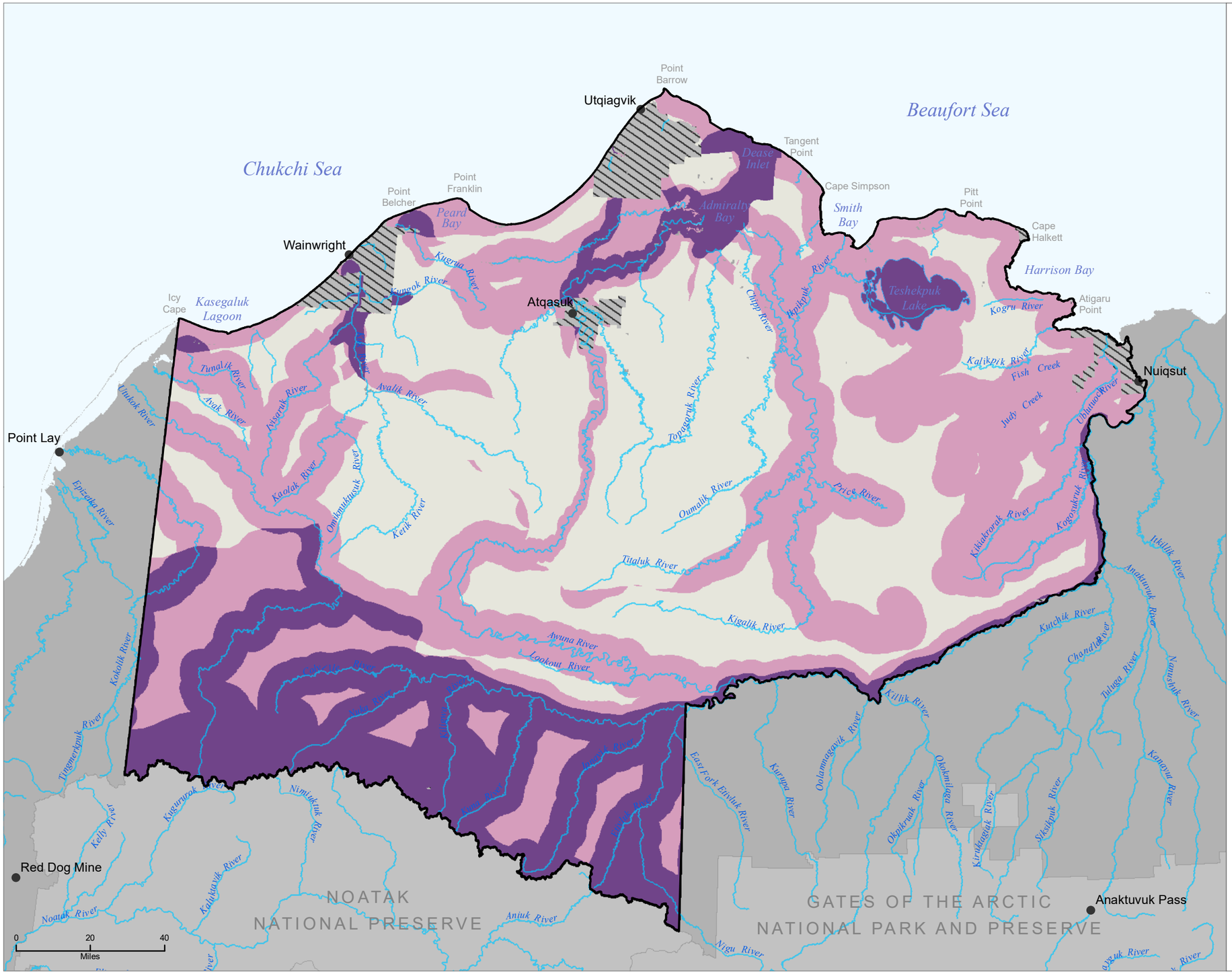
Inventory units

- Colville River Valley
- DeLong Mountains/ Arctic Foothills
- Ikpikpuk River
- Kasegaluk Lagoon
- Teshekpuk Lake Area
- Utukok River Uplands
- Inventoried, but not classified

- National Petroleum Reserve-Alaska
- Outside the BLM's surface authority

Data source: BLM GIS 2019
Print date: 06/10/2020

Map 3-30



VRI Class

- II
- III
- IV

- National Petroleum Reserve-Alaska
- Outside the BLM's surface authority

Data source: BLM GIS 2019
Print date: 06/10/2020

Map 3-31

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Appendix B

Reasonably Foreseeable Development Scenario for the National Petroleum Reserve in Alaska Integrated Activity Plan Environmental Impact Statement

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ACRONYMS AND ABBREVIATIONS

	Full Phrase
BBO	billion barrels of oil
BLM	Bureau of Land Management
BOPD	barrels of oil per day
CPF	central processing facility
EIS	environmental impact statement
IAP	integrated activity plan
NPR-A	National Petroleum Reserve in Alaska
TCF	trillion cubic feet
U.S.	United States
VSM	vertical support member

Appendix B. Reasonably Foreseeable Development Scenario for the National Petroleum Reserve in Alaska Integrated Activity Plan Environmental Impact Statement

Details of the processes and disturbance of oil development and infrastructure are described in section 4.2.1.2 of the 2012 National Petroleum Reserve in Alaska (NPR-A) Integrated Activity Plan (IAP; BLM 2012). Information from the 2012 IAP generally has remained valid and accurate; this document focuses on new and revised information that has become available since the publication of that document. This document projects reasonably foreseeable development scenarios for the purposes of impact analysis only.

B.1 General Assumptions and Timeline

Following a lease sale, exploration would commence on prospective leases. Assuming a discovery on an exploration well, additional wells would be drilled to delineate the resource. Delineation and development activities could take from 3 to 6 years after discovery. Delineation of the resource would lead to unitization as well as establishment of the initial participating area. A participating area is a specific hydrocarbon reservoir (i.e., field or pool) contained within a geologic formation. Development of surface facilities would lead to new oil production from the participating area. This process could take a minimum of 7 to 8 years following a lease sale. Considering economic viability; logistics of oil and gas permitting, exploration, and development; and distances between existing operations and potential future operations in the NPR-A, it is more likely that 10 years or more would pass between a lease sale and the first oil production from a discovery.

Production activities continue year-round for 10 to 70 years, depending on the field size and number of satellite pads necessary to produce it. Field abandonment, including well plugging and site restoration, can take from 2 to 5 years after production ends. It is also assumed that sufficient gravel would be available for all theoretical development infrastructure in the projections made in this document.

B.2 Formations, Geology, and Petroleum Systems

The Topset Play (inclusive of the uppermost portion of the Torok and overlying Nanushuk formations) is expected to be the primary target for development over the life of this updated IAP. Several discoveries have been identified, and seismic data suggest that unexplored trapping mechanisms are present. Oil was discovered at Pikka in 2015 and confirmed to be connected with Horseshoe to the south. The Pikka-Horseshoe discovery is estimated to hold a technically recoverable volume of 1.2 billion barrels of oil (BBO; Houseknecht et al. 2017). The Willow discovery, also located in the Topset Play, is estimated to contain approximately 300 million barrels of recoverable oil. The Smith Bay discovery is estimated to contain 1.8 to 2.4 BBO technically recoverable, and an estimated 200,000 barrels of oil per day (BOPD) production rate (Decker 2018).

The Beaufortian sequence is the second-most probable target for new oil discoveries and includes the Alpine sands. In 2003, the United States (U.S.) Geological Survey estimated that there were approximately 7.2

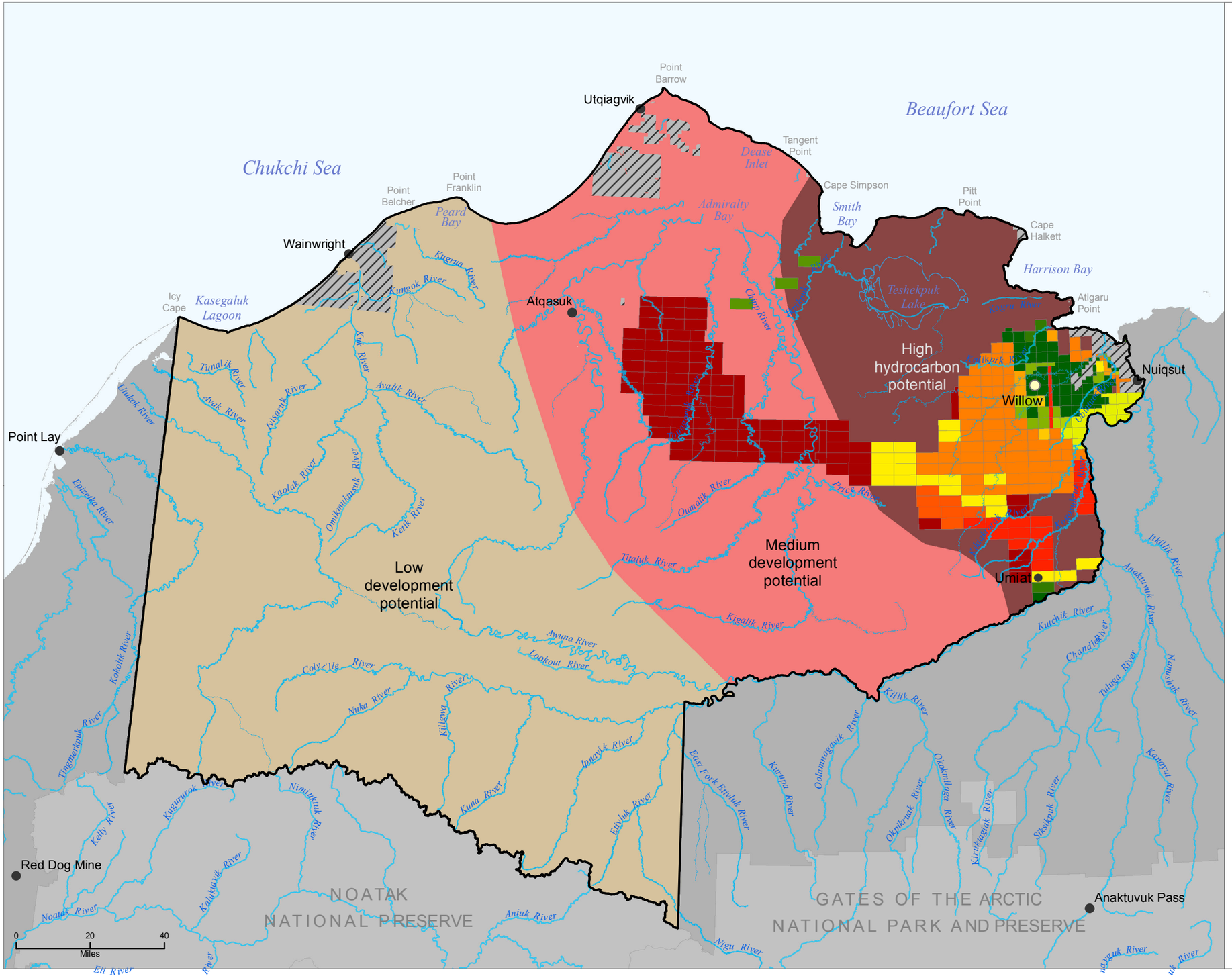
million barrels of undiscovered technically recoverable oil within the sequence in the NPR-A. The report estimated that oil reserves are located predominantly in the northeast and that this area contains numerous oil accumulations large enough for a stand-alone or satellite development (Houseknecht 2003); however, more recent exploration drilling in the sequence found that reservoir quality was generally poor, with high gas-to-oil ratios, and much of the oil trapped in relatively small pools. The sequence is now considered less productive than the U.S. Geological Survey estimated in 2003, with the most recent estimate that the formation contains a mean projected amount of approximately 41 million barrels of recoverable oil (Houseknecht et al. 2017).

The Ellesmerian system extends across much of the North Slope and is estimated to contain up to 77 BBO equivalent (Bird 1994). The system contains predominantly gas, but it is theorized it could contain some oil. Houseknecht et al. (2017) estimate that the mean amount the Ellesmerian system assessment units contain is approximately 32 million barrels of recoverable oil, but it is most likely that no economically viable oil pools exist in this system.

Approximately 4,082,000 acres of the NPR-A planning area have been classified as having high petroleum development potential (**Map B-1**). Only high-potential areas are considered to be reasonable targets for development at this time; however, understanding of the location of oil and gas reserves is incomplete, and development may occur outside these areas. Petroleum development potential was based on a combination of factors, including known and theorized discoveries, seismic study information, production rates of similar developments, the locations and extent of formations of interest, the hypothesized location of the oil-gas line, the distance to infrastructure, and leasing interest from operators. In high-potential areas it is considered likely that additional oil accumulations will be discovered and developed. In medium-potential areas it is considered likely that additional gas accumulations will be discovered and possible that oil accumulations will be discovered; development could occur in these areas. In low-potential areas it is considered less likely that oil or gas accumulations of any significant size will be discovered, and unlikely that any development will occur.

In recognition that the petroleum resources in the NPR-A have not been extensively explored and documented, and that development of petroleum resources is affected by a variety of factors, including oil price, the distance to existing infrastructure, and operator interest, this document is intended to present a variety of possible development levels to allow for a thorough analysis of impacts on other resource values. Production scenarios were developed based on the characteristics and traits of existing and planned developments from across the Alaska North Slope. This document is not intended be a plan or guidebook for future development. Information used and presented is based on best information and operational technology available at the time of publication.

In 2010 the U.S. Geological Survey estimated that the total volume of non-associated gas in the NPR-A planning area was approximately 52.8 trillion cubic feet (TCF). Most gas reserves are expected to be in the southern and central parts of the NPR-A (Houseknecht et al. 2010). In another study of the six assessment units in the Nanushuk and Torok formations, across the northern portion of the NPR-A, the U.S. Geological Survey estimated approximately 6.9 TCF of associated recoverable gas and 17.5 TCF of non-associated recoverable gas in those units (Houseknecht et al. 2017).



Development potential
- High
- Medium
- Low

Authorized oil and gas lease tract
- 1999
- 2002
- 2004
- 2008
- 2010
- 2011
- 2013
- 2014
- 2015
- 2016
- 2017
- 2018
- 2019

- National Petroleum Reserve-Alaska
- Outside the BLM's subsurface authority

Data source: BLM GIS 2019
Print date: 04/14/2020

Map B-1

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B.3 EXISTING AND PROBABLE UPCOMING DEVELOPMENTS AND INFRASTRUCTURE

Colville Delta 5 is a satellite field that transfers oil to the Alpine processing unit on state lands. The Colville Delta 5 pad is on Native-owned private lands within the NPR-A boundary. The participating areas produced from the Colville Delta 5 pad are primarily state and Native with some minor federal holdings. Colville Delta 5 began production in 2017 and is producing approximately 37,000 BOPD from the encompassing Colville River Unit (ConocoPhillips 2019a).

Greater Mooses Tooth 1 began production in late October 2018 and was recently producing from federal leases and Alaska Native lands at a rate of 11,500 BOPD (ConocoPhillips 2019b). Peak production for Greater Mooses Tooth 1 could eventually reach 25,000 to 30,000 BOPD (ConocoPhillips 2018). Production from Greater Mooses Tooth 1 is processed through the Alpine central processing facility (CPF). Greater Mooses Tooth 2 is a planned development connected by an 8-mile road to Greater Mooses Tooth 1 within the Greater Mooses Tooth Unit. Construction and drilling are ongoing, with 36 wells permitted in the initial development phase. The pad can accommodate 48 well slots. Production will occur from both federal minerals and Alaska Native minerals. Peak production is projected to be 35,000 to 40,000 BOPD (ConocoPhillips 2019c). ConocoPhillips is expected to conduct additional seismic exploration in support of Greater Mooses Tooth 1 and Greater Mooses Tooth 2 in the near future.

The Willow development is a planned development in the Bear Tooth Unit. The permitting process for the location is ongoing. The project would construct five drill sites, with each designed and sized to accommodate all drilling and operations facilities, wellhead shelters, drill rig movement, and material storage. Each drill site is sized to accommodate 40 to 70 wells, at a typical 20-foot wellhead spacing, and up to 251 total wells across the 5 pads (ConocoPhillips 2019d). First oil production would occur in 2025. When operational, it is estimated that the Willow development production would have a peak production of approximately 160,000 BOPD (BLM 2020).

On December 11, 2019, the Bureau of Land Management (BLM) announced the results of a lease sale in the NPR-A with approximately 1 million acres leased (BLM 2019a). Most of the area leased were in areas ranked as medium potential in this document. Petroleum reservoirs in medium-potential areas are generally expected to contain predominantly gas and little oil. Rather than oil producers, exploration companies purchased the leases in these areas, and the leases are generally regarded as speculative or exploratory leases (Treinen 2019). Should the lessee discover a reservoir with economic potential, that resource could be exploited in a development similar to the ones described in this document.

Umiat is a historic field that was first explored in 1944 by the U.S. Navy. Twelve exploration wells were drilled by the federal government between 1944 and 1979, with industry drilling two additional wells in 2013 and 2014. Shallow oil was discovered in the Grandstand formation. Information from wells suggests that a larger pool exists with an estimated 1 BBO in place (Oil and Gas Journal 2010). The BLM approved an exploratory unit at Umiat in September 2019 that encompasses two federal leases. It is approximately 60 miles from the nearest infrastructure and 92 miles from the Trans-Alaska Pipeline System. Initial development would require a substantial investment for infrastructure connection.

Smith Bay is located on the northeast coastline of the NPR-A. Caelus Energy Alaska LLC announced in 2018 results of a three-dimensional seismic survey and drilled two exploration wells within the waters of Smith Bay on State minerals, estimating 6 to 10 BBO in place (Lidji 2018). The distance to existing infrastructure means that a large investment would be required to develop the location. There is an assumption that the reservoir also extends onshore into the NPR-A, but no development plans have been

announced for either onshore or offshore development. Offshore development would be outside the NRP-A planning area; it would require onshore pipelines to transport oil to market and gravel pads for barge landing and equipment staging and storage.

Operators have expressed interest in conducting exploration and potential development in the Teshekpuk Lake area, which is currently closed to development. Exploration is limited to some three-dimensional seismic surveys and several legacy wells prior to 1982. This location around Teshekpuk Lake would be attractive for leasing due the ability to tie into infrastructure at the nearby Alpine or future Willow developments.

The Gubik field is a gas field that likely extends into the NPR-A. No development is expected. If gas infrastructure were extended to the North Slope, this field could become viable for development at some point.

Two gas pipelines to connect the North Slope to southern Alaska or an export terminal are in the planning process. Proponents of the Alaska-LNG project propose to construct an approximately 800-mile pipeline connecting a natural gas liquefaction facility and export terminal in Nikiski, Alaska, to developments in Prudhoe Bay and Point Thompson. It is expected to deliver approximately 3.5 billion cubic feet of gas per day when complete (AGDC 2019). The proponents of the Alaska Stand-Alone Pipeline project propose to connect Prudhoe Bay to an existing ENSTAR gas pipeline system in the Matanuska-Susitna Borough and to a pipeline connecting to Fairbanks. The pipeline is designed to deliver approximately 500 million cubic feet of gas per day when complete (ASAP 2017).

It is expected that lease-level winter exploration would continue to occur outside the existing federal units. The exploration drilling would likely be informed by new or existing seismic survey data. Much of the NPR-A has been explored by two-dimensional seismic surveys, with three-dimensional seismic surveys now covering much of the eastern portion of the NPR-A. It is expected that additional three-dimensional surveys will be conducted in the NPR-A at the lease-block level (as opposed to NPR-A wide) as operators acquire subsurface information.

In contrast to historic practices, modern seismic surveying uses fewer heavy vibroseis vehicles and occurs only on snow roads when the tundra is frozen in order to minimize any impacts on the surface. Only rubber-tracked and ski-mounted vehicles, which exert a lower ground pressure, are used. Modern seismic vehicles have leak detection and containment systems to reduce the risk of spill damage. Additionally, seismic equipment has shrunk in size and weight due to improvements in battery and sensor technology, as well as a desire to reduce impacts. Exploration drilling is expected to occur within the high- and medium-potential zones but is not limited to those locations. Exploration drilling locations will be dictated by geologic and seismic information and as new information is gathered. Any future discoveries may lead to future unitization or unit expansion.

B.4 PROJECTED DEVELOPMENT

Existing and planned developments, including the Willow development, are not included in the production and disturbance calculations presented below for the range of alternatives. The impacts associated with existing and planned developments will not change regardless of which alternative is selected; including them in the reasonably foreseeable development scenario is not useful in allowing readers and the decision-maker to compare impacts across alternatives. Impacts associated with existing and planned developments are therefore considered in the cumulative impacts analysis rather than the reasonably foreseeable development scenario.

Areas where new development is likely to occur are Teshekpuk Lake, Umiat, and Smith Bay, and additional development near the Willow development. Possible new development projects are described below in terms of projected oil production, construction surface disturbance, water use, and gravel use. The projections of development locations and sizes were based on known and theorized discoveries, seismic study information, the production rates of similar developments, operator interest or announcements, and leasing information. Projections are designed to present maximum reasonable development speed scenarios to provide for analysis under the National Environmental Policy Act of 1969.

Proposed natural gas pipelines connecting to the Alaska North Slope are planned to connect first to the existing gas resource at Prudhoe Bay, which contains approximately 25 TCF of gas (ConocoPhillips 2019e). Additional pipeline extensions are expected to go to Point Thompson, Burger Field, and existing oil fields with simultaneous development of gas. Approximately 45 TCF of known gas resources are in the North Slope, and estimates suggests the possibility of an additional 200 TCF of undiscovered gas across the entire North Slope (Mack 2016). The timeline for NPR-A connection to one of the proposed gas pipelines would depend on the size of gas accumulations discovered and the distance from those accumulations to existing infrastructure. Connection to a natural gas pipeline is not expected to occur during the 20-year timeframe analyzed in this reasonably foreseeable development scenario and the NPR-A IAP/ environmental impact statement (EIS).

Some exploration drilling has occurred for oil shale on the North Slope, but development remains highly speculative and has not yet been proven to be commercially or technically viable. No shale oil development is expected during the life of the IAP/EIS.

Coal is present in the planning area, but development of coal resources is prohibited by the statutory mineral withdrawal in the 1976 Naval Petroleum Reserves Production Act. Development of coalbed methane is unlikely due to the challenging operating environment and distance to any potential markets. As part of the Alaska Rural Energy Project, four shallow coalbed methane wells were drilled on federal mineral estate and tested from 2007 through 2009 for potential use by the village of Wainwright for heat and power generation; however, the village has not taken the necessary steps to further develop the wells (Clark et al. 2010).

B.5 INFRASTRUCTURE REQUIREMENTS AND DEVELOPMENT ACTIVITIES

A typical 6-acre ice pad for exploration drilling is 1 foot thick and requires 1.5 million gallons of water (BLM 2018a). Current drilling technology is self-contained; there are no reserve pits. Drilling of a test well can take from 10 days to 4 weeks depending on how well the stratigraphic succession of the area is understood and the total vertical depth or measured depth of the exploration well.

A CPF is the operational center for long-term production. A typical pad for a CPF and associated facilities, which include an airstrip, workers' camp, and production well pad, is approximately 80 acres (BLM 2012). Similar projects estimate gravel needs at 10,000 to 14,000 cubic yards of gravel per acre (BLM 2019b), for a total of 1,500,000 cubic yards per 80-acre CPF and associated facilities.

A typical satellite well pad associated with potential future development in the NPR-A is projected to have approximately 30 to 40 wells and occupy approximately 15 acres. A well pad of this size would require approximately 185,000 cubic yards of gravel. Pads would be constructed to a thickness sufficient to maintain a stable thermal regime. This hypothetical scenario assumes an average 7-foot thickness, based on data from the Willow Master Development Plan (BLM 2019b). Technology has resulted in a reduction in the size of development ground disturbance over time relative to the amount of oil produced. Should that trend continue, impacts and facility sizes could be less than assumed here. Drilling and completing each

production well would require anywhere from 420,000 gallons of water for a shallow vertical well to 8 million gallons of water for a deep well with an extended lateral[1].

Well laterals are assumed to extend an average of 4 miles based on current developments and the anticipated subsurface geology across most of the NPR-A. However, current technology allows for up to 7-mile laterals depending on formation depth and continuity. Wells would be hydraulically fractured for initial stimulation; however, hydraulic stimulation will only occur in the initial stage of drilling to stimulate flow at the production wells and is not used for continued production during the life of the well. Water use for hydraulic fracturing in the NPR-A will be less than the multistage hydraulic fracturing used in unconventional reservoirs. Water flooding using parallel injection wells would be used to maintain reservoir pressure and increase production. Water demand for maintaining reservoir pressure is proportional to the oil production from the field; a field with a daily production rate of 50,000 BOPD would require approximately 2 million gallons of water per day. Water resources are generally abundant across the NPR-A. An approved permit is required to withdraw water. Natural gas can also be reinjected to stimulate oil production. North Slope producers will frequently alternate water flooding with gas injection to stimulate oil recovery.

Roads in North Slope oil and gas developments create a ground disturbance of approximately 7.5 acres per mile and require approximately 56,000 cubic yards of gravel per mile (BLM 2019b).

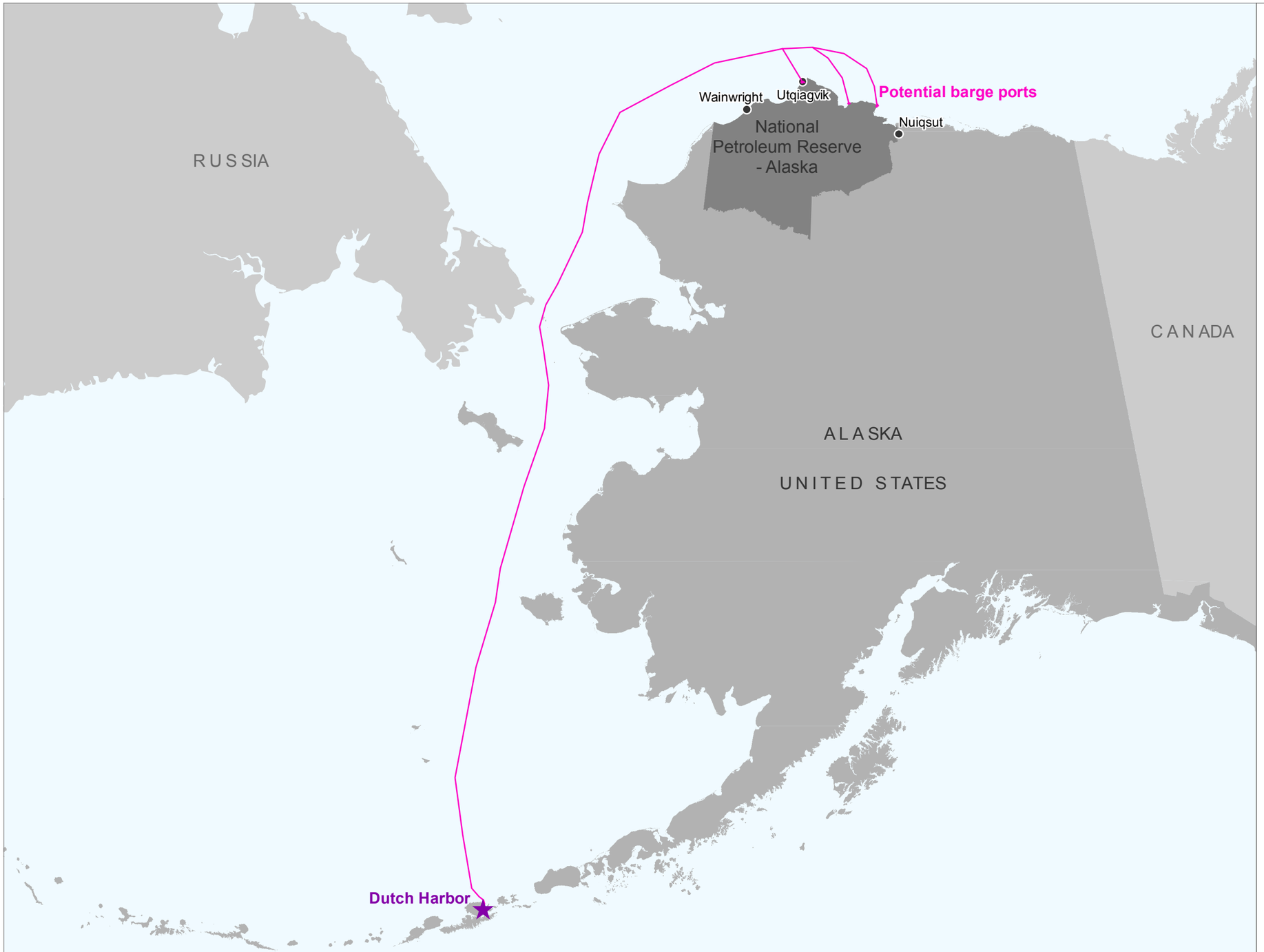
Pipelines would be used to transport oil to CPFs and eventually to the Trans-Alaska Pipeline System. They are also used to transport water, fuel, and electricity to satellite pads. Pipeline vertical support members (VSMs) in the Arctic create approximately 0.04 acres of surface disturbance per pipeline mile (BLM 2012).

In the event that sufficient water resources are not available in the NPR-A, a seawater treatment plant could be constructed to supply the water needed for drilling and water flooding. The total area for comparable Arctic seawater treatment plants and their required support pads is approximately 15 acres. A potential pad of this size would require approximately 150,000 cubic yards of gravel.

A barge landing and storage pad could be required to transport large equipment, such as CPF modules and drill rigs, into the development area. This type of pad would cover approximately 10 acres and require approximately 100,000 cubic yards of gravel. Alternatively, a module transfer island could be constructed; this type of facility covers approximately 12 acres and allows the transfer of larger modules, which would require fewer trips (BLM 2018b). Alternatively, dock infrastructure from the Willow project could be reused. Possible locations for the barge landing include Atigaru Point, Smith Bay, and Utqiagvik; however, additional study would be needed to confirm site suitability. Barges with supplies would be transported from Dutch Harbor in Unalaska (see **Map B-2**). One to two barge landings per year are expected.

In the event that planned North Slope gas pipelines are extended to the NPR-A, the pipeline VSMs would create approximately the same disturbance as VSMs for oil pipelines. Gas wells require approximately the same pad area per well as oil wells; however, the number of wells per pad may be different. In the contiguous U.S., wells per pad can vary from 1 or 2 up to 60 gas wells, depending on the underlying geology of the area and the length of horizontal wells (Litvak 2018). Because well spacing depends on reservoir characteristics, which are unknown at this time, it is impossible to predict the number of gas wells per pad that would be used in any NPR-A operations. Gas separation and processing facilities would also be

[1]Rob Brumbaugh, BLM Alaska Oil and Gas Section Chief, personal communication to Francis Craig, EMPSi Minerals Specialist, on May 29, 2019.



Potential marine vessel transportation route

National Petroleum Reserve-Alaska

Data source: BLM GIS 2019
Print date: 04/14/2020

Map B-2

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required before the gas could be added to the production pipeline; however, NPR-A developments would likely use gas facilities constructed for earlier gas developments outside the project area. If natural gas were being produced from existing oil developments, gas transport pipelines could likely be mounted on the existing VSMs used for oil and water pipelines; otherwise, additional infrastructure would be required.

B.6 GRAVEL NEED AND RESOURCES

Gravel resources in the planning area are generally scarce and may be a major factor in the viability of future developments. Operators on the North Slope have found that roadless developments present operational and logistical difficulties, so future developments are expected to be connected by gravel roads in most cases. Gravel resources are scarce near current infrastructure. Gravel studies are ongoing by both industry and the federal government. The Clover deposit is relatively small with a fairly poor resource. The Tingmiaqiaq location recently discovered by ConocoPhillips for Willow infrastructure needs is located near the confluence of Bills Creek and the Ublutuoch River. Much of the Colville River is currently closed to entry for gravel mining. Operators may need to transport gravel from outside the planning area to facilitate development.

Based on data from Willow development planning and other North Slope developments, average facility acreages and gravel needs were developed. A CPF and associated facilities, such as an airstrip and workers' camp, would encompass 80 acres and require 1.5 million cubic yards of gravel. A satellite pad would cover 15 acres and require 185,000 cubic yards of gravel. Roads would cover 7.5 acres per mile and would require 56,000 cubic yards of gravel per mile. A seawater treatment plant would cover 15 acres and require 150,000 cubic yards of gravel. A barge landing and storage area would require 100,000 cubic yards of gravel. Pipeline supports would disturb 0.04 acres per mile and not require gravel.

B.7 WATER USAGE

Ice road construction uses approximately 1 million gallons of water per mile, although use of ice chips can reduce water use substantially (BLM 2012).

Similar to other North Slope developments, drilling and completing each potential well would require anywhere from 420,000 gallons of water for a shallow vertical well to 8 million gallons of water for a deep well with an extended lateral[2]. Additionally, water is injected into formations to maintain reservoir pressure. Water demand for maintaining reservoir pressure is equal to the oil production from the field; a field with a daily production rate of 50,000 BOPD would require approximately 2 million gallons of water per day (1 barrel is equal to 42 gallons).

B.8 THEORETICAL DEVELOPMENT SCENARIOS

Theoretical development scenarios are presented as entirely hypothetical development cases and are not intended to be used for locations of impacts. Scenarios are unconstrained, meaning they are developed without consideration of existing or potential restrictions on development activities. Existing developments and planned developments that are already in the permitting process, such as the Willow development, are not included in the development or production projections below.

[2]Rob Brumbaugh, BLM Alaska Oil and Gas Section Chief, personal communication to Francis Craig, EMPSi Minerals Specialist, on May 29, 2019.

B.8.1 Low

Under a low development scenario, future development would occur only in the most promising areas and would connect to existing or planned infrastructure in the Willow development. Under this scenario, peak production from NPR-A developments could reach a maximum of 120,000 BOPD sometime in approximately the next 20 years, after which production is expected to decline at a rate of approximately 8 percent per year.

Assuming this development would construct 2 satellite pads, 40 miles of roads, 30 miles of elevated pipeline, 1 seawater treatment plant, and 1 barge landing, a total of 356 acres would be disturbed and a total of 2,860,000 cubic yards of gavel would be required. These figures do not include disturbance from ice roads and pads or from gravel supply pits.

Under this scenario, the peak production of 120,000 BOPD would require approximately 5 million gallons of water per day to maintain reservoir pressure. Natural gas may be injected alternatively for a period of time as a substitute to continuous water injection.

B.8.2 Medium

Under a medium development scenario, additional satellite developments would be added in the Bear Tooth Unit and connected to the Willow development CPF. A new CPF and development would likely be constructed in the area south or west of Teshekpuk Lake. Under this scenario, peak production from NPR-A developments could reach a maximum of 210,000 BOPD sometime in approximately the next 20 years, after which production is expected to decline at a rate of approximately 8 percent per year.

Assuming this development would construct 1 CPF, 10 satellite pads, 160 miles of roads, 150 miles of elevated pipeline, 1 seawater treatment plant, and 1 barge landing, a total of 1,461 acres would be disturbed and a total of 12,560,000 cubic yards of gravel would be required. These figures do not include disturbance from ice roads and pads or from gravel supply pits.

Under this scenario, the peak production of 210,000 BOPD would require approximately 9 million gallons of water per day to maintain reservoir pressure. Natural gas may be injected alternatively for a period of time as a substitute to continuous water injection.

B.8.3 High

Under a high development scenario, three CPFs and associated satellite pads would be constructed in the planning area, most likely at Smith Bay, south of Teshekpuk Lake, and north of Umiat, Alaska. Under this scenario, peak production from NPR-A developments could reach a maximum of 500,000 BOPD sometime in approximately the next 20 years, after which production is expected to decline at a rate of approximately 8 percent per year. Total lifetime production under this scenario is expected to be approximately 2.6 BBO.

Assuming this development would construct 3 CPFs, 20 satellite pads, 250 miles of roads, 240 miles of elevated pipeline, 2 seawater treatment plants, and 2 barge landings, a total of 2,475 acres would be disturbed and a total of 22,700,000 cubic yards of gravel would be required. These figures do not include disturbance from ice roads and pads or from gravel pits.

Under this scenario, the peak production of 500,000 BOPD would require approximately 21 million gallons of water per day to maintain reservoir pressure. Natural gas may be injected alternatively for a period of time as a substitute to continuous water injection.

B.9 DEVELOPMENT PROJECTIONS BY ALTERNATIVE

See Chapter 2 of the Final IAP/EIS for detailed descriptions and maps of areas open to leasing under standard terms and conditions, areas open to leasing with limitations, and areas closed to leasing. **Table B-1**, below, shows management allocations by alternative in areas classified as having high petroleum development potential. Existing leases are not subject to new restrictions, and closed areas that have been leased are included as potentially producing area in the projections.

Table B-1
Acres of Oil and Gas Leasing Allocations in High Petroleum Development Potential Areas, by Alternative

Alternative	A	B	C	D	E
Open with standard terms and conditions	1,436,000	1,199,000	1,546,000	1,567,000	1,487,000
No surface occupancy	638,000	779,000	1,381,000	1,571,000	1,631,000
Timing limitation	0	0	137,000	761,000	777,000
Controlled surface use	0	0	0	183,000	187,000
Closed	2,008,000	2,103,000	1,017,000	0	0
Closed area under preexisting lease	19,000	302,000	0	0	0
No surface occupancy area under preexisting lease	485,000	537,000	585,000	514,000	651,000

BLM GIS 2019

Table B-2, below, shows projected peak oil production, surface disturbance, and gravel volume required by alternative.

Table B-2
Production, Surface Disturbance, Gravel Needs and Water Use, by Alternative

Alternative	Production Case	Low	Medium	High
A	Peak production in BOPD	61,529	107,675	256,369
	Surface disturbance (acres)	183	749	1,269
	Gravel needs (cubic yards)	1,466,433	6,440,000	11,639,172
	Peak water use (gallons per day)	2,584,204	4,522,357	10,767,516
B	Peak production in BOPD	67,026	117,295	279,275
	Surface disturbance (acres)	199	816	1,382
	Gravel needs (cubic yards)	1,597,452	7,015,385	12,679,079
	Peak water use (gallons per day)	2,815,091	4,926,409	11,729,544
C	Peak production in BOPD	90,073	157,629	375,306
	Surface disturbance (acres)	267	1,097	1,858
	Gravel needs (cubic yards)	2,146,752	9,427,692	17,038,902
	Peak water use (gallons per day)	3,783,066	6,620,418	15,762,852
D	Peak production in BOPD	120,000	210,000	500,000
	Surface disturbance (acres)	356	1,461	2,475
	Gravel needs (cubic yards)	2,860,000	12,560,000	22,700,000
	Peak water use (gallons per day)	5,040,000	8,820,000	21,000,000
E	Peak production in BOPD	120,000	210,000	500,000
	Surface disturbance (acres)	356	1,461	2,475
	Gravel needs (cubic yards)	2,860,000	12,560,000	22,700,000
	Peak water use (gallons per day)	5,040,000	8,820,000	21,000,000

B.9.1 Alternative A

The reduction in areas open to leasing and the continued closure of the area around Teshekpuk Lake and Smith Bay would result in an estimated reduction in oil production of approximately 49 percent compared with the unconstrained projection. **Table B-1,** above, shows acres of high petroleum development potential that are open to leasing subject to standard terms and conditions, open with development restrictions, and closed. Under Alternative A, a development would be expected around Umiat, as well as additional satellite developments using the Alpine or Willow CPF for processing. The possibility exists that a discovery and development could occur in other areas of the NPR-A. Developments near Smith Bay and near Teshekpuk Lake would not be possible due to closures.

Table B-2, above, shows estimated peak daily production, acres of disturbance, gravel requirements, and water use following the high, medium, and low production levels from the theoretical development projections adjusted for management under Alternative A. Production is expected to peak within 3 years of the completion of drilling and decline at a rate of approximately 8 percent after that. **Table B-3**, below, shows the approximate number of facilities for each case under this alternative.

Total lifetime production from new developments under this alternative could reach 1.35 BBO.

Table B-3
Alternative A—Number of Facilities

Alternative A	High	Med	Low
CPF, airstrip, anchor well pad	2	1	0
Satellite pads	10	5	1
Gravel roads (miles)	128	82	20
VSMs (miles)	122	77	15
Seawater treatment plant	1	1	1
Barge landing and equipment storage	1	1	1

B.9.2 Alternative B

The reduction in area open to leasing and especially the closure of the area around Teshekpuk Lake and Smith Bay would result in an estimated reduction in oil production of approximately 44 percent compared with the unconstrained projection. A lease deferral around Nuiqsut could delay development in this area; however, much of the deferral area is already under lease. The lease deferral around Atqasuk is unlikely to affect development, as no development is expected in that area. **Table B-1**, above, shows acres of high petroleum development potential that are open to leasing subject to standard terms and conditions, open with development restrictions, and closed. Under Alternative B, a development would be expected around Umiat, as well as additional satellite developments using the Alpine or Willow CPF for processing. The possibility exists that a discovery and development could occur in other areas of the NPR-A. Developments near Smith Bay and near Teshekpuk Lake would not be possible due to closures.

Table B-2, above, shows the estimated peak daily production, acres of disturbance, gravel requirements, and water use following the high, medium, and low production levels from the theoretical development projections adjusted for management under Alternative B. Production is expected to peak within 3 years of the completion of drilling and decline at a rate of approximately 8 percent after that. **Table B-4**, below, shows the approximate number of facilities for each case under this alternative.

Total lifetime production from new developments under this alternative could reach 1.27 BBO.

Table B-4
Alternative B—Number of Facilities

Alternative B	High	Med	Low
CPF, airstrip, anchor well pad	2	1	0
Satellite pads	11	6	1
Gravel roads (miles)	140	90	22
VSMs (miles)	134	84	17
Seawater treatment plant	1	1	1
Barge landing and equipment storage	1	1	1

B.9.3 Alternative C

The reduction in area open to leasing would result in an estimated reduction in oil production of approximately 25 percent compared with the unconstrained projection. **Table B-1**, above, shows acres of high petroleum development potential that are open to leasing subject to standard terms and conditions, open with development restrictions, and closed. Under Alternative C, developments would be expected around Umiat and Smith Bay. Additional satellite pads are possible in the area south or east of Teshekpuk Lake. The possibility exists that a discovery and development could occur in other areas of the NPR-A. Large-scale developments near Teshekpuk Lake would not be possible due to closures.

Table B-2, above, shows estimated peak daily production, acres of disturbance, gravel requirements, and water use following the high, medium, and low production levels from the theoretical development projections adjusted for management under Alternative C. Production is expected to peak within 3 years of the completion of drilling and decline at a rate of approximately 8 percent after that. **Table B-5**, below, shows the approximate number of facilities for each case under this alternative.

Total lifetime production from new developments under this alternative could reach 1.98 BBO.

Table B-5
Alternative C—Number of Facilities

Alternative C	High	Med	Low
CPF, airstrip, anchor well pad	2	1	0
Satellite pads	15	8	2
Gravel roads (miles)	188	120	30
VSMs (miles)	180	113	23
Seawater treatment plant	2	1	1
Barge landing and equipment storage	2	1	1

B.9.4 Alternative D

Leasing management under this alternative would result in the same amount of estimated oil production as the unconstrained scenarios described in **Section B.8**. A small portion of the no surface occupancy area under Teshekpuk Lake would not be accessible using current directional drilling technologies, but it could become accessible in the future with technological advancements. **Table B-1**, above, shows acres of high petroleum development potential that are open to leasing subject to standard terms and conditions, open with development restrictions, and closed. Under Alternative D, developments would be expected around Umiat, Smith Bay, and Teshekpuk Lake. The possibility exists that a discovery and development could occur in other areas of the NPR-A.

Table B-2, above, shows estimated peak daily production, acres of disturbance, gravel requirements, and water use following the high, medium, and low production levels from the theoretical development projections adjusted for management under Alternative D. Production is expected to peak within 3 years of the completion of drilling and decline at a rate of approximately 8 percent after that. **Table B-6**, below, shows the approximate number of facilities for each case under this alternative.

Total lifetime production from new developments under this alternative could reach 2.64 BBO.

Table B-6
Alternative D—Number of Facilities

Alternative D	High	Med	Low
CPF, airstrip, anchor well pad	3	1	0
Satellite pads	20	10	2
Gravel roads (miles)	250	160	40
VSMs (miles)	240	150	30
Seawater treatment plant	2	1	1
Barge landing and equipment storage	2	1	1

B.9.5 Alternative E

Leasing management under this alternative would result in the same amount of estimated oil production as the unconstrained scenarios described in **Section B.8**. A small portion of the no surface occupancy area under Teshekpuk Lake would not be accessible using current directional drilling technologies, but it could become accessible in the future with technological advancements. The Teshekpuk Lake 10-year lease deferral could delay the start date of some development that is expected to occur. **Table B-1**, above, shows acres of high petroleum development potential that are open to leasing subject to standard terms and conditions, open with development restrictions, and closed. Under Alternative E, developments would be expected around Umiat, Smith Bay, and Teshekpuk Lake. The possibility exists that a discovery and development could occur in other areas of the NPR-A.

Table B-2, above, shows estimated peak daily production, acres of disturbance, gravel requirements, and water use following the high, medium, and low production levels from the theoretical development projections adjusted for management under Alternative E. Production is expected to peak within 3 years of the completion of drilling and decline at a rate of approximately 8 percent after that. **Table B-7**, below, shows the approximate number of facilities for each case under this alternative.

Total lifetime production from new developments under this alternative could reach 2.64 BBO.

Table B-7
Alternative E—Number of Facilities

Alternative E	High	Med	Low
CPF, airstrip, anchor well pad	3	1	0
Satellite pads	20	10	2
Gravel roads (miles)	250	160	40
VSMs (miles)	240	150	30
Seawater treatment plant	2	1	1
Barge landing and equipment storage	2	1	1

B.10 GRAVEL SUPPLY SURFACE DISTURBANCE

Based on other developments on the North Slope, gravel pits, associated overburden storage, and operational pads require approximately 26.8 acres per 1 million cubic yards of gravel. **Table B-8**, below, shows projected acreage required for gravel supply for each alternative and development case. This figure is broken out from other calculations above due to the fact that some gravel supplies could be transported from outside the planning area.

Table B-8
Acres of Gravel Mine Disturbance, by Alternative

Alternative	High Production Scenario	Medium Production Scenario	Low Production Scenario
A	312	173	39
B	340	188	43
C	457	253	58
D	608	337	77
E	608	337	77

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Appendix C
Collaboration and Coordination

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ACRONYMS AND ABBREVIATIONS

	Full Phrase
ANCSA	Alaska Native Claims Settlement Act of 1971
BLM	Bureau of Land Management
EIS	environmental impact statement
IAP	integrated activity plan
NPR-A	National Petroleum Reserve in Alaska

Appendix C. Collaboration and Coordination

C.1 OVERVIEW

C.1.1 Introduction

As the lead agency for the National Petroleum Reserve in Alaska (NPR-A) Integrated Activity Plan/Environmental Impact Statement (IAP/EIS), the Bureau of Land Management (BLM) collaborated and consulted with other federal agencies, state and local government agencies, tribal governments, and Alaska Native Claims Settlement Act of 1971 (ANCSA) corporations during preparation of the IAP/EIS. The extent and purpose of collaboration and consultation with these agencies and organizations varied, based on their expertise and interests, as detailed below. This appendix also includes a list of preparers of the NPR-A IAP/EIS (see **Section C.6**, below).

C.1.2 Cooperating Agencies

The following are participating in the NPR-A IAP/EIS as cooperating agencies: the Bureau of Ocean Energy Management, Iñupiat Community of the Arctic Slope, National Park Service, North Slope Borough, State of Alaska, and U.S. Fish and Wildlife Service. The BLM requested their participation because of their expertise. Their participation does not constitute their approval of the analysis, conclusions, or alternatives presented in the IAP/EIS; the BLM is solely responsible for these.

C.1.3 Tribes, ANCSA Corporations, and North Slope Communities

The BLM, as the lead federal agency, consulted with federally recognized tribal governments during preparation of this IAP/EIS and identified seven tribes that could be substantially affected by it. Consistent with the Department of the Interior policy on government-to-government consultation with tribes, the BLM first sent a letter of notification and inquiry on November 8, 2018, to the federally recognized tribes in the communities of Anaktuvuk Pass, Atqasuk, Nuiqsut, Point Lay, Utqiagvik, and Wainwright and to the Iñupiat Community of the Arctic Slope.

In its letter, the BLM informed these entities of the upcoming IAP/EIS and offered them the opportunity to participate in formal government-to-government consultations, to consult on cultural resources under Section 106 of the National Historic Preservation Act of 1966, or to simply receive information about the project. The dates and locations of government-to-government meetings that have taken place are provided below in **Section C.2**; the dates and locations of public meetings in North Slope communities are provided below in **Section C.3**. Additional information on the initiation and extent of consultation is provided in **Chapter 1, Section 1.7** of the IAP/EIS.

The BLM also sent a letter of notification on November 8, 2018, to the Arctic Slope Regional Corporation and the village corporations for the communities of Anaktuvuk Pass, Atqasuk, Nuiqsut, Point Lay, Utqiagvik, and Wainwright. In this letter the BLM offered them the opportunity to participate in formal ANCSA corporation consultation on the IAP/EIS. The BLM has held consultations with the Arctic Slope Regional Corporation and the Kuukpik Corporation to discuss the IAP/EIS process (see **Section C.4**, below).

In November 2018, the BLM also sent letters to the North Slope Subsistence Resource Advisory Council and the 32 representatives that make up the Western Arctic Caribou Herd Working Group, inviting them to consult on the new IAP/EIS. Points of contact for all North Slope entities (tribes, corporations, government,

and nongovernmental organizations) are included on the BLM's mailing list, and they receive all public email updates.

C.1.4 Local Consultation Under Federal Law

In accordance with Section 106 of the National Historic Preservation Act, the BLM requested to consult with the Alaska State Historic Preservation Office to determine how proposed activities could affect cultural resources listed on or eligible for listing on the National Register of Historic Places. The State Historic Preservation Office declined to consult with the BLM on the IAP/EIS; acknowledging that the NPR-A IAP/EIS, as a land use plan, is an administrative action without the potential to affect historic properties. Formal consultations with the State Historic Preservation Office may be required when individual projects are implemented in the future.

To comply with Section 7(a)(2) of the Endangered Species Act, the BLM began consulting with the U.S. Fish and Wildlife Service and National Marine Fisheries Service early in the IAP/EIS process. The U.S. Fish and Wildlife Service and National Marine Fisheries Service provided input on issues, data collection and review, and alternatives development. The BLM is consulting with the U.S. Fish and Wildlife Service and National Marine Fisheries Service and developed biological assessments with each agency.

C.1.5 Consultation with Working Groups

NPR-A Working Group—The NPR-A Working Group was established in the 2013 IAP Record of Decision and includes city, tribal, and ANCSA corporation representatives of all North Slope communities. The NPR-A Working Group was established to provide meaningful, regular input by local communities to the management of the NPR-A. The BLM held teleconference meetings to consult with the NPR-A Working Group on the new IAP/EIS on the following dates:

- March 8 and 22, 2019
- April 18, 2019
- June 20, 2019
- August 19, 2019
- March 19, 2020

Western Arctic Caribou Herd Working Group—The Western Arctic Caribou Herd Working Group is a permanent organization of 20 stakeholders established in 1997 to ensure conservation of the Western Arctic caribou herd and the ecosystem on which it depends, and to maintain traditional and other uses for the benefit of all people now and into the future. The working group consists of subsistence users from communities within the range of the herd, other Alaska hunters, guides, transporters, conservationists, and reindeer herders. The BLM made presentations to the working group and answered questions about the project at the Western Arctic Caribou Herd Working Group meetings in Anchorage on December 13, 2018, and December 12, 2019, and spoke on the phone with the Chair of the working group's resource development committee on December 6, 2019, as the committee was developing its comments.

North Slope Subsistence Regional Advisory Council—The North Slope Subsistence Regional Advisory Council was established in 1980 pursuant to the Alaska National Interest Lands Conservation Act; it provides advice and recommendations to the Federal Subsistence Board on subsistence hunting, trapping, and fishing issues on federal public lands and waters on the North Slope. The council has 10 appointed members typically serving 3-year terms and representing eight rural communities. The BLM provided

project information and answered questions telephonically with the North Slope Subsistence Regional Advisory Council on April 3, 2019; October 23, 2019; and April 1, 2020.

C.2 CONSULTATION WITH FEDERALLY RECOGNIZED TRIBES[1]

Location	Date	Tribal Government
Teleconference	February 13, 2019	Native Village of Nuiqsut
Teleconference	March 6, 2019	Native Village of Nuiqsut
Nuiqsut, Alaska	April 30, 2019	Native Village of Nuiqsut
Teleconference	June 18, 2019	Native Village of Nuiqsut
Teleconference	February 26, 2019	Iñupiat Community of the Arctic Slope
Teleconference	May 2, 2019	Iñupiat Community of the Arctic Slope
Utqiagvik, Alaska	December 16, 2019	Iñupiat Community of the Arctic Slope
Wainwright, Alaska	January 14, 2020	Native Village of Wainwright
Anaktuvuk Pass, Alaska	January 16, 2020	Naqsragmiut Tribal Council
Teleconference	January 13, 2020	Native Village of Nuiqsut
Teleconference	March 6, 2020	Native Village of Barrow

C.3 PUBLIC MEETINGS

Location	Date	Venue
Anchorage, Alaska	December 10, 2018	Campbell Creek Science Center
Atqasuk, Alaska	December 11, 2018	Atqasuk Community Center
Anaktuvuk Pass, Alaska	December 12, 2018	Anaktuvuk Pass Community Center
Fairbanks, Alaska	December 13, 2018	Morris Thompson Cultural and Visitor Center
Nuiqsuit, Alaska	January 05, 2019	Nuiqsut Community Center
Utqiagvik, Alaska	January 04, 2019	Iñupiat Heritage Center
Wainwright, Alaska	January 09, 2019	Wainwright Community Center
Point Lay, Alaska	January 10, 2019	Point Lay Community Center
Point Lay, Alaska	December 10, 2019	Point Lay Community Center
Anchorage, Alaska	December 11, 2019	Z.J. Loussac Public Library
Utqiagvik, Alaska	December 16, 2019	Iñupiat Heritage Center
Atqasuk, Alaska	December 17, 2018	Atqasuk Community Center
Fairbanks, Alaska	December 18, 2019	Morris Thompson Cultural and Visitor Center
Nuiqsut, Alaska	January 8, 2020	Nuiqsut Trapper School
Wainwright, Alaska	January 14, 2020	Wainwright Community Center
Anaktuvuk Pass, Alaska	January 15, 2020	Anaktuvuk Pass Community Center

[1]Some of the consultations listed in this table were official government-to-government consultation, and others were informal consultation.

C.4 ANCSA CORPORATION CONSULTATION

Corporation	Date
Arctic Slope Regional Corporation	Teleconference: April 9, 2019
Kuukpik Corporation	In Person: March 7, April 12, May 1, 2019, and March 13, 2020
Arctic Slope Regional Corporation	In Person: February 20, 2020
Atqasuk Corporation	Teleconference: March 6, 2020
Wainwright Steering Committee	Teleconference: March 10 and April 21, 2020
Olgoonik Corporation	Teleconference: April 3, 2020

C.5 INCLUSION OF TRADITIONAL KNOWLEDGE

Traditional knowledge is critical in assessing impacts on rural communities, particularly with regard to their observations and information concerning subsistence practices and cultural concerns. Throughout the National Environmental Policy Act process, testimony was provided and traditional knowledge was shared in a variety of forums, such as public meetings and government-to-government and ANCSA consultations. A report was compiled of available traditional knowledge that had been documented in the six North Slope communities of Anaktuvuk Pass, Atqasuk, Nuiqsut, Point Lay, Utqiagvik, and Wainwright since 1976 and as relevant to the NPR-A. The BLM took into consideration traditional knowledge when developing the alternatives and incorporated it into the resource sections.

C.6 LIST OF PREPARERS

Preparer	Name	Role/Responsibility
BLM Interdisciplinary Team	Stephanie Rice	Project Manager, Principal-in-Charge, Facilitator, Public Involvement Lead, Human Environment and Special Designations Lead, Comment Analysis Lead, Decision File/Administrative Record Lead, Special Areas
	Serena Sweet	Assistant Project Manager, Petroleum Lead Resources and Spills Lead
	Cindy Hamfler	GIS
	Sarah Lamar	Renewable Resources Lead
	Stacey Fritz	Socioeconomics Lead, Subsistence Uses and Resources, Sociocultural Systems, Environmental Justice, Economy
	Zach Lyons	Nonrenewable Resources Lead, Physiography, Geology and Minerals, Petroleum Resources, Sand and Gravel Resources
	Vanessa Rathbun	Technical Writer and Editor, Word Processing/508 Compliance
	Craig Nicholls	Climate and Meteorology, Air Quality
	Alan Peck	Climate and Meteorology, Air Quality, Acoustic Environment
	Bob King	Paleontological Resources, Cultural Resources
	Joe Keeney	Paleontological Resources, Cultural Resources
	Eric Geisler	Soil Resources
	Matt Whitman	Water Resources and Fish and Aquatic Species
	Melody Debenham	Solid and Hazardous Waste
	Scott Guyer	Vegetation, Wetlands, and Floodplains
	Thomas St. Clair	Wildland Fire
	Debbie Nigro	Birds
	Tim Vosburgh	Terrestrial Mammals

Preparer	Name	Role/Responsibility
BLM Interdisciplinary Team *(continued)*	Casey Burns	Marine Mammals
	Donna Wixon	Landownership and Uses, Recreation, Wild and Scenic Rivers, Wilderness Characteristics, Visual Resources, Transportation, Renewable Energy
	Lonnie Bryant	Landownership and Uses, Transportation
	Sarah Yoder	Public Health and Safety
	Jeff Bruno	Public Health and Safety
Environmental Management and Planning Solutions, Inc. (EMPSi)	Chad Ricklefs, AICP	Project Manager
	Katie Patterson, JD	Assistant Project Manager, Geology and Minerals
	Molly McCarter	Public Involvement Lead
	David Batts	Principal-in-Charge
	Marcia Rickey, GISP	GIS Lead
	Angie Adams	Human Environment and Special Designations Team Lead
	Zoe Ghali	Socioeconomics Team Lead
	Francis Craig	Nonrenewable Resources Team Lead, Renewable Energy, Physiography, Geology and Minerals, Petroleum Resources, Sand and Gravel Resources
	Sean Cottle	Comment Analysis Lead, Special Areas (includes Marine Protected Areas, Wild and Scenic Rivers, and Wilderness Characteristics, Qualities, and Values)
	Megan Stone	Decision File/Administrative Record Lead
	Amy Cordle	Air Quality, Climate and Meteorology, Acoustics
	Lindsay Chipman, PhD	Fish and Aquatic Species
	Alex Dierker	GIS
	Kevin Doyle	Paleontological Resources, Cultural Resources
	Derek Holmgren	Visual Resources
	Jenna Jonker	GIS
	Meredith Zaccherio	Vegetation, Wetlands and Floodplains, Wildland Fire
	Dan Morta	Wildland Fire
	Lindsay Chipman, PhD	Fish and Aquatic Species
	Kevin Rice	Birds, Terrestrial Mammals, Marine Mammals
	Peter Gower, AICP, CEP	Renewable Energy, Landownership and Use, Recreation, Transportation
	Angelo Sisante	Landownership and Use, Environmental Justice, Recreation, Transportation, Economy
	Matthew Smith	Public Health and Safety, Soil Resources, Water Resources, Solid and Hazardous Waste
	Amy Lewis	Special Areas (includes Marine Protected Areas, Wild and Scenic Rivers, and Wilderness Characteristics, Qualities, and Values)
	Kevin Rice	Birds, Terrestrial Mammals, Marine Mammals
	Josh Schnabel	Acoustics
	Matt Smith	Public Health and Safety, Soil Resources, Water Resources, Sold and Hazardous Waste
	Andy Spellmeyer	Comment Analysis
	Amanda Tuttle	Spills Modeling and Analysis, Public Involvement, Comment Analysis

Preparer	Name	Role/Responsibility
Environmental Management and Planning Solutions, Inc. (EMPSi) *(continued)*	Meredith Zaccherio	Vegetation, Wetlands and Floodplains, Wildland Fire
	Randolph Varney	Technical Editing
	Kim Murdock	Technical Editing
	Cindy Schad	Word Processing
Alaska Biological Research, Inc. (ABR, Inc.)	Robert Burgess	Renewable Resources Team Lead, Fish and Aquatic Species, Birds, Marine Mammals
	Wendy Davis	Vegetation, Wetlands and Floodplains
	Susan Bishop, PhD	Vegetation, Wetlands and Floodplains
	John Seigle	Fish and Aquatic Species
	Adrian Gall	Marine Mammals
	Rick Johnson	Birds
	Alexander Prichard	Terrestrial Mammals
DOWL	Keri Nutter, CPG	Physiography, Geology and Minerals, Soil Resources, Sand and Gravel Resources
	Richard Pribyl	Water Resources
	Adam Morrill	Solid and Hazardous Waste
	Paul Pribyl, PE	Petroleum Resources
Northern Economics, Inc.	Leah Cuyno, PhD	Economy
	Patrick Burden	Economy
	Don Schug	Environmental Justice
Stephen R. Braund & Associates (SRB&A)	Stephen Braund	Subsistence Uses and Resources, Sociocultural Systems, Section 810 Preliminary Evaluation
	Paul Lawrence	Cultural Resources, Subsistence Uses and Resources, Sociocultural Systems, Section 810 Preliminary Evaluation
	Elizabeth Sears	Sociocultural Systems, Section 810 Preliminary Evaluation
	Jake Anders	Cultural Resources
Ramboll Group	Krish Vijayaraghavan	Climate and Meteorology, Air Quality
	Courtney Taylor	Climate and Meteorology, Air Quality

Appendix D
Laws and Regulations

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ACRONYMS AND ABBREVIATIONS

	Full Phrase
AAC	Alaska Administrative Code
AS	Alaska Statute
BLM	Bureau of Land Management
CAA	Clean Air Act of 1963
CFR	Code of Federal Regulations
CWA	Clean Water Act of 1972
EIS	environmental impact statement
EPA	U.S. Environmental Protection Agency
IAP	integrated activity plan
MMPA	Marine Mammal Protection Act of 1972
NSB	North Slope Borough
ROW	right-of-way
SHPO	State Historic Preservation Office
U.S.	United States
USACE	U.S. Army Corps of Engineers
U.S.C.	United States Code
USFWS	U.S. Fish and Wildlife Service

Appendix D. Laws and Regulations

Requirements of federal, state, and local laws and regulations, and policies associated with future development in the National Petroleum Reserve in Alaska are provided below.

D.1 INTERNATIONAL AGREEMENTS

D.1.1 Agreement on the Conservation of Polar Bears (Range States Agreement)

This is an agreement between the governments of Canada, Denmark, Norway, the former Union of Soviet Socialist Republics, and the United States (U.S.). It recognizes the responsibilities of circumpolar countries for coordinating actions to protect polar bears. The agreement prohibits hunting, killing, and capturing polar bears except by local people under traditional rights or for bona fide scientific and conservation purposes, preventing serious disturbance to the management of other living resources. This multilateral agreement also commits each associated country to adhere to sound conservation practices by protecting the ecosystem of polar bears. Special attention is given to denning areas, feeding sites, and migration corridors, based on best available science through coordinated research. The agreement was signed by the U.S. on November 15, 1973, in Oslo, Norway; Congress ratified it on September 30, 1976, and it went into force in this country on November 1, 1976.

D.1.2 Inuvialuit-Iñupiat Polar Bear Management Agreement

Signed in 1988 and reaffirmed in 2000 by the Inuvialuit Game Council and the North Slope Borough (NSB) Fish and Game Management Committee, the Inuvialuit-Iñupiat Polar Bear Management Agreement is a voluntary user-to-user agreement between Inuvialuit hunters in Canada and Iñupiaq hunters in Alaska. It provides for annual quotas and hunting seasons, protects bears in dens or during den construction, and protects females accompanied by cubs-of-the-year and yearlings. It allows for the collection of information and specimens to monitor harvest composition and provides for annual meetings to exchange information on the harvest, research, and management. The Inuvialuit-Iñupiat Polar Bear Management Agreement also establishes a joint commission to implement it and a technical advisory committee, consisting of biologists from agencies in the U.S. and Canada involved in research and management. Their function is to collect and evaluate scientific data and make recommendations to the joint commission.

D.2 FEDERAL LAWS AND REGULATIONS AND POLICIES

The following summarizes federal laws and regulations, and policies relevant to the oil and gas leasing program in the National Petroleum Reserve in Alaska. Some obligations would be the applicant's responsibility, and others would be required of federal agencies before they grant authorizations to oil and gas companies.

The Barrow Gas Field Transfer Act of 1984 (Public Law 98-366) authorized actions under an agreement between the NSB and the Secretary of the Interior. Part of the act authorizes the secretary to grant rights-of-way (ROWs) to the NSB so it can provide energy supplies to villages on the North Slope.

D.2.1 Bureau of Land Management

- The National Environmental Policy Act of 1969 sets policy and provides the means by which the federal government, including the Bureau of Land Management (BLM) and the federal cooperating agencies, examines major federal actions that may have significant impacts on the environment.

Examples are the oil and gas leasing and development contemplated in this environmental impact statement (42 United States Code [U.S.C.] 4321 et seq.).

- Under Section 302 of the Federal Land Policy and Management Act of 1976 (43 U.S.C. 1701 et seq.), the Secretary of the Interior has broad authority to regulate the use, occupancy, and development of public lands and to take whatever action is required to prevent unnecessary or undue degradation of public lands (43 U.S.C. 1732).
- Section 28 of the Mineral Leasing Act of 1920 (30 U.S.C. 185; 43 Code of Federal Regulations [CFR] 2880) provides the BLM with the authority to issue ROW grants for oil and natural gas pipelines and related facilities not authorized by appropriate leases.
- Under the Naval Petroleum Reserves Production Act of 1976, the BLM issues ROW grants and temporary use permits for constructing, operating, and maintaining pipelines, production facilities, and facilities related to them (42 U.S.C. 6501 et seq.).
- Section 810 of the Alaska National Interest Lands Conservation Act (16 U.S.C. 3101) establishes procedures for federal land management agencies to evaluate the effect of federal actions on subsistence uses and needs, the availability of other lands for the purposes sought to be achieved, and other alternatives that would reduce or eliminate the use, occupancy, or disposition of public lands needed for subsistence purposes (16 U.S.C. 3120).
- The BLM issues geophysical permits to conduct seismic activities, as described in 43 CFR 3152, under authority of the Mineral Leasing Act of 1920, Alaska National Interest Lands Conservation Act of 1980 (16 U.S.C. 3101 et seq.), Federal Land Policy and Management Act of 1976 (43 U.S.C. 1701 et seq.), Naval Petroleum Reserves Production Act of 1976, and Department of the Interior Appropriations Act, Fiscal Year 1981 (Public Law 96-514).
- Under the authority of the Naval Petroleum Reserves Production Act of 1976 and other federal laws for development and production of federal leases, the BLM reviews, denies, approves, or approves with appropriate modifications and conditions applications for permits to drill (including drilling plans and surface-use plans of operations) and subsequent well operations (43 CFR 3160) for development and production on federal leases.
- As described in 43 CFR Parts 3130 and 3180, under the Mineral Leasing Act of 1920 (30 U.S.C. 181 et seq.), Federal Oil and Gas Royalty Management Act of 1982 (30 U.S.C. 1701 et seq.), Naval Petroleum Reserves Production Act of 1976, and Department of the Interior Appropriations Act, Fiscal Year 1981, the BLM approves lease administration requirements, including unit agreements and plans of development, drilling agreements, and participating area determinations for exploring for and developing oil and gas leases.
- In accordance with Section 106 of the National Historic Preservation Act of 1966, the BLM is consulting with the Alaska State Historic Preservation Office (SHPO) to determine how proposed activities could affect cultural resources listed on or eligible for listing on the National Register of Historic Places. Formal consultations with the SHPO may be required when individual projects are implemented. The SHPO declined to consult with the BLM on the National Petroleum Reserve in Alaska Integrated Activity Plan (IAP)/Environmental Impact Statement (EIS. The SHPO acknowledged that, as a land use plan, the National Petroleum Reserve in Alaska IAP/EIS is an administrative action without the potential to affect historic properties. Section 106 of the National Historic Preservation Act (54 U.S.C. 300301 et seq.) and its implementing regulations (36 CFR 800) require the BLM to consider the effects of federal undertakings on historic properties. Other relevant federal cultural resource protection laws that the BLM is charged with upholding are the

Antiquities Act of 1906 (54 U.S.C. 320301 et seq.), the American Indian Religious Freedom Act of 1978 (42 U.S.C. 1996), Archaeological Resources Protection Act of 1979 (16 U.S.C. 470aa et seq.), the Abandoned Shipwreck Act of 1987 (43 U.S.C. 2101 et seq.), and Executive Order 13007 (Indian Sacred Sites). The Native American Graves Protection and Repatriation Act of 1990 (25 U.S.C. 3001 et seq.) requires the BLM to plan for and facilitate the return of human remains, funerary and sacred objects, and objects of cultural patrimony to lineal descendants and culturally affiliated Alaska Native tribes.

- The BLM consults with the U.S. Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service regarding the effects of its actions on threatened and endangered species and designated critical habitat.
- The BLM conducts Executive Order 13175 tribal consultation and consultation under the Alaska Native Claims Settlement Act.
- Under the Magnuson-Stevens Fishery Conservation and Management Act of 1976, the BLM consults with the National Marine Fisheries Service regarding authorized, funded, or undertaken actions that may adversely affect essential fish habitat.
- The BLM issues material sale permits under the Materials Act of 1947 and the Naval Petroleum Reserves Production Act of 1976.

D.2.2 U.S. Fish and Wildlife Service

- The USFWS Mitigation Policy of January 23, 1981 (reinstated via 2016 policy withdrawal effective July 30, 2018) provides direction on how to develop mitigation recommendations to offset the impacts of development on species or their habitats.
- The Endangered Species Act of 1973 states that all federal agencies, in consultation with and with the assistance of the Secretary of the Interior or Commerce, shall ensure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered or threatened species. Furthermore, an agency's action shall not destroy or adversely modify the habitat of such species that the secretary determines to be critical. Section 9 (16 U.S.C. 1538) of the Endangered Species Act identifies prohibited acts related to endangered species and prohibits all persons, including federal, state, and local government employees, from taking listed species of fish and wildlife, except as specified under provisions for exemption (16 U.S.C. 1535(g)(2) and 1539). Generally, the USFWS manages land and freshwater species, while the National Marine Fisheries Service manages marine species, including anadromous salmon; however, the USFWS is responsible for some marine animals, such as nesting sea turtles, walruses, polar bears, sea otters, and manatees.
- All marine mammals are protected under the Marine Mammal Protection Act of 1972 (MMPA; 16 U.S.C. 1361 et seq.). The National Marine Fisheries Service and the USFWS share jurisdiction for the MMPA, depending on the species being considered. Under the MMPA, taking marine mammals without a permit or exception is prohibited. Under the MMPA, "take" means "to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal." The MMPA defines harassment as "any act of pursuit, torment, or annoyance which (i) has the potential to injure a marine mammal or marine mammal stock in the wild [Level A harassment]; or (ii) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering [Level B harassment]." Under Section 101(a)(5)(D) of the MMPA, the USFWS may

issue a letter of authorization for incidental take, for up to 1 year, of small numbers of marine mammals, where the take would be limited to harassment (Incidental Harassment Authorization).

- The Migratory Bird Treaty Act of 1918 (16 U.S.C. 703 et seq.) makes it illegal for anyone to take, possess, import, export, transport, sell, purchase, barter, or offer for sale, purchase, or barter any migratory bird, or the parts, nests, or eggs of such a bird, except under the terms of a valid permit issued under federal regulations. The migratory bird species protected by the act are listed in 50 CFR 10.13.
- The Bald and Golden Eagle Protection Act of 1940 prohibits taking eagles, including their parts, nests, or eggs. If a project may result in take, and after avoidance and minimization measures are established, the USFWS may issue an eagle take permit.
- Under the Fish and Wildlife Coordination Act of 1934, the USFWS provides consultation on impacts on fish and wildlife resources.

D.2.3 Environmental Protection Agency

The U.S. Environmental Protection Agency's (EPA) authority to regulate oil and gas development is contained in the Clean Water Act of 1972 (CWA; 33 U.S.C. 1251 et seq.), the Clean Air Act (CAA; 42 U.S.C. 7401 et seq.), and the Safe Drinking Water Act (42 U.S.C. 300f et seq.). These authorities are discussed below.

- Under Section 402 of the CWA (33 U.S.C. 1342), the EPA has delegated authority to the State of Alaska to issue permits for discharging pollutants from a point source into Waters of the U.S. for facilities, including those for oil and gas, operating within the State's jurisdiction. Point-source discharges that require an Alaska Pollutant Discharge Elimination System permit include sanitary and domestic wastewater, gravel pit and construction dewatering, hydrostatic test water, and stormwater discharges (40 CFR 122).
- The EPA co-administers the CWA Section 404 program with the U.S. Army Corps of Engineers (USACE). The EPA develops and interprets policy, guidance, and the Section 404(b)(1) guidelines, which are the environmental criteria used in evaluating permit applications. The EPA also determines the scope of geographic jurisdiction and the applicability of statutory exemptions to the permit requirements. It approves and oversees state and tribal assumption of Section 404 permitting authority, reviews permit applications for compliance with the guidelines, and provides comments to the USACE. The EPA can elevate specific permit cases or policy issues pursuant to Section 404(q), under which it has the authority to prohibit, deny, or restrict the use of any defined area as a disposal site. Lastly, the EPA has independent authority to enforce Section 404 provisions.
- Under the Safe Drinking Water Act of 1974 (42 U.S.C. 300f et seq.), the EPA's responsibilities are to manage the underground injection control program and the direct implementation of Class I and Class V injection wells in Alaska. These wells are for injecting nonhazardous and hazardous waste through a permitting process for fluids that are recovered from down hole. The injection wells also are for municipal waste, stormwater, and other fluids that do not come up from down hole (40 CFR 124A, 144, and 146). The EPA oversees the Class II program delegated to the State of Alaska and managed by the Alaska Oil and Gas Conservation Commission; this Class II program includes Class II enhanced oil recovery, storage, and disposal wells that may receive nonhazardous produced fluids originating from down hole, including muds and cuttings (40 CFR 147). The EPA issues an underground injection control Class 1 industrial well permit under the Safe Drinking Water Act of

1974 (42 U.S.C. 300f et seq. and 40 CFR Parts 144 and 146) for underground injection of Class I (industrial) waste materials.

- Under Section 311 of the CWA, as amended (33 U.S.C. 1321; 40 CFR 112), the EPA requires a "spill prevention containment and countermeasure plan" for storing over 660 gallons of fuel in a single container or over 1,320 gallons in aggregate aboveground tanks.
- Under the CWA, as amended (Oil Pollution Act [33 U.S.C. 40] and Facility Response Plan Rule [40 CFR 112.20–112.21], the EPA requires a facility response plan to identify and ensure the availability of sufficient response resources for the worst case discharge of oil to the maximum extent practicable, ". . . generally for facilities that transfer over water to or from vessels, and maintaining a capacity greater than 42,000 gallons, or any facility with a capacity of over one million gallons."
- Under Sections 165 (42 U.S.C. 7475) and 502 of the CAA (42 U.S.C. 7661a), the State of Alaska is authorized to issue air quality permits for facilities operating within State jurisdiction for the Title V operating permit (40 CFR 70) and the "prevention of significant deterioration" permit (40 CFR 52.21) to address air pollution emissions. The EPA oversees the State's program.
- Under Section 309 of the CAA (42 U.S.C. 7609), the EPA requires a review and evaluation of the draft and final environmental impact statements for compliance with the Council on Environmental Quality guidelines.
- Under Sections 301–304, 311, and 312 of the Emergency Planning and Community Right-to-Know Act (42 U.S.C. 11001 et seq.), the EPA requires that states establish emergency planning, emergency release notification, community right-to-know reporting, and toxic chemical release inventory.
- The EPA retains oversight authority over the Alaska Pollutant Discharge Elimination System program; however, to address air pollutant emissions, it delegates authority to the Alaska Department of Environmental Conservation to issue air quality permits for facilities operating within State jurisdiction. This includes a Title V operating permit and a prevention of significant deterioration permit under the CAA, as amended (42 U.S.C. 7401 et seq.).

D.2.4 National Oceanic and Atmospheric Administration Fisheries

The National Oceanic and Atmospheric Administration is responsible for the stewardship of national marine resources. The agency conserves and manages fisheries to promote sustainability and to prevent the lost economic potential associated with overfishing, declining species, and degraded habitats. It provides consultation under the following:

- Endangered Species Act of 1973, Section 7(a)(2), on the effects on threatened or endangered species
- Fish and Wildlife Coordination Act on the effects on fish and wildlife resources
- MMPA on the effects on marine mammals; it issues incidental harassment authorization under the MMPA for incidental takes of protected bowhead whales and ringed seals.
- Magnuson-Stevens Fishery Conservation and Management Act of 1976 for effects on essential fish habitat; the act requires federal agencies to consult with the Secretary of Commerce on any action authorized, funded, or undertaken or proposed to be authorized, funded, or undertaken by such agency that may adversely affect essential fish habitat identified under the act.

D.2.5 U.S. Army Corps of Engineers

The USACE has the authority to issue or deny permits for placing dredge or fill material in the Waters of the U.S., including wetlands, and for work or structures in, on, over, or under navigable Waters of the United States. These USACE authorities are set forth as follows:

- Under Section 404 of the CWA (33 U.S.C. 1344), the USACE regulates discharges of dredge and fill material in Waters of the U.S., including wetlands.
- Under Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 403), the USACE has regulatory authority for work and structures performed in, on, over, or under navigable Waters of the United States.
- Under Section 103 of the Marine Protection Research and Sanctuaries Act of 1972 (33 U.S.C. 1413), the USACE issues Section 103 ocean dumping permits for transporting dredged material for ocean disposal.

D.2.6 Bureau of Ocean Energy Management

The Bureau of Ocean Energy Management provided subject matter expertise in drafting and reviewing this IAP/EIS as part of the BLM interdisciplinary team. The Interagency Working Group on Coordination of Domestic Energy Development and Permitting in Alaska, established under Executive Order 13580, adopted the concept of integrated Arctic management to ensure that decisions on development and conservation made in the Arctic are driven by science, stakeholder engagement, and government coordination.

D.3 Executive Orders

In addition to the statutory authorities described above, a number of executive orders may apply, as follows: Executive Orders 13783 (promoting energy independence and economic growth), 11988 (floodplain management), 11990 (protection of wetlands), 13158 (marine protected areas), 12898 (environmental justice), 13007 (Indian sacred sites), 13175 (tribal consultation), and 13112 (invasive species control).

D.4 State of Alaska

The State issues several permits. The Alaska Department of Natural Resources issues permits for temporary water use and water rights, permits for cultural resource surveys, concurrence on the effects on cultural resources evaluated under Section 106, and other authorizations for activities associated with oil and gas development. The Alaska Department of Fish and Game issues fish habitat permits. The Alaska Department of Environmental Conservation issues prevention of significant deterioration and other air quality permits as part of the implementation plans. The Alaska Department of Environmental Conservation is responsible for issuing several permits and plan approvals for oil and gas exploration and development, including the storage and transport of oil and cleanup of oil spills. The Alaska Oil and Gas Conservation Commission issues drilling permits and approves production, injection, and disposal plans for exploration and development.

Additional State authorities are presented below.

D.4.1 Alaska Department of Natural Resources

- Issues a material sales contract for mining and purchase of gravel from state lands under Alaska Statute (AS) 38.05.850 and 11 Alaska Administrative Code (AAC) 71.070 and 71.075
- Issues ROW and land use permits for use of State land, ice road construction on State land, and State freshwater bodies under AS 38.05.850

- Issues "temporary water use and water rights" permits under AS 46.15 for water use necessary for construction and operations
- Issues pipeline ROW leases for pipeline construction and operation across State lands under AS 38.35.020
- Issues Alaska cultural resource permits for surveys under the Alaska Historic Preservation Act (AS 41.35.080)
- Adjudicates instream flow reservations and other applications for reserved water rights under AS 46.15.145, Reservation of Water; permissible instream uses are the protection of fish and wildlife habitat, migration, and propagation; recreation and parks; navigation and transportation; and sanitation and water quality.
- The Office of History and Archaeology identifies and protects historic properties in Alaska and is led by the SHPO. Section 106 of the National Historic Preservation Act of 1966 (54 U.S.C. 300301 et seq.) and its implementing regulations (36 CFR 800) require federal agencies to consider the effects of federal undertakings on properties listed on, or eligible for listing on, the National Register of Historic Places. It requires federal agencies to identify cultural sites that may be affected and determines their eligibility to be listed. This consultation is done through the SHPO, who evaluates assessments and issues concurrences with findings on federal lands under Section 106 and on State lands under the Alaska Historic Preservation Act (AS 41.35.010–41.35.240).

D.4.2 Alaska Department of Environmental Conservation

- Issues an Alaska Pollutant Discharge Elimination System wastewater discharge permit for wastewater disposal into all State waters under a transfer of authority from the EPA National Pollutant Discharge Elimination System Program under Section 402 of the CWA, as amended (33 U.S.C. 1342; AS 46.03.020, 46.03.100, 46.03.110, 46.03.120, and 46.03.710; 18 AAC 15, 70, and 72.500). These permits may include a mixing zone approval where appropriate. In addition to developing, issuing, modifying, and renewing permits, the Alaska Pollutant Discharge Elimination System program includes the Storm Water Program, Compliance and Enforcement, Federal Facilities, and the Pretreatment Program.
- Issues a certificate of reasonable assurance/Alaska Pollutant Discharge Elimination System and mixing zone approval for wastewater disposal into all State waters for permits issued by the USACE under Sections 402 and 404 of the CWA; these permits may include discharge of dredge and fill material into Waters of the United States.
- Issues a certificate of reasonable assurance under Section 401 of the CWA (401 Certification), which is required for validity of the USACE Section 404 permit.
- Issues a Class I well wastewater disposal permit for underground injection of non-domestic wastewater under AS 46.03.020, 46.03.050, and 46.03.100.
- Reviews and approves all public water systems, including plans, monitoring programs, and operator certifications, under AS 46.03.020, 46.03.050, 46.03.070, and 46.03.720 (18 AAC 80.005).
- Approves domestic wastewater collection, treatment, and disposal plans for domestic wastewaters (18 AAC 72).
- Approves financial responsibility for cleaning up oil spills (18 AAC 75).
- Reviews and approves the oil discharge prevention and contingency plan under the Oil Pollution Act of 1990 and the certificate of financial responsibility for storage or transport of oil under AS

46.04.030 and 18 AAC 75. The State review applies to oil exploration and production facilities, crude oil pipelines, oil terminals, tank vessels and barges, and certain non-tank vessels.

- Issues Title V operating permits and prevention of significant deterioration permits under CAA Amendments (Title V) for air pollutant emissions from construction and operation (18 AAC 50).
- Issues Alaska Pollutant Discharge Elimination System permits under Section 402, of the CWA, as amended (33 U.S.C. 1342) for discharges into Waters of the United States. The EPA delegated full program authorization in November 2012.
- Issues solid waste disposal permits for State lands under AS 46.03.010, 46.03.020, 46.03.100, and 46.03.110; AS 46.06.080; and 18 AAC 60.005; and 200.
- Reviews and approves solid waste processing and temporary storage facilities plans for handling and temporarily storing solid waste on federal and State lands under AS 46.03.005, 46.03.010, and 46.03.020, and 18 AAC 60.430
- Approves the siting of hazardous waste management facilities

D.4.3 Alaska Department of Fish and Game

- The Fishway Act (AS 16.05.841) deals exclusively with fish passage; it applies to streams with documented resident fish use and without documented use by anadromous fish.
- The Anadromous Fish Act (AS 16.05.871) applies to streams specified in the Anadromous Waters Catalog as important for the spawning, rearing, or migration of anadromous fishes; AS 16.05.871 is a broader authority than AS 16.05.841 and extends to anadromous fish habitat.
- Under AS 16.05.841 and AS 16.05.871, the agency issues fish habitat permits for activities in streams used by fish that the agency determines could represent impediments to fish passage or for traveling in, excavating, or culverting anadromous fish streams.
- Issues public safety permits for nonlethal hazing of wild animals that are creating a nuisance or a threat to public safety.
- Evaluates potential impacts on fish, wildlife, and fish and wildlife users and presents any related recommendations to the Alaska Department of Natural Resources or to federal permitting agencies via the Fish and Wildlife Coordination Act.

D.4.4 Alaska Oil and Gas Conservation Commission

- Issues permits to drill under 20 AAC 25.05
- Issues approval for annular disposal of drilling waste (20 AAC 25.080)
- Authorizes plugging, abandonment, and location clearance (20 AAC 25.105–25.172)
- Authorizes production practices (20 AAC 25.200–25.245)
- Authorizes Class II waste disposal and storage (20 AAC 25.252)
- Approves workover operations (20 AAC 25.280)
- Requires information and documentation as requested by the commissioner (20 AAC 25.300–25.320)
- Authorizes enhanced recovery operations under 20 AAC 25.402–460

D.4.5 Alaska Department of Public Safety

The State Fire Marshall within the Department of Public Safety reviews and approves plans for compliance with the fire and life safety regulations at 13 AAC 50.025..

D.5 NORTH SLOPE BOROUGH

The NSB, as a Home Rule Borough, issues development permits and other authorizations for oil and gas activities under the terms of its ordinances (NSB Municipal Code Title 19). The Iñupiat History, Language, and Culture Division is responsible for traditional land use inventory clearance.

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Appendix E

Final Alaska National Interest Lands Conservation Act Section 810 Evaluation of Subsistence Impacts

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MAPS

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ACRONYMS AND ABBREVIATIONS

	Full Phrase
ANILCA	Alaska National Interest Lands Conservation Act
BLM	Bureau of Land Management
BMP	Best Management Practices
CAH	Central Arctic Caribou Herd
GMT	Greater Mooses Tooth
IAP/EIS	Integrated Activity Plan/Environmental Impact Statement
NPR-A	National Petroleum Reserve in Alaska
NSO	No Surface Occupancy
ROP	Required Operating Procedures
TCH	Teshekpuk Caribou Herd
U.S.C.	United States Code
WAH	Western Arctic Caribou Herd

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Appendix E. Final Alaska National Interest Lands Conservation Act Section 810 Evaluation of Subsistence Impacts

This evaluation of subsistence impacts is for the National Petroleum Reserve-Alaska (NPR-A) Integrated Activity Plan/Environmental Impact Statement (IAP/EIS). The Bureau of Land Management (BLM) has developed the NPR-A IAP/EIS to determine the appropriate management of all BLM-managed lands in the NPR-A in a manner consistent with existing statutory direction and Secretarial Order 3352. Secretarial Order 3352 directed development of a revised IAP that "strikes an appropriate balance of promoting development while protecting surface resources." The NPR-A IAP/EIS considers a range of alternatives that makes areas available for leasing, including areas not currently open to leasing, examines current special area boundaries, and considers new or revised lease stipulations and required operating procedures (ROPs; referred to as best management practices [BMPs] in the 2012 IAP/EIS).

In addition to the no action alternative (Alternative A), the NPR-A IAP/EIS considers four action alternatives (Alternatives B, C, D, and E), all of which differ in the areas available for leasing and infrastructure, the lease stipulations and required operating procedures that would apply to on-the-ground activities, and the suitable rivers recommended for Wild and Scenic River designation. All action alternatives would remove the Colville River Special Area from the BLM's management plan for the NPR-A. Only under Alternative B would all 12 eligible rivers in the southwestern portion of the NPR-A be found suitable and recommended for inclusion in the National Wild and Scenic Rivers System to protect their free-flowing condition, water quality, and outstandingly remarkable values. Alternative A represents continued implementation of the current IAP adopted in the February 2013 record of decision. Under Alternative A, approximately 52 percent (11.8 million acres) of the NPR-A's subsurface estate would be available for oil and gas leasing, including some lands closest to existing leases centered on the Greater Mooses Tooth and Bear Tooth units and Umiat. Lands near Teshekpuk Lake would continue to be unavailable for oil and gas leasing. New infrastructure would be prohibited on 8.3 million acres. Of the four action alternatives, Alternative B would make available the fewest acres for oil and gas leasing and infrastructure development. Compared with Alternative A, Alternative B would close areas closer to Utqiagvik, Atqasuk, and Nuiqsut to oil and gas leasing and would defer leasing in the northeastern portion of the NPR-A for 10 years. Alternative C would make more areas available for oil and gas leasing and infrastructure development than Alternatives A and B, opening to leasing additional lands in the Teshekpuk Lake Special Area and in the Utukok River Uplands Special Area. Alternatives D and E would make the greatest number of acres available for oil and gas leasing and infrastructure development, including a larger area surrounding Teshekpuk Lake.

Chapter 3, *Affected Environment and Environmental Consequences*, of the NPR-A IAP/EIS describes the current environmental condition of the planning area and potential effects of the alternative management scenarios on the physical, biological, and socioeconomic environment. In particular, Section 3.4.3, *Subsistence Uses and Resources*, addresses the affected environment and environmental consequences for subsistence. Other relevant sections include Section 3.3.3, *Fish*, Section 3.3.4, *Birds*, Section 3.3.5, *Terrestrial Mammals*, Section 3.4.4, *Sociocultural Systems*, Section 3.4.11, *Economy*, and Section 3.4.12, *Public Health*. This evaluation uses that information to assess potential impacts on subsistence uses and needs pursuant to Section 810(a) of the Alaska National Interest Lands Conservation Act (ANILCA).

E.1 SUBSISTENCE EVALUATION FACTORS

Section 810(a) of ANILCA, 16 United States Code (U.S.C) 3120(a), requires that an evaluation of subsistence uses and needs must be completed for any federal determination to "withdraw, reserve, lease, or otherwise permit the use, occupancy or disposition of public lands." Most of the NPR-A is on BLM-managed public lands except for Alaska Native lands near the four communities within the NPR-A (Wainwright, Atqasuk, Utqiagvik, and Nuiqsut) and Native allotments that are in various locations throughout the NPR-A (particularly along key river drainages). Thus, an evaluation of potential impacts on subsistence uses and needs under ANILCA Section 810(a) must be completed for the NPR-A IAP/EIS. All impacts on subsistence uses and needs are evaluated herein regardless of land status within the planning area.

ANILCA requires that this evaluation include findings on three specific issues:

1. The effect of use, occupancy, or disposition on subsistence uses and needs
2. The availability of other lands for the purposes sought to be achieved
3. Other alternatives that would reduce or eliminate the use, occupancy, or disposition of public lands needed for subsistence purposes (16 U.S.C. Section 3120(a))

Following BLM Alaska guidance (BLM IM No. AK-2011-008), three factors are considered when determining if a significant restriction of subsistence uses and needs may result from the proposed action, alternatives, or cumulatively:

1. A reduction in the abundance of harvestable resources used for subsistence purposes. Forces that might cause a reduction include adverse impacts on habitat, direct impacts on the resource, increased harvest, and increased competition from non-subsistence harvesters.
2. A reduction in the availability of resources used for subsistence purposes caused by an alteration in their distribution, migration, or location.
3. A limitation on the access of subsistence users to harvestable resources. Such an evaluation includes only physical and legal barriers.

NPR-A IAP/EIS, Section 3.4.3, *Subsistence Uses and Resources, Affected Environment*, and Appendix T, *Subsistence Use and Resources*, provide information on areas and resources important for subsistence use, and the degree of dependence of the six primary subsistence study communities (Anaktuvuk Pass, Atqasuk, Nuiqsut, Point Lay, Utqiagvik, and Wainwright) on different subsistence resources. The NPR-A IAP/EIS, Section 3.4.3, *Subsistence Uses and Resources, Direct and Indirect Impacts*, provides data on subsistence resource availability and limitations that each alternative would place on access and is used to determine whether the alternatives may cause a significant restriction to subsistence uses.

A finding that the proposed action may significantly restrict subsistence uses imposes requirements to notify the State of Alaska and appropriate regional and local subsistence committees, hold hearings in affected communities, and make the following determinations before BLM can authorize the use of public lands:

- Such a significant restriction of subsistence uses is necessary and consistent with sound management principles for the use of the public lands.
- The proposed activity would involve the minimal amount of public lands necessary to accomplish the purposes of the use, occupancy, or other disposition.
- Reasonable steps would be taken to minimize adverse effects upon subsistence uses and resources resulting from such actions (16 U.S.C. 3120(a)).

A proposed action or alternative would be considered to significantly restrict subsistence uses if, after consideration of stipulations or protection measures (e.g., lease stipulations and BMPs or ROPs) included as a part of each alternative, it can be expected to result in a substantial reduction in the opportunity to continue subsistence uses of renewable resources. Substantial reductions in the opportunity to continue subsistence uses generally are caused by large reductions in resource abundance, a major redistribution of resources, extensive interference with access, or major increases in the use of those resources by non-subsistence users (BLM IM AK-2011-008).

As noted above, this ANILCA Section 810 evaluation relies primarily on the information contained in the NPR-A IAP/EIS. When analyzing the effects of the alternatives, all of the six primary subsistence study communities are given equal attention, as all of these communities have use areas overlapping the NPR-A and could be affected to varying degrees depending on the alternative. Four communities are within the NPR-A (Atqasuk, Nuiqsut, Utqiagvik, and Wainwright), and these communities would be most likely to experience direct impacts of oil and gas or infrastructure development within the NPR-A (**Map E-1**).

Point Lay has use areas overlapping the western portion of the NPR-A. While Anaktuvuk Pass has peripheral uses of the NPR-A in its southern and southeastern portions, the community of Anaktuvuk Pass has a particularly high reliance on caribou that migrate from areas of high development potential into traditional harvesting areas and are therefore included as a primary study community. In addition to the primary study communities, the NPR-A IAP/EIS addresses potential impacts on seven communities that have peripheral uses of the NPR-A (Ambler, Kiana, Kobuk, Noatak, Noorvik, Selawik, and Shungnak) and indirect and cumulative impacts on the 42 communities that harvest caribou from the Western Arctic Caribou Herd (WAH) and/or the Teshekpuk Caribou Herd (TCH), the primary caribou herds that use the NPR-A (**Map E-1**).

In addition to ANILCA, Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations* (59 *Federal Register* 7629; February 16, 1994) calls for an analysis of the effects of federal actions on minority populations and low-income populations with regard to subsistence. Specifically, environmental justice is:

> *The fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people, including a racial, ethnic, or socioeconomic group should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of federal, state, local, and tribal programs and policies.*

Regarding the subsistence consumption of fish and wildlife, Section 4-4 of the order requires federal agencies to collect, maintain, and analyze information on the consumption patterns of populations who principally rely on fish or wildlife for subsistence, and to communicate to the public any risks associated with those consumption patterns. To this end, the alternatives subsistence analyses, located in Section 3.4.3 of the NPR-A IAP/EIS, have been reviewed and found to comply with Executive Order 12898.

E.2 ANILCA Section 810(a) Evaluations and Findings for All Alternatives and the Cumulative Case

Evaluations and findings for Alternatives A, B, C, D, and E and the cumulative case are presented individually in the following sections. The NPR-A IAP/EIS uses the term ROPs to replace the term BMPs used in the 2012 NPR-A IAP/EIS. Under Alternative A (the no action alternative), the BMPs and lease stipulations from the 2012 NPR-A IAP/EIS would remain in effect, as adopted in the current IAP February 2013 record of decision.

Under Alternatives B through E, new ROPs and lease stipulations would be established. These ROPs and lease stipulations are listed in the NPR-A IAP/EIS, Table 2-1. Additional protections for biologically sensitive areas are listed in Table 2-2 and would apply differently under the four action alternatives. The mitigating effects of these ROPs, lease stipulations, and additional protections are accounted for in the following evaluations and findings.

In the NPR-A IAP/EIS, the BLM analyzed potential direct impacts on subsistence uses and resources based on the percentage of documented subsistence use areas for each community that are open to oil and gas leasing and infrastructure development. In addition, this evaluation considers this information in the context of whether potentially affected subsistence use areas are in areas of low, medium, or high development potential (**Map E-1**) and whether subsistence resources of high material and cultural importance would be affected; this information is provided under the individual alternatives discussions. The NPR-A IAP/EIS analyzes impacts based on the potential for direct and indirect impacts resulting from activities expected to occur under the reasonably foreseeable development scenario (NPR-A IAP/EIS, Appendix B, *Reasonably Foreseeable Development Scenario*). Future analyses for specific on-the-ground activities would occur with site-specific scenarios, and these analyses would determine how and to what level subsistence uses would be affected based on specific infrastructure design, placement, and operational details.

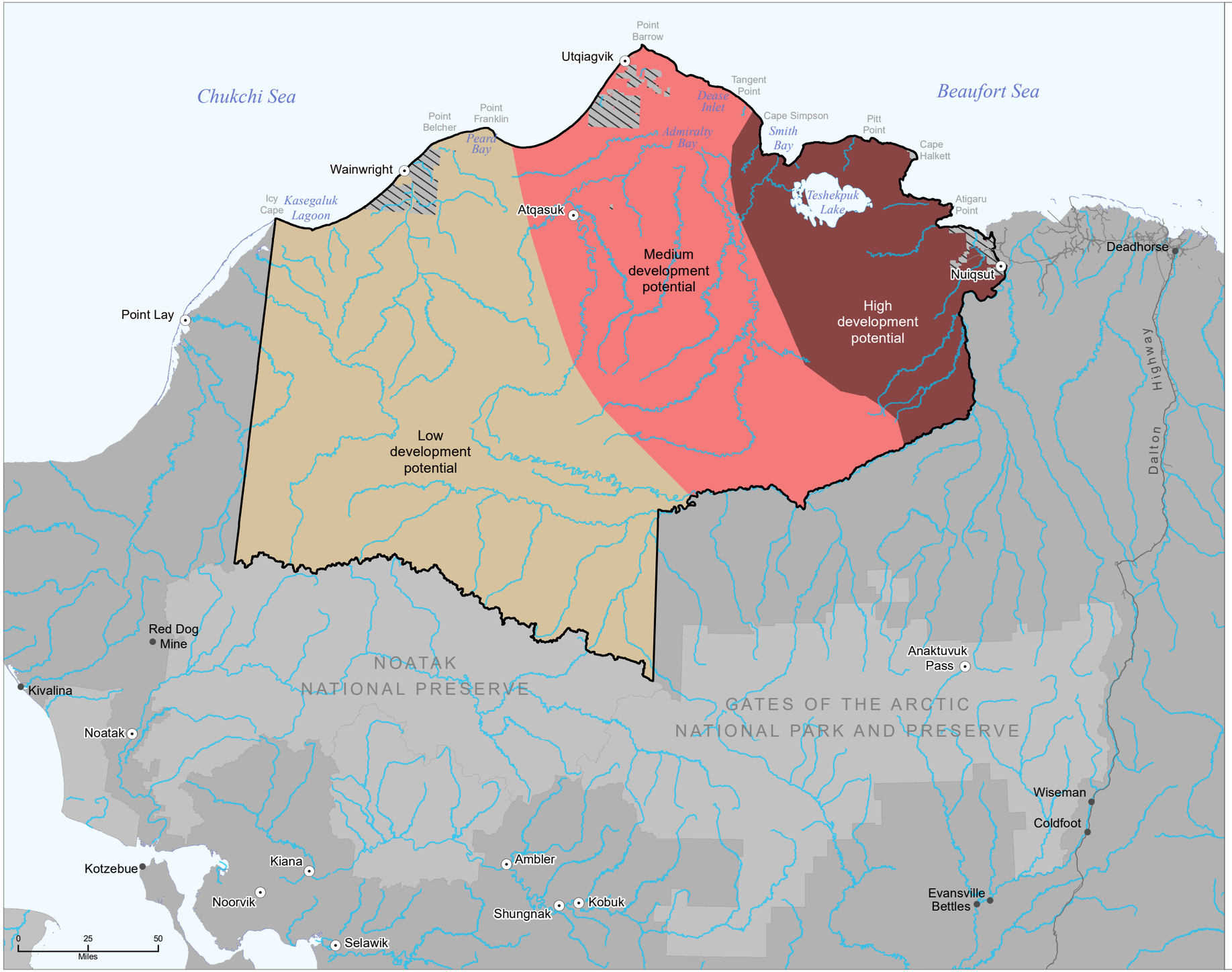
E.2.1 Evaluation and Finding for Alternative A (No Action Alternative)

Alternative A of the NPR-A IAP/EIS is composed of decisions established in the 2013 record of decision for the 2012 NPR-A IAP/EIS. Under Alternative A, the BLM would continue to implement existing management practices in the NPR-A. Under this alternative, the areas open to oil and gas leasing and infrastructure, management of NPR-A lands and rivers, and BMPs and lease stipulations would remain the same. Under Alternative A, 34,000 acres are closed to fluid mineral leasing but have valid existing leases, and 729,000 acres that are subject to no surface occupancy (NSO) also have valid existing leases. Where there are valid existing leases, activities that are currently allowed pursuant to the 2013 record of decision would continue. If the existing leases are developed, the likelihood of potential impacts on the study communities would increase (NPR-A IAP/EIS, Section 3.4.3, *Subsistence Uses and Resources, Direct and Indirect Impacts*).

Under Alternative A, management of the NPR-A would continue as previously approved under the February 2013 NPR-A IAP record of decision. Currently proposed projects such as Greater Mooses Tooth Two (GMT2) (under construction) and Willow (undergoing the National Environmental Policy Act process) would proceed, and reasonably foreseeable projects such as development at Umiat and additional satellite developments using the Alpine and Willow central processing facilities are expected to occur (NPRA IAP/EIS, Appendix B**,** *Reasonably Foreseeable Development Scenario*).

In addition to oil and gas leasing, continuation of the existing management plan under Alternative A would permit or restrict other activities such as seismic surveys, gravel mining, and infrastructure development (e.g., roads and pipelines) in certain areas. Thus, the analysis is of potential direct and indirect impacts on subsistence resource abundance, resource availability, and harvester access resulting from on-the-ground post-leasing activities, other oil and gas activities not associated with leasing (e.g., seismic surveys), mining, and infrastructure development within the NPR-A. Actions that may impact subsistence uses include noise, traffic, and human activity, infrastructure, contamination, and legal or regulatory barriers. Other impacts pertaining to changes in income, revenue, employment rates, and general development and culture are addressed in the NPR-A IAP/EIS but do not pertain to changes in resource abundance, resource availability, or harvester access and are not analyzed here in accordance with BLM guidance (BLM IM No. AK-2011-008).

National Petroleum Reserve-Alaska EIS Subsistence Study Communities



- Subsistence study community
- Other community

Development Potential

- High
- Medium
- Low

- National Petroleum Reserve-Alaska
- Outside the BLM's surface authority

Data source: BLM GIS 2019
Map prepared by Stephen R. Braund & Associates
Print date: 05/05/2020

Map E-1

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Evaluation of the Effect of Use, Occupancy, or Disposition on Subsistence Uses and Needs

Under Alternative A, approximately 52 percent of NPR-A lands would be available for oil and gas leasing and infrastructure development, with large portions of land protected for surface resources. Lands in the northeast and southwest portions of the NPR-A, including those around Teshekpuk Lake and around the Utukok River Uplands, key habitat areas for the WAH and TCH, would continue to be closed to oil and gas leasing and infrastructure development.

The NPR-A (**Map E-1**) and its drainages are heavily used by the six primary study communities presented in the NPR-A IAP/EIS for hunting and harvesting of large land mammals, small land mammals, salmon and non-salmon fish, migratory and upland game birds, and vegetation (see **Maps E-2** through **E-7**). Marine mammals and fish (including salmon and non-salmon fish) are also harvested offshore from the NPR-A in coastal and nearshore areas. As presented in NPR-A IAP/EIS, Appendix A, large land mammals, salmon and non-salmon fish, vegetation, marine mammals, and migratory birds are all resources of high material and cultural importance to one or more of the six primary study communities. Thus, this evaluation focuses on potential impacts on subsistence uses of all of the above resources for the six primary study communities. In addition, this evaluation addresses impacts on communities who have peripheral uses of the NPR-A and communities who harvest from the TCH and WAH, the two primary herds that use the NPR-A.

Impacts on resource availability and harvester access would be most likely to occur for communities that have regular use of NPR-A lands (e.g., Atqasuk, Point Lay, Nuiqsut, Utqiagvik, and Wainwright), and even more likely for communities who have use areas overlapping areas of high development potential where development is most likely (e.g., Nuiqsut; see **Tables E-1** through **E-4**). Impacts on resource abundance would affect all subsistence users of the TCH and/or WAH either through decreased resource availability or through changes in harvest restrictions in response to reduced herd populations. Thus, impacts on subsistence resource abundance, particularly for the WAH, which has a broader user base than the TCH, would extend well beyond the NPR-A. Under Alternative A, Atqasuk would have the greatest percentage of their use areas open to oil and gas leasing, followed by Utqiagvik, Wainwright, Nuiqsut, Point Lay, and Anaktuvuk Pass (see **Table E-1**). A majority of use areas for Utqiagvik, Wainwright, Atqasuk, and Point Lay are in areas of low to medium development potential (**Maps E-2** through **E-7**) and thus the likelihood of oil and gas development occurring within those communities' subsistence areas is lower than for Nuiqsut. In the case of Atqasuk, use areas for large land mammals and small land mammals overlap with areas of high development potential and so this community could also experience direct impacts on resource availability and access but on the periphery of their hunting area (**Table E-1**; **Map E-3**). Large land mammals are a resource of high importance for the community of Atqasuk (NPR-A IAP/EIS, Appendix T, Table T-4, *Harvest Characteristics of Atqasuk*). Oil and gas exploration would likely continue in areas of medium development potential that are open to oil and gas leasing, including in currently leased areas directly to the east and southeast of Atqasuk, presenting potential temporary conflicts with subsistence users (Appendix B, *Reasonably Foreseeable Development Scenario*). Although exploration is likely and development is possible in areas of medium development potential, only areas of high development potential are considered likely targets for development at this time (Appendix B).

Nuiqsut is currently the community most directly affected by oil and gas development on the North Slope. Lands of high development potential to the west, southwest, and south of Nuiqsut would remain open to oil and gas leasing under Alternative A, and these lands are used for subsistence harvesting of multiple resources, including resources of high material and cultural importance (see **Tables E-1** and **E-2**, **Map E-4**, NPR-A

Table E-1
Percentage of NPR-A Subsistence Use Areas Closed and Open to Fluid Mineral Leasing

Community	Alt. A		Alt. B		Alt. C		Alt. D		Alt. E		Percent of Total Use Areas in NPR-A
	Closed	Open	Closed	Open	Closed	Open	Closed	Open	Closed	Open	
Anaktuvuk Pass	3	<1	3	<1	0	4	0	4	0	4	4
Atqasuk	25	71	36	60	4	92	1	94	1	95	100
Utqiagvik	28	33	30	30	15	45	11	49	11	49	62
Nuiqsut	14	26	16	24	5	35	0	40	0	40	41
Point Lay	29	10	32	7	27	12	27	12	27	12	40
Wainwright	36	29	39	26	24	41	24	41	24	41	66

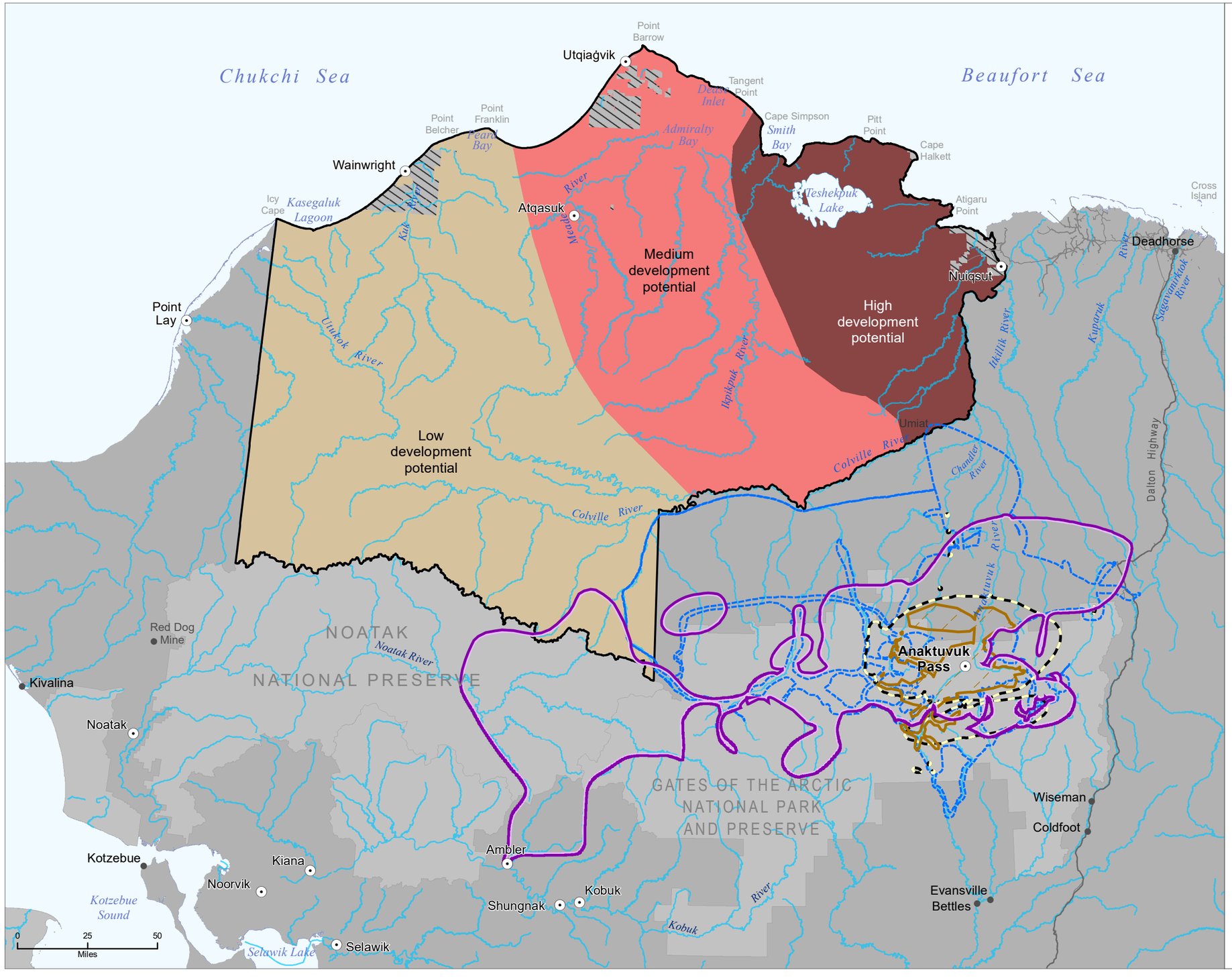
Source: See NPR-A IAP/EIS, Table T-2, Data Sources
"Open" lands include any lands open to leasing, including those subject to no surface occupancy, controlled surface use, timing limitations, best management practices, and standard terms and conditions.

IAP/EIS, Appendix T, Table T-5, *Harvest Characteristics of Nuiqsut*). Therefore, direct impacts on harvester access would continue to grow for the community of Nuiqsut as oil and gas development expands into this area.

Utqiagvik subsistence use areas extend to the southeast of the community into areas of high development potential (**Map E-6**), with the greatest number of overlapping use areas near the mouth of Teshekpuk Lake, which would remain closed to oil and gas development under Alternative A, and south of Teshekpuk Lake surrounding the Price and Ikpikpuk rivers, which would remain open to oil and gas development (NPR-A IAP/EIS, Appendix A). Utqiagvik use areas for land mammals (high resource importance), non-salmon fish (high resource importance), and birds overlap areas of high development potential open to oil and gas leasing under Alternative A.

A large area of land surrounding Atqasuk and representing a substantial portion of their traditional use area would remain open to oil and gas leasing under Alternative A (**Map E-3**). Most of the area overlapping Atqasuk subsistence use areas would be in areas of medium development potential. While the potential for direct impacts would be less than for Nuiqsut, exploration would likely continue to occur in these areas, causing temporary impacts on subsistence users. A small portion of Atqasuk use areas for large and small land mammals would also overlap areas of high development potential (**Table E-2**, **Map E-3**). Oil and gas leasing and development within medium development potential areas could affect harvester access, resource availability, and resource abundance for Atqasuk and could lead to a situation similar to that seen in Nuiqsut where the community is boxed in by development. Although exploration is likely and development is possible in medium development potential areas, only high development potential areas are considered likely targets for development at this time (Appendix B).

Anaktuvuk Pass Subsistence Use Areas, All Studies



- Subsistence study community
- Other community
- All resources, lifetime previous to 1979 [a]
- All resources, 2011 [b]
- All resources, 2014 [c]
- All resources, 2001-2010 [d]

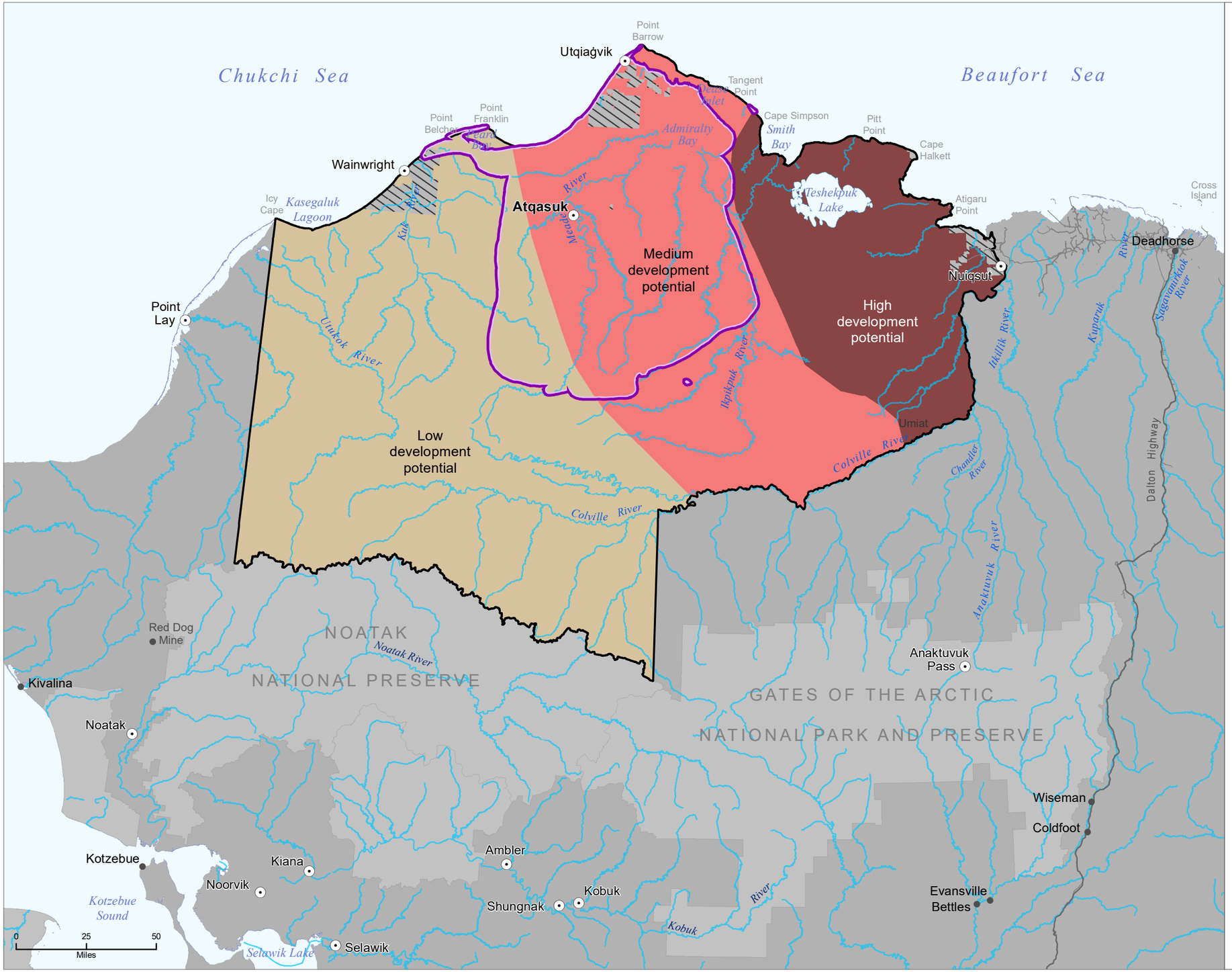
Development Potential

- High
- Medium
- Low

- National Petroleum Reserve-Alaska
- Outside the BLM's surface authority

Data sources: a) Pedersen 1979 b) Holen et al. 2012 c) Brown et al. 2016 d) SRB&A 2013
Map prepared by Stephen R. Braund & Associates
Print date: 05/05/2020

Map E-2



- Subsistence study community
- Other community
- All resources, lifetime previous to 1979 [a]

Development Potential

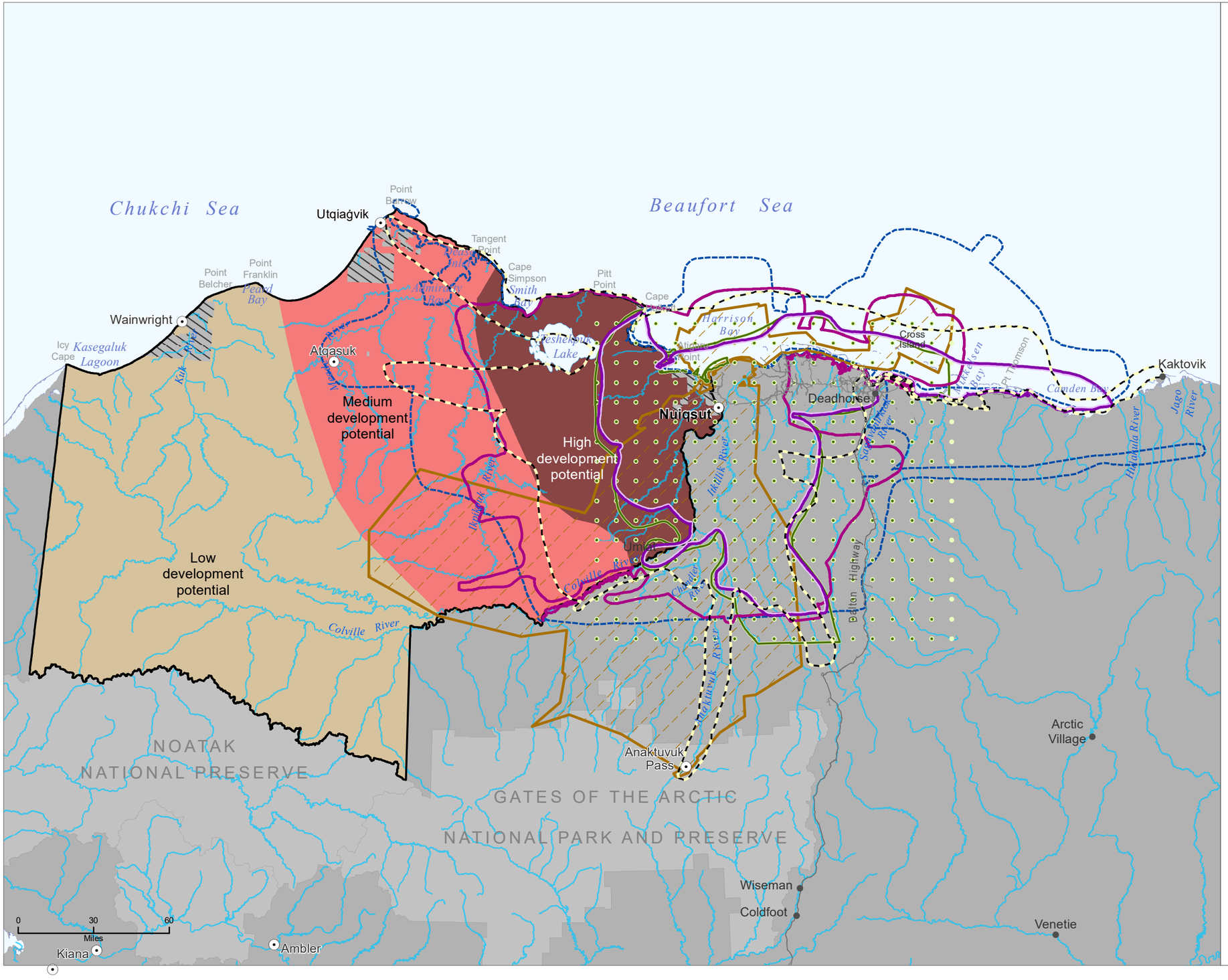
- High
- Medium
- Low

- National Petroleum Reserve-Alaska
- Outside the BLM's surface authority

Data source: a) Pedersen 1979
Map prepared by Stephen R. Braund & Associates
Print date: 05/14/2020

Map E-3

Nuiqsut Subsistence Use Areas, All Studies



- Subsistence study community
- Other community
- All resources, early 1970s [a]
- All resources, lifetime previous to 1979 [b]
- All resources, 1973-1986 [c]
- All resources, 1994-2003 [d]
- All resources, 2014 [e]
- All resources, 1995-2006 [f]

Development Potential

- High
- Medium
- Low

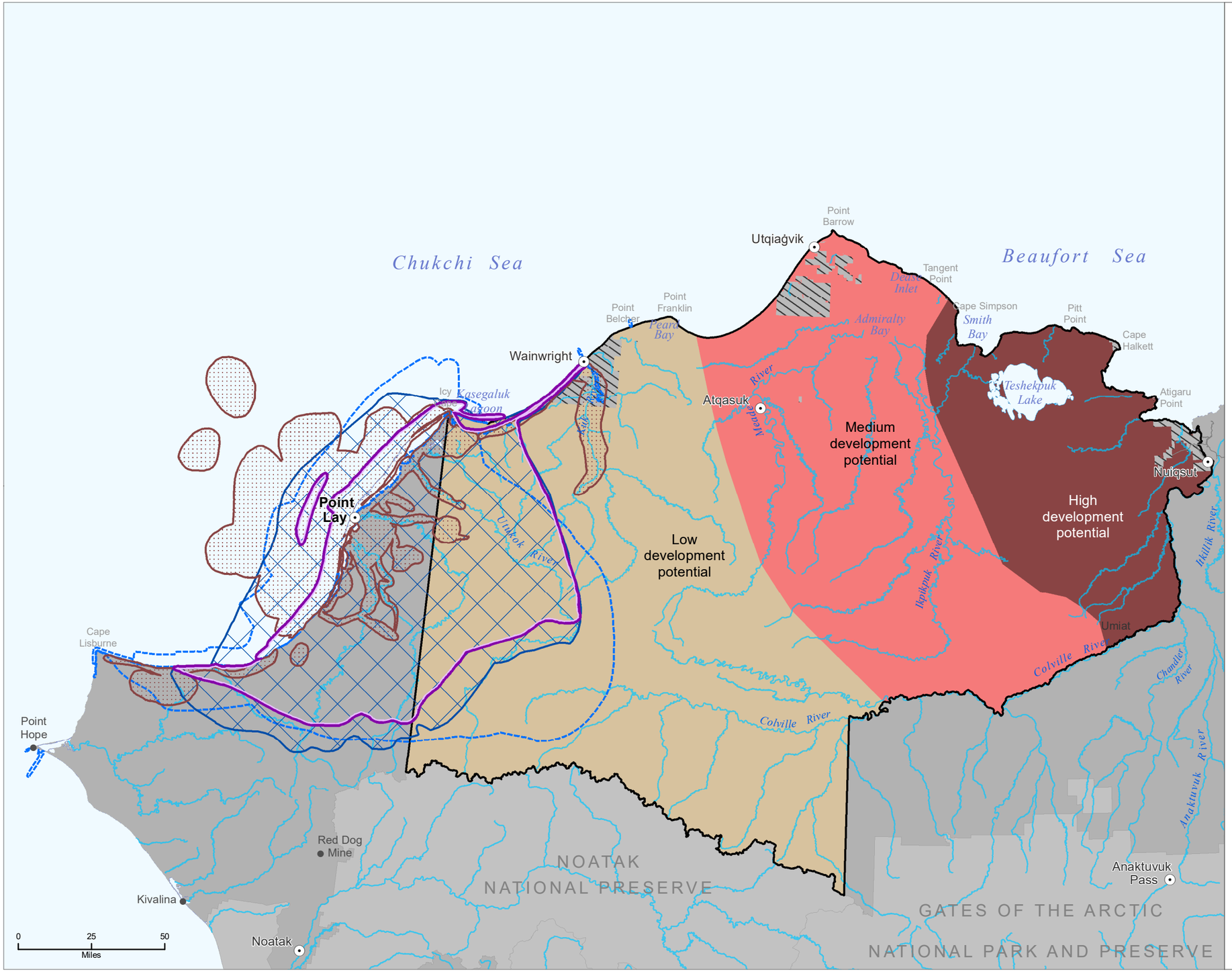
- National Petroleum Reserve-Alaska
- Outside the BLM's surface authority

Data sources: a) Brown 1979 b) Pedersen 1979 c) Pedersen 1986 d) BLM 2004 e) Brown et al. 2016 f) SRB&A 2010a
Map prepared by Stephen R. Braund & Associates
Print date: 05/05/2020

Map E-4

Point Lay Subsistence Use Areas, All Studies

U.S. DEPARTMENT OF THE INTERIOR | BUREAU OF LAND MANAGEMENT | ALASKA | NATIONAL PETROLEUM RESERVE IN ALASKA



- Subsistence study community
- Other community
- All resources, lifetime previous to 1979 [a]
- All resources, lifetime previous to 1987 [b]
- All resources, 2012 [c]
- All resources, 1997-2006 [d]

Development Potential

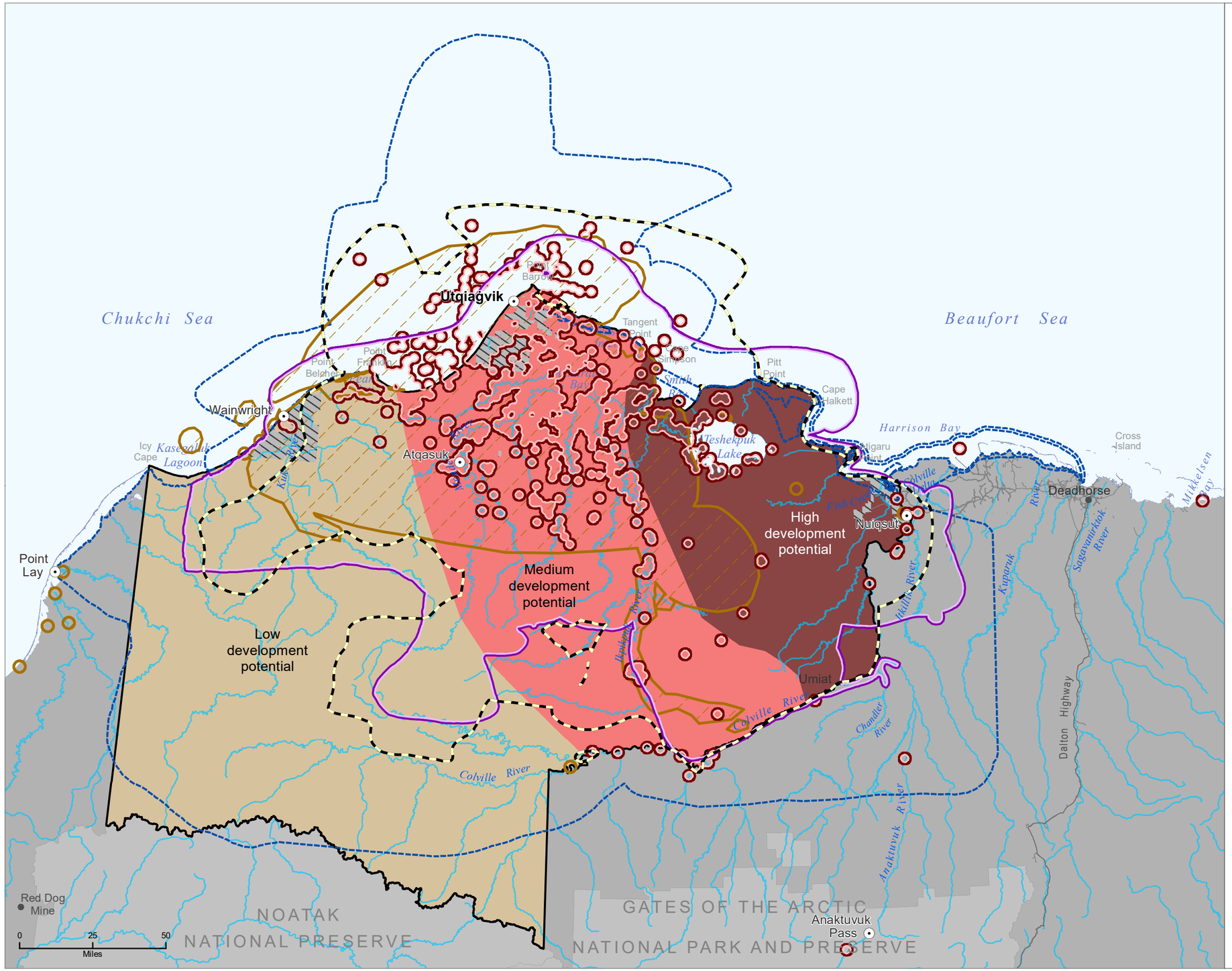
- High
- Medium
- Low

- National Petroleum Reserve-Alaska
- Outside the BLM's surface authority

Data sources: a) Pedersen 1979 b) Impact Assessment Inc. 1989 c) Braem et al. 2017 d) SRB&A 2014b
Map prepared by Stephen R. Braund & Associates
Print date: 05/05/2020

Map E-5

Utqiaġvik Subsistence Use Areas, All Studies



- Subsistence study community
- Other Community
- All resources, lifetime Previous to 1979 [a]
- All resource harvest sites buffered, 1987-1989 [b]
- All resources, 1987-1989 [c]
- All resources, 2014 [d]
- All resources, 1997-2006 [e]

Development Potential

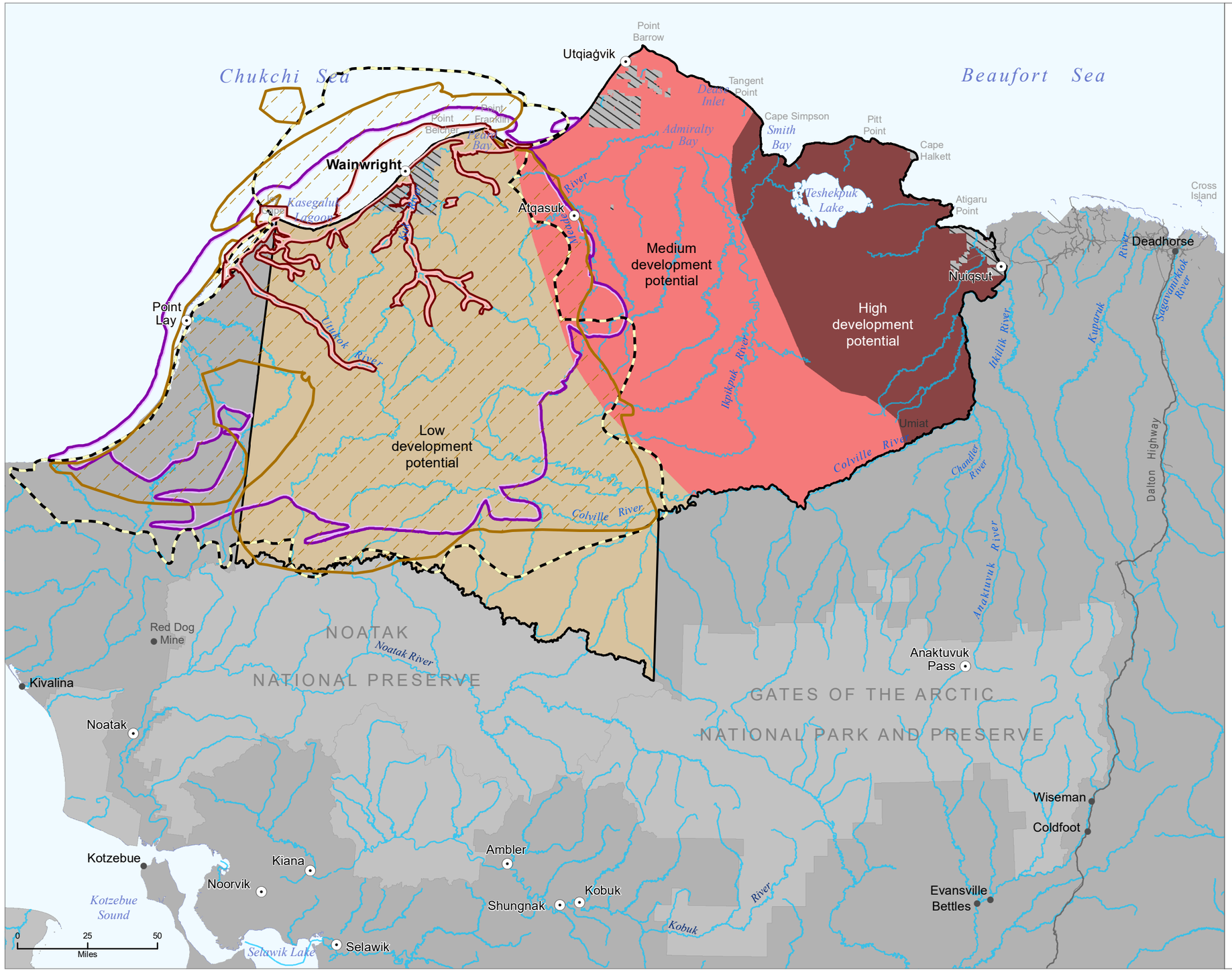
- High
- Medium
- Low

- National Petroleum Reserve-Alaska
- Outside the BLM's surface authority

Data sources: a) Pedersen 1979 b) SRB&A and ISER 1989 c) SRB&A Unpublished d) Brown et al. 2016 e) SRB&A 2010a
Map prepared by Stephen R. Braund & Associates
Print date: 05/05/2020

Map E-6

Wainwright Subsistence Use Areas, All Studies

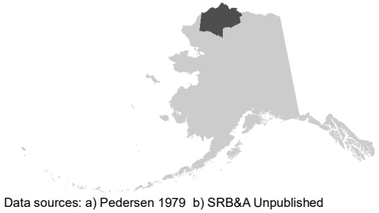


- Subsistence study community
- Other community
- All resources, lifetime previous to 1979 [a]
- All resources, 1987-1989 [b]
- All resources, lifetime previous to 1982 [c]
- All resources, 1998-2007 [d]

Development Potential

- High
- Medium
- Low

- National Petroleum Reserve-Alaska
- Outside the BLM's surface authority



Data sources: a) Pedersen 1979 b) SRB&A Unpublished
c) Nelson 1981 d) Wainwright Traditional Council and The Nature Conservancy 2008
Map prepared by Stephen R. Braund & Associates
Print date: 05/05/2020

Map E-7

Table E-2
Subsistence Use Areas Crossing Areas Open to Fluid Mineral Leasing, Alternative A

Resource	Anaktuvuk Pass	Atqasuk	Nuiqsut	Point Lay	Utqiagvik	Wainwright
Large Land Mammals	H[1]	H[1]	H	L	H	M
Small Land Mammals	H[1]	H[1]	H	L	H	M
Salmon	ND	See "Non-Salmon Fish"	ND	N	M	See "Non-Salmon Fish"
Non-Salmon Fish	N	M[2]	H	L	H	M[2]
Marine Mammals	ND	M	H	N	M	L
Migratory Birds	N	M	H	L	H	L
Upland Birds	N	M	H	L	H	M
Bird Eggs	ND	ND	H[1]	N	M	ND
Marine Invertebrates	ND	ND	ND	ND	M	N
Vegetation	N	M	H	N	M	ND

H = Use Areas Overlapping Areas of High Development Potential Open to Fluid Mineral Leasing
M = Use Areas Overlapping Areas of Medium Development Potential Open to Fluid Mineral Leasing
L = Use Areas Overlapping Areas of Low Development Potential Open to Fluid Mineral Leasing
N = No Use Areas Overlapping Areas Open to Fluid Mineral Leasing
ND = No data
[1] Minimal/Slight Overlap of Use Areas
[2] Original sources list data for "Fish," which in some cases includes salmon; data specific to salmon or non-salmon fish are not available.

While nearly 30 percent of Wainwright lands would remain open to oil and gas leasing, most of these lands would be in an area of low to medium development potential (**Tables E-1** and **E-2**); the area immediately around Wainwright and along the Kuk River, a key subsistence harvesting area for the community, would remain closed to oil and gas leasing (**Map E-7**). A small percentage of Point Lay and Anaktuvuk Pass use areas would remain open to oil and gas leasing under Alternative A (**Table E-1**). While Anaktuvuk Pass large and small land mammal use areas would overlap areas of high development potential (**Table E-2**), these use areas represent a small proportion of the overall use areas for that community and impacts on access would be relatively unlikely (**Map E-2**).

Under Alternative A, new infrastructure would be prohibited directly around Teshekpuk Lake and in the southwest portion of the NPR-A near the Utukok River uplands, although exceptions would be made for essential pipeline crossings, roads, or essential coastal infrastructure. In the case of the primary study communities, Atqasuk would continue to have the greatest percentage of their use area open to new infrastructure (65 percent), followed by Utqiagvik (30 percent), Nuiqsut (27 percent), Wainwright (23 percent), and Point Lay (8 percent; **Table E-3**). Anaktuvuk Pass would have less than 1 percent of subsistence use areas open to infrastructure development in the NPR-A. Under the reasonably foreseeable development scenario, Alternative A is expected to result in between 20 (low development scenario) and 128 (high development scenario) miles of gravel roads. New infrastructure could impact access to use areas for Atqasuk, Utqiagvik, Nuiqsut, Point Lay, and Wainwright due to direct overlap with use areas (**Maps E-3** through **E-7**). Oil and gas infrastructure is most likely to occur in high development potential areas, which is primarily used by subsistence hunters in the community of Nuiqsut. Under Alternative A, there is no requirement that subsistence users be allowed to use industrial roads. Additionally, roads may be unavailable for use during the construction phase, which could last between 1 and 7 years, depending on the size of the development.

Table E-3
Percentage of NPR-A Subsistence Use Areas Closed and Open to Infrastructure

Community	Alt. A		Alt. B		Alt. C		Alt. D		Alt. E		Percent of Total Use Areas in NPR-A
	Closed	Open	Closed	Open	Closed	Open	Closed	Open	Closed	Open	
Anaktuvuk Pass	4%	<1%	4%	<1%	<1%	3%	<1%	3%	3%	<1%	4%
Atqasuk	27%	65%	47%	45%	25%	68%	25%	68%	23%	69%	100%
Utqiagvik	30%	30%	38%	22%	24%	35%	23%	37%	24%	36%	62%
Nuiqsut	12%	27%	22%	17%	12%	27%	11%	29%	11%	29%	41%
Point Lay	31%	8%	33%	6%	30%	8%	30%	8%	30%	8%	40%
Wainwright	41%	23%	45%	20%	32%	32%	31%	32%	33%	32%	66%

Source: See NPR-A IAP/EIS, Appendix T, Subsistence Use and Resources, Table T-2, Subsistence Data Sources
[1] "Open" lands include any lands available for new subsistence infrastructure. Lands which are unavailable for new infrastructure except for essential pipeline crossings, roads, or coastal infrastructure are not considered "Open."

While oil and gas infrastructure is most likely to occur within areas of high development potential, other non-oil and gas infrastructure could occur elsewhere within the NPR-A, affecting subsistence use areas for other communities. Under Alternative A, all six primary study communities could potentially have infrastructure overlap subsistence use areas for key resources, though only a minimal area would be open to infrastructure for Anaktuvuk Pass. Nuiqsut, Utqiagvik, Atqasuk, Point Lay, and Wainwright (limited overlap for most resources) have subsistence use areas for multiple resources overlapping areas open to new infrastructure, thus increasing the likelihood of infrastructure related impacts on those communities (**Table E-4**).

Table E-4
Subsistence Use Areas Overlapping Areas Open to New Infrastructure, Alternative A

Resource	Anaktuvuk Pass	Atqasuk	Nuiqsut	Point Lay	Utqiagvik	Wainwright
Large Land Mammals	X	X	X	X	X	X
Small Land Mammals	X	X	X	X	X	X
Salmon	ND	See "Non-Salmon Fish"	N	N	X	See "Non-Salmon Fish"
Non-Salmon Fish	N	X[2]	X	X[1]	X	X[2]
Marine Mammals	ND	X	N	X[1]	X[1]	X
Migratory Birds	N	X	X	X[1]	X	X
Upland Birds	N	X	X	X	X	X[1]
Bird Eggs	ND	ND	N	N	X	X[1]
Marine Invertebrates	ND	ND	ND	ND	X[1]	X[1]
Vegetation	N	X	X	N	X	ND

X = Use Areas Overlapping Areas Open to New Infrastructure
N = No Use Areas Overlapping Areas Open to New Infrastructure
ND = No data
[1] Minimal/Slight Overlap of Use Areas
[2] Original sources list data for "Fish," which in some cases includes salmon; data specific to salmon or non-salmon fish are not available.

Subsistence Resource Abundance

The NPR-A is used by the six primary study communities to harvest various species of terrestrial mammals, fish, birds, marine mammals, and vegetation. Large land mammals and non-salmon fish are resources of high importance among all six primary study communities, and both resources occur and are harvested throughout the NPR-A. Additional resources of high importance for most of the six primary study communities are migratory birds and marine mammals. The NPR-A contains key nesting habitat for migratory birds, and marine mammal habitat for seals, bowhead whales, and walrus, all key subsistence species, occurs offshore from the NPR-A. In all cases, the likelihood of oil and gas and infrastructure development within the NPR-A affecting resource abundance would depend on the location, magnitude, and nature of future development. Conclusions regarding potential impacts on resource abundance are based on the reasonably foreseeable development scenario (NPR-A IAP/EIS, Appendix B, *Reasonably Foreseeable Development Scenario*), the likelihood of oil and gas development within key habitat areas, and the likelihood of a large-scale oil spill occurring in key habitat areas.

Primary large land mammal resources harvested within the NPR-A include caribou, moose, and to a lesser extent, Dall sheep and bear. As noted above, the WAH and TCH are the primary caribou herds that occur in the NPR-A, with seasonal migrations occurring through the area during the spring and fall, and key calving grounds for both herds in the Utukok River uplands (WAH) and around Teshekpuk Lake (TCH; NPR-A IAP/EIS, Section 3.3.5, *Terrestrial Mammals, Affected Environment*). Impacts on caribou populations could occur through direct mortality or through decreased calf survival resulting from impacts on calving grounds or to the behavior of maternal caribou. Injuries and mortality of caribou and other resources resulting from vehicle collisions along industry and other roads in the NPR-A may occur but are not expected to have population-level effects (NPR-A IAP/EIS, Section 3.3.5, *Terrestrial Mammals, Direct and Indirect Impacts*).

Future oil and gas infrastructure in the planning area, particularly in the TCH calving grounds near Teshekpuk Lake and WAH calving grounds in the Utukok River uplands, could cause a shift in calving distribution during some years, which would likely reduce calf survival and halt herd growth. To the extent that calving grounds are disturbed by oil and gas development, WAH and TCH calf survival and herd numbers could be reduced. An overall reduction in the WAH or TCH could affect harvest success among the Iñupiat on the North Slope as well as other study communities located within the range of these herds. In the case of Alternative A, most high-density calving grounds surrounding Teshekpuk Lake and the Utukok River uplands would remain closed to oil and gas leasing and infrastructure development. TCH caribou would have a somewhat higher potential than the WAH for exposure to infrastructure development within their calving grounds under Alternative A. Infrastructure within TCH calving grounds would likely result in displacement of calving caribou; however, the magnitude of displacement would depend on the size and nature of oil and gas and infrastructure development. Certain infrastructure, such as pipelines to transport oil and gas from offshore leases, would still be permitted in areas closed to leasing and development and could contribute to habitat fragmentation but are not expected to affect access to mosquito relief habitat for the TCH.

Moose occur throughout the NPR-A but particularly along the Colville River drainage where residents typically hunt them during the late summer and fall months. While ground traffic along project roads may result in individual injuries or mortalities to moose, these mortalities are not expected to have population level effects. In addition, because permanent oil and gas facilities would be prohibited within certain distances of major rivers, the likelihood of direct impacts on moose, which prefer riparian habitat, would be low. The NPR-A is heavily used by North Slope hunters for furbearer (e.g., wolf and wolverine) hunting and trapping. While furbearers and small land mammals do not contribute a large amount in terms of subsistence foods, furbearer hunting and trapping is a specialized activity that has cultural importance. While wolf and wolverine would

likely be displaced by infrastructure and human activity and some individual mortalities of wolverine may occur, overall population levels are not expected to be affected by future developments. Thus, the abundance of wolf and wolverine available for subsistence use would likely not be impacted under Alternative A (NPR-A IAP/EIS, Section 3.3.5, *Terrestrial Mammals*).

North Slope residents harvest non-salmon fish in rivers and streams throughout the NPR-A, with key drainages being the Colville, Fish, Chipp, Ikpikpuk, Meade, Inaru, Kuk, Kokolik, and Utukok rivers. Key subsistence non-salmon fish species among the study communities include broad and humpback whitefish, Arctic and least cisco, Dolly Varden, Arctic grayling, smelt, and burbot. Depending on the location and magnitude of development within the NPR-A, impacts on fish abundance could occur within individual harvesting drainages for the NPR-A communities; however, most impacts on fish abundance are not expected to extend throughout the NPR-A unless a large-scale contamination event occurred. Oil and gas and infrastructure development could affect fish habitat by reducing fish passage, degrading water quality (e.g., increased turbidity from dust and gravel spray or road and pad construction activities), and reducing water quantity (NPR-A IAP/EIS, Section 3.3.3, *Fish*). ROP E-6 (BMPs E-6 and E-15 under Alternative A) would mitigate impacts on fish passage by requiring that all crossings be designed to allow for fish passage. Under Alternative A, most rivers and streams in areas open to oil and gas leasing would be subject to NSO. Habitat loss and degradation could displace or cause individual mortalities of these resources, but these changes are not expected to cause population-level effects across the NPR-A. A large oil spill would have serious adverse effects on aquatic habitats; however, such large-scale spills within major waterbodies are not expected to occur (NPR-A IAP/EIS, Section 3.3.3, *Fish*).

Migratory birds are another resource heavily hunted within the NPR-A and of high importance to most North Slope communities. Key migratory bird species include white-fronted geese, black brant, snow geese, Canada geese, and eiders (although primarily in coastal and nearshore areas). Habitat loss and degradation could displace or cause individual mortalities of migratory birds, but population-level effects are not expected. While unlikely, large spills on land could affect waterfowl nesting and feeding areas and cause mortality to large numbers of individual birds, affecting their availability to harvesters across the NPR-A and in other regions (e.g., south of the planning area; NPR-A IAP/EIS, Section 3.3.4, *Birds*).

Other resources harvested within or offshore from the NPR-A include vegetation, primarily along key waterways, and marine mammals. Vegetation harvesting areas could be affected by spills and contamination along roads, waterways, and in coastal areas. Dust deposition along roads would affect the abundance of vegetation within a certain distance from road corridors and may result in the loss of individual berry or plant harvesting patches. Residents would likely use alternate harvesting areas in these cases. Invasive nonnative plants could be transported into the planning area along roads and could reduce availability of native species of plants and berries in those areas. Large-scale oil spills in open water associated with vessel or barge traffic, particularly during the summer months, could have negative effects on large numbers of marine mammals, thus affecting the availability of these resources to Nuiqsut, Utqiagvik, Point Lay, and Wainwright residents. However, the likelihood of a large-scale spill occurring is small (NPR-A IAP/EIS, Section 3.3.6, *Marine Mammals*).

Subsistence Resource Availability

Impacts on wildlife and vegetation resources related to habitat loss and disturbance are discussed in Section 3.3.1 and Sections 3.3.3 through 3.3.6 of the NPR-A IAP/EIS. The NPR-A includes primary calving, wintering, and migratory grounds for the WAH and TCH. The NPR-A also includes key habitat for other terrestrial mammals (moose, wolf/wolverine), fish, and migratory birds, and is offshore from key marine

mammal migratory and feeding grounds. North Slope residents harvest vegetation such as berries and greens in various locations throughout the NPR-A but particularly along river corridors and coastal areas. Impacts on resource availability may occur as a result of noise, traffic, and human activity, infrastructure, and contamination. Communities that are most likely to experience impacts on resource availability are those with a greater percentage of use areas overlapped by areas open to oil and gas leasing and infrastructure development (see **Tables E-1** and **E-2**), particularly in areas of high development potential (see **Tables E-3** and **E-4**). Under Alternative A, Nuiqsut and Utqiagvik have the highest number of subsistence use areas overlapping areas of high development potential open to oil and gas and infrastructure development (**Tables E-3** and **E-4**). Atqasuk has a higher percentage of subsistence use areas overlapped, but most subsistence use areas (with the exception of Atqasuk large land mammals and small land mammals, which overlap minimally with areas of high development potential) are in areas of low to medium development potential (see **Tables E-1** and **E-2**). The peripheral study communities of Ambler, Kiana, Kobuk, Noatak, Noorvik, Selawik, and Shungnak all have lifetime subsistence use areas documented on the periphery of the NPR-A; however, in all cases more recent mapped data indicate that use areas do not extend to the NPR-A. Thus, any impacts on these communities would likely be indirect and affect resources that occur in and migrate through the NPR-A and are harvested elsewhere (e.g., caribou and migratory birds).

Noise, Traffic, and Human Activity

Noise, traffic, and human activity associated with post-leasing oil and gas activities and infrastructure development would result from construction, gravel mining, air, vessel, and ground traffic, seismic activity, drilling, and human presence. While oil and gas development is a major source of air traffic on the North Slope, other sources of air traffic include scientific and agency research, recreational uses, and commercial flights. Impacts on resource availability resulting from noise, traffic, and human activity are discussed in NPR-A IAP/EIS, Section 3.4.3, *Subsistence Uses and Resources, Direct and Indirect Impacts.* Noise and traffic associated with oil and gas activities in the NPR-A could potentially affect the availability of resources, such as caribou, marine mammals, furbearers, small land mammals, fish, and migratory birds. Most impacts related to noise and traffic would be local, occurring in areas where subsistence use areas overlap with noise and traffic-generating activities. However, certain impacts, particularly those related to caribou migration, could extend outside the NPR-A and would be regional. Even small changes in resource migration or distribution from a biological perspective can have larger impacts on subsistence users if resources are not in traditional use areas at expected times of the year. According to traditional knowledge of North Slope Iñupiat, furbearers, caribou, and marine mammals are particularly sensitive to noise and human activity (SRB&A 2018a, 2009).

Potential impacts on the availability of land mammals include displacement of wildlife from areas of heavy oil and gas activity; diversion of wildlife, particularly caribou, from their usual migratory routes; and skittish behavior that results in reduced harvest opportunities (SRB&A 2018a). Until recently, air traffic, particularly helicopter traffic, has been the most commonly reported impact on caribou hunting to the Nuiqsut Caribou Subsistence Monitoring Project (SRB&A 2018a, CPAI 2018, SRB&A 2019a). Residents from Nuiqsut and other North Slope communities (SRB&A 2018a, 2009) note that air traffic can cause skittish behavior in caribou, either causing them to stay inland from riversides or diverting them from their usual migration and crossing routes; such impacts could occur for NPR-A harvesters as they travel along the coast or rivers by boat or inland by snowmachine looking for caribou. Observed behavioral responses include caribou "scattering" rather than remaining in groups where they are easier to hunt, acting skittish, and deflecting away from the source of noise or away from riversides (where hunters wait for them) (SRB&A 2010b, 2011, 2012, 2013, 2014a, 2015, 2016, 2017a, 2018a). Hunters have frequently recounted experiences where a potentially successful harvest was disrupted by air traffic overhead, with caribou diverting to locations too far from

riversides for hunters to access. Data show a potential decrease in hunting success among Nuiqsut hunters, despite the fact that overall harvest numbers for the community of Nuiqsut have remained stable. This includes a greater percentage of households reporting unsuccessful harvests over time and a higher average number of trips taken per caribou harvested (SRB&A 2019b). ROP F-4 (BMP F-1 under Alternative A) places restrictions on the timing, location, and altitude of aircraft, in addition to requiring consultation with subsistence users.

In addition to air traffic, roads and road traffic can cause behavioral and migratory changes in caribou and other land mammal resources that can affect hunting success (NPR-A IAP/EIS, Section 3.3.5, *Terrestrial Mammals, Direct and Indirect Impacts*). Deflections or delays of caribou movement from roads and associated ground traffic and human activity have been documented both by active harvesters (SRB&A 2010b, 2011, 2012, 2013, 2015, 2014a, 2016, 2017a, 2018a) and during behavioral studies on caribou (Wilson, Parrett, Joly, and Dau 2016). Impacts from roads are particularly high during times of high levels of ground traffic (i.e., more than 15 trips per hour). Impacts from air and ground traffic would be greatest during the peak caribou hunting season which, for most communities in the NPR-A, occurs throughout the summer and fall (June through October) (SRB&A 2010a, 2014b, 2018a). Under all alternatives, ROP K-9 would place restrictions on ground traffic within the TCH Habitat Area, including speed limits of 15 miles per hour when caribou are within 0.5 miles of the road and temporarily stopping traffic to prevent displacement of calving caribou.

Other potential sources of impacts on caribou availability include construction noise (including noise associated with sand and gravel mining), seismic activity, drilling noise, and general human activity, which could cause avoidance behavior or skittishness in caribou within hunting areas. Winter seismic exploration has the potential to displace caribou, which could affect winter harvests of caribou; this would be particularly likely for TCH caribou, many of which remain in the NPR-A year-round (NPR-A IAP/EIS, Section 3.3.5, *Terrestrial Mammals*).

The WAH and TCH routinely occur in the NPR-A throughout the spring calving and summer insect seasons (May through August), with the WAH calving primarily in the Utukok River uplands in the southwestern portion of the NPR-A and the TCH calving near Teshekpuk Lake in the northeastern portion of the NPR-A. The WAH generally winters to the south of the NPR-A following the fall migration, while much of the TCH remains in the NPR-A throughout the winter with some heading south into the Brooks Range. Thus, impacts on caribou resource availability could occur for most NPR-A subsistence hunters. According to NPR-A IAP/EIS, Section 3.3.5, *Terrestrial Mammals*, WAH caribou may be more sensitive to air and noise traffic than the TCH, which has had more exposure to development activities; however, both herds have had less exposure to development and infrastructure than other Alaskan caribou herds such as the Central Arctic Herd (CAH).

Other land mammal hunting activities that could be affected by noise, traffic, and human activity include moose hunting and furbearer hunting and trapping. Moose hunters have reported similar impacts as those described for caribou hunting as a result of noise and traffic; however, these impacts would likely occur on a more localized, individual level rather than diverting movement or causing larger-scale changes in distribution. In addition to large land mammals, furbearers, such as wolf and wolverine, have been reported to avoid areas of heavy traffic, drilling noise, seismic testing, and other activity. Seismic activity may occur throughout the NPR-A in areas open or closed to oil and gas leasing, although it is less likely to occur in areas closed to leasing. Impacts on moose hunting would likely peak in the fall, while impacts on wolf and wolverine

hunting would be highest in winter. Because oil and gas development and infrastructure would be limited at various distances from rivers, where most residents hunt them, impacts on moose hunting would be less likely.

In addition to air and ground traffic, barging and shipping traffic associated with oil and gas development activities within the NPR-A could affect the availability of marine resources such as seals, bowhead whales, and walrus. Impacts on marine mammals from noise and traffic have been reported by whaling crews and marine mammal hunters in Nuiqsut, Wainwright, and Utqiagvik (SRB&A 2009, 2017b) and documented through western science (NPR-A IAP/EIS, Section 3.3.6, *Marine Mammals*). Vessel and air traffic in offshore areas could cause skittish behavior and affect marine mammal distribution in hunting areas for Utqiagvik and Wainwright and to the west of primary seal hunting grounds in Harrison Bay for Nuiqsut (Nuiqsut whaling occurs farther to the east of the NPR-A at Cross Island). Oil and gas development within the NPR-A would likely require barge and vessel traffic and potential construction of barge landings or module transfer islands to support onshore development. Conflict Avoidance Agreements between industry and the Alaska Eskimo Whaling Commission are generally considered an effective measure by whaling crews, industry, and agencies for minimizing impacts on whaling. However, not all vessel traffic, such as that from barging not associated with oil and gas development, is subject to these agreements, so impacts from shipping and marine traffic associated with other NPR-A activities such as infrastructure development could occur even with an agreement in place. Increased noise and activity associated with oil and gas development and exploration could result in large stampedes of walrus, which have increased in density in Chukchi Sea nearshore waters and barrier islands in recent years, resulting in walrus injury or mortality (see NPR-A IAP/EIS, Section 3.3.6, *Marine Mammals*). Various ROPs would place restrictions on marine vessel traffic when in the vicinity of marine mammals or key marine mammal habitat (ROPs K-4, K-5, H-1, and H-4).

Other sources of impacts on marine mammals include air and ground traffic and seismic activity in coastal and nearshore areas, and noise from construction and operation of nearshore facilities such as saltwater treatment plants and module transfer islands (NPR-A IAP/EIS, Section 3.3.6, *Marine Mammals*). Seal hunting commonly occurs in nearshore areas both during the open water and winter seasons; noise and traffic in those areas would likely result in temporary displacement of seals and could affect harvester success in those areas. Some seals would likely habituate to industrial noise and vessel traffic. Overall, because the majority of development would be land-based and because of the existence of Conflict Avoidance Agreements to reduce impacts associated with barging, impacts on resource availability may occur in isolated instances for individual hunters but are not expected to occur on a large scale.

Noise and traffic associated with future oil and gas development or infrastructure development could also disturb other subsistence resources, such as birds and fish, and could cause temporary reductions in harvesting success for NPR-A harvesters; however, most displacement would be temporary and would not result in large-scale changes in distribution (NPR-A IAP EIS Sections 3.3.3, *Fish* and Section 3.3.4, *Birds*). Birds may be displaced from or avoid areas of heavy traffic and noise. If construction, heavy air traffic, or ice roads and associated traffic occur in commonly used geese hunting areas during the spring or summer months, then NPR-A residents could experience decreased hunting success during the affected hunting season(s) (NPR-A IAP/EIS, Section 3.4.3, *Subsistence Uses and Resources*). However, routine operational activities (e.g., road and air traffic) are not expected to result in large-scale distribution changes or disturbances to birds (NPR-A IAP/EIS, Section 3.3.4, *Birds*). For geese, responses to human presence and foot traffic are stronger than responses to air and ground traffic, although close approaches by helicopters and aircraft landings also cause flushing reactions in nesting geese (NPR-A IAP/EIS, Section 3.3.4, *Birds*). Marine vessel traffic associated with NPR-A development could result in disturbances of birds, such as eiders, in the nearshore marine environment; however, these impacts likely would be temporary and at a small scale.

Actions that could disturb or displace fish include seismic surveys, dredging and blasting, and pile driving for bridges and pipeline crossings. Fish may exhibit avoidance behaviors in the vicinity of noise generated by seismic surveys, vehicles, machinery, and marine vessels. Such impacts would be greatest during construction but could continue through the life of any development project (NPR-A IAP/EIS, Section 3.3.3, *Fish*). During winter, residents from Utqiagvik, Atqasuk, Nuiqsut, and Wainwright fish through the ice at riverine locations within the NPR-A. Depending on the location of seismic surveys, which could occur throughout the NPR-A in areas open and closed to oil and gas leasing, these individuals could experience decreased fishing success resulting from seismic activities (SRB&A 2009). Reduced catch rates resulting from the use of seismic air guns have been documented by Engas, Lokkeborg, and Soldal (1996) and Engas and Lokkeborg (2002). Impacts of vibroseis are believed to be minimal when strict seismic survey guidelines, such as those required under ROP 14, are followed (NPR-A IAP/EIS, Section 3.3.3, *Fish*).

The above impacts on resource availability may be considered minimal from a biological standpoint in that overall population levels or species distribution would not be affected; however, small changes in the behavior or distribution of a resource can have larger impacts on subsistence resource availability when resources are not present in traditional hunting areas at the expected times and in adequate abundance. Changes in resource availability may not occur to the extent that overall community harvest amounts are affected; however, subsistence users may experience decreased harvest success, which results in having to take more frequent or longer hunting trips or traveling farther in search of resources. Such changes could increase hunter risks to safety and contribute to social stress within communities, thus affecting community well-being and health.

While noise and traffic would be most likely to occur in areas of oil and gas development, other activities such as air and vessel traffic related to scientific research and recreation would also continue to occur under Alternative A throughout much of the NPR-A. These activities would also affect subsistence resource availability for NPR-A subsistence users. While most impacts on resource availability related to noise and traffic would be local in extent and would affect communities who have direct uses of the NPR-A, such as Atqasuk, Nuiqsut, Point Lay, Utqiagvik, and Wainwright, more widespread changes in migration or abundance resulting from noise and traffic and infrastructure (see discussion below) could cause planning area-wide or regional impacts extending throughout the NPR-A or outside the NPR-A to other communities, such as Anaktuvuk Pass and the peripheral and caribou study communities. Impacts on resource availability that extended to communities outside the NPR-A would be most likely to occur for terrestrial migratory resources such as caribou. Such large-scale impacts would be most likely to occur during times of particularly heavy construction or traffic activity, and the likelihood of herd-wide changes in resource availability would vary from year to year depending on planned development activities. Heavy construction noise and helicopter, plane, and ground traffic (along gravel roads) combined with impacts of infrastructure (see below) could affect the timing or location of WAH or TCH caribou arrival into subsistence harvesting areas south of the NPR-A during the fall and winter (e.g., to the 42 WAH/TCH study communities or the peripheral study communities) or into NPR-A community hunting areas during the summer. Reduced harvests of caribou by NPR-A communities could disrupt existing sharing networks to other communities and regions if residents are unable to share as widely or frequently as they are accustomed to doing.

Infrastructure

Potential infrastructure associated with NPR-A exploration and development includes roads (gravel and ice), gravel pads, runways, pipelines, bridges, facilities (e.g., camps and central processing facilities and community infrastructure), gravel mines, module transfer islands, and saltwater treatment plants. Infrastructure can affect resource availability through habitat loss/alteration, displacement, and obstruction or diversion of resources. While most infrastructure-related impacts would occur in the vicinity of infrastructure

areas, impacts that result in the diversion of resources such as caribou or fish could have farther reaching impacts on resource availability. Large-scale effects on caribou migration, for example, could extend outside the NPR-A area and be regional.

Roads associated with oil and gas development in addition to community infrastructure projects (e.g., a road from Utqiagvik to Nuiqsut) would remove habitat but also pose as a linear barrier to movement for migratory resources such as caribou. The physical presence of roads in combination with road traffic can cause caribou and other mammals to exhibit avoidance or delayed or diverted crossing behaviors (see above, under *Noise, Traffic, and Human Activity*). Roads in calving areas also can displace calving caribou. A road, such as the one proposed north of Teshekpuk Lake, could displace maternal caribou during calving and affect access to TCH mosquito-relief habitat during the summer (NPR-A IAP/EIS, Section 3.3.5, *Terrestrial Mammals*). Studies on the North Slope show that caribou distribution, especially cows with calves, changes around transportation corridors, and that some caribou are influenced in their movement by the presence of roads (NRC 2003). Pipelines, particularly those placed near roads, may also displace or deflect caribou. Displacement of CAH caribou has been observed at existing North Slope oil fields, with decreased use occurring up to 5 kilometers, 2 kilometers, and 1 kilometer of infrastructure during calving, post-calving, and mosquito seasons, respectively. Similar displacement levels would be expected in the NPR-A, although the potential for hunting activity along road corridors and the relatively lower habituation of the WAH and TCH (compared with the CAH) may result in greater displacement distances (NPR-A IAP/EIS, Section 3.3.5, *Terrestrial Mammals*). Temporary deflections of caribou within the NPR-A resulting from roads has already been observed by Nuiqsut hunters, who indicate that caribou tend to hesitate upon reaching the CD5 and Greater Mooses Tooth One (GMT1) roads and are less available in areas closer to the community, although hunters also observe caribou crossing roads and hunt for caribou along these roads (SRB&A 2018a). Road avoidance is particularly likely during times of high human activity, including ground vehicle use. In addition to general displacement from infrastructure and short-term delays, roads have been documented to cause longer-term delays in caribou migration, particularly when traffic levels are high.

An overall deflection of migration could have substantial impacts on residents hunting caribou in overland and riverine areas during the summer and fall. Temporary changes in distribution have not been shown to alter overall migration patterns or herd distribution; however, small changes in caribou distribution and movement from a biological perspective can have large impacts on hunter success, as residents are generally limited in how far and fast they can travel, particularly during the snow-free season. Impacts on resource availability resulting from changes in caribou migration are particularly likely if a community is on the periphery of a herd's seasonal movements (e.g., Nuiqsut is on the western periphery of the TCH and the eastern periphery of the CAH).

The six primary subsistence study communities harvest from both the WAH and the TCH, although some communities rely more on one herd than the other (e.g., Nuiqsut primarily harvests from the TCH). Hunting of both herds occurs year-round but peaks in the summer, when both herds migrate to riverine and coastal areas in the NPR-A for insect relief, and in the fall, when both herds migrate to their southern wintering grounds (NPR-A IAP/EIS, Section 3.4.3, *Subsistence Uses and Resources*). If caribou experience long-term delays from their annual spring and fall migrations as a result of oil and gas and other non-oil and gas infrastructure, then they may arrive in traditional hunting areas later than expected or they may be diverted away from traditional hunting areas altogether, thus reducing resource availability for local hunters. Infrastructure related to oil and gas development is more likely to occur in the eastern portion of the NPR-A, which has high development potential. Thus, residents who hunt the TCH in the eastern portion of the NPR-A—particularly Nuiqsut and Utqiagvik—may be more likely to experience impacts on resource availability

of caribou resulting from oil and gas infrastructure. Other areas with lesser development potential may experience infrastructure development not associated with oil and gas, such as a road across the NPR-A to Utqiagvik, and thus may also experience impacts on resource availability of caribou resulting from infrastructure. Finally, oil and gas development may still occur in areas of lower development potential.

The presence of roads within the NPR-A may serve to mitigate some of the impacts of roads and infrastructure on resource availability. In Nuiqsut, residents have reported that access to roads has offset some of the impacts of increased infrastructure and activity on resource availability by providing hunting access to areas farther from the community that may have been previously more difficult to access depending on the time of year and available transportation methods, although some report avoiding the roads altogether. Individuals not using roads to access subsistence use areas and resources may experience reduced success closer to their communities if roads affect resource availability through physical infrastructure or by creating hunting corridors. While use of roads has increased, caribou harvests in the vicinity of roads have not increased, indicating that while roads may mitigate impacts on resource availability they do not provide a net benefit to resource availability; however, these conclusions are based on a relatively small number of study years, and the use and benefits of roads may evolve over time (SRB&A 2019a).

Infrastructure may affect the availability of other land mammals on the North Slope, such as moose and furbearers. Impacts on moose likely would be minimal, as most infrastructure would be prohibited near rivers where moose occur in the highest densities. However, bridges across rivers and associated traffic may result in avoidance behaviors by moose in those areas. Furbearers such as wolf and wolverine may also display avoidance behavior near infrastructure, which could affect resource availability in traditional hunting areas. However, infrastructure would likely not cause large-scale changes in the distribution of furbearers in NPR-A hunting areas. Thus, moose and furbearer hunters may experience decreased hunting success in certain areas and may spend more time and effort harvesting resources in certain cases but would likely not experience overall declines in harvest amounts.

Infrastructure in marine habitat would be limited to barge landing sites, module transfer islands, seawater treatment plants, and ice roads. Nearshore infrastructure could result in habitat loss or alteration for seals, particularly ringed seals overwintering in nearshore areas, and denning polar bears (NPR-A IAP/EIS, Section 3.3.6, *Marine Mammals*). While nearshore infrastructure could temporarily displace marine mammals in the offshore environment during the open water months, most impacts of infrastructure on marine mammals would occur in winter. As a majority of marine mammal hunting occurs in the open water months, impacts on marine mammal resource availability would be minimal.

Infrastructure would result in the loss or degradation of some fish habitat, which could affect the availability of fish to subsistence users in certain drainages. Marine habitat loss would occur from direct placement of gravel fill associated with module transfer island infrastructure, but this would not affect lake or riverine habitat. Dust deposition from gravel roads and pads may also cause long-term degradation of fish habitat. Some infrastructure such as ice roads and bridge piers or piles may alter stream flows and obstruct passage of fish along river or stream corridors, thus affecting their availability upstream or downstream from infrastructure. However, alteration of stream flows and obstruction of fish passage is relatively unlikely, as these potential impacts would be mitigated by slotting of iced roads in the spring and, in the case of permanent infrastructure, installation of culverts or use of bridges (NPR-A IAP/EIS, Section 3.3.3, *Fish*). ROP E-6 (BMPs E-6 and E-14 under Alternative A) would mitigate impacts on waterbody crossings by requiring that all crossings undergo fish and hydrologic studies prior to construction and are designed to ensure fish passage. Introduction of nonnative aquatic plants by boats and float planes could also displace native species and alter

flow patterns and habitat. Infrastructure would also cause habitat loss and alteration for waterfowl through placement of gravel fill, fugitive dust and associated effects on vegetation, and changes in drainage patterns. Such changes could cause displacement of waterfowl from traditional hunting areas. Roads and other oil and gas or community infrastructure may result in the removal of key berry and wild plant harvesting areas, depending on the location of the infrastructure. Subsistence users often have specific locations where they target fish (fish camps and net sites), waterfowl (bird blinds), and berries and plants (specific locations along rivers and coastal areas), and thus even minor displacement of these resources could have more substantial impacts on individual harvesters depending on the location of infrastructure. The more infrastructure there is (e.g., under the high development scenario), the more likely that displacement could affect overall resource availability for the study communities.

Contamination

Oil spills, transport of waste and hazardous materials, fugitive dust, and air emissions could affect the availability of certain resources due to documented or perceived contamination of those resources. Depending on its size and location, an oil spill could affect the terrestrial, riverine, and marine environments, thus affecting large portions of the study communities' resource bases. If an oil spill causes reduced health of certain resources or displaces resources from traditional hunting areas, then they could become less available to the subsistence users. Contamination could occur during all phases of oil and gas development and could range from being easily contained and site specific to occurring over a larger area and causing local or, in the case of a large-scale oil spill or a spill that affects migratory resources, regional effects. Contamination associated with oil spills would be most likely to occur in areas of high development potential and therefore most likely to affect communities such as Nuiqsut, Utqiagvik, and Atqasuk who use or are close to those areas. Impacts could also extend to other communities such as Wainwright and Point Lay if oil and gas development extends into areas of medium and low development potential or if infrastructure projects occur within their traditional lands.

Because of the lower possibility of containment, a spill in water (e.g., rivers, streams, or in nearshore areas) could have greater effects on resource availability, particularly for fish and marine mammals (e.g., seals and bowhead whales). Fish harvesting occurs in numerous river and lake systems across the NPR-A. If a spill or contamination event occurs or if residents perceive that activities upstream from fish camps and net sites are contaminating the water, they may reduce harvesting activities in the area due to concerns that the fish are unsafe to eat. Similarly, resources such as caribou and waterfowl that feed in areas that are affected by spills may also become unavailable to local residents due to these concerns. Small spills in the planning area or air contamination (either real or perceived) could also cause subsistence users to avoid harvesting certain resources, particularly near development areas. This could have potential indirect effects on human health through reduced consumption of nutritional foods and increased stress and anxiety (NPR-A IAP/EIS, Section 3.4.12, *Public Health*).

In addition to spills, use and storage of hazardous materials, solid waste, and drilling waste, generation of air emissions, treatment and disposal of wastewater, and dust deposition could result in real or perceived degradation of land mammal, marine mammal, waterfowl, and fish habitat. Dust deposition from gravel infrastructure, ground traffic, and construction activities could affect fish and other habitat over the long term (Section 3.3.3, *Fish*). Vegetation harvests may be affected by dust deposition along roads, and caribou, waterfowl, and other resources may ingest contaminated vegetation in the event of fugitive dust and small-scale spills along roadways (NPR-A IAP/EIS, Section 3.3.1, *Vegetation,* Section 3.3.4, *Birds,* and Section 3.3.5, *Terrestrial Mammals*). Along the Spur Road near Nuiqsut, most dust deposition has occurred within 50

feet of road edges, although dust deposition may occur up to 100 meters from roads in more heavily travelled areas (NPR-A IAP/EIS, Section 3.3.1, *Vegetation*).

Thus far, air and water quality sampling and testing of subsistence foods on the North Slope have found contaminant and VOC concentrations below the levels of concern for human health (NPR-A IAP/EIS, Section 3.4.12, *Public Health*). However, North Slope residents continue to be concerned about the impact of increasing development in the region on human health and the health of fish and wildlife upon which residents rely. If individuals perceive or confirm subsistence resources to be contaminated and avoid harvesting resources that feed near oil and gas or other non-oil and gas infrastructure, they may experience reduced resource availability. Resources that are perceived as contaminated by subsistence users are often considered unavailable for subsistence use (SRB&A 2009); during a recent Bureau of Ocean Energy Management-funded study, nearly a quarter of Utqiagvik, Wainwright, and Point Lay households (between 22 and 26 percent) and nearly half of Nuiqsut households (47 percent) reported avoidance in the previous year of certain subsistence foods due to concerns about contamination (SRB&A 2017b). Under Alternative A, BMPs A-9 and A-11 would require monitoring of air quality and contaminants in subsistence foods, which could help reduce concerns by local residents.

Access to Subsistence Resources

Infrastructure (e.g., gravel and ice roads, pipelines, and facilities) related to oil and gas development and other projects could occur throughout much of the NPR-A and could create physical and legal barriers to access for communities who use the NPR-A.

Development of road, pipeline, and other linear infrastructure could present a physical barrier to NPR-A subsistence users when accessing hunting or harvesting areas. Any subsistence uses areas permanently overlain by new infrastructure would be inaccessible to subsistence uses throughout the life of any oil and gas project. Additionally, infrastructure would pose physical obstructions to subsistence users if roads and pipelines are not designed to account for overland hunter travel, or if bridges and causeways obstruct travel along rivers or coastlines. Some residents in Nuiqsut have reported difficulty safely crossing certain gravel roads with snowmachines or four-wheel vehicles, particularly when hauling trailers or sleds, due to the steep side slopes (SRB&A 2018a). Tundra access ramps and road pullouts at regular distances have reduced but not eliminated issues with off-road travel; in some cases, residents traveling overland may have to travel farther to find a suitable location to cross roads. ConocoPhillips Alaska, Inc. recently upgraded the subsistence ramps located at intervals along the CD5 and GMT1 roads to reduce crossing difficulties. Pipelines can also pose a physical obstruction to residents traveling overland, particularly during the winter when heavy snowdrifts reduce clearance in certain areas; however, 7-foot minimum pipeline heights are generally adequate for harvesters on snowmachines or four-wheelers to cross underneath. A number of ROPs address the potential for direct obstructions to access for subsistence users, including ROP E-1, E-4 (Alternative A only), E-5, and E-7. These ROPs address local use of roads, pipeline heights, and infrastructure footprints and may reduce physical barriers to harvester access.

During project construction, it is possible that local use of roads or access to new infrastructure could be restricted or prohibited due to high traffic volumes and safety concerns. It may also be difficult or impossible to safely cross over roads while they are under construction. Although such impacts would likely be limited to the construction phase of new infrastructure or project development, they would create a legal or regulatory barrier to harvester access. The magnitude of these impacts would be greater if the project construction phase is longer. Even after the construction phase, some roads or areas would be subject to standard safety rules or other regulations that would restrict use. Under Alternative A, 20 miles of gravel road and one satellite pad

would be built under the low development scenario, 82 miles of gravel road, 5 satellite pads and 1 central processing facility would be built under the medium development scenario, and 128 miles of gravel road, 10 satellite pads, and 2 central processing facilities would be built under the high development scenario.

Discharge of firearms likely would be prohibited within a certain radius or in the direction of infrastructure, and residents would likely avoid hunting in certain areas due to concerns about human safety and damage to property. Thus, a larger area than project footprints would be unavailable for subsistence use as a result of infrastructure and oil and gas development. Pipelines or roads in coastal areas or in the vicinity of navigable waterways could affect residents' hunting activities if they are unable to shoot inland due to the presence of pipelines or roads; such impacts would also occur for individuals traveling overland if infrastructure forces hunters to reorient themselves or travel farther to hunt safely. In some cases, infrastructure may increase access for certain NPR-A residents if their communities have road access. Use of roads by subsistence users to access traditional hunting and harvesting areas has been documented in Nuiqsut and other rural Alaskan villages. Under ROP E-1 for the action alternatives, subsistence pullouts and access ramps will be incorporated into all future project designs on all roads, thus facilitating harvester access; under Alternative E, ROP E-1 additionally requires that permittees allow local use of gravel roads and ice roads where appropriate. ROPs H-1 and H-2 would require consultation with local residents to facilitate subsistence access and notify residents of upcoming activities. In the case of Nuiqsut, while the percentage of harvesters using roads has increased over time, the percentage of caribou harvested within the vicinity of roads has not increased (SRB&A 2019a). In addition, use of roads decreases with distance from the community of Nuiqsut and with density of infrastructure (BLM 2019). Roads are most likely to provide a net benefit for individuals who have limited time due to job or other commitments, or individuals who do not have access to overland or riverine methods of transportation (e.g., snowmachines, four-wheelers, or boats). Other hunters may benefit from the use of roads when resources are unavailable closer to their community. Nuiqsut residents have reported using roads to access caribou that are reported to be farther from the community as a result of increased development to the west. Depending on the nature and location of road infrastructure in the NPR-A, use of roads by local residents could result in increased subsistence harvesting competition between communities by concentrating harvesters into corridors and changing the dynamic of community use area patterns.

Evaluation of the Availability of Other Lands for the Purpose Sought to be Achieved

The Naval Petroleum Reserves Production Act of 1976, as amended, instructs the Secretary of the Interior to conduct oil and gas leasing in the NPR-A. Congress authorized petroleum production in 1980 and directed the Secretary of the Interior to undertake a program of competitive leasing of potential oil and gas tracts in the Reserve. The BLM has completed the NPR-A IAP/EIS to determine the appropriate management of all BLM-managed lands in the NPR-A in a manner consistent with existing statutory direction and Secretarial Order 3352. Secretarial Order 3352 directed development of an updated EIS that "strikes an appropriate balance of promoting development while protecting surface resources." Lands outside the NPR-A are not subject to the Naval Petroleum Reserves Product Act, or Secretarial Order 3352, and therefore would not fulfill the purpose sought to be achieved.

Evaluation of Other Alternatives that would Reduce or Eliminate the Use, Occupancy, or Disposition of Public Lands Needed for Subsistence Purposes

No alternatives would eliminate the use of public lands needed for subsistence purposes. However, Alternative B would open fewer subsistence lands to oil and gas leasing and infrastructure development than Alternative A. The NPR-A IAP/EIS, Section 2.3, *Alternatives Considered but Eliminated from Detailed Analysis*, discusses other alternatives that were considered but eliminated from detailed analysis because they addressed

issues that were adequately addressed under the other alternatives, or because they did not meet the purpose of the proposed action to conduct oil and gas leasing in the NPR-A.

Findings for Alternative A

1. **Reductions in the availability of subsistence resources described above for Alternative A may significantly restrict subsistence uses for the community of Nuiqsut.**
2. **Limitations on subsistence user access described above for Alternative A may significantly restrict subsistence uses for the community of Nuiqsut.**

Because these effects may reach the level of a significant restriction, a positive determination pursuant to ANILCA Section 810 is required and hearings must be held with subsistence users from the affected communities before final determinations, described below in Section E.4, can be made.

This evaluation concludes that implementation of Alternative A is not expected to result in a large reduction in the abundance (population level) of caribou or any other subsistence resource, nor is there any expectation that there will be a major increase in the harvest of caribou by non-subsistence users. Therefore, this finding of "may significantly restrict" is only triggered by two other primary factors that must be considered: a) reduction in the availability of resources caused by alterations of their distribution, and; b) limitation of access by subsistence harvesters. Rationale for these findings and the determination of significance are summarized below.

Rationale for the finding of reductions in the availability of subsistence resources under Alternative A

Under Alternative A, the community of Nuiqsut harvests eight of the ten subsistence resource categories in areas open to leasing that have a high development potential (see **Table E-2**). All four of the subsistence resources of high material and cultural importance (caribou, marine mammals, non-salmon fish, and migratory birds) are harvested in areas open to leasing and with a high potential for development. Of particular importance is the overlap of areas with high development potential with subsistence use areas for caribou harvest.

Temporary changes in caribou distribution have not been shown to alter overall migration patterns or herd distribution; however, small changes in caribou distribution and movement from a biological perspective can have large impacts on hunter success, as residents are generally limited in how far and fast they can travel, particularly during the snow-free season. Impacts on resource availability resulting from changes in caribou migration are particularly likely if a community is on the periphery of a herd's seasonal movements, and Nuiqsut is on the western periphery of the TCH and the eastern periphery of the CAH. Research on the CAH following development of the Kuparuk and Milne Point oilfields suggests that during and immediately after calving, maternal caribou with young calves tend to avoid areas within 1.25 to 3.1 miles of active roads and pads (Dau and Cameron 1986; Lawhead 1988; Cameron et al. 1992; Cronin et al. 1994; Nellemann and Cameron 1996; Lawhead et al. 2004; Vistnes and Nellemann 2008; Prichard et al. 2019) and caribou densities declined in areas with higher density of infrastructure (Nellemann and Cameron 1996). Aerial surveys conducted before and after construction of the Milne Point road indicated that caribou densities within 0 to 2.49 miles of the road decreased, while densities 2.49 to 3.75 miles from the road increased (Cameron et al. 1992) after construction. Displacement can occur even with low traffic levels, and impacts from roads are particularly high during times of high ground traffic (15 trips per hour). Should similar effects occur around infrastructure built in areas of high development potential near the community of Nuiqsut, hunters may have

to travel further to harvest caribou in adequate amounts because there may be fewer animals available near infrastructure.

Infrastructure and activity in core hunting areas can also reduce availability by causing skittish behavior in caribou. Aircraft traffic, and to a lesser extent vehicle traffic, has been reported by local hunters to cause skittish behavior in caribou and decrease hunting success. Observed behavioral responses to aircraft traffic include caribou "scattering" rather than remaining in groups where they are easier to hunt, acting skittish, and deflecting away from the source of noise or away from riversides (where hunters wait for them) (SRB&A 2010b, 2011, 2012, 2013, 2014a, 2015, 2016, 2017a, 2018a). As areas that are open for leasing and new infrastructure under Alternative A are developed, Nuiqsut hunters may need to make additional trips to harvest animals that are skittish due human activity or travel farther to hunt in undisturbed areas. This would constitute a major redistribution of resources. which may significantly restrict subsistence uses for the community of Nuiqsut.

Rationale for the finding of limitations on subsistence user access under Alternative A

Under Alternative A, infrastructure (e.g., gravel and ice roads, pipelines, and facilities) related to oil and gas development and other projects would be allowed in Nuiqsut's subsistence use area and could present legal and physical barriers to access.

Discharge of firearms likely would be prohibited within a certain radius or in the direction of infrastructure, and residents may avoid hunting in certain areas due to concerns about human safety and damage to property. Pipelines or roads along the Colville River could affect Nuiqsut residents' hunting activities if they are unable to shoot inland from the river due to the presence of pipelines or roads. Although the Colville River has a 2-mile buffer from its western bank where infrastructure is prohibited, essential road and pipeline crossings would still be permitted within this setback. In addition, the entire setback area is available for leasing under Alternative A, which increases the likelihood of an essential crossing being necessary. Pipelines and roads can also impact individuals traveling overland west of the community if infrastructure forces hunters to reorient themselves (i.e., a caribou is spotted on the other side of the road or pipeline from the hunter) or travel farther to hunt safely. Under Alternative A, there is no requirement for permittees to grant local residents the right to use a permittee's road during or after construction.

Access may also be physically restricted by linear infrastructure blocking hunters' ability to travel overland or along rivers. Infrastructure would pose physical obstructions to subsistence users if roads and pipelines are not designed to account for overland hunter travel, or if bridges and causeways obstruct travel along rivers or coastlines. Some residents in Nuiqsut have reported difficulty safely crossing certain gravel roads with snowmachines or four-wheel vehicles, particularly when hauling trailers or sleds, due to the steep side slopes (SRB&A 2018a). Tundra access ramps and road pullouts at regular distances have reduced but not eliminated issues with off-road travel; in some cases, residents traveling overland may have to travel farther to locate a suitable location to cross the road. If bridges and roads are not designed to allow subsistence hunters to cross them, or if there is an inadequate number of crossings or crossings are poorly designed, subsistence hunters would need to travel around infrastructure to reach their hunting areas.

During project construction, local harvesters may be restricted or prohibited from using roads, and crossing them may be difficult or unsafe due to high traffic volumes. Gravel roads cannot be driven on while they are being constructed, and ice roads used to support construction have high volumes of industrial traffic and may be legally restricted from subsistence use. Under the medium and high development scenarios, 82 and 128 miles of gravel road, respectively, could be constructed in Nuiqsut's subsistence use areas.

Subsistence hunters' use of roads can provide a countervailing effect on impacts on access; however, it is unclear how big of an effect this would have. In the case of Nuiqsut, while the percentage of harvesters using roads has increased over time, the percentage of caribou harvested within the vicinity of roads has not increased (SRB&A 2019a). There is also no requirement to allow subsistence users access to a lessee's road or for the lessee to build ramps to facilitate access across roads under Alternative A. Under Alternative A, subsistence users in Nuiqsut may experience extensive interference with access, which may significantly restrict subsistence uses.

E.2.2 Evaluation and Finding for Alternative B

Alternative B is similar to Alternative A but would increase the amounts of land unavailable for oil and gas leasing and closed to infrastructure development. Under Alternative B, the area in the northeastern portion of the NPR-A closed to oil and gas leasing would extend farther to the east into the Fish Creek drainage, and leases would be deferred for at least 10 years in an area bounded by the Colville River in the east, Harrison Bay in the north, and Umiat in the south. It is important to note that much of the land in the deferral area has already been leased, and BLM cannot prohibit development or renewal of existing leases. Under Alternative B, 491,000 acres are closed to fluid mineral leasing but have valid existing leases. In addition, 844,000 of the acres subject to NSO under Alternative B also have valid existing leases. These areas may be subject to only standard terms and conditions while the terms of the existing leases are in effect. Thus, if existing leases are developed, the percentage of use areas potentially affected by oil and gas leasing, activity, and infrastructure under Alternative B (i.e., areas open to leasing and areas open only to standard terms and conditions) would increase for some study communities. However, if these leases were to expire or be surrendered, they would not be offered for sale again until the expiration of the deferral period.

Alternative B would also restrict oil and gas leasing in the lands around and to the east of Atqasuk and to the east and south of Utqiagvik. Alternative B would increase the area around most river and creek drainages that are subject to NSO. Alternative B would allow for two north-south pipeline corridors within the Teshekpuk Lake Special Area. The reasonably foreseeable development scenario under Alternative B is similar to that described under Alternative A, with development expected around Umiat and associated with the Alpine and Willow developments. Despite the decrease in areas open to infrastructure, the reasonably foreseeable development scenario anticipates a slightly higher amount of gravel roads in miles under Alternative B compared with Alternative A (NPR-A IAP/EIS, Section 3.4.3, *Subsistence Uses and Resources, Direct and Indirect Impacts*).

Evaluation of the Effect of Use, Occupancy, or Disposition on Subsistence Uses and Needs

The effects of Alternative B on subsistence would be similar to those described for Alternative A with the following differences:

1. Alternative B would make available a smaller portion of subsistence use areas for the primary study communities for oil and gas leasing and new infrastructure, thus resulting in a lower potential for direct impacts on subsistence.
2. Alternative B would make unavailable for leasing some core subsistence use areas for Nuiqsut and would defer leasing in key Nuiqsut subsistence use areas to the west of the Colville River, potentially providing a temporary reduction in the magnitude of ongoing development impacts on that community.

3. Alternative B would make lands directly around Atqasuk and Utqiagvik unavailable for oil and gas leasing, thus reducing the likelihood and magnitude of direct impacts on those communities' subsistence activities.

Overall, Alternative B would reduce the potential for direct impacts on the primary study communities, particularly Nuiqsut, Atqasuk, and Utqiagvik, because a smaller percentage of subsistence use areas would be available for oil and gas development and new infrastructure (**Table E-3**), and fewer subsistence use areas would be open to leasing in areas of medium to high development potential for certain communities (Utqiagvik and Atqasuk; **Table E-5**; NPR-A IAP/EIS, Appendix A, Map 2-3). Under Alternative B, the area in the northeastern portion of NPR-A closed to oil and gas leasing would extend farther to the east into the Fish Creek drainage, an area of key subsistence use for Nuiqsut for multiple resources. In addition, leasing would be deferred for at least 10 years in the northeast portion of the NPR-A between Harrison Bay in the north and Umiat in the south, a core Nuiqsut hunting ground for caribou, moose, fish, furbearers, and waterfowl. Deferring leases for 10 years in this area would allow for the continued monitoring of subsistence impacts resulting from the CD5, GMT1, and GMT2 developments, which could provide greater understanding of subsistence impacts to inform future development within the community's subsistence use areas. However, existing leases, such as those for the Bear Tooth and Greater Mooses Tooth units, extend throughout much of the deferral area and may experience development. Under Alternative B, 22 miles of gravel road and 1 satellite pad would be built under the low development scenario, 90 miles of gravel road, 6 satellite pads, and 1 central processing facility would be built under the medium development scenario, and 140 miles of gravel road, 11 satellite pads, and 2 central processing facilities would be built under the high development scenario.

Table E-5
Subsistence Use Areas Overlapping Areas Open to Fluid Mineral Leasing, Alternative B

Resource	Anaktuvuk Pass	Atqasuk	Nuiqsut	Point Lay	Utqiagvik	Wainwright
Large Land Mammals	H[1]	H[1]	H	L	H	M
Small Land Mammals	H[1]	H[1]	H	L	H	M
Salmon	ND	See "Non-Salmon Fish"	N	N	M[1]	See "Non-Salmon Fish"
Non-Salmon Fish	N	M[2]	H	L	H	M[2]
Marine Mammals	ND	ND	H	N	M[1]	L
Migratory Birds	N	M	H	L	H	L
Upland Birds	N	M	H	L	H	M
Bird Eggs	ND	ND	H[1]	N	M[1]	ND
Marine Invertebrates	ND	ND	ND	ND	N	N
Vegetation	N	M	H	N	M	ND

H = Use Areas Overlapping Areas of High Development Potential Open to Fluid Mineral Leasing
M = Use Areas Overlapping Areas of Medium Development Potential Open to Fluid Mineral Leasing
L = Use Areas Overlapping Areas of Low Development Potential Open to Fluid Mineral Leasing
N = No Use Areas Overlapping Areas Open to Fluid Mineral Leasing
ND = No data
[1] Minimal/Slight Overlap of Use Areas
[2] Original sources list data for "Fish," which in some cases includes salmon; data specific to salmon or non-salmon fish are not available.

Alternative B would close oil and gas leasing in the northernmost portion of the Utukok River Uplands Special Area, thus reducing potential impacts on subsistence harvesters from Wainwright, Point Lay, Atqasuk, and Utqiagvik. The western portion of the Colville River Special Area, a key hunting and trapping area among some Utqiagvik and Wainwright harvesters, would be open to leasing under Alternative B; however, Alternative B would also have the highest infrastructure setback from the Colville River, at 7 miles.

The larger area closed to infrastructure development and oil and gas leasing in the northeastern portion of the NPR-A would also reduce impacts on key habitat areas for caribou and waterfowl, and the larger buffers around major river drainages that would be subject to NSO, including those around the Colville River, would reduce impacts on fish and other resources that prefer riparian habitats (e.g., moose). Under Alternative B, permanent oil and gas infrastructure would be limited within 7 miles of the Colville River, thus reducing potential impacts on fish and other resources that prefer riparian habitats, such as moose. Finally, the addition of 12 wild and scenic rivers under Alternative B in the southwestern portion of the NPR-A would further reduce impacts on fish and other resources along key river systems, particularly for the communities of Wainwright and Point Lay. Thus, the potential for impacts on resource abundance and resource availability under Alternative B would be lower than under Alternative A. Because a larger area in the northeastern portion of the NPR-A would be closed to new infrastructure, any road development connecting Utqiagvik to Nuiqsut would likely be rerouted farther south and would therefore increase potential impacts and benefits to harvester access for the community of Atqasuk.

Table E-6
Subsistence Use Areas Overlapping Areas Open to New Infrastructure, Alternative B

Resource	Anaktuvuk Pass	Atqasuk	Nuiqsut	Point Lay	Utqiagvik	Wainwright
Large Land Mammals	X[1]	X[1]	X	X	X	X
Small Land Mammals	X[1]	X[1]	X	X	X	X
Salmon	ND	See "Non-Salmon Fish"	N	N	X	See "Non-Salmon Fish"
Non-Salmon Fish	N	X[2]	X	X[1]	X	X[2]
Marine Mammals	ND	X	N	X[1]	X	X
Migratory Birds	N	X	X	X[1]	X	X
Upland Birds	N	X	X	X	X	X
Bird Eggs	ND	ND	N	N	X	ND
Marine Invertebrates	ND	ND	ND	ND	X	X[1]
Vegetation	N	X	X	N	X	ND

X = Use Areas Overlapping Areas Open to New Infrastructure
N = No Use Areas Overlapping Areas Open to New Infrastructure
ND = No data
[1] Minimal/Slight Overlap of Use Areas
[2] Original sources list data for "Fish," which in some cases includes salmon; data specific to salmon or non-salmon fish are not available.

Evaluation of the Availability of Other Lands for the Purpose Sought to be Achieved

The evaluation of the NPR-A IAP/EIS Alternative B is identical to that provided in Section E.2.1 for Alternative A.

Evaluation of Other Alternatives that would Reduce or Eliminate the Use, Occupancy, or Disposition of Public Lands Needed for Subsistence Purposes

No alternatives would eliminate the use of public lands needed for subsistence purposes, and none would reduce the use of lands needed for subsistence purposes more than Alternative B. The NPR-A IAP/EIS, Section 2.3, *Alternatives Considered but Eliminated from Detailed Analysis*, discusses other alternatives that were considered but eliminated from detailed analysis because they addressed issues that were adequately addressed under the other alternatives, or because they did not meet the purpose of the proposed action to conduct oil and gas leasing in the NPR-A.

Findings for Alternative B

1. **Reductions in the availability of subsistence resources described above for Alternative B may significantly restrict subsistence uses for the community of Nuiqsut.**
2. **Limitations on subsistence user access described above for Alternative B may significantly restrict subsistence uses for the community of Nuiqsut.**

Because these effects may reach the level of a significant restriction, a positive determination pursuant to ANILCA Section 810 is required and hearings must be held with subsistence users from the affected communities before final determinations, described below in Section E.4, can be made.

Rationale for the finding of reductions in the availability of subsistence resources under Alternative B

The rationale for the finding under Alternative B is the same as under Alternative A. Alternative B does provide more protection than Alternative A in Nuiqsut's caribou subsistence use areas, particularly near Fish Creek and along the Colville River's west bank; however, it is unlikely that these protections will have a substantial material effect on impacts because a majority of the land in these areas has already been leased (see Appendix B). The impacts on the availability of subsistence resources under Alternative B are likely to be the same for the community of Nuiqsut as under Alternative A.

Rationale for the finding of limitations on subsistence user access to resources under Alternative B

Under all action alternatives, ROP E-1 would require permittees to allow subsistence users to access permanent gravel and ice roads and to build subsistence pullouts and tundra access ramps along all gravel roads to facilitate access to subsistence use areas. ROP E-1 would also require permittees to construct boat ramps at all crossings of heavily used subsistence rivers to facilitate access by boat. This would substantially reduce the impacts of a road posing a physical barrier to overland travel and may increase access by boat to major subsistence rivers. This requirement would mitigate impacts on subsistence user access during the drilling and routine operations phases of an oil and gas development.

Nevertheless, there would remain both physical and legal barriers to user access that may significantly restrict subsistence user access to resources. ROP E-1 does not preclude the prohibition or limitation of harvester access of gravel or ice roads during construction phases for safety reasons (e.g., high traffic volumes). In instances of extended construction, such restrictions could create both physical and regulatory barriers to subsistence user access because subsistence users would need to route travel around them, requiring both more time and fuel. Even after construction, industrial road use is often subject to standard safety rules, some of which would restrict use for some residents (e.g., no unaccompanied minors). In addition, throughout the life of any oil and gas or other infrastructure project, the discharge of firearms likely would be prohibited within a certain radius or in the direction of infrastructure and residents may avoid hunting in certain areas due to

concerns about human safety and damage to property. Although Alternative B makes unavailable for leasing some core subsistence use areas for Nuiqsut and would defer leasing in key Nuiqsut subsistence use areas to the west of the Colville River, the reasonably foreseeable development scenario nonetheless anticipates an increase in development around Nuiqsut. Under the medium development scenario, 90 miles of gravel road, 6 satellite pads, and 1 central processing facility could be built in Nuiqsut's subsistence use areas. Under the high development scenario, construction could increase to 140 miles of gravel road, 11 satellite pads, and 2 central processing facilities. This may lead to a situation in which there is continuously a development under construction, and gravel road construction and the ice roads used to support that construction present a physical and legal barrier to access because they cannot be used by hunters to travel to subsistence harvest areas. The footprint of these developments and their safety radius would also be effectively unavailable to subsistence hunters for the life of the project.

As such, the restrictions levied on gravel and ice road use during construction and the limitations to firearm use around infrastructure throughout the life of any oil and gas project may cause extensive interference with access for residents of Nuiqsut.

E.2.3 Evaluation and Finding for Alternative C

Alternative C would be similar to Alternative A but would increase the area available for oil and gas leasing and open to new infrastructure development. Alternative C would open a greater portion of the Teshekpuk Lake and Utukok River Uplands Special Areas to oil and gas leasing and infrastructure development, although core areas would remain closed to leasing and infrastructure. Alternative C would allow for one north-south pipeline to the east of Teshekpuk Lake. While 5,269,000 acres of land are subject to NSO under Alternative C, 866,000 acres of this land have existing leases, which may be subject only to standard terms and conditions while the terms of the leases are in effect. Thus, if the existing leases are developed, the percentage of use areas potentially affected by oil and gas infrastructure under Alternative C would increase for some study communities (NPR-A IAP/EIS, Section 3.4.3, *Subsistence Uses and Resources, Direct and Indirect Impacts*).

According to the reasonably foreseeable development scenario for Alternative C, development could occur at Umiat and around Smith Bay. Development in Smith Bay would increase the potential for direct impacts on Utqiagvik harvesters who conduct marine mammal hunting offshore from Smith Bay and travel through Smith Bay to subsistence camps and cabins along the Miguakiak River (NPR-A IAP/EIS, Section 3.4.3, *Subsistence Uses and Resources, Direct and Indirect Impacts*). The area open to infrastructure development under Alternative C would be similar to Alternative A but with a larger area open to infrastructure along the upper Colville River. Under Alternative C, 30 miles of gravel road and 2 satellite pad would be built under the low development scenario, 120 miles of gravel road, 8 satellite pads, and 1 central processing facility would be built under the medium development scenario, and 188 miles of gravel road, 15 satellite pads, and 2 central processing facilities would be built under the high development scenario.

Evaluation of the Effect of Use, Occupancy, or Disposition on Subsistence Uses and Needs

The effects of Alternative C on subsistence would be similar to those described for Alternative A with the following differences:

1. Alternative C would make available a larger portion of subsistence use areas for the primary study communities for oil and gas leasing and new infrastructure, thus resulting in a higher potential for direct impacts on subsistence uses.

2. Alternative C would allow oil and gas leasing and development in key subsistence drainages in the northern NPR-A, including the Ikpikpuk, Chipp, Topaguruk, and lower Meade and Inaru rivers, thus increasing the likelihood of impacts on Utqiagvik and Atqasuk subsistence uses.
3. Alternative C would make available a greater portion of the area to the south, east, and southeast of Teshekpuk Lake, including the Atigaru Point area, for oil and gas leasing, thus increasing the potential for direct impacts on Nuiqsut subsistence uses and impacts on caribou calving habitat.
4. Alternative C would make available the southwestern portion of the NPR-A (in the Utukok River Uplands Special Area) for oil and gas leasing and infrastructure development, thus increasing potential impacts on WAH caribou and on resource availability for peripheral study communities.

Overall, Alternative C would increase the potential for direct impacts on the primary study communities, particularly Nuiqsut, Atqasuk, and Utqiagvik, because a larger percentage of the subsistence use areas would be made available for oil and gas leasing and new infrastructure (**Tables E-1** and **E-3**) and more subsistence use areas would be open to leasing in areas of medium to high development potential for certain communities (Utqiagvik and Atqasuk; **Table E-7**). The percentage of subsistence use areas open to oil and gas leasing under Alternative C would be higher than Alternative A for Atqasuk (92 percent of subsistence use areas), Utqiagvik (45 percent), Wainwright (41 percent), and Nuiqsut (35 percent; **Table E-1**). Subsistence use areas open to infrastructure development under Alternative C would be similar to Alternative A, except for Wainwright, whose potentially affected use areas would increase from 23 percent to 32 percent, increasing the likelihood of direct impacts for that community. Areas open to new infrastructure would overlap similar resource uses as Alternative A (**Table E-8**).

Table E-7
Subsistence Use Areas Overlapping Areas Open to Fluid Mineral Leasing, Alternative C

Resource	Anaktuvuk Pass	Atqasuk	Nuiqsut	Point Lay	Utqiagvik	Wainwright
Large Land Mammals	H[1]	H[1]	H	L	H	M
Small Land Mammals	H[1]	H[1]	H	L	H	M
Salmon	ND	See "Non-Salmon Fish"	N	N	M	See "Non-Salmon Fish"
Non-Salmon Fish	N	H[2]	H	L	H	M[2]
Marine Mammals	ND	H[1]	H	L[1]	H[1]	L
Migratory Birds	N	M	H	L	H	L
Upland Birds	N	M	H	L	H	M
Bird Eggs	ND	ND	H[1]	N	M	ND
Marine Invertebrates	ND	ND	ND	ND	M	N
Vegetation	N	M	H	N	H	ND

H = Use Areas Overlapping Areas of High Development Potential Open to Fluid Mineral Leasing
M = Use Areas Overlapping Areas of Medium Development Potential Open to Fluid Mineral Leasing
L = Use Areas Overlapping Areas of Low Development Potential Open to Fluid Mineral Leasing
N = No Use Areas Overlapping Areas Open to Fluid Mineral Leasing
ND = No data
[1] Minimal/Slight Overlap of Use Areas
[2] Original sources list data for "Fish," which in some cases includes salmon; data specific to salmon or non-salmon fish are not available.

Table E-8
Subsistence Use Areas Overlapping Areas Open to New Infrastructure, Alternative C

Resource	Anaktuvuk Pass	Atqasuk	Nuiqsut	Point Lay	Utqiagvik	Wainwright
Large Land Mammals	X	X	X	X	X	X
Small Land Mammals	X	X	X	X	X	X
Salmon	ND	See "Non-Salmon Fish"	N	N	X	See "Non-Salmon Fish"
Non-Salmon Fish	N	X[2]	X	X[1]	X	X[2]
Marine Mammals	ND	X[1]	N	X	X[1]	X
Migratory Birds	N	X	X	X	X	X
Upland Birds	N	X	X	X	X	X
Bird Eggs	ND	ND	N	N	X	ND
Marine Invertebrates	ND	ND	ND	ND	X	X[1]
Vegetation	N	X	X	N	X	ND

X = Use Areas Overlapping Areas Open to New Infrastructure
N = No Use Areas Overlapping Areas Open to New Infrastructure
ND = No data
[1] Minimal/Slight Overlap of Use Areas
[2] Original sources list data for "Fish," which in some cases includes salmon; data specific to salmon or non-salmon fish are not available.

Under Alternative C, oil and gas leasing would be allowed near a number of key subsistence drainages in the northern portion of the NPR-A and in core subsistence harvesting areas for the communities of Atqasuk and Utqiagvik (see **Maps E-3** and **E-6**). A greater acreage of fish, waterfowl, and land mammal habitat would be open to oil and gas leasing (see **Table E-7**) and infrastructure (see **Table E-8**) under Alternative C, thus increasing the potential for impacts on resource abundance and availability for the study communities. Alternative C would open additional WAH and TCH habitats to oil and gas leasing and infrastructure development. The southern portion of the Utukok River Uplands Special Area and areas along the upper Colville River would be opened to oil and gas leasing and infrastructure. These areas are consistently used by the WAH during their summer migrations; while oil and gas development is not expected to occur in these areas because of their low to medium development potential, such development could affect large groups of caribou. Under Alternative C, some areas near high-density TCH calving areas could be developed, thus causing displacement of calving caribou (NPR-A IAP/EIS, Section 3.3.5, *Terrestrial Mammals*).

Evaluation of the Availability of Other Lands for the Purpose Sought to be Achieved

The evaluation of the NPR-A IAP/EIS Alternative C is identical to that provided in Section E.2.1 for Alternative A.

Evaluation of Other Alternatives that would Reduce or Eliminate the Use, Occupancy, or Disposition of Public Lands Needed for Subsistence Purposes

No alternatives would eliminate the use of public lands needed for subsistence purposes, although Alternatives A and B would make available fewer subsistence use areas to oil and gas leasing and infrastructure development than Alternative C. The NPR-A IAP/EIS, Section 2.3, *Alternatives Considered by Eliminated from Detailed Analysis,* discusses other alternatives that were considered but eliminated from detailed analysis because they addressed issues that were adequately addressed under the other alternatives, or because they did not meet the purpose of the proposed action to conduct oil and gas leasing in the NPR-A.

Findings for Alternative C

1. **Reductions in the availability of subsistence resources described above for Alternative C may significantly restrict subsistence uses for the community of Nuiqsut.**

2. **Limitations on subsistence user access described above for Alternative C may significantly restrict subsistence uses for the community of Nuiqsut.**

Because these effects may reach the level of a significant restriction, a positive determination pursuant to ANILCA Section 810 is required and hearings must be held with subsistence users from the affected communities before final determinations, described below in Section E.4, can be made.

Rationale for the finding of reductions in the availability of subsistence resources under Alternative C

The rationale for the finding under Alternative C is the same as under Alternative A.

Rationale for the finding of limitations on subsistence user access to resources under Alternative C

The rationale for the finding under Alternative C is the same as under Alternative B.

E.2.4 Evaluation and Finding for Alternative D

Under Alternative D, the number of acres available for oil and gas leasing would be higher than under Alternatives A, B, and C. Alternative D would likely see a higher number of satellite pads (between 2 and 20) compared with Alternatives A, B, and C (NPR-A IAP/EIS, Appendix B, *Reasonably Foreseeable Development Scenario*). The entire Teshekpuk Lake Special Area would be available for oil and gas leasing subject to NSO stipulations and timing limitations in certain areas. Under Alternative D, the only areas entirely closed to oil and gas leasing are in the western portion of the NPR-A surrounding the Utukok River Uplands Special Area, Kasegaluk Lagoon, Peard Bay, and Kuk River. Under Alternative D, 767,000 acres of land subject to NSO have existing leases that may be subject only to standard terms and conditions while the terms of the leases are in effect. Thus, if the existing leases are developed, the percentage of use areas affected by oil and gas infrastructure under Alternative D would likely increase for some of the study communities (NPR-A IAP/EIS, Section 3.4.3, *Subsistence Uses and Resources, Direct and Indirect Impacts*).

The remainder of the NPR-A would be open to oil and gas leasing subject to NSOs, controlled surface use, timing limitations, or standard terms and conditions. Areas closed to new infrastructure development under Alternative D are similar to Alternative A, with the exception of the southwestern portion of the NPR-A (including the upper Colville River and portions of the Utukok River Uplands Special Area) and a larger portion of lands surrounding Teshekpuk Lake being open to infrastructure development. Estimated miles of gravel roads under Alternative D (between 40 and 250 miles) are higher than under Alternative A.

Under the reasonably foreseeable development scenario for Alternative D, development around Smith Bay, Umiat, and Teshekpuk Lake could occur. Teshekpuk Lake is a key calving and insect relief area for the TCH and a traditional and contemporary subsistence harvesting area for Nuiqsut and Utqiagvik residents. A number of families from Utqiagvik have camps and cabins on Miguakiak River, an outlet of Teshekpuk Lake, from which they fish and hunt for caribou, waterfowl, and furbearers. Under Alternative D, 40 miles of gravel road and 2 satellite pad would be built under the low development scenario, 160 miles of gravel road, 10 satellite pads, and 1 central processing facility would be built under the medium development scenario, and 250 miles of gravel road, 20 satellite pads, and 3 central processing facilities would be built under the high development scenario. Alternative D would also open the southern portion of the Utukok River Uplands Special Area to

oil and gas leasing. While in an area of low development potential, infrastructure and activity in this area could affect WAH caribou that regularly use the area during their spring migrations and summer movements (NPR-A IAP/EIS, Section 3.4.3, *Subsistence Uses and Resources, Direct and Indirect Impacts*).

Evaluation of the Effect of Use, Occupancy, or Disposition on Subsistence Uses and Needs

The effects of Alternative D on subsistence would be similar to those described for Alternative A with the following differences:

1. Alternative D would make available a larger portion of subsistence use areas for the primary study communities for oil and gas leasing and new infrastructure, thus resulting in a higher potential for direct impacts on subsistence.
2. Alternative D would allow oil and gas leasing throughout the northeastern portion of the NPR-A, including in all areas of high development potential and in key subsistence use areas for the communities of Utqiagvik, Atqasuk, and Nuiqsut.
3. Alternative D would make the entire Teshekpuk Lake Special Area available for oil and gas leasing and allow infrastructure development in 88 percent of the Teshekpuk Lake Special Area, thus increasing potential for impacts on caribou calving and insect relief habitat and migratory bird habitat.
4. Alternative D would make available the southwestern portion of the NPR-A (in the Utukok River Uplands Special Area) for oil and gas leasing and infrastructure development, thus increasing potential impacts on WAH caribou and on resource availability for peripheral study communities.

Overall, as compared with Alternative A, Alternative D would increase the potential for direct impacts on the primary study communities, particularly Nuiqsut, Atqasuk, and Utqiagvik, because a larger percentage of subsistence use areas would be open to oil and gas development and new infrastructure (**Tables E-1** and **E-3**), and more subsistence use areas would be in areas of medium to high development potential for certain communities (Utqiagvik and Atqasuk; **Table E-9**). The percentage of subsistence use areas open to oil and gas leasing under Alternative D would be substantially higher than Alternative A for Atqasuk (94 percent of subsistence use areas), Utqiagvik (49 percent), Nuiqsut (40 percent), and Wainwright (41 percent; **Table E-1**). Subsistence use areas open to infrastructure development under Alternative D would be similar to Alternative A (within a few percentage points), except for Wainwright, whose potentially affected use areas would increase from 23 percent to 32 percent, and Utqiagvik, whose potentially affected use areas would increase from 30 percent to 37 percent. These changes would increase the likelihood of direct impacts for those communities (**Table E-3**). The number of resource activities open to infrastructure development would be similar to Alternative A (**Table E-10**). Although exploration is likely and development is possible in areas of medium development potential, only high development potential areas are considered likely for development at this time (Appendix B). Within the NPR-A, most of Utqiagvik's core subsistence use area (**Map E-6**; SRB&A 2010a), and the majority of all Atqasuk subsistence use areas (**Map E-3**) occur in the medium development potential area (see Appendix B).

Under Alternative D, oil and gas leasing would be allowed near a number of key subsistence drainages in the northern portion of the NPR-A, including around Teshekpuk Lake, and in core subsistence harvesting areas for the communities of Nuiqsut, Atqasuk, and Utqiagvik (see **Maps E-2** through **E-7**). A number of families from Utqiagvik have camps and cabins on Miguakiak River, an outlet of Teshekpuk Lake, from which they fish and hunt for caribou, waterfowl, and furbearers. A greater acreage of fish, waterfowl, and land mammal

Table E-9
Subsistence Use Areas Overlapping Areas Open to Fluid Mineral Leasing, Alternative D

Resource	Anaktuvuk Pass	Atqasuk	Nuiqsut	Point Lay	Utqiagvik	Wainwright
Large Land Mammals	H[1]	H[1]	H	L	H	M
Small Land Mammals	H[1]	H[1]	H	L	H	M
Salmon	ND	See "Non-Salmon Fish"	N	N	H	See "Non-Salmon Fish"
Non-Salmon Fish	N	H[2]	H	L	H	M[2]
Marine Mammals	ND	H[1]	H	L[1]	H[1]	L
Migratory Birds	N	M	H	L	H	L
Upland Birds	N	M	H	L	H	M
Bird Eggs	ND	ND	H[1]	N	M	ND
Marine Invertebrates	ND	ND	ND	ND	M	N
Vegetation	N	M	H	N	H	ND

H = Use Areas Overlapping Areas of High Development Potential Open to Fluid Mineral Leasing
M = Use Areas Overlapping Areas of Medium Development Potential Open to Fluid Mineral Leasing
L = Use Areas Overlapping Areas of Low Development Potential Open to Fluid Mineral Leasing
N = No Use Areas Overlapping Areas Open to Fluid Mineral Leasing
ND = No data
[1] Minimal/Slight Overlap of Use Areas
[2] Original sources list data for "Fish," which in some cases includes salmon; data specific to salmon or non-salmon fish are not available.

Table E-10
Subsistence Use Areas Overlapping Areas Open to New Infrastructure, Alternative D

Resource	Anaktuvuk Pass	Atqasuk	Nuiqsut	Point Lay	Utqiagvik	Wainwright
Large Land Mammals	X	X	X	X	X	X
Small Land Mammals	X	X	X	X	X	X
Salmon	ND	See "Non-Salmon Fish"	N	N	X	See "Non-Salmon Fish"
Non-Salmon Fish	N	X[2]	X	X[1]	X	X[2]
Marine Mammals	ND	X[1]	N	X	X[1]	X
Migratory Birds	N	X	X	X[1]	X	X
Upland Birds	N	X	X	X	X	X
Bird Eggs	ND	ND	N	N	X	ND
Marine Invertebrates	ND	ND	ND	ND	X	X[1]
Vegetation	N	X	X	N	X	ND

X = Use Areas Overlapping Areas Open to New Infrastructure
N = No Use Areas Overlapping Areas Open to New Infrastructure
ND = No data
[1] Minimal/Slight Overlap of Use Areas
[2] Original sources list data for "Fish," which in some cases includes salmon; data specific to salmon or non-salmon fish are not available.

habitat would be open to oil and gas leasing and infrastructure under Alternative D, thus increasing the potential for impacts on resource abundance and availability for the study communities. Compared with Alternative A, the amount (in miles) of anadromous waterbodies closed to oil and gas leasing would decrease by 82 percent under Alternative D, increasing the potential for more widespread impacts on fish habitat (NPR-

A IAP/EIS, Section 3.3.3, *Fish*). In addition, three times as many white-fronted geese (17 percent of the birds in the NPR-A) would occur in areas open to infrastructure under Alternative D than Alternative A (NPR-A IAP/EIS, Section 3.3.4, *Birds*). Alternative D would open additional WAH and TCH habitats to oil and gas leasing and infrastructure development. The southern portion of the Utukok River Uplands Special Area and areas along the upper Colville River would be opened to oil and gas leasing and infrastructure. These areas are consistently used by the WAH during their summer migrations; while oil and gas development is not expected to occur in these areas because of their low to medium development potential, such development could affect large groups of caribou. Under Alternative D, much of the TCH calving area and other key migratory areas surrounding Teshekpuk Lake would be open to infrastructure development and oil and gas leasing, resulting in the potential for substantial displacement and impacts on migratory movements, thus reducing resource abundance and availability for users of this herd (NPR-A IAP/EIS, Section 3.3.5, *Terrestrial Mammals*).

Evaluation of the Availability of Other Lands for the Purpose Sought to be Achieved

The evaluation of the NPR-A IAP/EIS Alternative D is identical to that provided in Section E.2.1 for Alternative A.

Evaluation of Other Alternatives that would Reduce or Eliminate the Use, Occupancy, or Disposition of Public Lands Needed for Subsistence Purposes

No alternatives would eliminate the use of public lands needed for subsistence purposes, although Alternatives A, B, and C would open fewer subsistence lands to oil and gas leasing and infrastructure development than Alternative D. The NPR-A IAP/EIS, Section 2.3, *Alternatives Considered but Eliminated from Detailed Analysis,* discusses other alternatives that were considered but eliminated from detailed analysis because they addressed issues that were adequately addressed under the other alternatives, or because they did not meet the purpose of the proposed action to conduct oil and gas leasing in the NPR-A.

Findings for Alternative D

1. **Reductions in abundance of subsistence resources described above for Alternative D may significantly restrict subsistence uses for the communities of Nuiqsut, Atqasuk, Utqiagvik, Wainwright, and Anaktuvuk Pass.**
2. **Reductions in the availability of subsistence resources described above for Alternative D may significantly restrict subsistence uses for the community of Nuiqsut.**
3. **Limitations on subsistence user access described above for Alternative D may significantly restrict subsistence uses for the community of Nuiqsut.**

Because these effects may reach the level of a significant restriction, a positive determination pursuant to ANILCA Section 810 is required and hearings must be held with subsistence users from the affected communities before final determinations, described below in Section E.4, can be made.

Rationale for the finding of reductions in abundance of subsistence resources under Alternative D

Under Alternative D, 75 percent of the calving range of the TCH would be available for leasing and infrastructure development (Appendix A, Map 2-7). Depending on the location of development, this alternative could result in substantial displacement from current calving areas, with potential impacts on caribou survival, body condition, and productivity. Limiting major construction activities could potentially lower the amount of displacement, but caribou are displaced from roads even with low traffic rates (Lawhead

et al. 2004). The authorized officer can stop traffic for up to 4 weeks. Displacement from inactive infrastructure appears to be limited (Lawhead et al. 2004), so this stipulation could lower calving displacement if implemented; however, implementation is not required. The scale of the impacts would depend on the availability and quality of alternative calving areas as well as predator levels in alternative areas. If alternative calving areas have higher predator densities or lower habitat quality, as suggested by Wilson et al. (2012), there could be negative impacts on calf survival and negative effects on body condition and future productivity of maternal females. Substantial displacement could also result in longer movements between calving areas and mosquito-relief habitat, which could also lower caribou body condition. Because a substantial portion of calving TCH females could be displaced from preferred calving areas, the impacts on herd demographics are difficult to predict but could potentially be large. Increased use of late summer and winter range during calving could also decrease forage quality during those seasons.

The ability of caribou to access mosquito-relief habitat near the coast is also a concern for development on the TCH range. Because TCH caribou move fastest during mid-summer (Person et al. 2007, Prichard et al. 2014) a large proportion of the TCH could be exposed to infrastructure constructed in high-use areas of the mosquito season range. Alternative D has limited protections in place for the areas north of Teshekpuk Lake and the narrow corridors on either side of the lake used extensively during the mosquito season (Appendix A, Map 2-7). This could result in substantial delays or deflections in movements to mosquito-relief areas, with the potential for impacts on body condition and productivity.

No quantitative analysis of the proportion of community harvests by herd exists; however, general characterizations of use of the TCH indicate that because they occur primarily within the NPR-A, particularly the northern and eastern portions, the primary communities that rely on the herd are Nuiqsut, Atqasuk, and Utqiagvik (Braem 2017). Residents of two other North Slope villages, Wainwright and Anaktuvuk Pass, also harvest from the TCH; their caribou harvests are a variable mixture of WAH and TCH caribou. Impacts resulting from a large decrease in abundance of the TCH would be most severe for Anaktuvuk Pass, which obtains 86 percent of its total subsistence harvest by weight from caribou (see Appendix T, Table T-3). It is impossible to determine what proportion of the Anaktuvuk Pass annual harvest comes from TCH caribou; however, given the material importance of caribou for Anaktuvuk Pass, a large decrease in abundance of the TCH may significantly restrict subsistence uses for that community. In Wainwright, caribou is a resource of high material importance and accounts for 28 percent of its total subsistence harvest (see Appendix T, Table T-8). Wainwright also harvests caribou from the WAH; however, they are at the periphery of the WAH distribution, and it is unclear if a decrease in harvest of TCH caribou could be made up through more harvesting of WAH caribou (see Appendix A, Maps 3-21 and 3-22). A large decline in the abundance of the TCH may result in a significant restriction of subsistence use of the TCH for the communities of Anaktuvuk Pass, Utqiagvik, Nuiqsut, Wainwright, and Atqasuk.

Rationale for the finding of reductions in the availability of subsistence resources under Alternative D

The rationale for the finding under Alternative D is the same as under Alternative A for the community of Nuiqsut.

Rationale for the finding of limitations on subsistence user access to resources under Alternative D

The rationale for the finding under Alternative D is the same as under Alternative B.

E.2.5 Evaluation and Finding for Alternative E

Under Alternative E, the number of acres available for oil and gas leasing would be the highest of any alternative. The entire Teshekpuk Lake Special Area would be available for oil and gas leasing subject to NSO stipulations and timing limitations in certain areas. Under Alternative E, the only areas entirely closed to oil and gas leasing are in the western portion of the NPR-A, including Kasegaluk Lagoon, Peard Bay, and a large portion of the Utukok River Uplands Special Area. Under Alternative E, two WAH movement corridors in the southernmost portion of the Utukok River Uplands Special Area would be subject to NSO; under Alternatives C and D, these areas are only subject to timing limitations. Alternative E would also defer leases for at least 10 years in two areas near Teshekpuk Lake, including one area along the Miguakiak River to its confluence with the lake, and another area to the east of Teshekpuk Lake along Kogru River to Atigaru Point. The area along Miguakiak River is a key subsistence area for certain families from Utqiagvik; thus, these deferrals would delay potential impacts on these subsistence uses.

The remainder of the NPR-A would be open to mineral leasing subject to NSOs, controlled surface use, timing limitations, or standard terms and conditions. While 5,939,000 acres of land are subject to NSO under Alternative E, 893,000 acres of this land have existing leases. Thus, if the existing leases are developed, the percentage of use areas affected by oil and gas infrastructure under Alternative E would likely increase for some of the study communities (NPR-A IAP/EIS, Section 3.4.3, *Subsistence Uses and Resources, Direct and Indirect Impacts*). The reasonably foreseeable development scenario for Alternative E is the same as that described under Alternative D, with development expected to occur around Teshekpuk Lake.

Areas closed to new infrastructure development under Alternative E would be lower than any alternative. A smaller portion of the Utukok River Uplands Special Area would be unavailable for new infrastructure, and the area north of Teshekpuk Lake would be available for a mixture of infrastructure, essential pipeline crossings, and essential coastal infrastructure. Areas closed to new infrastructure development under Alternative E are similar to those under Alternative D, except for the two WAH movement corridors in the southern portion of the Utukok River Uplands Special Area, which would be unavailable for new infrastructure except for essential roads and pipeline crossings.

Evaluation of the Effect of Use, Occupancy, or Disposition on Subsistence Uses and Needs

The effects of Alternative E on subsistence would be similar to those described for Alternative A with the following differences:

1. Alternative E would make available a larger portion of subsistence use areas for the primary study communities for oil and gas leasing and new infrastructure, thus resulting in a higher potential for direct impacts on subsistence.
2. Alternative E would allow oil and gas leasing throughout the northeastern portion of the NPR-A, including in all areas of high development potential and in key subsistence use areas for the communities of Utqiagvik, Atqasuk, and Nuiqsut.
3. Alternative E would make the entire Teshekpuk Lake Special Area available for oil and gas leasing and allow infrastructure development in 90 percent of the Teshekpuk Lake Special Area, thus increasing potential for impacts on caribou calving and insect relief habitat and migratory bird habitat.
4. Alternative E would make available the southwestern portion of the NPR-A (in the Utukok River Uplands Special Area) for oil and gas leasing subject to NSOs and essential pipeline crossings

associated with infrastructure development, thus increasing potential impacts on WAH caribou and on resource availability for peripheral study communities.

Overall, as compared with Alternative A, Alternative E would substantially increase the potential for direct impacts on the primary study communities, particularly for Nuiqsut, Atqasuk, and Utqiagvik because a larger percentage of subsistence use areas would be open to oil and gas development and new infrastructure (**Tables E-1** and **E-3**) and more subsistence use areas would be in areas of medium to high development potential for certain communities (Utqiagvik, Nuiqsut, and Atqasuk; **Table E-11**). The percentage of subsistence use areas open to oil and gas leasing under Alternative E would be substantially higher than Alternative A for Atqasuk (95 percent of subsistence use areas), Utqiagvik (49 percent), Nuiqsut (40 percent), and Wainwright (41 percent; **Table E-1**). Subsistence use areas open to infrastructure development under Alternative E would be similar to Alternative A (within a few percentage points), except for Wainwright, whose potentially affected use areas would increase from 23 percent to 32 percent, and Utqiagvik, whose potentially affected use areas would increase from 30 percent to 36 percent. These changes would increase the likelihood of direct impacts for those communities (**Table E-3**). The number of resource activities open to infrastructure development would be similar to Alternative A (**Table E-12**).

Under Alternative E, oil and gas leasing would be allowed near a number of key subsistence drainages in the northern portion of the NPR-A, including around Teshekpuk Lake, and in core subsistence harvesting areas for the communities of Nuiqsut, Atqasuk, and Utqiagvik (see **Maps E-2** through **E-7**). A greater acreage of fish, waterfowl, and land mammal habitat would be open to oil and gas leasing and infrastructure under Alternative E, thus increasing the potential for impacts on resource abundance and availability for the study communities. Compared with Alternative A, under Alternative E there is a 62 percent decrease in fish habitat units that are closed to fluid mineral leasing, and a 78 percent decrease in Anadramous Water Catalog stream habitat protections. Additionally, no Coastal Plain or Lower Colville habitat unit lands are fully closed to fluid mineral leasing under Alternative E, resulting in a significant decrease in potential aquatic habitat protections (NPR-A IAP/EIS, Section 3.3.3, *Fish*). In addition, the number of birds in areas open to oil and gas leasing in all three development potential areas under Alternative E would be the second highest among all alternatives. An estimated 66,732 birds, or 63 percent of the total birds, in the NPR-A occur in areas open to oil and gas leasing under Alternative E, similar to but slightly less than under Alternative D (NPR-A IAP/EIS, Section 3.3.4, *Birds*).

Compared with Alternative A, Alternative E would open additional WAH and TCH habitats to oil and gas leasing and infrastructure development. The area between Teshekpuk Lake and the coast is a critical habitat and calving area that, under Alternative E, would largely be available for new infrastructure and open to fluid mineral leasing, subject to NSOs and controlled surface use (NPR-A IAP/EIS, Section 3.3.5, *Terrestrial Mammals*). Compared with Alternative D, Alternative E would allow for infrastructure in closer proximity to Teshekpuk Lake on the south side. While Alternatives C and D open the southern portion of the Utukok River Uplands Special Area to infrastructure development, under Alternative E, two WAH migratory corridors in the Utukok River Uplands Special Area would be unavailable for new infrastructure except for essential roads and pipeline crossings. The lack of infrastructure in these key movement corridors would help to reduce impacts on WAH caribou movement and subsistence resource availability.

Table E-11
Subsistence Use Areas Overlapping Areas Open to Fluid Mineral Leasing, Alternative E

Resource	Anaktuvuk Pass	Atqasuk	Nuiqsut	Point Lay	Utqiagvik	Wainwright
Large Land Mammals	H[1]	H[1]	H	L	H	M
Small Land Mammals	H[1]	H[1]	H	L	H	M
Salmon	ND	See "Non-Salmon Fish"	N	N	H	See "Non-Salmon Fish"
Non-Salmon Fish	N	H[2]	H	L	H	M[2]
Marine Mammals	ND	H[1]	H	L[1]	H[1]	L
Migratory Birds	N	M	H	L	H	L
Upland Birds	N	M	H	L	H	M
Bird Eggs	ND	ND	H[1]	N	M	ND
Marine Invertebrates	ND	ND	ND	ND	M	L[1]
Vegetation	N	M	H	N	H	ND

H = Use Areas Overlapping Areas of High Development Potential Open to Fluid Mineral Leasing
M = Use Areas Overlapping Areas of Medium Development Potential Open to Fluid Mineral Leasing
L = Use Areas Overlapping Areas of Low Development Potential Open to Fluid Mineral Leasing
N = No Use Areas Overlapping Areas Open to Fluid Mineral Leasing
ND = No data
[1] Minimal/Slight Overlap of Use Areas
[2] Original sources list data for "Fish," which in some cases includes salmon; data specific to salmon or non-salmon fish are not available.

Table E-12
Subsistence Use Areas Overlapping Areas Open to New Infrastructure, Alternative E

Resource	Anaktuvuk Pass	Atqasuk	Nuiqsut	Point Lay	Utqiagvik	Wainwright
Large Land Mammals	X	X	X	X	X	X
Small Land Mammals	X	X	X	X	X	X
Salmon	ND	See "Non-Salmon Fish"	N	N	X	See "Non-Salmon Fish"
Non-Salmon Fish	N	X[2]	X	X[1]	X	X[2]
Marine Mammals	ND	X[1]	N	X	X[1]	X
Migratory Birds	N	X	X	X[1]	X	X
Upland Birds	N	X	X	X	X	X
Bird Eggs	ND	ND	N	N	X	ND
Marine Invertebrates	ND	ND	ND	ND	X	X[1]
Vegetation	N	X	X	N	X	ND

X = Use Areas Overlapping Areas Open to New Infrastructure
N = No Use Areas Overlapping Areas Open to New Infrastructure
ND = No data
[1] Minimal/Slight Overlap of Use Areas
[2] Original sources list data for "Fish," which in some cases includes salmon; data specific to salmon or non-salmon fish are not available.

Evaluation of the Availability of Other Lands for the Purpose Sought to be Achieved

The evaluation of the NPR-A IAP/EIS Alternative E is identical to that provided in Section E.2.1 for Alternative A.

Evaluation of Other Alternatives that would Reduce or Eliminate the Use, Occupancy, or Disposition of Public Lands Needed for Subsistence Purposes

No alternatives would eliminate the use of public lands needed for subsistence purposes, although Alternatives A, B, and C would open fewer subsistence lands to oil and gas leasing and infrastructure development than Alternatives D and E. The NPR-A IAP/EIS, Section 2.3, *Alternatives Considered but Eliminated from Detailed Analysis*, discusses other alternatives that were considered but eliminated from detailed analysis because they addressed issues that were adequately addressed under the other alternatives, or because they did not meet the purpose of the proposed action to conduct oil and gas leasing in the NPR-A.

Findings for Alternative E

1. **Reductions in abundance of subsistence resources described above for Alternative E may significantly restrict subsistence uses for the communities of Nuiqsut, Atqasuk, Utqiagvik, Wainwright, and Anaktuvuk Pass.**
2. **Reductions in the availability of subsistence resources described above for Alternative E may significantly restrict subsistence uses for the community of Nuiqsut.**
3. **Limitations on subsistence user access described above for Alternative E may significantly restrict subsistence uses for the community of Nuiqsut.**

Because these effects may reach the level of a significant restriction, a positive determination pursuant to ANILCA Section 810 is required and hearings must be held with subsistence users from the affected communities before final determinations, described below in Section E.4, can be made.

Rationale for the finding of reductions in abundance of subsistence resources under Alternative E

The rationale for the finding under Alternative E is the same as under Alternative D.

Rationale for the finding of reductions of availability of subsistence resources under Alternative E

The rationale for the finding under Alternative E is the same as under Alternative A.

Rationale for the finding of limitations on subsistence user access to resources under Alternative E

The rationale for the finding under Alternative E is the same as under Alternative B.

E.2.6 Evaluation and Finding for the Cumulative Case

The NPR-A IAP/EIS, Section 3.4.3, *Subsistence Uses and Resources* contains a description of the cumulative case, which evaluates the impacts of the proposed action in conjunction with past, present, and reasonably foreseeable future actions on subsistence. Impacts from past and present actions on subsistence are discussed in NPR-A IAP/EIS, Section 3.4.3, *Subsistence Uses and Resources, Current Impacts on Subsistence*, while impacts of climate change on subsistence are discussed in Section 3.4.3, *Subsistence Uses and Resources, Climate Change*. Reasonably foreseeable future projects in the NPR-A (as projected in the reasonably foreseeable development; NPR-A IAP/EIS, Appendix B) that are reasonably anticipated to occur as a result of a particular leasing alternative in the next 20 years are described in NPR-A IAP/EIS, Section 3.4.3, *Subsistence Uses and Resources, Direct and Indirect Impacts.* These impacts are summarized above in Sections E.2.1, E.2.2, E.2.3, E.2.4, and E.2.5.

In addition to actions directly resulting from oil and gas leasing within the NPR-A that are discussed under the individual alternatives discussions, other reasonably foreseeable activities include additional oil and gas development outside the NPR-A, such as the Nanushuk development in the Colville River region, continued development of Kuparuk and Prudhoe Bay, the Liberty Development in the Beaufort Sea, both federal and state offshore lease sales and development, and development of a natural gas pipeline from the North Slope to Canada, Valdez, or Cook Inlet. Other reasonably foreseeable infrastructure projects are new permanent and seasonal roads, airport and community infrastructure improvements, and continued and increased marine vessel traffic and air traffic associated with shipping, scientific research, and recreation and tourism activities and business in the region.

Evaluation of the Effect of Use, Occupancy, or Disposition on Subsistence Uses and Needs

Cumulative effects on subsistence would vary in magnitude depending on the alternative selected. Cumulative impacts on subsistence would likely be highest under Alternatives D and E, which would make available the greatest amount of NPR-A lands for oil and gas leasing and infrastructure development and offer the least protections to subsistence resources such as caribou, moose, fish, and waterfowl. Cumulative impacts would be lowest under Alternative B, which would make large portions of the NPR-A unavailable for oil and gas leasing and infrastructure development and offers additional protections to key subsistence resources and lands. Regardless of the alternative selected, the types of impacts that would occur in the cumulative case would be similar. Cumulative oil and gas activity, transportation projects, and climate change will increasingly restrict subsistence uses and affect the availability of subsistence resources such as caribou.

Oil and gas development within the NPR-A is relatively new and confined to the northeastern portion of the NPR-A. The no action and action alternatives would allow for continuing expansion of oil and gas leasing and development into a large area, most of which is relatively undeveloped and has been used primarily for subsistence and recreation purposes. Six communities have direct uses of the NPR-A and an additional seven communities have documented historic (although not current) peripheral uses of the planning area. These and the 42 caribou study communities rely heavily on the WAH and TCH, both of which calve in and migrate through the NPR-A.

Reasonably foreseeable future activities in the region include continued oil and gas development outside of and offshore from the NPR-A (e.g., the Nanushuk development, Liberty Development in the Beaufort Sea, and Beaufort Sea OCS lease sales); development of a natural gas pipeline; infrastructure projects, including new permanent and seasonal roads; and continued and increased marine vessel traffic and air traffic associated with shipping, scientific research, and recreation and tourism activities and business in the region. These activities, in combination with the no action or action alternatives, would contribute to the cumulative effects of development on subsistence resources and activities, because it would represent a net increase in the amount of land used for oil and gas and other development, in addition to a related increase in industrial activity, including air and ground traffic. Development of the NPR-A in combination with reasonably foreseeable future actions would likely result in impacts on resource abundance, resource availability, and harvester access for the six primary study communities. In the event of large-scale changes in resource migration, distribution, or abundance resulting from infrastructure development or a large-scale contamination event, impacts on resource abundance and availability could extend outside the NPR-A to the 7 peripheral and 42 caribou study communities.

The community of Nuiqsut would likely feel the greatest cumulative impacts from development within the NPR-A, as they are currently impacted by oil and gas development in and around the Colville River Delta,

and any future development to the west, south, or north of the community would further contribute to those impacts. Since 2000, oil and gas exploration and development has expanded into Nuiqsut's core subsistence use areas, including the Colville River Delta (Alpine drill sites CD1 through CD4) and to the north and west of the community toward Fish (Uvlutuuq) Creek (Alpine drill site CD5, GMT1, and GMT2). As a result, the frequency of conflicts between subsistence and development activities have increased (SRB&A 2019a). Further development of the NPR-A, in combination with existing and future developments, would continue a pattern of development infrastructure surrounding the Nuiqsut to the north, west, and southwest of the community and the perception by many in the community that they are being boxed in by development. Many in Nuiqsut perceive that they are also surrounded to the east by infrastructure associated with the Prudhoe Bay and Kuparuk developments, areas which are now considered off-limits to subsistence uses despite being considered part of the community's traditional use area (SRB&A 2018b). Development of the Nanushuk project would introduce infrastructure directly to the east of the Colville River Delta and leave only the southerly direction untouched by oil and gas infrastructure. Despite the lack of infrastructure to the south, oil and gas leasing and exploration has occurred to the south of the community and may result in oil and gas development in the future.

To date, major oil and gas development has not occurred within the core hunting areas for the other five primary study communities of Anaktuvuk Pass, Atqasuk, Point Lay, Utqiagvik, or Wainwright. However, these communities have experienced impacts from oil and gas exploration and other research and recreation-related activities in the NPR-A. Development of the currently proposed Willow Project within the Bear Tooth Unit would introduce a major oil and gas development in the eastern edge of Utqiagvik's hunting area and would facilitate additional oil and gas development farther west. The development would include up to five drill sites, a central processing facility, and some combination of gravel and ice roads that would connect Willow to the Alpine Development, thus resulting in impacts on subsistence related to development infrastructure and activity, particularly for the community of Nuiqsut. The development would also contribute to offshore impacts through the delivery of sealift modules via barges to Oliktok Dock. Further development of the NPR-A, particularly under Alternatives D and E, would likely result in the introduction of major oil and gas infrastructure and activity into core hunting areas for Utqiagvik and Atqasuk, and potentially for other communities as well. As development infrastructure expands into previously undeveloped areas, additional communities may experience impacts similar to those felt by the community of Nuiqsut and, eventually, the perception that they are surrounded by development.

Development activities and infrastructure can change hunting patterns and use areas over time by introducing barriers, impediments, or restrictions to access; by facilitating access to lesser-used hunting areas via roads; or by causing changes to the availability of subsistence resources in the vicinity of development. Nuiqsut's core subsistence use area has shifted west over time due to Prudhoe Bay development, and recent research has documented decreased use of traditional use areas, including the Nigliq Channel, in part due to development activities and infrastructure (SRB&A 2019a). Similar impacts could occur as development encroaches into the eastern portion of subsistence use areas for Utqiagvik and Atqasuk. While NPR-A subsistence users would adapt, to varying extents, to the changes occurring around them and may even continue to harvest resources at adequate levels, their connection to certain traditional areas may decrease over time.

Decreased use in some development areas may occur in conjunction with increased use of road-accessible areas. The Kuukpik Spur Road was constructed in 2014 and 2015 to facilitate access for Nuiqsut hunters to the Alpine development's roads. The road has provided access to residents, and the road system has seen increased use in every year since its construction. Despite the increased use, caribou harvests within the road-

connected area, as a percentage of the total reported harvest, have not seen a corresponding increase, indicating that the roads provide a countervailing effect that partially mitigates the impacts of roads and associated development on subsistence resource availability (SRB&A 2019a). Road development within the NPR-A, particularly if roads are connected to NPR-A communities, would likely provide benefits to access while also contributing to habitat fragmentation and changes in resource availability. Communities not connected to future roads may experience greater impacts on resource availability, as they would not experience the countervailing benefits to harvester access.

Increased development of infrastructure and development activity (e.g., traffic and human presence) on the North Slope would continue to cause displacement and habitat alteration/degradation for key subsistence resources, including caribou, furbearers, fish, and geese. Offshore activity associated with NPR-A development could also displace key marine resources such as fish, eiders, seals, and bowhead whales. Over time, these changes could affect the health and abundance of different subsistence resources on the North Slope. Under Alternatives C, D, and E, if development occurs in the core calving areas for the TCH or WAH, or if development reduces access to key insect relief habitats, the herds could experience an overall decline in productivity and abundance, thus affecting any of the 42 communities who use this herd. Because they open more lands to development in the vicinity of Teshekpuk Lake, Alternatives D and E would have the greatest potential to contribute to impacts on TCH habitat. In addition to the additive effects of increasing oil and gas infrastructure in the region, increased activity, including oil and gas exploration and seismic activity, air traffic, vessel traffic, scientific research, recreation, and sport hunting and fishing activities, would also contribute to subsistence impacts on Nuiqsut, Utqiagvik, Atqasuk, Point Lay, Wainwright, and Anaktuvuk Pass by increasing the frequency of noise and air traffic disturbances, vessel disturbances, and interactions with non-local researchers, workers, and recreationists. Increased noise disturbances would contribute to existing impacts on subsistence resource availability.

The cumulative effects of current and future activities related to restrictions on access to traditional areas, changes in hunting patterns, and reduced resource abundance and availability are likely to continue as long as oil and gas exploration and development continues on the North Slope.

Evaluation of the Availability of Other Lands for the Purpose Sought to be Achieved

The evaluation of the cumulative case is identical to that provided in Section E.2.1 for Alternative A.

Evaluation of Other Alternatives that would Reduce or Eliminate the Use, Occupancy, or Disposition of Public Lands Needed for Subsistence Purposes

The evaluation of the cumulative case is identical to that provided above in Section E.2.5.

Findings for Alternatives A, B, C and the Cumulative Case

1. **Reductions in the availability of subsistence resources described above for Alternatives A, B, and C and the cumulative case may significantly restrict subsistence uses for the communities of Nuiqsut, Utqiagvik, Wainwright, and Point Lay.**
2. **Limitations on subsistence user access described above for Alternatives A, B, and C and the cumulative case may significantly restrict subsistence uses for the community of Nuiqsut.**

Because these effects may reach the level of a significant restriction, a positive determination pursuant to ANILCA Section 810 is required and hearings must be held with subsistence users from affected communities before final determinations, described below in Section E.4, can be made.

Rationale for the finding of reductions in the availability of subsistence resources in the cumulative case

In the cumulative case, the availability of marine mammals, particularly whales, for subsistence harvest may decrease as a result of the development and activity on State and federal offshore leases in the Beaufort and Chukchi Seas. Development of offshore leases in both State and federal waters would overlap in time and space with barge traffic associated with onshore development in the NPR-A. Bowhead whales are one of the most important species for subsistence and cultural practices for Arctic communities, and whale harvest often provides the largest portion of a community's yearly protein. Although development of offshore leases in conjunction with barge traffic traveling to the NPR-A is unlikely to have significant biologic effects on whales, the noise and activity associated with development and operation on offshore leases could deflect whales further from shore as they migrate and cause a major redistribution of that resource from a subsistence perspective, leading to increased expense and risk in order to harvest whales in adequate amounts.

For the community of Nuiqsut, terrestrial development on State lands in conjunction with development in the NPR-A is also expected to produce a major redistribution of caribou in Nuiqsut's traditional subsistence use areas. The rationale for this finding is the same as under Alternative A.

Rationale for the finding of limitations on subsistence user access in the cumulative case

The rationale for this finding is the same as for the base case for all alternatives, but development on State and private lands near the NPR-A will increase the magnitude of these impacts. Development on State lands of the Nanushuk project along the Colville River, as well as existing developments such as the Alpine development and Kuparuk, would cumulatively restrict access for Nuiqsut hunters in conjunction with development in the NPR-A. Subsistence harvesters have reported difficulty navigating the Nigliq Channel bridge crossing by boat, and developments on State lands do not all have access ramps to mitigate the impacts of roads, forming a physical barrier to overland travel. Discharge of firearms would likely be prohibited within a certain radius or in the direction of infrastructure on State lands, and residents have avoided hunting in certain areas due to concerns about human safety and damage to property. Leases on State lands have a 0.5-mile development setback along the Colville River, a heavily used subsistence corridor for caribou hunting. Pipelines or roads along the Colville River could affect Nuiqsut residents' hunting activities if they are unable to shoot inland from the river due to the presence of pipelines, roads, camps, and drill pads. Cumulatively, the physical and legal restrictions on access resulting from development on State lands and in the NPR-A constitutes extensive interference with access to traditional subsistence use areas for Nuiqsut under Alternatives A, B, C and the cumulative case.

Findings for Alternative D, E, and the Cumulative Case

1. **Reductions in the abundance of subsistence resources described above for Alternative D and E and the cumulative case may significantly restrict subsistence uses for the communities of Nuiqsut, Utqiagvik, Atqasuk, Wainwright, and Anaktuvuk Pass.**
2. **Reductions in the availability of subsistence resources described above for Alternative D and E and the cumulative case may significantly restrict subsistence uses for the communities of Nuiqsut, Utqiagvik, Wainwright, and Point Lay.**
3. **Limitations on subsistence user access described above for the cumulative case may significantly restrict subsistence uses for the community of Nuiqsut.**

Because these effects may reach the level of a significant restriction, a positive determination pursuant to ANILCA Section 810 is required and hearings must be held with subsistence users from affected communities before final determinations, described below in Section E.4, can be made.

Rationale for the finding of reductions in the abundance of subsistence resources in the cumulative case

The rationale for this finding is the same as under Alternative D.

Rationale for the finding of reductions in the availability of subsistence resources in the cumulative case

The rationale for this finding is the same as under Alternatives A, B, C and the cumulative case.

Rationale for the finding of limitations on subsistence user access in the cumulative case

The rationale for this finding is the same as under Alternatives A, B, C and the cumulative case.

E.3 NOTICE AND HEARING

ANILCA Section 810(a) provides that no "withdrawal, reservation, lease, permit, or other use, occupancy or disposition of the public lands which would significantly restrict subsistence uses shall be effected" until the federal agency gives the required notice and holds a hearing in accordance with ANILCA Sections 810(a)(1) and (2). BLM provided notice in the *Federal Register* that it made positive findings pursuant to ANILCA Section 810 that Alternatives A, B, C, D and the cumulative case presented in the NPR-A IAP Draft EIS met the "may significantly restrict" threshold. As a result, public hearings were held in the potentially affected communities of Anaktuvuk Pass, Atqasuk, Nuiqsut, Point Lay, Utqiagvik, and Wainwright in order to solicit public comments from the subsistence users in potentially affected communities. Notice of these hearings were provided in the *Federal Register* and by way of the local media, including the Arctic Sounder newspaper, and KBRW, the local Barrow radio station with coverage to all villages on the North Slope. Meeting dates and times were posted on BLM's website at www.blm.gov/alaska.

E.4 SUBSISTENCE DETERMINATIONS UNDER THE ANILCA SECTIONS 810(A)(3)(A), (B), AND (C)

ANILCA Section 810(a) provides that there would be no "withdrawal, reservation, lease, permit, or other use, occupancy or disposition of the public lands which would significantly restrict subsistence uses," until the federal agency gives the required notice and holds a hearing, in accordance with ANILCA Section 810(a)(1) and (2), and makes the following three determinations required by ANILCA Section 810(a)(3)(A), (B), and (C): 1) that such a significant restriction of subsistence use is necessary, consistent with sound management principles for the use of the public lands; 2) that the proposed activity would involve the minimal amount of public lands necessary to accomplish the purposes of such use, occupancy, or other such disposition; and 3) that reasonable steps would be taken to minimize adverse impacts on subsistence uses and resources resulting from such actions (16 U.S.C. 3120(a)(3)(A), (B), and (C)). The BLM has found in this evaluation that all alternatives and the cumulative case will result in a significant restriction to subsistence uses. The BLM undertook the notice and hearing procedures required by ANILCA Section 810 (a)(1) and (2) in conjunction with releasing the Draft EIS in order to solicit public comment from the potentially affected communities of Anaktuvuk Pass, Atqasuk, Nuiqsut, Point Lay, Utqiagvik, and Wainwright.

The determinations below satisfy the requirements of ANILCA Section 810(a)(3)(A), (B), and (C).

E.4.1 Significant Restriction of Subsistence Use is Necessary, Consistent with Sound Management Principles for the Utilization of Public Lands

The BLM is undertaking a revision to the NPR-A IAP/EIS to determine the appropriate management of all BLM-managed lands in the NPR-A in a manner consistent with existing statutory direction and Secretarial Order 3352. Secretarial Order 3352 directed the development of a schedule to "effectuate the lawful review

and development of a revised IAP for the NPR-A that strikes an appropriate balance of promoting development while protecting surface resources." While Secretarial Order 3352 directs the development of a schedule for the review and development of a revised IAP for the NPR-A, the order does not inform the purpose of the underlying actions that are being considered in this IAP/EIS. The Naval Petroleum Reserves Production Act of 1976, as amended, and its implementing regulations require oil and gas leasing in the NPR-A and the protection of surface values to the extent consistent with exploration, development, and transportation of oil and gas.

It was in furtherance of these objectives, together with other management guidance found in the Naval Petroleum Reserves Production Act, Federal Land Policy and Management Act, National Environmental Policy Act, and ANILCA that this IAP/EIS was undertaken. After considering a broad range of alternatives, Alternative E was developed to fulfill the purpose and need of this planning effort, while incorporating protective measures that serve to minimize impacts on important subsistence resources and subsistence-use areas. Alternative E considers the necessity for economically feasible development while providing effective protections to minimize any impacts on subsistence resources and uses. Under Alternative E, the lease stipulations and required operating procedures that accompany the alternative serve as the primary mitigation measures to be used to reduce the impact of the proposed activity on subsistence uses and resources.

The BLM has considered and balanced a variety of factors with regard to the proposed activity on public lands, including, most prominently, the comments received during the public meetings and hearings, which stressed the importance of protecting essential caribou movement/migration corridors for both the Teshekpuk Lake and Western Arctic caribou herds. The BLM has determined that the significant restrictions that may occur under Alternative E, when considered together with all the possible impacts of the cumulative case, is necessary, consistent with sound management principles for the use of these public lands, and for BLM to fulfill the management goals for the planning area as guided by Secretarial Order 3352 and the statutory directives in the Naval Petroleum Reserves Production Act, Federal Land Policy and Management Act, and other applicable laws.

E.4.2 The Proposed Activity will involve the Minimal Amount of Public Lands Necessary to Accomplish the Purposes of such Use, Occupancy, or Other Disposition

The BLM has determined that Alternative E involves the minimal amount of public lands necessary to accomplish the purposes of the planning effort—namely, to consider consistent oil and gas leasing stipulations and required operating procedures across the entire NPR-A, while providing special protections for specific habitats and site-specific resources and uses, and allowing the opportunity for necessary infrastructure to support oil and gas exploration and development. Alternatives that varied between opening no additional lands, fewer additional lands, and some additional lands were analyzed.

Alternative E, including its stipulations and required operating procedures, emphasizes the protection of surface resources while making approximately 18.7 million acres of federally owned subsurface (82 percent of the total in NPR-A) available for oil and gas leasing. Facility footprints are required to be minimized and permittees are encouraged to use existing infrastructure. Alternative E would adjust the boundaries of two Special Areas to account for changes in the distribution of important surface resources and would eliminate the Colville River Special Area. Alternative E makes available for leasing the entirety of the Teshekpuk Lake Special Area and partially protects critical habitat for migratory birds and the Teshekpuk Caribou Herd through lease stipulations and required operating procedures. A core area in the Utukok River Uplands Special Area would also be unavailable for leasing; this area includes important calving and insect-relief habitat for the Western Arctic Caribou Herd. Major coastal waterbodies that are integral for subsistence uses and needs

such as Admiralty Bay, Wainwright Inlet, Peard Bay, and Kasegaluk Lagoon are unavailable for leasing or are available with NSO under Alternative E.

E.4.3 Reasonable Steps will be Taken to Minimize Adverse Impacts upon Subsistence Uses and Resources Resulting from such Actions.

When BLM began its National Environmental Policy Act scoping process, it internally identified subsistence as one of the major issues to be addressed. The BLM gathered information during consultation with Native entities, regional working groups, cooperating agencies, and during public meetings to develop protective measures that minimize adverse impacts on subsistence uses. These include:

- ROP E-1 protects subsistence use and access to terrestrial subsistence hunting and fishing areas.
- ROP E-3 protects subsistence use and access to marine subsistence hunting and fishing areas.
- ROP E-7 sets standards for road and pipeline design to ensure unimpeded travel of subsistence users.
- ROP F-4 reduces the impacts of air traffic on subsistence users.
- ROP H-1 requires consultation with affected communities to prevent unreasonable conflicts with subsistence users.
- ROP H-3 prevents competition from outside hunters for subsistence resources.
- Stipulation K-1 establishes development setbacks for important subsistence rivers.

Given these steps, as well as other lease stipulations and required operating procedures that serve to directly protect various subsistence resources or their habitat, the BLM has determined that Alternative E includes reasonable steps to minimize adverse impacts on subsistence uses and resources.

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Appendix F

Approach to the Environmental Analysis

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MAP

ACRONYMS AND ABBREVIATIONS

	Full Phrase
ASTAR	Arctic Strategic Transportation and Resources
BLM	Bureau of Land Management
CD	Colville Delta
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CPF	central processing facility
EIS	environmental impact statement
GHG	greenhouse gas
GMT-1	Greater Mooses Tooth-1
GMT-2	Greater Mooses Tooth-2
IAP	integrated activity plan
NEPA	National Environmental Policy Act of 1969
NPR-A	National Petroleum Reserve-Alaska
NSB	North Slope Borough
OHV	off-highway vehicle
PFYC	Potential Fossil Yield Classification
RFD	reasonably foreseeable development
RFFA	reasonably foreseeable future action
ROP	required operating procedure
ROW	right-of-way
STP	seawater treatment plant
U.S.	United States
VRM	visual resource management
VSM	vertical support member

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Appendix F. Approach to the Environmental Analysis

F.1 INTRODUCTION

The impact assessment method conforms to the guidance found in the following sections of the Council on Environmental Quality (CEQ) regulations for implementing the National Environmental Policy Act of 1969 (NEPA): 40 Code of Federal Regulations (CFR) 1502.24 (Methodology and Scientific Accuracy); 40 CFR 1508.7 (Cumulative Impact); and 40 CFR 1508.8 (Effects). CEQ regulations require that agencies "rigorously explore and objectively evaluate" the impact of all alternatives. The action alternatives presented in this environmental impact statement (EIS) offer specific areas of the National Petroleum Reserve in Alaska (NPR-A) as available for lease sale,[1] rather than project-level exploration and development of oil and gas. Because of this, the focus of the analysis is on the potential impacts of these future phases, which may follow leasing. Since existing leases are from 1999 to 2019, past integrated activity plan (IAP) lease stipulations are in place for different leases. To analyze the effect of stipulations that are less protective than this IAP, the BLM examined existing leased areas as if they were open, subject to standard stipulations. The existing leased areas' environmental impacts were analyzed in past IAPs.

F.2 DIRECT AND INDIRECT IMPACTS

Direct and indirect impacts are considered in Chapter 3 of the Final IAP/EIS, consistent with direction provided in 40 CFR 1502.16.

> **Direct effects**—These are caused by the proposed action and occur at the same time and place (40 CFR 1508.8). Two examples of direct effects are wetlands are filled when placing gravel pads and the direct mortality of wildlife or vegetation.
>
> **Indirect effects**—These are caused by the proposed action and are later in time or farther removed in distance but are still reasonably foreseeable. Indirect effects "may include growth inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems" (40 CFR 1508.8). Indirect effects are caused by the proposed action but do not occur at the same time or place as the direct effects.

Potential effects are quantified where possible using geographic information systems and other applications; in the absence of quantitative data, best professional judgment prevails. Impacts are sometimes described using ranges of potential impacts or in qualitative terms.

The standard definitions for terms used in the analysis are as follows, unless otherwise stated:

> **Context**—Describes the area or location (site-specific, local, program area-wide, or regional) in which the impact could occur. Site-specific impacts would occur at the location of the action, local impacts would occur in the general vicinity of the program area, program area-wide impacts would

[1]Subject to applicable laws, terms, conditions, stipulations of the lease, and project-specific environmental review and permits.

affect most or all of the program area, and regional impacts would extend beyond the program area boundaries.

Duration—Describes the duration over which an effect would occur, either short term or long term. Short term is anticipated to begin and end within the first 5 years after the action is implemented; long term lasts beyond 5 years to the end of or beyond the 20-year program time frame.

Intensity—Impacts are discussed using quantitative data, where possible.

F.3 CUMULATIVE IMPACTS

The cumulative impact analysis considers impacts of a proposed action and its alternatives that may not be consequential when considered individually, but, when combined with impacts of other actions, they may be consequential. As defined by CEQ regulations (40 CFR 1508.7 and 1508.25(a)(2)), a cumulative impact is ". . . the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions (RFFAs) regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time."

The purpose of the cumulative impacts analysis is to determine if the impacts of the actions considered in this EIS, together with other past, present, and RFFAs, could interact or accumulate over time and space, either through repetition or combined with other impacts. Another purpose is to determine under what circumstances and to what degree they might accumulate.

Additional requirements of other regulatory agencies would further reduce any cumulative impacts.

F.3.1 Method

The method used for cumulative impacts analysis in this EIS consists of the following steps:

- Identify issues, characteristics, and trends in the affected environment that are relevant to assessing cumulative effects of the action alternatives—This includes discussions on lingering effects from past activities that demonstrate how they have contributed to the baseline condition for each resource. This information is summarized in Chapter 3 of the Final IAP/EIS.
- Describe the potential direct and indirect effects of future oil and gas exploration, development, and production—As noted above, issuing oil and gas leases would have no direct impacts on the environment, because by itself a lease does not authorize any on-the-ground oil and gas activities; however, issuing a lease represents an irretrievable commitment of oil and gas resources for potential future exploration and development, subject to further environmental review and authorization, that would result in impacts on the environment. These are considered potential indirect impacts of leasing. Such post-lease activities could include seismic and drilling exploration, development, and transportation of oil and gas in and from the NPR-A; therefore, the analysis in Chapter 3 of the Final IAP/EIS for each resource is of potential direct, indirect, and cumulative impacts from on-the-ground post-lease activities.
- Define the spatial (geographic) and temporal (time frame) for the analysis—This time frame may vary between resources, depending on the historical data available and the relevance of past events to the current baseline.
- Identify past, present, and RFFAs, such as other types of human activities and natural phenomena that could have additive or synergistic effects; summarize past and present actions, within the

defined temporal and spatial time frames; and identify any RFFAs that could have additive, countervailing, or synergistic effects on identified resources.

- Use a specific method to screen all of the direct and indirect effects, when combined with the effects of external actions, to capture those synergistic and incremental effects that are potentially cumulative—Both adverse and beneficial effects of external factors are assessed and then evaluated in combination with the direct and indirect effects for each alternative on the various resources to determine if there are cumulative effects.
- Evaluate the impact of the potential cumulative effects and assess the relative contribution of the action alternatives to cumulative effects.
- Discuss the rationale for determining the impact rating, citing evidence from the peer-reviewed literature, and quantitative information, where available. When confronted with incomplete or unavailable information, ensure compliance with 40 CFR 1502.22.

The analysis also considers the interaction among the impacts of the proposed action with the impacts of various past, present, and RFFAs, as follows:

- Additive—The impacts of actions add together to make up the cumulative impact
- Countervailing—The impacts balance or mitigate the impacts of other actions
- Synergistic—The impact of the actions together is greater than the sum of their individual impacts

In this EIS, both the temporal and geographic scope of the cumulative impact analysis could vary according to the resource under consideration. Generally, the appropriate time frame for cumulative impacts analysis spans from the 1970s through full realization of the hypothetical development scenario (Appendix B of the Final IAP/EIS). The BLM anticipates that to occur approximately 70 years after the Record of Decision for this EIS is signed; it recognizes that the time frame for production could be more or less than 70 years, given the speculative nature of the hypothetical development scenarios.

The geographic scope generally encompasses the North Slope of Alaska and the near-shore marine environment but extends beyond these areas for some resources, such as terrestrial wildlife. Details associated with the impact indicators, geographic scope, and analysis assumptions for each resource are found in **Section F.4**, below.

F.3.2 Past, Present, and RFFAs

Relevant past and present actions are those that have influenced the current condition of the resource. For the purposes of this EIS, past and present actions are both human-controlled and naturally occurring events. Past actions were identified using agency documentation, NEPA analyses, reports and resource studies, peer-reviewed literature, and best professional judgment.

The RFFA is used in concert with the CEQ definitions of indirect and cumulative effects, but the term itself is not defined further. Most regulations that refer to "reasonably foreseeable" do not define the meaning of the words but do provide guidance on the term. For this analysis, RFFAs are those that are external to the proposed action and are likely (or reasonably certain) to occur, although they may be subject to a degree of uncertainty. Typically, they are based on such documents as plans, permit applications, and fiscal appropriations. RFFAs considered in the cumulative effects' analysis consist of projects, actions, or developments that can be projected, with a reasonable degree of confidence, to occur over the next 70 years.

Recent environmental reports, surveys, research plans, NEPA compliance documents, and other source documents have been evaluated to identify these actions. RFFAs were assessed to determine if they were speculative and would occur within the analytical time frame of the EIS. Projects and activities considered in the cumulative effects analysis are summarized in **Table F-1** and shown in **Map F-1**. These projects and activities are discussed in more detail below.

Table F-1
Past, Present, and RFFAs Considered in the Cumulative Effects Analysis

Category	Area	Actions and Activities	Description
Oil and gas exploration, development, and production	• Onshore North Slope • State and federal waters (Beaufort Sea, Chukchi Sea, Smith Bay, Harrison Bay) • Western Canadian Arctic	• Geological and geophysical surveys • Infrastructure development • Gravel mining, e.g., Arctic Slope Regional Corporation Gravel Mine • Geotechnical borehole surveys • Construction and maintenance • Exploration • Production wells • Surface, air, and marine traffic • Scientific research, directly related to oil and gas, for avian studies, bathymetry, cultural resources, and fisheries	Competitive oil and gas lease sales, lease exploration, and development have occurred across the North Slope; continued activity is expected. The number of flights by cargo-rated planes associated with oil and gas development tends to increase dramatically during summer. See below for an additional discussion.
Transportation (separate from oil and gas)	• Surface • Air • Marine	• Roads and vehicular traffic in communities • International marine vessel traffic • Shipping and barging to Deadhorse, Kaktovik, Point Hope, Point Lay, Utqiagvik, and Wainwright • Aircraft traffic • Ambler Road	Surface, air, and marine transportation services are available in the program area. Federal, state, and tribal governments maintain plans for ongoing maintenance and development. Marine transportation is projected to increase with decreases in sea ice associated with climate change. See below for an additional discussion.

Category	Area	Actions and Activities	Description
Subsistence activities	• Utqiagvik • Nuiqsut • Wainwright • Atqasuk • Kaktovik	• Hunting • Trapping • Fishing • Whaling • Sealing • Traveling • Berry picking	Anticipate a continuation of traditional past and present subsistence practices (see Section 3.4.3 of the Final IAP/EIS). See below for an additional discussion.
Recreation and tourism	• Arctic National Wildlife Refuge • Various locations across the North Slope • Beaufort Sea and nearshore areas • North American Arctic	• Wildlife and scenic viewing and photography • Sport and commercial hunting and fishing • Boating and river recreation • Camping • Hiking • Ecotourism	Past and present recreational uses of the program area are expected to continue (see Section 3.4.6 of the Final IAP/EIS). See below for an additional discussion.
Scientific research	• Onshore North Slope • Nearshore waters • Outer continental shelf waters • Colville River Delta • Teshekpuk Lake • Arctic National Wildlife Refuge	• Arctic National Wildlife Refuge studies • Threatened and endangered species studies • Biological, geophysical, archaeological, and socioeconomic surveys • Stock and harvest assessments	Scientific research and surveys have occurred throughout the program area and are expected to continue. See below for an additional discussion.
Community development	• Utqiagvik • Nuiqsut • Atqasuk • Kaktovik • North Slope Borough (NSB)	• Demographic/population change • Migration • Infrastructure development projects	Anticipate a continuation of infrastructure development projects. See below for an additional discussion.
Climate change	Global	Trends in climate change are described in the Greater Mooses Tooth-2 (GMT2) Supplemental EIS (BLM 2018, Section 3.2.4) and are projected to continue and interact with other RFFAs in the program area.	Long-term changes in temperature and precipitation, with associated changes in the atmosphere, water resources, permafrost, vegetation, wetlands, fish and wildlife habitat, and subsistence practices

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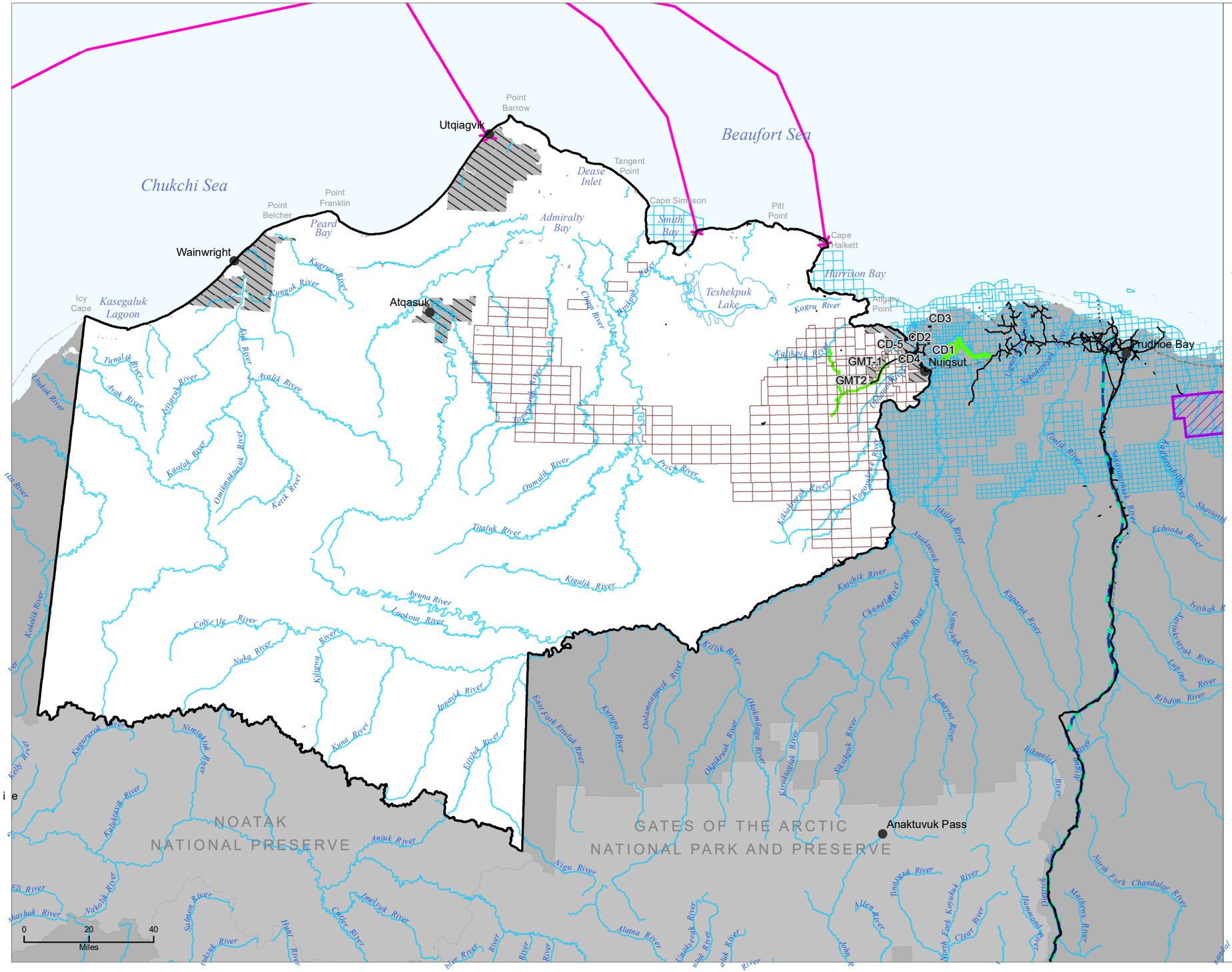

- Current on- or offshore State of Alaska lease
- Authorized BLM oil and gas lease tract
- Proposed oil and gas infrastructure
- Alaska LNG Project (liquefied natural gas)
- Alaska Standalone Gas Pipeline (similar route as the AK LNG Project)
- Potential marine vessel transportation route
- Staines Seismic Project
- National Petroleum Reserve-Alaska
- Outside the BLM's surface authority

Data source: BLM GIS 2019
Print date: 04/23/2020

Map F-1

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Oil and Gas Exploration, Development, and Production

Onshore oil development has been a primary agency of industrial change on the North Slope. Oil and gas exploration has occurred on the North Slope since the early 1900s, and oil production started at Prudhoe Bay in 1977. Onshore gas production from the Barrow Gas Field began over 60 years ago. Associated industrial development has included the creation of industry-supported airfields at Deadhorse and Kuparuk and an interconnected industrial infrastructure that includes roads, pipelines, production and processing facilities, gravel mines, and docks. Air traffic is also associated with oil and gas development, primarily from May through August, involving small propeller-driven aircraft and larger cargo-rated planes, such as the DC-6 and C-130. Oil and gas activities that have occurred in the Beaufort Sea are exploration wells and seismic surveys, geohazard surveys, geotechnical sampling programs, and baseline biological studies and surveys.

Both onshore and offshore reasonably foreseeable future oil and gas activities are considered in the cumulative effects' analysis. It includes a discussion of activities on federal mineral estate in the NPR-A that have already begun or where NEPA compliance has been completed, as well as activities on non-federal mineral estate in and next to the NPR-A. The discussion does not include small discoveries and undiscovered resources that are unlikely to be developed within the temporal scope of this EIS.

Activities anticipated to occur on federal mineral estate in the NPR-A, where the NEPA compliance process has not yet begun, are accounted for in the reasonably foreseeable development (RFD) scenario (see Appendix B of the Final IAP/EIS) and are analyzed as part of direct/indirect impact analysis. The impacts of present projects described below are accounted for in the affected environment sections (see Chapter 3 of the Final IAP/EIS).

The following present and reasonably foreseeable future oil and gas projects are included in the cumulative effects' analysis, either through referencing the affected environment discussion or through analysis in the cumulative effects section:

- **SAExploration 3-Dimensional Seismic Exploration Surveys (reasonably foreseeable future)—** A proposed 3-dimensional seismic exploration of the Coastal Plain of the Arctic Refuge that would begin the winter after it is approved. The project would include program area access from Deadhorse, fuel storage, and up to two mobile camps, each capable of housing up to 160 people. There would be 360 miles of snow trails associated with moving as many as two camps across the program area. There also would be approximately 50 trailers, including support trailers that make up a camp. Fuel would be delivered daily by ground vehicles to the camps. Crews would be changed twice weekly, either by aircraft or ground vehicle. Seismic operations would be conducted using 12 to 15 rubber-tracked vibrators and 20,000 to 25,000 wireless autonomous recording devices for each of the two crews. Vibroseis vehicles would be positioned 41, 25, and 200 feet from an adjacent receiver point on a given line. In a typical square mile, there would be 4 linear miles of receivers and 8 linear miles of source.
- **Liberty (reasonably foreseeable future)—**The Liberty Prospect is 5 miles offshore in about 20 feet of water, inside the Beaufort Sea's barrier islands. It is 20 miles east of Prudhoe Bay and about 8 miles east of the Hilcorp Alaska LLC-operated Endicott oil field. Development would include constructing a gravel island for production facilities, including 16 wells. Oil produced from the island would be piped through a subsea pipe to an elevated 1.5-mile-long onshore pipeline to a tie-in with the onshore Badami oil pipeline.

- **Point Thomson (present)—**Point Thomson, a gas condensate field, produces condensate that is shipped via a 22-mile oil pipeline to a tie-in into the Badami Oil Pipeline that then transports the oil to Pump Station 1 on the Trans-Alaska Pipeline. The drill site and production facilities are on State onshore lands just west of the Arctic Refuge. The project includes production pads, process facilities, an infield road system, a pipeline, infield gathering lines, and an airstrip.
- **Nanushuk (reasonably foreseeable future)—**The project is southeast of the East Channel of the Colville River, approximately 52 miles west of Deadhorse and about 6.5 miles from Nuiqsut (at the southernmost project boundary). The project will include construction of the Nanushuk pad, comprised of drill site 1, a central processing facility (CPF), drill site 2, drill Site 3, an operations center pad, infield pipelines, the export/import Nanushuk pipeline, infield roads, an access road, a tie-in pad, and a potable water system. The project also includes temporary discharges to 5.8 acres of jurisdictional waters of the United States for screeding[2] at the Oliktok Dock.
- **Alpine Colville Delta (CD) 5 (present)**—This Alpine field satellite development drill site is on Alaska Native Claims Settlement Act Corporation lands near Nuiqsut. It is the first commercial oil production from the NPR-A and went into production in late 2015. As a satellite to the Alpine CPF, CD5 has only minimal on-site processing facilities; however, it required 6 miles of gravel road, 4 bridges, and 32 miles of pipelines. It includes a gravel road and natural gas pipeline from Alpine CPF into Nuiqsut. ConocoPhillips Alaska, Inc., plans to continue drilling an additional 18 wells at CD5 after the original 15 wells are completed, for an eventual total of 33 wells.
- **Narwhal Reservoir (reasonably foreseeable future)—**This is a potential future project located primarily in the Colville River Unit. Production from this reservoir could occur from existing pads, such as the CD1 or CD4 pads, from a drill site at or near the location of the 2018 Putu exploration well, or a combination of these. If development occurs from an existing pad, there may be accompanying pad expansion. If a new drill site is constructed, ConocoPhillips Alaska expects that it would connect by road and pipeline to existing Alpine infrastructure. ConocoPhillips Alaska anticipates that any fluids produced from an existing or new drill site would be processed at the Alpine CPF.
- **Greater Mooses Tooth (present/reasonably foreseeable future)—**The Greater Mooses Tooth-1 (GMT1) project was the first commercial development on federal lands in the NPR-A; the first oil was produced in October 2018. The GMT1 development involves an 11.8-acre drilling pad, with a 7.6-mile-long road, two bridges, and pipelines that connect to Alpine CPF through the CD5 road and pipeline extension. The drilling pad can support up to 33 wells, but initially it will have only nine wells. Production from GMT1 is expected to peak at 25,000 to 30,000 barrels of oil per day. The GMT2 project is also on federal lands in the NPR-A. The project could include up to 48 wells drilled from a 14-acre drill pad, 8 miles to the southwest of GMT1. The proposed 8.2-mile gravel road and pipeline would connect through GMT1 and on to Alpine CPF through the existing CD5 extension. Construction for GMT2 began in early 2019. GMT2 anticipated peak production will be higher than GMT1 at 35,000 to 40,000 barrels of oil per day.
- **Willow (reasonably foreseeable future)—**The Willow oil and gas prospect is on federal oil and gas leases that ConocoPhillips holds in the Bear Tooth Unit of the NPR-A, approximately 30 air miles west of Nuiqsut. The proposed project includes the construction, operation, and maintenance of up to five drill sites, with 251 total wells across the five pads (40 to 70 wells per drill pad), a

[2]Screeding is the use of a straight surface or purpose-made tool to smooth and flatten concrete or asphalt after it is placed on a surface.

CPF, an operations center pad, gravel roads, ice roads and ice pads, one or two airstrips (varies by alternative), pipelines, and a gravel mine site on BLM-managed lands in the NPR-A. In its master development plan/EIS, the BLM will analyze an option for connecting a module transfer island to facilitate module delivery via sealift barges. This would occur in waters managed by the State of Alaska or the marine traffic ending at Oliktok Dock, using existing gravel roads and ice roads. First production is anticipated to be around 2025.

- **State of Alaska Offshore Leases (present)—**The State of Alaska has issued 69 leases in state waters off the coast of NPR-A. There are 26 leases in Smith Bay, 24 in upper Harrison Bay, and 19 in lower Harrison Bay.
- **Greater Prudhoe Bay/Kuparuk (reasonably foreseeable future)—**This main producing part of the North Slope is expected to have numerous small developments, as smaller accumulations of oil are discovered and can be produced using existing infrastructure.
- **Alaska Liquid Nitrogen Gas Project (reasonably foreseeable future)—**This development would include a gas treatment plant at Prudhoe Bay, a 42-inch-diameter, high-pressure, 800-mile pipeline, and eight compressor stations to move the gas to a proposed liquefaction plant at Nikiski, on the Kenai Peninsula. The pipeline would be designed to accommodate an initial mix of gas from the Prudhoe Bay and Point Thomson fields and room to accommodate other gas fields in the decades ahead. The Alaska LNG project would be mutually exclusive to the Alaska stand-alone gas pipeline (below), meaning only one, if any, would be built.
- **Alaska Stand Alone Gas Pipeline (reasonably foreseeable future)—**This pipeline is envisioned to be a reliable, affordable energy source to Alaskan communities. Production from this project would emphasize in-State distribution, although surplus gas would also likely be condensed and exported. The 727-mile, low pressure pipeline route would generally parallel the Trans-Alaska Pipeline System and the Dalton Highway corridor. The pipeline would be underground, with approximately five elevated stream crossings, compressor stations, possible fault crossings, pigging facilities, and off-take valve locations. A gas conditioning facility would need to be constructed near Prudhoe Bay and would likely require one or more large equipment modules to be offloaded at the west dock loading facility. Shipments to the west dock would likely require improving the dock facilities and dredging to deepen the navigational channel to the dock head. The Alaska Stand Alone Gas Pipeline would be mutually exclusive to the Alaska LNG Project (above), meaning only one, if any, would be built.

  Arctic Strategic Transportation and Resources (ASTAR)—This program is a collaboration between the State of Alaska, the NSB, and other North Slope stakeholders. Its purposes are to prioritize community needs and to identify infrastructure opportunities that offer the most cumulative benefit for the region.

  ASTAR will consider a broad range of potential infrastructure projects, such as permanent and seasonal roads, utilities, new or updated community facilities, fiber optics, trail marking programs, airport facilities, and improved wastewater infrastructure (proposed road networks do not currently connect to Arctic Village or Venetie). The planning area includes the entire NSB boundary, including State lands, the NPR-A, and the Arctic Refuge.

  The effects of the ASTAR program could include increasing the cultural and community connectivity, lowering the cost of goods and services, preserving or enhancing subsistence traditions, increasing health and safety for NPR-A residents and stakeholders, increasing access to

education, improving workforce development opportunities, and reducing environmental impacts by identifying potential ways for the public and private project owners to work together.

The ASTAR team is also working to identify and fill data gaps, such as gravel material locations, water resources, and LiDAR, needed to advance projects in the region. Information collected from ASTAR will be made public, with the intent of assisting with future infrastructure decisions.

- **Umiat Development**—The BLM has received an application for an exploration unit in the Umiat area. All requirements and obligations under 43 CFR 3137 would need to be met to maintain the unit and lead to development. As per regulation, once a unit is established, the operator would have 10 years to reach production. Road access would be necessary to support future development. The most likely routes would depend on the closest infrastructure. If a road were constructed under the ASTAR program, under one proposal, it would be through Umiat and would connect to the Dalton Highway near Franklin Bluffs. If this road does not get built, the operator may choose to construct an approximately 70-mile road north and connect it to a point near the proposed Willow development. Due to distance from other infrastructure, a CPF would be built at Umiat.
- **Federal Offshore Leasing Program in the Chukchi and Beaufort Seas**—All of the Chukchi Sea and most of the Beaufort Sea are unavailable for leasing and development. Leasing in the Chukchi and Beaufort Seas is governed by the current Bureau of Ocean Energy Management 5-year leasing plan, which will expire in 2022. The issue of whether this closure can be lifted is being litigated at the 9th Circuit Court of Appeals. If the Department of the Interior prevails in the litigation, a leasing plan would likely be developed that would offer tracts for sale in the Chukchi Sea and in those portions of the Beaufort Sea currently closed to leasing.

Transportation

In addition to air, land, and marine transport associated with oil and gas activities, there is frequent marine and air traffic associated with coastal communities on the North Slope. It is reasonable to assume that trends associated with transportation to facilitate the maintenance and development of coastal communities will continue. Typically, vessels offshore of the program area are those that support oil and gas industries, barges or cargo vessels used to supply coastal villages, smaller vessels used for hunting and location transportation during the open water period, research vessels, and a limited number of recreational vessels. Passenger and air cargo flights between Fairbanks and each of the communities across the North Slope often include several scheduled flights of small propeller-driven aircraft. Government agencies, researchers, and recreationists often charter aircraft for travel and research. Aircraft traffic is expected to continue; levels of traffic may increase because of increased industrial activity, tourism, and community development.

The proposed Ambler Road project proponent would construct a new 211-mile roadway on the south side of the Brooks Range, extending west from the Dalton Highway to the south bank of the Ambler River. The road would be open only to mining-related industrial use and would be closed to the public. It would include bridges, material sites, maintenance stations, and related infrastructure and utilities.

Subsistence Activities

Subsistence activities occur throughout the NPR-A and in the surrounding areas. Subsistence hunters primarily use off-highway vehicles (OHVs), boats, and snow machines for access. The types of subsistence uses and activities that were described in Section 3.4.3 of the Final IAP/EIS are expected to continue. Current and past hunting, gathering, fishing, and trapping would be similar in the types of activities and areas used by the communities in the program area in the foreseeable future.

Recreation and Tourism

Recreational fishing in the NPR-A occurs predominantly opportunistically by people in the area, primarily for recreation, such as big game hunting or float trips. As of 2019, there were no commercial sport fishing recreation permit requests or authorizations for the area.

The NPR-A offers opportunity, but limited access, for primitive unconfined recreation, including backpacking and hiking, wildlife viewing, hunting, fishing, and boating. There are no federal, State, or NSB public recreational facilities in the project area. The lack of a developed public road system into or through the area limits recreational access almost exclusively to charter aircraft during summer or snow machines or dogsleds during winter. In 2018, there were six special recreational permit holders authorized to conduct hunting and viewing of scenery and wildlife in the NPR-A.

Scientific Research

There are scientific research programs that take place in the NPR-A and surrounding areas. These activities involve vessel, air, and overland transport of researchers and equipment, and they could contribute to cumulative effects. This would come about through the disturbance of terrestrial and marine wildlife, impacts on subsistence harvest, or sediment/soil disturbance through biological or chemical sampling.

Community Development

Community development projects in Arctic communities involve both large and small infrastructure projects. For example, the bridge to Nuiqsut is a past community development project. Smaller projects resulting from and leading to community growth could further increase demand for public services and infrastructure, such as airport construction upgrades, roads, port and dock construction, telecommunications, alternative energy infrastructure, and telecommunications projects.

Climate Change

Climate change is an ongoing factor in the consideration of cumulative effects in the Arctic. It could affect the habitat, behavior, distribution, and populations of fish and wildlife in the program area. Climate change could also affect the availability of, or access to, subsistence resources. The trends in climate change that were described in the GMT2 Final Supplemental EIS (BLM 2018), and incorporated by reference into this EIS, are expected to continue.

F.3.3 Actions Not Included in the Cumulative Analysis

Developments for which a solid proposal has not been submitted or that seem unlikely to occur in the foreseeable future are considered speculative. These may include projects that are discussed in the public arena but are not currently authorized by law or for which there is no current proposal before an authorizing agency. Speculative developments are not considered reasonably foreseeable and are not evaluated as part of the cumulative impacts' analysis.

F.3.4 Oil and Gas Activities on Non-Federal Lands

The program area is next to State of Alaska lands and waters and contains inholdings owned by Alaska Native Claims Settlement Act corporations. Although there are no plans to develop these non-federal lands for oil and gas, leasing in the NPR-A could result in exploration and development of recoverable hydrocarbons. Future NEPA analyses associated with NPR-A leasing will consider oil and gas activities on non-federal lands once project-specific details are available.

F.4 RESOURCE INDICATORS AND ASSUMPTIONS

For organizational purposes, Chapter 3 is divided into sections by subject area, such as water resources, terrestrial mammals, and recreation. Though they are described and analyzed in discrete sections, these subjects are dynamic and interrelated. A change in one resource can affect other resources. For example, water quality affects fish populations, which in turn influences subsistence harvests, which can have implications for other outcomes, such as human health and sociocultural systems. As a result, there is some overlap among the resource sections in Chapter 3 of the Final IAP/EIS, and the impacts described in one section may depend on the analysis from another section.

During the writing process, resource specialists shared data and discussed interrelated aspects of the analyses to better capture the interrelated nature of environmental resources. The indicators, analysis areas, and assumptions used for each resource analysis are detailed below.

F.4.1 Climate and Meteorology

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
Construction—General activity • Use and storage of heavy construction equipment in the project area • Use and storage of hazardous materials during construction phases, such as fuels, lubricants, and solvents	Indirect. Use of equipment releases greenhouse gases (GHG) emissions, affecting climate.	• GHG emissions, reported in metric tons, are used as an indicator for climate impacts. • Production-related GHG emissions would be compared to Alaska emission. • Total (production plus downstream) indirect GHG emissions would be compared to U.S. and global emissions totals.
Construction—Freshwater withdrawal and domestic water disposal • Use of water withdrawal pumps and additional equipment associated with water withdrawal during construction	See Row 1	See Row 1
Construction—Gravel mining • Blasting • Excavation and transport of gravel at mine site • Stockpiled overburden associated with gravel mine • Annual dewatering of mine during operations	See Row 1	See Row 1

Action Affecting Resource	Type of Impact	Impact Indicators
Construction—Site Preparation • Preparations associated with constructing ice roads and pads (compacting snow, placing insulation, and creating ice infrastructure) • Preparations associated with gravel road and pad construction (placing gravel fill, adjusting previously undisturbed terrain, compacting gravel, and grading)	See Row 1	See Row 1
Construction—Deep excavation and drilling activity • Excavation for pipeline vertical support member placement • Horizontal directional drilling underneath waterbodies during pipeline installation	See Row 1	See Row 1
Construction—In-water work, freshwater • Installing culverts for stream crossings • Pile driving and sheet piling during construction • Placing fill in waterbodies • Installing water withdrawal intake from lakes and ponds	See Row 1	See Row 1
Construction—Traffic activity • Increased air traffic • Increased ground traffic • Increased marine vessel traffic	See Row 1	See Row 1

Action Affecting Resource	Type of Impact	Impact Indicators
Drilling and operations—General activity • Use and storage of heavy equipment in project area • Use and storage of hazardous materials during drilling and operations, such as fuels, lubricants, and solvents	See Row 1	See Row 1
Drilling and Operations—Domestic wastewater disposal • Use of wastewater disposal pumps and additional equipment associated with wastewater disposal	See Row 1	See Row 1
Drilling and operations—Traffic activity • Increased air traffic • Increased ground traffic	See Row 1	See Row 1
Drilling—General drilling • Production and injection well drilling • Subsurface injections of water, drill waste, or miscible-injectant	See Row 1	See Row 1
Operations—Gas and oil processing and infrastructure pad • Natural gas flaring at Willow Central Facility • Subsurface injection of produced water and natural gas as part of pressure maintenance and water flood for secondary recovery • Use of facilities equipment operating at the Willow Central Facility, infrastructure pad, or other nearby facilities, such as incinerators, turbines, and generators	See Row 1	See Row 1

Action Affecting Resource	Type of Impact	Impact Indicators
Transportation, processing/refining, and combusting produced oil • Oil transported via pipeline outside of the NPR-A and connecting with the Trans-Alaska Pipeline System • Oil refinement into commercial products • Oil product combustion	Indirect. Use of equipment and combustion of oil products releases GHG emissions, affecting global climate.	See Row 1
Effects of climate change on the NPR-A	Effects of climate change on oil development infrastructure that could be authorized in the NPR-A	Qualitative

Impact Analysis Area

- Direct—No direct impacts from this management plan; all impacts are indirect
- Indirect—The geographic extent of the NPR-A, plus downstream oil refining and consumption
- Cumulative—U.S., with focus on the Arctic North Slope

Analysis Assumptions

- Willow Master Development Plan Draft EIS, Alternative B (BLM 2019) greenhouse gas emissions normalized to emissions per barrel of oil produced during peak production would be representative of NPR-A IAP indirect emissions per barrel of oil produced in future developments.
- Market effects that would reduce net downstream emissions (from refining and consumption) of oil produced in the NPR-A are ignored in the calculations of downstream emissions.

F.4.2 Air Quality

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
Construction—General activity • Use and storage of heavy construction equipment in project area • Use and storage of hazardous materials during construction phases, such as fuels, lubricants, and solvents	Indirect. Use of equipment releases criteria and hazardous air emissions, affecting air quality and air quality related values.	• Criteria pollutant impacts in micrograms per cubic meter relative to National Ambient Air Quality Standards and Alaska Ambient Air Quality Standards • Hazardous air pollutant impacts in micrograms per cubic meter, relative to short-term, chronic, and carcinogenic thresholds • Visibility (units of delta deciviews) and deposition (units of kilograms per hectare per year), relative to air quality related value thresholds

Action Affecting Resource	Type of Impact	Impact Indicators
Construction—Freshwater withdrawal and domestic water disposal • Use of water withdrawal pumps and additional equipment associated with water withdrawal during construction phases	See Row 1	See Row 1
Construction—Gravel mining • Blasting • Excavation and transportation of gravel at mine site • Stockpile overburden associated with gravel mine • Annual dewatering of mine during operations	See Row 1	See Row 1
Construction—Site Preparation • Preparations for ice road and pad construction (compacting snow, placing insulation, and creating ice infrastructure • Preparations associated with gravel road and pad construction (gravel fill placement, adjustments to previously undisturbed terrain, compaction of gravel, and grading)	See Row 1	See Row 1
Construction—Deep excavation and drilling activity • Excavation for pipeline vertical support member placement • Horizontal directional drilling underneath waterbodies during pipeline installation	See Row 1	See Row 1
Construction—In-water work, freshwater • Installation of culverts for stream crossings • Pile driving and sheet piling during construction • Placement of fill in waterbodies • Installation of water withdrawal intake from lakes and ponds	See Row 1	See Row 1

Action Affecting Resource	Type of Impact	Impact Indicators
Construction—Traffic activity • Increased air traffic • Increased ground traffic • Increased marine vessel traffic	See Row 1	See Row 1
Drilling and operations—General activity • Use and storage of heavy equipment in project area • Use and storage of hazardous materials during drilling and operations, such as fuels, lubricants, and solvents	See Row 1	See Row 1
Drilling and operations—Domestic wastewater disposal • Use of wastewater disposal pumps and additional equipment associated with wastewater disposal	See Row 1	See Row 1
Drilling and operations—Traffic Activity • Increased air traffic • Increased ground traffic	See Row 1	See Row 1
Drilling—General drilling • Production and injection well drilling • Subsurface injections of water, drill waste, or miscible-injectant	See Row 1	See Row 1
Operations—Gas and oil processing and infrastructure pad • Natural gas flaring at Willow Central Facility • Subsurface injection of produced water and natural gas as part of pressure maintenance and water flood for secondary recovery • Use of facilities equipment operating at the Willow Central Facility, infrastructure pad, or other nearby facilities, such as incinerators, turbines, and generators	See Row 1	See Row 1

Impact Analysis Area

- Direct—No direct impacts from this management plan; all impacts are indirect
- Indirect—The geographic extent of the NPR-A plus three assessment areas (conservation system units) near the NPR-A: Arctic National Wildlife Refuge, Gates of the Arctic National Park, and Noatak National Preserve
- Cumulative—NPR-A plus three assessment areas (conservation system units) near the NPR-A: Arctic National Wildlife Refuge, Gates of the Arctic National Park, and Noatak National Preserve

Analysis Assumptions

- Willow Master Development Plan Draft EIS, Alternative B (BLM 2019) criteria and hazardous air pollutant emissions normalized to emissions per barrel of oil produced during peak production would be representative of IAP indirect emissions per barrel of oil produced in future developments.
- Willow Master Development Plan Draft EIS, Alternative B (BLM 2019) multi-well horizontally drilled wells pads, pad sizes, sources, layout, and connecting infrastructure to processing facilities are representative of typical future development in the NPR-A.

F.4.3 Acoustic Environment

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
• Noise from drill rigs • Noise from pile driving • Noise from aircraft • Noise from gravel mining and blasting • Noise from construction of roads, well pads, and other ancillary support activities • Noise from the CPF • Noise from flaring • Noise from coastal and offshore sources • Noise from seismic surveys of unleased areas • Noise from non-oil and gas construction activities, such as construction of community infrastructure • Noise from the use of motorized equipment such as snow machines, all-terrain vehicles, occasional small aircraft, and limited local vehicle traffic associated with scientific activities	Impacts on human receptors from noise- and vibration-generating activities—Human receptors likely to be affected by post-lease oil and gas development activities are residents of NPR-A communities, including Nuiqsut and Utqiagvik; subsistence users of the Nuiqsut and Utqiagvik subsistence use areas; and recreationists in the southeastern portion of the NPR-A. Human receptors who could be affected by development activities unrelated to oil and gas, such as community infrastructure development and scientific activities, are residents of the NPR-A communities, subsistence users of subsistence areas, and recreationists throughout the NPR-A. Impacts on sensitive species from noise- and vibration-generating activities—Sensitive species are caribou, polar bear, seals, whales, and migratory birds.	• Estimated sound levels from noise-generating activities at various distances in decibels • Duration of sound (short-term or long-term) • Number of aircraft flights

Impact Analysis Area

The impact area for noise resources is the NPR-A and surrounding sensitive resources that could be affected by activities on the NPR-A. Stinchcomb (2017) suggests that noise from aircraft can be detected up to 65 miles away, with background noise, providing an outer estimate for the geographic area for aircraft noise disruption.

- Direct/Indirect
  - The high potential area illustrated in Figure B-1, Appendix B of the Final IAP/EIS
  - Throughout the planning area, including areas open to leasing and areas where activities unrelated to oil and gas, such as infrastructure development, would occur
  - The marine transit route illustrated in Figure B-2, Appendix B of the Final IAP/EIS
  - Areas under aircraft flight routes associated with post-leave development in the NPR-A
  - Coastal areas where infrastructure and facilities necessary for oil and gas production in the NPR-A would be located, such as a seawater treatment plant (STP) and barge landings (potential barge landings are shown on Figure B-2, Appendix B of the Final IAP/EIS; an STP location would depend on where an oil and gas development is sited)
  - Cumulative—Same as direct/indirect, plus development east of the NPR-A

Analysis Assumptions

- Background ambient noise levels are approximately 35 decibels, based on Stinchcomb (2017) and 50 decibels for developed areas.
- Future IAP post-lease development would be focused in the high potential areas illustrated in Appendix B of the Final IAP/EIS, Figure B-1, and little to no change in the acoustic environment would occur in the remaining portion of the NPR-A, with the possible exception of increases or decreases in noise from aircraft overflights.
- Decibels typically attenuate at a rate of 6 per doubling of distance for point sources.

F.4.4 Physiography

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
• Material resource extraction sites • Embankment fill	• Direct surface disturbance to vegetation; removal of surface and subsurface; destruction of surface landforms	• Acres and volume of material disturbed

Impact Analysis Area

- Direct/Indirect—The program area is the geographic scope of the analysis area.
- Cumulative—The program area is the geographic scope of the analysis area.

Analysis Assumptions

- None.

F.4.5 Geology and Minerals

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
• Material resource extraction sites • Reclamation	• Direct surface disturbance to vegetation; removal of surface-insulating organics, causing frozen soils to thaw and destroying surface landforms • Sand and gravel mining in streams • Placing fill for construction of pads/roads • Changes in surface drainage/water impoundment • Changes in erosion where surface vegetation is removed • Change in river geomorphology as material is removed	• Acres and volume of material disturbed

Impact Analysis Area

- Direct/Indirect—The program area is the geographic scope of the analysis area.
- Cumulative—The program area is the geographic scope of the analysis area.

Analysis Assumption

- Mineral exploration and leasing, other than for petroleum and aggregate, will continue to be disallowed in the program area.

F.4.6 Petroleum Resources

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
Extraction of oil and gas	Reduction of oil and gas resources available for future use	Percentage of estimated total available reserves removed
Spills of oil and gas and releases of gas to the atmosphere	Loss of oil and gas resources for productive use	Number and volume of spills and gas leaks
Exploration phase	Improved understanding of petroleum oil and gas resources	Not applicable

Impact Analysis Area

- Direct/Indirect—Reduction in oil and gas resources available in the planning area
- Cumulative—Planning area

Analysis Assumptions

- Oil and gas development will occur under all action alternatives.
- Development will occur in a similar manner and will have impacts similar to other North Slope oil and gas developments.

F.4.7 Renewable Energy

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
Lands closed to renewable energy leasing	Reduction in the acreage available to renewable energy leasing and reduction in potential generation of renewable energy	Acres of federal surface closed to renewable energy leasing

Impact Analysis Area

- Direct/Indirect—Planning area
- Cumulative—Planning area

Analysis Assumption

- Areas recommended for withdrawal from renewable energy leasing are withdrawn.

F.4.8 Paleontological Resources

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
Ground-disturbing activities resulting from oil and gas development, infrastructure, gravel pits, and pipeline and road corridors	Permanent potential destruction and loss of paleontological resources; also deterioration through exposure, increased access, vandalism, and looting	Focus on areas where Potential Fossil Yield Classification (PFYC) 4-5 units are present; quantify acres, if possible; if there are known localities or exposures from past research, describe qualitatively.
Designation and management of special areas and Wild and Scenic Rivers, regarding whether paleontological resources would be at reduced risk of impacts	Positive impact by limiting allowable activities or giving special (maximum) consideration to resource values and reducing chances resources may be disturbed or destroyed	Acres of PFYC 4-5, or qualitatively
Climate change, natural weathering, erosion	Permanent destruction and loss of paleontological resources through exposure, direct damage, and unauthorized collecting from natural river and coastal erosion and climate change trends	Qualitative discussion of potential impacts in areas that may contain PFYC 4-5 units or known localities

Impact Analysis Area

- Direct/Indirect—All parts of the planning area where ground-disturbing activities will be permitted on BLM-managed land
- Cumulative—The program area, the North Slope of Alaska, and the near-shore marine environment

Analysis Assumptions

- Surrogate PFYC data from Brent Breithaupt has been developed in lieu of waiting for full review of the Alaska PFYC data.
- Paleontological resources are nonrenewable, but development projects can lead to new discoveries.
- Many more resources and locales likely exist in the NRP-A than are currently inventoried.
- The affected environment descriptions and impact analysis assumptions from the 2013 EIS will guide this analysis.

- The acres of known PFYC 4-5 units is relatively small in relation to the overall NPR-A, and known localities are few.
- Allocations are not equivalent to impacts, but allocations may increase or decrease the risk of impacts or affect the discovery, research, or interpretive potential of paleontological resources.
- The alternatives do not specify the specific locations' ground-disturbing activities.
- There will be further assessment of paleontological resource potential and impacts associated with ground-disturbing actions that may require a field inventory.
- The 2012 EIS and Record of Decision conclude that proposed NPR-A activities would have a very low probability of affecting paleontological resources.

F.4.9 Soil and Permafrost Resources

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
• Material resources extraction sites • Access roads/pads/staging areas/airstrips (gravel fill or ice) • Off-road tundra travel/activities • Construction of structures (e.g., pipeline vertical support members [VSMs] and building foundations) • Reclamation of embankments and pads	• Direct surface disturbance to vegetation • Removal of surface insulating organics to cause frozen soils to thaw and destroying surface landforms • Sand and gravel mining in streams affecting stream structure • Mining impacts on soil and permafrost (thawing, removal of soils) • Placement of fill for construction of pads/roads • Installation of piling for VSMs and infrastructure foundations (bridges)	• Acres of disturbance to soil and permafrost • Changes to soil and permafrost from placement of fills for embankments and pad, such as ground temperature and organic mat thickness • Changes to erosion of soil from placing fills for embankments and pad • Fugitive dust extents • Changes in drainage patterns due to permafrost thaw and redirection by embankments

Impact Analysis Area

- Direct/Indirect—Planning area
- Cumulative—Planning area

Analysis Assumptions

- Gravel fill roads and pads will be constructed across frozen soils.
- Pads and roads will be constructed to minimize potential thaw of frozen soils (use of thicker embankments or use of insulation).
- Water will pond at the base of embankments.
- Ice roads will be used for access during winter.
- Roads and pads will be reclaimed.
- Material will likely be extracted in sand, gravel, and hard rock sources.
- Material sites will be permitted separately from other infrastructure.

F.4.10 Sand and Gravel Resources

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
• Material resource extraction sites • Ice access roads and pads • Reclamation	• Direct surface disturbance to vegetation; removal of surface-insulating organics, causing frozen soils to thaw and destroying surface landforms • Sand and gravel mining in streams • Placing fill for construction of pads and roads • Changes in surface drainage and water impoundment • Changes in erosion where surface vegetation is removed • Change in river geomorphology as material is removed	• Acres and volume of material disturbed • Acres available for mineral material disposal

Impact Analysis Area

- Direct/Indirect—The program area is the geographic scope of the analysis area.
- Cumulative—The program area is the geographic scope of the analysis area.

Analysis Assumptions

- Sand and gravel will be extracted in both uplands and floodplains.
- Access roads constructed from ice roads will be required to access material sources.
- Material resources are to be considered within the entire analysis area.
- Only mineral material mining and petroleum resources will be developed in the planning area.

F.4.11 Water Resources

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
General disturbance caused by construction • Use of heavy equipment (general equipment operations) • Storage of heavy construction equipment in work areas	• Equipment will be taken across streams and will pass near lakes and ponds. There is a potential for erosion and increased turbidity and a potential to impound water and alter drainage patterns and flow regime. • There is an additional potential for hazardous contamination during transport to and from the site.	• Length of rivers in area open to infrastructure and leasing • Area of lakes in area open to infrastructure and leasing • Length of rivers and area of lakes in high development potential areas

Action Affecting Resource	Type of Impact	Impact Indicators
General disturbance caused by construction • Use and storage of hazardous materials during construction, such as fuels, lubricants, and solvents	• A spill or leak of hazardous material spill could affect surface waterbodies and shallow groundwater and consequently affect water quality. The extent would depend on the spill size, location, and response activities.	• Length of rivers in area open to infrastructure and leasing • Area of lakes in area open to infrastructure and leasing • Length of rivers and area of lakes in high development potential areas
Installation of culverts and bridges • Installation of culverts/bridges for stream crossings • Includes both initial summer placement and summer adjustments	• Culverts may alter surface flow and drainage and inundate or dry surrounding areas. • Bridge crossings may increase velocity and, as a result, increase erosion and turbidity, alter stream hydraulics and possible scour. • May affect downstream water quality due to increased erosion/turbidity. • May affect channel stability/alignment. Potential for culverts to wash out, causing deposition of sediment. Undersized culverts may impound water and lead to thermokarsting.	• Number of proposed culverts, bridges
Freshwater withdrawal caused by construction and drilling operation • Freshwater withdrawal associated with well drilling and associated construction of ice pads and ice roads and potable uses	• Water withdrawal from surface waterbodies may affect water resources (winter water volume available to fish species) and quality (dissolved oxygen available to resident fish). • There is also a potential for water withdrawal to affect availability or water quality of connected shallow groundwater.	• Water volume: Gallons of water withdrawn.

Action Affecting Resource	Type of Impact	Impact Indicators
Domestic wastewater disposal caused by construction and drilling operation • Wastewater that construction facilities, camps, and drilling operations create and dispose of	• Domestic wastewater may be disposed of via Class I injection wells or discharged to surface waterbodies, per Alaska Pollutant Discharge Elimination System General Permit. • Treated domestic wastewater effluent may affect water quality of receiving waterbodies, and there is a potential for spills if wastewater is transported. Discharged wastewater effluent may affect flows and channel stability in streams. • Water levels could be lowered by the need to use it for potable water, fire suppression, and maintenance.	• Length of rivers in area open to infrastructure • Area of lakes in area open to infrastructure • Proposed discharge rate into each waterbody • Description of condition of the wastewater being discharged with regard to pertinent water quality regulations
Gravel mining • Excavation of gravel at mine site	• There is a potential for changes in flow of adjacent stream channels, including alterations to channel alignment and erosion. • There is a potential for thermokarsting around pits. • Groundwater may be intercepted, creating ponds that would require pumping.	• Length of rivers in area open to sand/gravel mining • Area of lakes in area open to sand and gravel mining • Length of rivers and area of lakes in high development potential areas
Gravel mining • Ice pad stockpiling of overburden associated with gravel mine	• Stormwater runoff from stockpiled overburden could deposit sediment on tundra and transport pollutants.	• Length of rivers in area open to sand and gravel mining • Area of lakes in area open to sand and gravel mining • Length of rivers and area of lakes in high development potential areas

Action Affecting Resource	Type of Impact	Impact Indicators
Gravel mining • Annual mine dewatering during operational years	• Increase in sedimentation • Disruption of recharge • Thaw bulbs in the permafrost • Alteration of surface flow • Interception of groundwater flow • Discharges from dewatering may affect water quality of receiving waterbodies; discharges may affect flows in streams, potentially affecting channel stability or accelerating erosion and deposition, and the potential for increased thermokarsting. • Potential for dewatering to affect availability and discharge of effluent to affect water quality of connected shallow groundwater resources	• Drawdown of water table during pumping; volume (million gallons)
Site preparation and construction of ice roads and pads • Compacting snow • Installing insulation, as needed • Creating ice infrastructure	• Construction of ice roads would affect surface drainage patterns and may change the natural flow direction. Flow obstructions may increase depth and impoundment of flow and may affect channel stability or alignment. Flow over, around, and through obstruction may cause erosion of tundra or stream channels and deposition of sediment on tundra. • Potential loss of floodplain connectivity or changes to floodplain • Infiltration of meltwater into thawed soils in the active layer or unfrozen ground may affect shallow groundwater and water quality by changing alkalinity and pH.	• Length of rivers in area open to infrastructure and leasing • Area of lakes in area open to infrastructure and leasing • Water volume required for ice roads and pads

Action Affecting Resource	Type of Impact	Impact Indicators
Site preparation of gravel roads • Gravel placement for roads and pads • Fill material placement on previously undisturbed terrestrial terrain	• Gravel placement would affect surface drainage patterns and may change the natural flow direction. Flow obstructions due to absent or misplaced culverts may increase depth and impoundment of flow and may increase the potential for thermokarsting and cause turbidity. There could be impacts that would change stability and alignment. • Water overtopping roads and flowing around ends of pads or a culvert washout may erode and deposit sediment on tundra. • Potential loss of floodplain connectivity or changes to floodplains • Potential for stormwater runoff, leading to deposition of sediment and transport of pollutants	• Length of rivers in area open to infrastructure • Area of lakes in area open to infrastructure • Length of rivers and area of lakes in high development potential areas
Construction of deep excavations and drilling • Horizontal directional drilling underneath waterbodies during pipeline installation	• There is a potential for spills of drilling fluids.	• Length of rivers in area open to infrastructure • Area of lakes in area open to infrastructure • Length of rivers and area of lakes in high development potential areas
In-water work—freshwater pile driving • Pile driving (vibratory and impact) • Sheet pile installation • Excavation and auger drilling to install pipeline vertical support member	• May affect downstream water quality due to increased erosion and turbidity as a result of disturbing ground and the stream bed. • Backwater from bridge piles and sheet pile may affect channel stability and alignment.	• Length of rivers in area open to infrastructure
In-water work—Freshwater fill placement • Placing fill in waterbodies for roads • Possibility of placing fill in waterbodies for pads	• Potential drainage patterns, impound water, and lead to thermokarsting • Potential water quality degradation due to erosion and increased turbidity • Potential for overtopping or fill washout • Potential stormwater runoff when fill is put in place and contributing pollutants	• Length of rivers in area open to infrastructure • Volume of gravel required

Action Affecting Resource	Type of Impact	Impact Indicators
Freshwater in-water work • Installation of intake for water withdrawal from lakes and ponds	• May affect water quality due to bed disturbance	• Area of lakes in area open to infrastructure and leasing • Volume of water withdrawal required
In-water work • Screeding or other contouring of the subsurface	• Increase in turbidity during in-water work	• Length of rivers in area open to infrastructure • Area of lakes in area open to infrastructure • Length of rivers and area of lakes in high development potential areas
Marine In-Water Work • Placing fill in water to construct the module transfer island • Cutting sea ice to accommodate module transfer island construction • Pile and sheetpile driving (includes vibratory and impact) • Reclaiming module transfer island	• Temporary increase in turbidity during in-water work • Alteration of regional hydrodynamics • Possible alteration of coastal sediment transport such that erosion and sedimentation may occur; possible infill of lagoons and estuaries • Scour of seabed due to increased velocities in areas of carved ice in spring	• Acres to be filled, volume of fill • Bathymetry, water depth (feet)
Traffic • Increased ground traffic on gravel and ice roads; includes light- and heavy-duty trucks and gravel hauling • Travel on community roads • Increased road/off-road traffic to access sites for subsistence hunting and fishing, recreation, and scientific research	• Potential for dust to affect water quality through increased turbidity and deposition of sediment on tundra • Water for dust suppression may contribute stormwater runoff	• Length of rivers in area open to infrastructure • Area of lakes in area open to infrastructure • Length of rivers and area of lakes in high development potential areas
Traffic • Increased marine vessel traffic from barges and vessels supplying fuel and commercial goods, and drilling operations • Increased pass-through marine vessel traffic • Marine vessel support of scientific operations • Marine traffic from ships completing seismic or bathymetric studies	• Possible propeller wash from barges and tugs could stir up bottom sediments and increase turbidity.	• Number of vessel trips • Locations of barge landings

Action Affecting Resource	Type of Impact	Impact Indicators
Traffic • Increased traffic by small vessels on streams and lakes to access sites for subsistence hunting and fishing, recreation, and scientific research	• Temporary increase in turbidity from propellers	• Length of rivers in area open to infrastructure and leasing • Area of lakes in area open to infrastructure and leasing
Drilling and operations • Presence of new infrastructure • Changes in existing conditions of public access to the project site	• Potential for stormwater runoff from roads and pads that may cause turbidity, erosion, and sediment deposition	• Acres of new infrastructure
General disturbance caused by drilling and operations • Use and storage of fuels, chemicals, and other hazardous materials on the drill sites and other project locations	• Potentials for leaks and spills of hazardous materials to reach waterbodies and affect water quality; potential for spills during transport • A hazardous material spill could affect shallow groundwater	• Length of rivers in area open to infrastructure • Area of lakes in area open to infrastructure • Length of rivers and area of lakes in high development potential areas
Drilling and operations • Production and injection well drilling • Subsurface injection of produced water and natural gas for secondary recovery • Associated mud pit • Flaring of natural gas	• Potential for blowout during drilling to affect surface water, shallow groundwater, or deep groundwater quality • Potential for reserve-pit fluids to affect shallow groundwater quality if they reach surface waterbodies • Potentials for leaks and spills of hazardous materials to reach waterbodies and affect water quality • Potential thermokarsting created by insufficient insulation, warm drilling fluids in mud pits, flaring elevation; associated water pooling in subsided areas	• Length of rivers in area open to infrastructure • Area of lakes in area open to infrastructure • Length of rivers and area of lakes in high development potential areas

Impact Analysis Area

- Direct/indirect—Streams, lakes, ponds and wetlands of the planning area
- Cumulative—Watershed boundaries of streams/drainage flowing to and through the project area; drainage areas of ponds and lakes; boundaries of waterbodies, including aquifers

Analysis Assumptions

- Impacts on water resources are similar to those described in other North Slope EISs.
- Water withdrawals will be limited to lakes and no water will be withdrawn from streams and shallow aquifers.

F.4.12 Solid and Hazardous Waste

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
Management of solid waste generated by the development and operation of facilities • Exploratory drilling • Facility operations • Seismic activities • Road and facility construction Introduction of contaminants, including petroleum products, caused by the following: • Spills • Vehicle accidents and rollovers • Well blowouts • Pipeline leaks • Tank overfills Disposal of unregulated nonhazardous fluids Injection of nonhazardous fluids through Class I underground injection control	• Temporary and permanent storage of solid waste generated from activities in the storage area, landfill, or monofill (where one homogeneous type of waste is placed) • Air quality impacts from burning refuse • Design and implementation of wastewater facilities • Management of spills • Underground injection well • Staging and storage areas • Underground injection control (Class I or II wells)	• Underground injection control wells depth of discharge and type of materials • Include potential spill volumes (gallons and barrels) • Square footage needed for staging and storage
Management of solid waste generated by activities unrelated to oil and gas: • Subsistence and off-road travel • Recreation, such as camping, hiking, hunting, and off-road travel • Scientific activities and archaeological and paleontological digs • Community infrastructure projects	• Temporary and permanent storage of solid waste generated from activities	• Qualitative discussion of solid waste disposal from these scattered, localized activities

Impact Analysis Area

- Direct/Indirect—Direct impacts evaluated for the geographic extent of the NPR-A (minus communities); indirect impacts area is 0.25 miles outside of the direct impact geographic area
- Cumulative—Cumulative impacts evaluated for the same geographic area as the indirect impacts area, for example Willow and other known leases and development activities

Analysis Assumptions

- Projects will require a stormwater pollution protection plan, a spill, prevention, control, and countermeasure plan, a solid waste general permit, and an oil discharge prevention and contingency plan.
- Facilities will require a facility response plan to operate.
- Wastewater design will require approval from the Alaska Department of Environmental Conservation.
- Class I or Class II underground injection wells will require a permit/authorization from the Alaska Department of Environmental Conservation or the U.S. Environmental Protection Agency or both.
- Storing more than 55 gallons (in one container) of oils and other hazardous materials will have appropriate secondary containment.
- Best management practices will be implemented to prevent the discharge or accidental spill of petroleum or hazardous materials.

F.4.13 Vegetation

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
Seismic exploration: Use of tracked seismic-vibrator vehicles and camp trains pulled by tracked vehicles	• Direct Impacts on vegetation and plant communities from tracked vehicle traffic and the development of seismic trails	• Acres of vegetation classes in areas open to leasing and closed to leasing (in the high development potential zone only) for each alternative, classified by EIS-specific lease stipulations • Acres expected to be affected by seismic surveys in the decision area from the 2012 IAP/EIS (revised acreage estimates for seismic survey impacts in this EIS are not available) • No indicator available to assess possible plant community changes
Exploration drilling: Ice placement for ice roads, pads, and airstrips	• Direct impacts on vegetation and plant communities from ice placement and operation of ice roads, pads, and airstrips	• Acres of vegetation types in areas open to and closed to leasing (in the high development potential zone only) for each alternative, classified by EIS-specific lease stipulations • Acres expected to be affected by ice infrastructure in the decision area from the 2012 IAP/EIS (revised acreage estimates for seismic survey impacts in this EIS are not available) • No indicator available to assess possible plant community changes

Action Affecting Resource	Type of Impact	Impact Indicators
Project construction: Gravel mining	• Direct impacts, permanent loss of vegetated areas	• Acres of vegetation classes in areas open and closed to leasing (in the high development potential zone only) for each alternative, classified by EIS-specific lease stipulations • Acreage expected to be affected by gravel mining under the theoretical high, medium, and low development scenarios presented in the RFD scenario for each alternative
Project construction: Gravel placement for roads, pads, and airstrips	• Direct impacts, permanent loss of vegetated areas	• Acres of vegetation classes in areas open to leasing and closed to leasing (in the high development potential zone only) for each alternative, classified by EIS-specific lease stipulations • Acreage expected to be affected by gravel fill under the theoretical high, medium, and low development scenarios presented in the RFD scenario for each alternative
Project construction: Pipeline installation	• Direct impacts; permanent loss of vegetated areas	• Acres of vegetation types in areas open to leasing and closed to leasing (in the high development potential zone only) for each alternative, classified by EIS-specific lease stipulations • Acreage expected to be affected by the placement of VSMs for elevated pipelines under the theoretical high, medium, and low development scenarios presented in the RFD scenario (acreage figures are not available for each alternative separately) • Acreage expected to be affected by the installation of buried gas pipelines in the decision area from the 2012 IAP/EIS (revised acreage estimates for buried pipelines in this EIS are not available)

Action Affecting Resource	Type of Impact	Impact Indicators
Project operations: Use of gravel roads, pads, and airstrips	• Indirect impacts on vegetation and plant communities from drifted snow, altered hydrologic drainage patterns, and possible increases in thermokarst	• Acres of vegetation classes in areas open to leasing and closed to leasing (in the high development potential zone only) for each alternative, classified by EIS-specific lease stipulations • Area of a disturbance buffer zone expected to be affected by the indirect effects of gravel infrastructure • No indicator available to assess possible plant community changes
Project operations: Traffic on gravel roads	• Indirect alterations to vegetation and plant communities from gravel spray and dust fallout	• Acres of vegetation types in areas open to leasing and closed to leasing (in the high development potential zone only) for each alternative, classified by EIS-specific lease stipulations • Area of a disturbance buffer zone expected to be affected by the indirect effects of vehicle traffic on gravel roads • No quantitative indicator available to assess potential plant community changes
Project construction and operations: All disturbances with the capacity to introduce nonnative and invasive species	• Indirect changes to native plant communities and vegetation structure, with the potential introduction of nonnative and invasive species	• No quantitative indicator available to assess possible plant community changes
Project construction and operations: Oil and contaminant spills	• Direct impacts on vegetation and plant communities from tundra spills	• No indicator available to assess possible spill locations or magnitudes in relation to vegetation classes in the planning area
Abandonment and reclamation: Ice road construction, off-road tundra travel, gravel infrastructure removal, VSMs, and power poles	• Direct impacts on vegetation from reclamation	• No indicator available to assess possible reclamation locations or the intensity of reclamation in relation to vegetation types in the planning area
Community infrastructure, scientific, and subsistence activities: Off-road vehicle use, military site cleanup, tundra travel, off-runway landings, scientific research, and new community infrastructure	• Impacts on vegetation from community infrastructure projects, cleanup, tundra travel, off-runway landings, scientific research, and subsistence activities	• No indicator available to assess possible community infrastructure, scientific research, or subsistence activity locations or the intensity of those activities in relation to vegetation types in the planning area

Impact Analysis Area

- Direct/Indirect—No future development projects are planned under the revised leasing plans being considered in this EIS, and therefore no specific areas are known in which new developments could occur. Because of this, the impact analysis area for direct and indirect impacts was defined as the high development potential zone in the northeastern portion of the planning area. As described in the RFD scenario, the high development potential zone comprises 3,580,000 acres (see Appendix B of the Final IAP/EIS, Map B-1) and is the most likely area in which future developments would occur.
- Cumulative—The geographic area considered for cumulative impacts is the entire NPR-A and the foothills of the Brooks Range. The time frame for the analysis is all past and present developments on the NPR-A and extending forward 70 years. The 70-year time frame follows from Appendix B of the Final IAP/EIS, which notes that individual petroleum projects can be producing for 10 to 70 years.

Analysis Assumptions

- The analysis of possible direct impacts on vegetation resources during exploration—seismic surveys, ice roads, pads, and airstrips–depends on the estimates of acres likely to be affected by those activities that were prepared for the decision area in the 2012 NPR-A IAP/EIS. Updated estimates of the area expected to be affected during exploration were not prepared for this EIS, so the acreage figures from the 2012 IAP/EIS are assumed to apply to all current alternatives.
- The comparative analysis of possible direct impacts on vegetation resources among alternatives during construction and operations depends on the acreage estimates for the theoretical low, medium, and high development scenarios for gravel mining, gravel fill, and elevated pipeline impacts described in Appendix B of the Final IAP/EIS.
- The analysis of possible direct impacts on vegetation resources from installing buried gas pipelines depends on the number of acres likely to be affected by gas pipelines that were estimated for the decision area in the 2012 NPR-A IAP/EIS. Updated estimates of the area expected to be affected by gas pipelines were not prepared for this EIS, so the acreage figures from the 2012 IAP/EIS are assumed to apply to all current alternatives.
- The analysis of possible indirect effects on vegetation resources from the construction and use of gravel roads, pads, and airstrips depends on studies indicating that the most far-reaching indirect effects (dust deposition) were detectable up to 328 feet from the edge of gravel structures. No quantitative criteria are available to assess the extent of possible impacts on vegetation from petroleum and other contaminant spills, abandonment and reclamation, and community infrastructure, scientific, and subsistence activities. These impacts were qualitatively discussed.

F.4.14 Wetlands and Floodplains

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
Seismic exploration: Use of tracked seismic-vibrator vehicles and camp trains pulled by tracked vehicles	• Direct alteration of wetland types from tracked vehicle traffic and the development of seismic trails	• Acres of wetlands and water types in areas open and closed to leasing (in the high development potential zone only) for each alternative, classified by EIS-specific lease stipulations • Acres expected to be affected by seismic surveys in the decision area from the 2012 IAP/EIS (revised acreage estimates for seismic survey impacts in this EIS are not available)
Exploration drilling: Ice placement for ice roads, pads, and airstrips	• Direct alteration of wetland types from ice placement and operation of ice roads, pads, and airstrips	• Acres of wetlands and water types in areas open and closed to leasing (in the high development potential zone only) for each alternative, classified by EIS-specific lease stipulations • Acres expected to be affected by ice infrastructure in the decision area from the 2012 IAP/EIS (revised acreage estimates for seismic survey impacts in this EIS are not available)
Project construction: Gravel mining	• Direct impacts: Permanent loss of wetlands and Waters of the U.S.	• Acres of wetlands and water types in areas open and closed to leasing (in the high development potential zone only) for each alternative, classified by EIS-specific lease stipulations • Acres expected to be affected by gravel mining under the theoretical high, medium, and low development scenarios presented in the RFD scenario for each alternative
Project construction: Gravel placement for roads, pads, and airstrips	• Direct impacts: Permanent loss of wetlands and Waters of the U.S.	• Acres of wetlands and water types in areas open and closed to leasing (in the high development potential zone only) for each alternative, classified by EIS-specific lease stipulations • Acreage expected to be affected by gravel fill under the theoretical high, medium, and low development scenarios presented in the RFD scenario for each alternative

Action Affecting Resource	Type of Impact	Impact Indicators
Project construction: Pipeline installation	• Direct impacts: Permanent loss of wetlands and Waters of the U.S.	• Acres of wetlands and water types in areas open and closed to leasing (in the high development potential zone only) for each alternative, classified by EIS-specific lease stipulations • Acreage expected to be affected by the placement of VSMs for elevated pipelines under the theoretical high, medium, and low development scenarios presented in the RFD scenario (acreage figures are not available for each alternative separately) • Acreage expected to be affected by the installation of buried gas pipelines in the decision area from the 2012 IAP/EIS (revised acreage estimates for buried pipelines in this EIS are not available)
Project operations: Use of gravel roads, pads, and airstrips	• Indirect alteration of wetland types from drifted snow, altered hydrologic drainage patterns, and possible increases in thermokarst	• Acres of wetlands and water types in areas open and closed to leasing (in the high development potential zone only) for each alternative, classified by EIS-specific lease stipulations • Area of a disturbance buffer zone expected to be affected by the indirect effects of gravel infrastructure
Project operations: Traffic on gravel roads	• Indirect alteration of vegetation and wetland types from gravel spray and dust fallout	• Acres of wetlands and water types in areas open and closed to leasing (in the high development potential zone only) for each alternative, classified by EIS-specific lease stipulations • Area of a disturbance buffer zone expected to be affected by the indirect effects of vehicle traffic on gravel roads
Project construction and operations: Oil and contaminant spills	• Direct impacts on wetlands and plant communities from spills on tundra	• No indicator available to assess possible spill locations or magnitudes in relation to wetland types in the planning area
Abandonment and reclamation activities: Ice road construction, off-road tundra travel, gravel infrastructure removal, VSMs, and power poles	• Direct impacts on wetlands from reclamation	• No indicator available to assess possible reclamation locations or the intensity of reclamation activities in relation to wetland types in the planning area

Action Affecting Resource	Type of Impact	Impact Indicators
Community infrastructure, scientific, and subsistence activities: Off-road vehicle use, military site cleanup, tundra travel, off-runway landings, scientific research, and new community infrastructure	• Impacts on wetlands from community infrastructure projects, cleanup activities, tundra travel, off-runway landings, scientific research, and subsistence activities	• No indicator available to assess possible community infrastructure, scientific research, or subsistence activity locations, or the intensity of those activities in relation to wetland types in the planning area

Impact Analysis Area

- Direct/Indirect—No development projects are planned under the revised leasing plans being considered in this EIS, so no specific areas are known in which new developments could occur. Because of this, the impact analysis area for direct and indirect impacts was defined as the high development potential zone in the northeastern portion of the planning area. As described in the RFD scenario, the high development potential zone comprises 3,580,000 acres (see Appendix B of the Final IAP/EIS, Map B-1) and is the most likely area in which developments would occur.
- Cumulative—The geographic area considered for cumulative impacts is the entire Arctic NPR-A and the foothills of the Brooks Range. The time frame for the analysis is all past and present developments on the NPR-A and extending forward 70 years. The future 70-year time frame follows from Appendix B of the Final IAP/EIS, which notes that individual petroleum projects can be producing for 10 to 70 years.

Analysis Assumptions

- The analysis of possible direct impacts on wetland resources during exploration (seismic surveys, ice roads, pads, and airstrips) depends on the estimates of acres likely to be affected by those activities that were prepared for the decision area in the 2012 NPR-A IAP/EIS. Updated estimates of the area expected to be affected during exploration were not prepared for this EIS, so the acreage figures from the 2012 IAP/EIS are assumed to apply to all current alternatives.
- The comparative analysis of possible direct impacts on wetland resources among alternatives during construction and operations depends on the acreage estimates for the theoretical low, medium, and high development scenarios described in Appendix B of the Final IAP/EIS for gravel mining, gravel fill, and elevated pipeline impacts.
- The analysis of possible direct impacts on wetland resources from installing buried gas pipelines depends on the acres likely to be affected by gas pipelines that were estimated for the decision area in the 2012 NPR-A IAP/EIS. Updated estimates of the area expected to be affected by gas pipelines were not prepared for this EIS, so the acreage figures from the 2012 IAP/EIS are assumed to apply to all current alternatives.
- The analysis of possible indirect effects on wetland resources from the construction and use of gravel roads, pads, and airstrips depends on studies indicating that the most far-reaching indirect effects (dust deposition) were detectable up to 328 feet from the edge of gravel structures.

No quantitative criteria were available to assess the extent of possible impacts on wetlands from petroleum and other contaminant spills, abandonment, and reclamation and from community infrastructure, scientific, and subsistence activities. These impacts were qualitatively discussed.

F.4.15 Fish and Aquatic Species

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
Seismic surveys: ● Use of tracked seismic-vibrator vehicles and camp trains pulled by tracked vehicles ● Use of vibroseis, air guns, or dynamite (or other explosives) to image the subsurface	● Compaction of ice over and surrounding waterbodies could cause short-term delays in melt. ● Increased sound pressure in unfrozen waterbodies (springs) could disturb, injure, or kill fish.	● No quantitative indicator available to assess potential seismic survey impacts on fish
Water withdrawal from lakes for ice roads, water supply, dust suppression, and other uses	Alteration or loss of winter and summer aquatic habitat due to water withdrawal may include the following: ● Changes in water levels ● Ice compaction ● Increased turbidity and other changes in water chemistry ● Alteration of water flow during breakup; that is, seasonal changes to water quantity and quality ● Changes in permafrost or groundwater sources ● Injury or mortality of fish from entrainment or impingement at water intake	● Describe lake acreage that could be affected
Submarine pipeline construction for STP	Temporary loss of marine fish habitat	● No quantitative indicator available to assess habitat loss from submarine pipeline trenching
STP discharge to marine waters	Changes to salinity or other water quality from discharging brine from saltwater treatment plant	● No quantitative indicator available to assess potential STP water discharge impacts on water quality
Gravel mining for road and pad construction	Alteration or loss of aquatic habitat: ● Changes in water quality, including turbidity ● Direct mortality of aquatic species, if mining occurs in waterbodies ● Creation of deep aquatic habitat in gravel pits post-mining	● Acreage expected to be affected by gravel mining under the theoretical high, medium, and low development scenarios presented in the RFD scenario for each alternative; however, there is no specific indicator available to assess direct effects of gravel mining in fish-bearing waters, because mine site locations are unknown.

Action Affecting Resource	Type of Impact	Impact Indicators
Gravel fill for new roads, pads, culverts, and bridges	Direct aquatic habitat loss; indirect aquatic habitat alteration from the following: ● Gravel dust and spray ● Temporary turbidity and sedimentation during gravel placement, compaction, and grading ● Changes in natural drainage patterns, such as water impoundment	● Acreage expected to be affected by gravel mining under the theoretical high, medium, and low development scenarios presented in the RFD scenario for each alternative; however, there is no specific indicator available to assess direct effects of gravel mining in fish-bearing waters, because mine site locations are unknown.
Vehicle traffic on ice or gravel infrastructure	● Displacement of fish due to blocked passage from delayed melt of ice roads or pads and ice plugs in culverts or blockage at bridges ● Habitat and water quality alterations, due to dust, gravel spray, or sediment runoff from gravel roads	● No quantitative indicator available to assess potential indirect impacts on fish and fish habitats from use of ice and gravel infrastructure
Bridge construction: ● Placement of bridge piers or pile ● Foundations in water pile driving	● Loss or alteration of aquatic habitat from changes in water flow or ice blockage during spring breakup ● Disturbance or displacement of fish during in-water bridge construction or, assuming all work in winter, no in-water work	● No quantitative indicator available to assess potential impacts on fish and fish habitats during bridge construction
● Potential spills from storage, use, and transport of waste and hazardous materials, including crude oil, fuels, saltwater, drilling fluids, and other chemicals ● Potential oil spills from wells, pipelines, or other infrastructure	● Habitat alteration if spill enters waterbodies ● Injury or mortality of fish from spilled material if it enters waterbodies	● No quantitative indicator available to assess potential indirect impacts on fish and fish habitats from contaminant spills
Entrainment of fish during water gather activities for gravel mining and ice infrastructure construction	● Fish injury or mortality from entrainment	● No quantitative indicator available to assess potential fish entrainment impacts
Abandonment and reclamation to restore habitats and habitat functions	● Potential beneficial impacts for fish from the improvement of aquatic habitat functions	● No quantitative indicator available to assess potential impacts on fish from habitat reclamation activities

Impact Analysis Area

- Direct/Indirect—No future development projects are planned under the revised leasing plans being considered in this EIS, so no specific areas are known in which new developments could occur. Because of this, the impact analysis area for direct and indirect impacts in onshore areas is the high development potential zone in the northeastern portion of the planning area. As described in the

RFD scenario, this zone is the most likely area in which future developments would occur. Offshore, the analysis area includes nearshore coastal areas that could be used for barge routes, offshore STP facility pad construction, STP mixing zones, and other connected actions in marine waters.

- Cumulative—The geographic area considered for cumulative impacts is the entire NPR-A, adjacent nearshore waters in the Beaufort and Chukchi Seas, and the foothills of the Brooks Range. The time frame for the analysis is all past and present developments on the NPR-A and extending 70 years. The future 70-year time frame follows from Appendix B of the Final IAP/EIS, which noted that individual petroleum projects can be producing for 10 to 70 years.

Analysis Assumptions

- The BLM leases are for onshore development; offshore activities could be considered connected actions, but the analysis does not include assessment of offshore infrastructure.
- Barge landing areas or docks will be part of the alternatives.
- Knowledge of fish and aquatic invertebrate use of NPR-A waters is still relatively sparse. Because of this, the analysis assumes use by the species recorded over a broader area than has been sampled.
- Alternatives will include water withdrawal from freshwater sources and from marine waters via an onshore STP.
- Not all streams and lakes in the planning area are fish-bearing, and EFH and Anadromous Waters Catalog designations for the NPR-A are incomplete; therefore, the analysis relies on an incomplete, though likely representative index—the Anadromous Waters Catalog—of aquatic resources in the NPR-A. The analysis assumes that fish use most of the planning area.
- The high development potential zone predominantly encompasses lands in the Lower Colville River and NPR-A fish habitat units. The analysis primarily focuses on impacts on these units, which have the greatest likelihood of being affected by development under all alternatives. Impacts on other units will be of the same type but will be less likely to occur.
- Pipeline corridors in the Teshekpuk Lake Special Area were not included in the analysis of areas conditionally available to infrastructure development. The pipeline corridors will be assessed in the revised version of the fish section of Chapter 3 of the Final IAP/EIS.
- Deep (5 to 13 feet) and very deep (over 13 feet) lake habitats are collectively referred to as deep lake habitat. For the purposes of this analysis, both depth ranges provide fish habitat.

F.4.16 Birds

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
Open to leasing	• Loss or degradation of habitat or disturbance and displacement of birds if oil and gas exploration or development occurs. Associated drilling and ice roads can degrade habitat, increase bird strikes with vehicles, buildings, elevated structures, and suspended lines	• Acres open or closed to leasing

Action Affecting Resource	Type of Impact	Impact Indicators
Open to surface occupancy	● Loss or degradation of habitat or disturbance and displacement of birds if development infrastructure is constructed. Associated roads and infrastructure can increase bird strikes with vehicles, buildings, elevated structures, and suspended lines. Associated drilling and pipelines increase risk of spills and contamination. Increased access would increase subsistence harvest mortality.	● Acres open or closed to surface occupancy; stopover and breeding habitats would have a higher level of impacts if developed; if possible, acres of wetlands, waterbodies, coast, foothill, and riverine areas should be described.
Open to mineral materials (salables)	● Habitat loss, degradation, and disturbance and displacement	● Acres open to mineral materials with suitable bird habitat by species
Wild and Scenic River designation	● Designation would formalize habitat protection important for birds and their fish prey. Alternatives B, C, and D would open the possibility of degradation.	● River miles either designated (under Alternative B) or not designated (under Alternatives A, C, D, and E) as Wild and Scenic Rivers
River buffers	● Larger river buffers increase habitat protection.	● Acres of buffer widths
Open to right-of-way (ROW) corridors	● Loss or degradation of habitat or disturbance and displacement of birds if development infrastructure is constructed; associated roads and infrastructure can increase bird strikes with vehicles, buildings, elevated structures, and suspended lines; increases the risk of spills and contamination and mortality from hunting from increased access	● Acres occupied by gravel infrastructure and linear miles of pipelines; stopover, breeding habitats, and brood-rearing/molting areas would have a higher level of impacts; describe acres of wetlands, waterbodies, and coast, if possible.
Utqiagvik-Nuiqsut Road	● Loss or degradation of habitat or disturbance and displacement of birds if development infrastructure is constructed; associated roads and infrastructure can increase bird strikes with vehicles, buildings, elevated structures, and suspended lines; increases the risk of spills and contamination and mortality from hunting from increased access	● Acres occupied by gravel infrastructure and linear miles; stopover, breeding habitats, and brood-rearing/molting areas would have higher level of impacts; parse out acres of wetlands, waterbodies, and coast, if possible

Action Affecting Resource	Type of Impact	Impact Indicators
Surface disturbance from infrastructure footprints, such as open pit mine sites, cleared facility sites, pipeline corridors, tailing reservoirs, waste rock dumps, and timber harvest	● Habitat loss and alteration, including altered successional patterns; with rehabilitation after abandonment, potential creation of avian habitats previously absent on that site for some species and actions	● Non-quantitative locations of infrastructure uncertain
Gravel placement for roads and pads	● Habitat loss	● Non-quantitative locations of roads uncertain
Gravel placement (roads and pads)	● Habitat alteration from drifted snow and altered drainage patterns	● Non-quantitative locations of roads uncertain
Road traffic on gravel roads	● Habitat alteration from gravel spray and dust fallout	● Non-quantitative locations of roads uncertain
Water withdrawal from lakes for dust suppression and other uses	● Habitat alteration by reduced or fluctuating water levels, loss of nesting sites on lakeshores, reduced water quality and fish availability	● Describe extent of effect in qualitative terms by aquatic habitat (lakes, rivers, springs)
Road traffic, air traffic, noise, and human activities	● Disturbance and displacement of birds from affected areas	● Non-quantitative locations of facilities uncertain
Road traffic	● Injury and mortality from accidental collisions	● Describe potential for vehicle collisions
Towers, power lines, guy wires, and other aboveground structures	● Injury and mortality from accidental collisions	● Describe potential for bird strikes
Use and storage of hazardous materials	● Injury and mortality from accidental releases and discharges or insecure containment	● Describe potential for accidental exposure
Use and storage of hazardous materials	● Habitat loss and alteration from accidental releases	● Describe potential for releases and spills
Tailings and waste rock storage	● Contaminant exposure (habitat effects covered under infrastructure)	● Describe potential hazards
Impoundments/reservoirs	● Habitat loss and alteration, creation of aquatic habitat	● Non-quantitative locations uncertain
Mine impoundments	● Contaminant exposure	● Describe potential hazards
Human activities and waste management	● Attraction of predators and scavengers, including increased abundance of some birds, and resulting decrease in survival and nesting success for prey species	● Potential impacts on bird populations and predator/prey dynamics (non-quantitative)
Human activities and increased access	● Habitat alteration from OHV traffic	● Non-quantitative, describe potential effects
Human activities and increased access	● Disturbance and displacement from OHV traffic and foot traffic and habitat alteration from OHV traffic	● Non-quantitative, describe potential effects
Human activities and increased access	● Injury and mortality from increased hunting pressure for some species	● Non-quantitative potential for population impacts

Impact Analysis Area

- Direct/Indirect—NPRA, 5-mile coastal buffer, and marine corridor
- Cumulative—NPRA, 5-mile coastal buffer, and marine corridor

Analysis Assumptions

- Specific development-related impacts cannot be quantified because no specific projects are proposed. Impacts can be described only qualitatively, both because resource and impact data are unavailable and because project details are unknown. Also, vegetation mapping information is coarse over the planning area and habitat use data are lacking for most species.
- Alternatives will be compared in terms of acres open or closed to various resource extraction or other reasonably foreseeable future activities. These acreages will not differ among resources. Additionally, broad groupings of birds that may be affected will be discussed within these broadly defined vegetation types (based on generalized knowledge of habitat use and distribution). The vegetation map will intersect with no surface occupancy areas, with areas of high fluid mineral potential, and with pertinent land management actions associated with each management alternative.
- As in the 2012 IAP, the most important potential actions in the planning area will be related to oil and gas exploration, leasing, development, ROWs, and associated gravel mines (salable mineral materials disposal and extraction). As no maps are available for ROWs, no quantification of related impacts is possible.

F.4.17 Terrestrial Mammals

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
Seismic exploration	• Direct and indirect effects on vegetation and behavioral disturbance affecting caribou and other ungulates, carnivores (including denning grizzly bears and wolverines), and small mammals	• Acres under different land status, by alternative
Construction of ice roads and pads to support winter exploration and construction	• Habitat alteration by ice roads and pads	• Acres under different land status, by alternative
Gravel placement for roads and pads	• Direct habitat loss	• Acres under different land status, by alternative • Acres of high quality habitat (Wilson et al. 2012) under different land status, by alternative
Traffic on gravel roads	• Habitat alteration from gravel spray and dust fallout	• Acres of potentially affected habitat, by habitat type
Gravel mining	• Direct habitat loss • With rehabilitation after abandonment • Indirect habitat loss by disturbance during mining	• Acres or square miles of potentially affected habitat, by habitat type

Action Affecting Resource	Type of Impact	Impact Indicators
Road traffic, air traffic, noise, and human activities	• Disturbance and displacement of caribou and other species from affected areas	• Area of seasonal range use for Western Arctic Herd and Teshekpuk Caribou Herd in potential disturbance zones
Roads and pipelines	• Potential obstructions to caribou movements, especially to and from insect-relief habitat • Habitat loss due to spills or leaks	• Proportion of Western Arctic Herd and Teshekpuk Caribou Herd using the areas, based on kernel distribution (probability of density)
Road traffic	• Injury and mortality from accidental collisions	• Qualitative assessment
Potential spills from the following: • Storage, use, and transport of waste and hazardous materials, such as crude oil, fuels, saltwater, drilling fluids, and other chemicals • Wells, pipelines, or other infrastructure	• Injury and mortality from accidental releases and discharges or unsecured containment	• Describe potential accidental exposure for individuals and areas
Human activities and waste management	• Attraction of predators and scavengers, potential defense of life and property, mortality of grizzly bears • Increase in red fox density and decline in arctic fox density	• Qualitative assessment
Roads and pads	• Increased or altered access for subsistence hunters, out-of-area hunters, and other recreationists	• Qualitative assessment

Impact Analysis Area

- Direct/Indirect—Planning area (non-marine habitats)
- Cumulative—Annual ranges of the Western Arctic Herd, Teshekpuk Caribou Herd, and Central Arctic Herd

Analysis Assumptions

- Subsistence hunting will be allowed along gravel roads.
- Access approvals for recreation or non-subsistence uses in the program area will be dealt with at the application for permit to drill phase.
- Zone of influence during calving season—Maternal caribou may be displaced by up to 2.5 miles from roads and pads during and immediately after calving, spanning approximately 3 weeks, based on research in North Slope oilfields.
- Caribou will be locally displaced by subsistence hunting or other activity off roads and pads.
- Roads and pipelines may deflect and delay caribou movements, but long delays can be mitigated by appropriate design features, such as pipeline heights of 7 feet or more, pipeline/road separation of

500 feet or more, low traffic levels, and management of human activities, as developed in the existing North Slope oilfields.

- Known locations of occupied grizzly bear dens will be avoided by at least 0.5 miles, as stipulated by the State of Alaska.

F.4.18 Marine Mammals

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
Winter activities: Seismic exploration, construction, and use of ice roads and pads, gravel mining and blasting, hauling, and placement	• Direct habitat loss of polar bear critical habitat, including maternal denning habitat, from gravel mining and placement • Alteration of habitat and temporary loss of use of polar bear critical habitat, including maternal denning habitat, from construction of ice roads and pads • Behavioral disturbance of polar bears, especially denning females	• Acreage of critical habitat units, including mapped potential maternal denning habitat, affected by seismic exploration • Apply no-disturbance buffer of 1.0 mile around known, occupied maternal dens under regulatory requirements of current incidental take regulations, based on published literature on disturbance from equipment operation and noise
Marine vessel traffic during open-water season	• Behavioral disturbance of marine mammals by vessel passage and offloading during open-water season • Injury and mortality from accidental ship strikes	• Apply distance buffers along vessel route, from literature-based assessment of disturbance responses
Traffic, aircraft, noise, and human activities throughout the year	• Behavioral disturbance and displacement from affected areas • Injury and mortality of polar bears from vehicle strikes • Disturbance of polar bears through deterrence actions in areas of human activity	• Apply distance buffer of 1.0 mile from literature-based assessment of disturbance from equipment operation and noise and 1.0-mile no-disturbance buffer around barrier islands unit of critical habitat
Waste management and use and storage of hazardous materials throughout the year	• Potential attraction and injury and mortality of some polar bears • Injury and mortality from accidental releases and discharges or unsecured containment	• Qualitative assessment, considering required operating procedures for waste handling and human/bear interaction plans

Impact Analysis Area

- Direct/Indirect—Planning area (including docking structures and adjacent marine habitats) and associated marine transportation routes
- Cumulative—Range of affected species population/stock, such as the Southern Beaufort Sea stock of polar bears and Western Arctic stock of bowhead whales

Analysis Assumptions

- Onshore activities will affect polar bears primarily, except for activities in the vicinity of marine docking structures and module-staging pads at the coast.
- Alternatives will avoid destruction or adverse modification of designated critical habitat (to be addressed in biological assessments and biological opinions, which are being prepared separately).
- Maternal den surveys for polar bears will be conducted before any activities begin in the program area, so that occupied dens can be located and avoided by at least 1 mile during exploration and development.
- Vessel traffic can be expected each year, though the frequency is unknown.
- Barge landings may require habitat modification, such as dredging or screeding, that has direct effects (habitat modification) and indirect effects (loss of habitat use through disturbance from noise and activity) on seals and possibly walruses.

F.4.19 Landownership and Use

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
• Areas open or closed to leasing and infrastructure development • Avoidance criteria or stipulations that limit the placement or design of uses • Land tenure adjustments	• Restrictions of infrastructure development, including type, location, and design • Conveyance of lands out of federal management	• Acres managed as avoidance or exclusion areas for new ROWs, permits, or leases • Acres identified for conveyance out of federal management

Impact Analysis Area

- Direct/Indirect—Planning area
- Cumulative—Planning area

Analysis Assumption

- Demand for ancillary uses and permits, such as for communication sites, will increase, in conjunction with oil and gas development.
- There will be no lands conveyed into or out of federal management as part of this EIS.

F.4.20 Cultural Resources

Impacts and Indicators

Note: Types of impacts are not mutually exclusive and may occur across all actions that affect a resource.

Action Affecting Resource	Type of Impact	Impact Indicators
Construction • Ground disturbance • Traffic • Human presence • Ice roads • Water use requirements	• Physical destruction or damage • Removal of the cultural resource from its original location and loss of context • Vulnerability to erosion • Theft and vandalism	• Number of previously documented Alaska heritage resources in potentially affected area • Eligibility status of cultural resource sites • Traditional knowledge of culturally sensitive areas and traditional use areas and sites

Action Affecting Resource	Type of Impact	Impact Indicators
Proposed project operational infrastructure • CPF • Drill rigs and pads • Pipelines and VSMs • Roads • Material sites	• Change to character and setting • Change in use of or access to traditional sites • Proximity of proposed project components to culturally sensitive areas	• Same as above
Operation activities • Traffic • Human presence • Maintenance and security activities • Proposed project policies	• Introduction of vibration, noise, or atmospheric elements, such as visual, dust, and olfactory sense • Increased access to culturally sensitive areas	• Same as above
Oil spills	• Physical destruction or damage, including issues with dating damaged artifacts	• Same as above
General development	• Loss of cultural identity with a resource • Effects on beliefs and traditional religious practices • Neglect of a cultural resource that causes its deterioration • Lack of access to traditional use areas and effects on the broader cultural landscape	• Same as above
Construction • Ground disturbance • Traffic • Human presence • Ice roads • Water use requirements	• Physical destruction or damage • Removal of the cultural resource from its original location or loss of context • Vulnerability to erosion • Theft and vandalism	• Number of previously documented Alaska heritage resources in potentially affected area • Eligibility status of cultural resource sites • Traditional knowledge of culturally sensitive areas and traditional use areas and sites

Impact Analysis Area

- Direct/Indirect—Planning area
- Cumulative—Planning area

Analysis Assumptions

- All unsurveyed areas of the proposed program area could contain cultural resources.
- Cultural resource sites are eligible for listing under the National Register of Historic Places, unless previously evaluated.

F.4.21 Subsistence Uses and Resources

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
Noise, traffic, and human activity • Construction and drilling noise • Gravel mining • Air traffic • Ground traffic • Seismic activity • Barge traffic • Human presence	• Reduced resource availability due to changes in resource abundance, migration, distribution, or behavior • Increased costs and time associated with harvesting resources • Increased safety risks associated with traveling farther to harvest resources • Reduced user access due to harvester avoidance of development and human activity • Increased competition with outsider populations	• Results of wildlife chapters on impacts of noise, traffic, and human activity on wildlife • Use areas by resource and community in the planning area and by alternative, if possible • Analysis of material and cultural importance of subsistence species • Traditional knowledge of impacts on subsistence uses, resources, and activities
Infrastructure • Gravel roads • Ice roads • Pipelines • Gravel pads • Bridges • Gravel mines • Runways	• Loss of subsistence use areas to development infrastructure • Physical obstructions to hunters traveling overland • Physical obstructions to hunters along the coast due to pipelines • Reduced resource availability due to changes in resource abundance, migration, distribution, or behavior • Increased costs and time associated with harvesting resources • Increased safety risks associated with traveling farther to harvest resources • Reduced user access due to harvester avoidance of development infrastructure • Increased user access due to use of project roads for subsistence activities • Increased competition along roads as new roads are used as hunting corridors	See above.

Action Affecting Resource	Type of Impact	Impact Indicators
Contamination • Oil spills • Air pollution	• Reduced resource availability due to changes in resource abundance • Reduced resource availability due to harvester avoidance of contaminated resources • Reduced user access due to harvester avoidance because of concerns about contamination	• Results of NPR-A IAP/EIS Chapter 3 wildlife sections regarding impacts of oil spills on wildlife • Results of air quality and public health sections of the Final IAP/EIS • Traditional knowledge
Legal or regulatory barriers Security restrictions	• Reduced user access due to security restrictions around development infrastructure • Reduced user access due to harvester avoidance resulting from concerns about security restrictions and personnel • Reduced resource availability due to inability to hunt in or around certain infrastructure	• Use areas by resource by community in planning area and alternatives (if possible) • Traditional knowledge
Increased employment and revenues	• Increased subsistence activity due to cash from employment and other revenue • Decreased subsistence activity due to increased employment and resulting lack of time • Decreased overall community harvests resulting from lack of time to engage in subsistence activities	• Results of the Final IAP/EIS economy section • Traditional knowledge
Development—general	• Impacts on cultural practices, values, and beliefs	• Traditional knowledge
Noise, traffic, and human activity • Construction and drilling noise • Gravel mining • Air traffic • Ground traffic • Seismic activity • Barge traffic • Human presence	• Reduced resource availability due to changes in resource abundance, migration, distribution, or behavior • Increased costs and time associated with harvesting resources • Increased safety risks associated with traveling farther to harvest resources • Reduced user access due to harvester avoidance of development and human activity • Increased competition with outsider populations	• Results of the Final IAP/EIS wildlife sections regarding impacts of noise, traffic, and human activity on wildlife • Use areas by resource by community in planning area and alternatives (if possible) • Analysis of material and cultural importance of subsistence species • Traditional knowledge regarding impacts on subsistence uses, resources, and activities

Impact Analysis Area

- Direct—All areas used in the NPR-A planning area for subsistence purposes

- Indirect—All areas used by the primary and peripheral subsistence study communities, in addition to all caribou areas used by the 42 caribou study communities
- Cumulative—Same as direct and indirect

Analysis Assumption

- There will be oil and gas exploration, construction, drilling, and other operations similar to other developments on the North Slope.

F.4.22 Sociocultural Systems

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
Disruptions to subsistence activities and uses	• Social stresses associated with reduced harvests or changes in effort, costs, and risk • Changes in social ties and organizations from changes in subsistence providers • Loss of traditional use areas and knowledge associated with those places	• Results of the Final IAP/EIS subsistence section regarding impacts on subsistence • Traditional knowledge
Influx of nonresident temporary workers associated with project	• Conflicts between subsistence users and workers • Discomfort hunting in traditional use areas	• Results of the Final IAP/EIS economy section regarding outside workers • Results of subsistence chapter • Traditional knowledge
Influx of outsiders into community	• Increased social problems • Lack of infrastructure to support populations • Lack of knowledge and respect of traditional values, history, and beliefs	• Results of the Final IAP/EIS recreation chapter • Results of the Final IAP/EIS health chapter • Traditional knowledge
Changes in available technologies	• Changes in equipment for subsistence • Changes in transportation routes • Changes in social ties, sharing, and interactions	• Results of the Final IAP/EIS economic chapter regarding potential changes in employment and income • Traditional knowledge
Development—general	• Impacts on belief systems • Impacts on cultural identity	• Traditional knowledge

Impact Analysis Area

- Direct/Indirect—Communities addressed under subsistence sections
- Cumulative—Same as direct/indirect analysis area

Analysis Assumption

- The impact analysis on sociocultural systems will be from oil and gas activities similar to other developments on the North Slope.

F.4.23 Environmental Justice

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
• Exploration phase activities • Development and construction phase activities • Operations phase activities • Production of oil and gas resources	Direct and indirect effects • Subsistence effects • Sociocultural effects • Economic effects • Public health and safety effects	• High and adverse effects identified in other resource area analyses that can be shown to disproportionately accrue to minority populations, low-income populations, or Alaska Native tribal entities, as defined or described under CEQ guidance on the implementation of Executive Order 12898

Impact Analysis Area

- Direct/Indirect—All subsistence communities
- Cumulative—Same as direct/indirect analysis area

Analysis Assumptions

- Environmental justice impacts will derive from disproportionately high and adverse human health or environmental effects identified in other resource area analyses that could accrue to minority populations, low-income populations, or Alaska Native tribal entities. This could include such effects identified in any specific resource analysis, but primarily applies to subsistence, sociocultural, economics, and public health and safety.
- Minority and low-income populations are defined by CEQ guidance on the implementation of Executive Order 12898. The general reference population for this analysis is the State of Alaska.

F.4.24 Recreation

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
• Disturbance in priority recreation areas (direct) • Noise, lights, and human activity (direct/indirect)	• Change in the quality of the recreation setting or user experiences • Displacement of recreation opportunities from surface disturbance • Change in the level of access to recreation opportunities, including specially permitted commercial activities	• Acres of disturbance in priority recreation areas • Acres identified for conveyance out of federal management

Impact Analysis Area

- Direct/Indirect—Planning area
- Cumulative—Planning area

Analysis Assumptions

- Current recreation in the planning area will continue.
- Recreation numbers may increase due to population growth.
- The potential for user interactions between all types of users will increase with increasing use.

F.4.25 Wild and Scenic Rivers

Impacts and Indicators

Action Impacting Resource	Type of Impact	Impact Indicators
• Managing suitable river segments to protect their free flow, water quality, and outstandingly remarkable qualities • Recommending or not recommending suitable river segments for designation as a Wild and Scenic River	• 0.5- to 7-mile buffers—Within these buffers, permittees could construct essential pipelines and roads that cross the river, but no other permanent infrastructure would be permitted.	• Outstandingly remarkable values, tentative classification, and free-flowing nature of the river segment or corridor

Impact Analysis Area

- Direct/Indirect—Up to 7 miles of either side of the ordinary high-water mark of the suitable rivers in the NPR-A
- Cumulative—Up to 7 miles of either side of the ordinary high-water mark of the suitable rivers in the NPR-A

Analysis Assumptions

- The BLM would not permit any actions that would adversely affect the free-flowing nature, outstandingly remarkable values, or tentative classification of any portion of the suitable rivers or actions that would reduce water quality to the extent that they would no longer support the outstandingly remarkable values.

F.4.26 Wilderness Characteristics

Impacts and Indicators

Action Impacting Resource	Type of Impact	Impact Indicators
• Short-term and long-term surface disturbance caused by development and facilities, such as ice roads, pads, airstrips, snow trails, exploration wells, gravel pads, roads, and pipelines	• Surface disturbance activities from oil and gas development and facilities	• Changes to the naturalness, opportunities for solitude or primitive and unconfined recreation, and unique or supplemental values in the planning area

Impact Analysis Area

- Direct/Indirect—All lands in the NPR-A
- Cumulative—All lands in the NPR-A

Analysis Assumptions

- Wilderness characteristics are defined in Section 2 of the Wilderness Act and consist of size, naturalness, and outstanding opportunities for solitude or primitive and unconfined recreation. They may also include supplemental values.
- For all of the alternatives, size is a characteristic that will not be affected.
- The impacts on wilderness characteristics will be similar for all alternatives.
- The biggest difference between the alternatives in relation to wilderness characteristics is the total amount of activity that will take place under each alternative.

F.4.27 Visual Resources

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
Visual resource management (VRM) classes by alternative	• Potential for changes to the form, line, color, or texture of the characteristic landscape based on VRM classes that vary by alternative	• Acres of visual resource inventory classes in each VRM class for each alternative; table of visual resource inventory compared with VRM

Impact Analysis Area

- Direct/Indirect— BLM-managed surface lands in decision area
- Cumulative— BLM-managed surface lands in decision area

Analysis Assumptions

- For production and development of oil and gas, appropriate design techniques will be applied to conform with the appropriate VRM class.
- Activities that cause the most contrast and are the most noticeable to the viewer will have the greatest impact on changes to visual resources.
- As the number of acres of disturbance increase, the amount of changes to visual resources will also increase.
- The severity of a visual impact depends on a variety of factors, including the size of a project (such as the area disturbed and physical size of structures), the location and design of structures, roads, and trails, and the overall visibility of disturbed areas and structures.
- The more protection that is associated with the management of other resources and special designations, the greater the benefit to the visual resources.
- VRM class objectives apply to all resources. VRM class objectives would be adhered to through best management practices, project design, avoidance, or mitigation.
- Due to the slow rate of recovery of vegetation and surface conditions, all impacts on visual resources from surface disturbances associated with production and development of oil and gas will be long term.

F.4.28 Transportation

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
• Areas open, closed, or limited to public or subsistence access • Seasonal or other timing-related restrictions on access • Roads developed from the North Slope to the NPR-A developments • Pipelines and collocated infrastructure from the North Slope to the NPR-A developments	• Change in the level of access (increase or decrease) for subsistence and public access	• Acres or miles of designated routes open, closed, or limited to public or subsistence access

Impact Analysis Area

- Direct/Indirect—Planning area
- Cumulative—Planning area

Analysis Assumptions

- Commercial and casual visits will continue to increase, thereby increasing the demand for access.
- Development of infrastructure will increase access opportunities from roads developed.
- Those seeking access in the decision area have different and potentially conflicting ideas of what should constitute public access on public lands.
- The primary means of access in the decision area will continue to be by aircraft and, to a lesser extent, boat (summer) and snow machine (winter).

F.4.29 Economy

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
• Exploration phase activities • Development phase activities • Operations phase activities • Oil and gas activities	Direct and indirect effects • Employment effects • Income effects • Fiscal effects • NPR-A impact mitigation funds • Potential effects and opportunities on relevant and selected economic sectors	• Average number of part-time and full-time jobs • Income • Government revenues: property taxes, corporate income taxes, severance taxes, royalties, other local taxes and fees • Increase or decrease in economic activity by sector (most likely qualitative)

Impact Analysis Area

- Direct/Indirect
  - Local—Communities in the NPR-: Atqasuk, Nuiqsut, Wainwright, and Utqiaġvik, plus other North Slope communities that receive NSB grants and funds: Anaktuvuk Pass, Kaktovik, Point Hope, and Point Lay. Special focus and more details will be provided for Nuiqsut, being the closest community to current oil and gas activities in the planning area.
  - Regional—NSB
- State—Alaska
- Cumulative—Geographic scope would depend on the list of past, present, and RFFAs, most likely the North Slope region and statewide discussion.

Analysis Assumptions

The following assumptions and data were used in quantifying the potential economic impacts of post-leasing oil and gas activities:

- Description of potential oil and gas activities and time frames under each alternative—This includes scenarios or assumptions regarding exploration, development, and production activities, such as road/ice road construction, onshore pipelines, processing facilities, and camps. This is the basis for quantifying the magnitude and scale of economic impact (see Appendix B of the Final IAP/EIS).
- Production volumes by year—These data are used to calculate potential royalty payments and other state and federal government tax payments.

- Oil price forecasts—Oil price data are used to quantify potential royalty payments and other fiscal effects of the proposed project. Oil price projections were obtained from the Energy Information Administration Annual Outlook.
- Construction costs and construction schedule—This information is used to calculate indirect (or multiplier) effects of construction spending, as well as potential government revenues, including oil and gas property taxes and state corporate income taxes. These data can also be used to estimate direct employment requirements associated with construction.
- Annual operations and maintenance costs of the facilities—This information is used to calculate indirect (or multiplier) effects of operations and maintenance spending, as well as potential government revenues, including state corporate income taxes. These data can also be used to estimate direct employment requirements associated with the operations phase, if direct jobs data are not available.
- Tariffs and transportation costs—This information is used to calculate netback prices, which are the basis for calculating royalty payments. Data on existing tariffs and transportation costs are published by the Alaska Department of Revenue (ADOR 2018).
- Landownership—This is used to determine potential royalty and ROW payments that would accrue to the landowners.
- The effects on activities unrelated to oil and gas and those not associated with an NPR-A lease are discussed qualitatively.

F.4.30 Public Health and Safety

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
Surface disturbance associated with oil and gas development	• Impacts on subsistence harvest	• Acres of subsistence harvesting area disturbed • Change in wildlife patterns and avoidance of oil and gas development
Oil and gas development	• Increase in air pollution	• Change in quantity of air pollutants introduced from oil and gas operations
Oil and gas development	• Increase in noise pollution	• Change in noise levels
Oil and gas development	• Increase in water pollution	• Possibility of catastrophic oil spill • Change in quantity of water pollutants introduced from oil and gas operations
Oil and gas development	• Change in demand for the NSB public health system	• Change in unintentional accidents and injuries • Change in oil and gas revenue for the NSB
Oil and gas development	• Economic impacts on health	• Change in oil and gas revenue for NPR-A residents in the villages of the NSB
Oil and gas development	• Jobs and income	• Increase in income and employment for NPR-A residents

Action Affecting Resource	Type of Impact	Impact Indicators
Oil and gas development	• Accidents and safety	• Changes in NPR-A resident travel patterns for subsistence harvest • Increased construction and vehicle traffic
Oil and gas development	• Infectious diseases	• Influx of workers into the NPR-A and interaction between workers and NPR-A residents
Activities not associated with oil and gas exploration and development—aircraft use, river trips, site cleanup and remediation activities, overland moves, and community infrastructure projects	• Increase in noise pollution • Impacts on subsistence harvest	• Change in noise levels and potential impacts on subsistence harvesting • Presence of camps for recreation or scientific study that may result in avoidance of the area by hunters

Impact Analysis Area

- Direct/Indirect—NPR-A boundary, including the following eight villages of the NSB: Anaktuvuk Pass, Atqasuk, Kaktovik, Nuiqsut, Point Hope, Point Lay, Utqiagvik, and Wainwright; most villages of the Northwest Arctic Borough: Ambler, Kiana, Noatak, Shungnak, and, to a lesser extent, Kotzebue, Kobuk, Selawik and Noorvik, diet and nutrition includes the 42 communities outlined in the subsistence section in primary communities, peripheral communities, and those communities that rely on the Western Arctic Herd and Central Arctic Caribou Herd.
- Cumulative—NPR-A boundary; diet and nutrition includes the three communities outlined for direct and indirect impacts.

Analysis Assumptions

- The NPR-A IAP EIS analyzes various leasing alternatives and does not analyze specific developments in the NPR-A.
- A health impact assessment will be required for specific oil and gas development once the lease sale is complete.

F.5 REFERENCES

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Climate and Meteorology

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ATTACHMENT

ACRONYMS AND ABBREVIATIONS

	Full Phrase
°F	Fahrenheit
AMAP	Arctic Monitoring and Assessment Programme
BLM	Bureau of Land Management
BOEM	Bureau of Ocean Energy Management
BOPD	barrels of oil per day
°C	degrees Celsius
CH_4	methane
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalents
EIS	environmental impact statement
EPA	U.S. Environmental Protection Agency
°F	degrees Fahrenheit
IAP	integrated activity plan
IWC	Interagency Working Group
IPCC	Intergovernmental Panel on Climate Change
GHG	greenhouse gas
GWP	global warming potential
MMT	million metric tons
NEPA	National Environmental Policy Act
NPR-A	National Petroleum Reserve-Alaska
NOAA	National Oceanic and Atmospheric Administration
NWS	National Weather Service
N_2O	nitrous oxide
$PM_{2.5}$	particulate matter with diameters 2.5 micrometers or less
SCC	social cost of carbon
USGS	U.S. Geological Survey

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Appendix G. Climate and Meteorology

G.1 AFFECTED ENVIRONMENT

Climate change is affecting natural systems across the globe, with enhanced impacts in the Arctic. The atmosphere and oceans have warmed, the ice cover is shrinking, and permafrost is melting in high latitude and high elevation regions. It is extremely likely that human influence has been the dominant cause of the observed warming since the mid-twentieth century (Intergovernmental Panel on Climate Change [IPCC] 2014; World Meteorological Organization 2019).

G.1.1 Greenhouse Gases and Climate Change Overview

The major greenhouse gases (GHGs) are carbon dioxide (CO_2), nitrous oxide (N_2O), and methane (CH_4). GHGs are produced both naturally through volcanoes, forest fires, and biological processes and through human activities, such as the burning of fossil fuels, land use and water management changes, and agricultural processes. Since GHGs absorb infrared radiation emitted from earth's surface, they block heat from escaping to space and warm earth's atmosphere. GHGs are necessary for keeping the planet at a habitable temperature. Without GHGs, earth's surface temperature would be around 60 °F cooler than it is now.

Natural biological and geological processes regulate levels of naturally occurring GHGs in the atmosphere; however, human-caused emissions have driven atmospheric concentrations of GHGS to levels unprecedented in 800,000 years. Concentrations of CO_2, CH_4, and N_2O have increased by 40 percent, 150 percent, and 20 percent since 1750, largely due to economic and population growth (IPCC 2014). Continued emissions of GHGs are expected to continue to warm the planet (World Meteorological Organization 2019).

Although black carbon is not a GHG, it affects climate in a variety of ways. Black carbon is emitted as a combustion byproduct. The concentration of black carbon can vary spatially, seasonally, and vertically in the atmosphere (Creamean et al. 2018; Stohl et al. 2013; Xu et al. 2017; Arctic Monitoring and Assessment Programme [AMAP 2018). Black carbon affects the climate by absorption and scattering of sunlight. It can also influence clouds by altering the size and number of water droplets and ice crystals in water and ice clouds. Black carbon in cloud droplets decreases the cloud albedo, which heats and dissipates the clouds. This also changes the temperature structure in and around the cloud, changing cloud distribution.

There is considerable uncertainty regarding the effect of black carbon on climate, as it can either warm or cool the atmosphere; however, black carbon is considered an important reason for the rapid warming in the Arctic (Ding et al. 2018). Altogether, the total effect of black carbon is estimated to be +1.1 W/m^2, indicating a net warming effect (Bond et al. 2013). Ramanathan and Carmichael (2008) estimated that the total forcing from black carbon varies from 0.4 to 1.2 W/m^2, with an average of 0.9 W/m^2. A large fraction of the black carbon in the Arctic can be attributed to long-range transport from Europe, Russia, and Asia (Ikeda et al. 2017). Black carbon is considered to be a short-lived climate forcer, and targeting its emissions may provide more immediate benefits, compared with the longer term goals of reducing CO_2 levels (Boone 2012; Cavazos-Guerra et al. 2017).

G.1.2 Regulatory Framework

On March 28, 2017, Presidential Executive Order 13783 (EO 13783), "Promoting Energy Independence and Economic Growth," was issued. EO 13783 required agencies to immediately review existing regulations and suspend, revise, or rescind those that burden the development of domestic energy resources beyond the degree

necessary to protect the public interest or otherwise comply with the law. As a result, many of the previous executive orders and federal guidance related to climate change have been revoked or rescinded.

On October 30, 2009, the USEPA issued the reporting rule for major sources of GHG emissions (40 CFR 98). The rule required a wide range of sources and source groups to record and report selected GHG emissions. Various oil and gas operations are required to monitor and report GHG emissions under this regulation. The State of Alaska does not have any GHG regulations beyond federal regulations.

G.1.3 Climatology of the NPR-A

Several monitoring stations were used to characterize climate and meteorology in the National Petroleum Reserve-Alaska (NPR-A). Monthly average precipitation and temperature data were acquired from National Oceanic and Atmospheric Administration (NOAA) National Weather Service (NWS) stations at Umiat, Kuparuk, Utqiagvik, and Nuiqsut (**Figure G-1**). Additional monthly average precipitation and temperature data were obtained from the Applied Climate Information System, which is maintained by the NOAA Regional Climate Centers, as well as from NOAA's National Centers for Environmental Information. A monitoring station operated at Nuiqsut by SLR International Corporation on behalf of ConocoPhillips Alaska, Inc. was used to characterize prevailing wind patterns.

Table G-1 provides summaries of average monthly temperatures and precipitation. The NPR-A is classified as northern polar climate, with long and cold winters and short and cool summers. The annual average temperature in the NPR-A is approximately 10°F, with monthly average temperatures below freezing from October to May (BLM 2012). The coldest temperatures, usually in February, range from 8 to -15°F at the maximum and from -6 to -30°F at minimum on average (**Table G-1**), with the lower temperatures along the coast and higher temperatures inland. Summer temperatures rise above freezing, with the highest temperatures typically being in July. The average maximum and minimum temperatures in July range from 45 to 65°F and 35 to 45°F.

Annual average precipitation in the NPR-A is low, ranging from 2.7 inches at Nuiqsut to 13.3 inches at Chandalar Shelf Dot (**Table G-1**). Precipitation is highest during summer, with over three-fourths of the total annual precipitation falling between June and September. Though snowfall is sparser during the summer, it can occur during any month, with the highest average snowfall in October. There is generally snow on the ground from October to May (BLM 2012).

The prevailing wind direction measured at the ConocoPhillips Alaska, Inc. Nuiqsut monitoring station from 2013 to 2017 was from the northeast, with wind speeds averaging 5 meters per second (m/s). The maximum observed wind speed was 22.4 m/s and calm winds were infrequent, occurring for less than 1 percent of the time during the 5-year period.

Since the NPR-A covers a large geographic area, meteorological conditions could differ from measurements collected at Nuiqsut, a site that is influenced by its proximity to the coast. Similar to measurements collected at Nuiqsut, prevailing winds in the coastal plains in the NPR-A are frequently intense, particularly during winter, with very few calm periods. The prevailing wind direction in winter is generally northeast or easterly. At coastal locations in summer, temperature gradients between the surface and the ocean set up a diurnal land/sea breeze effect, and the wind direction depends on the direction to the coast. Farther inland a similar physical driver sets up diurnal flow patterns in mountains and valleys (commonly referred to as Mountain/Valley Flow) between the Brooks Range Foothills to the south of the NPR-A and the coastal plains. Mountain/Valley flow influences the wind direction at interior locations of the NPR-A, such as Umiat.

Figure G-1. Monitoring Stations Used to Characterize Climate and Meteorology in the NPR-A

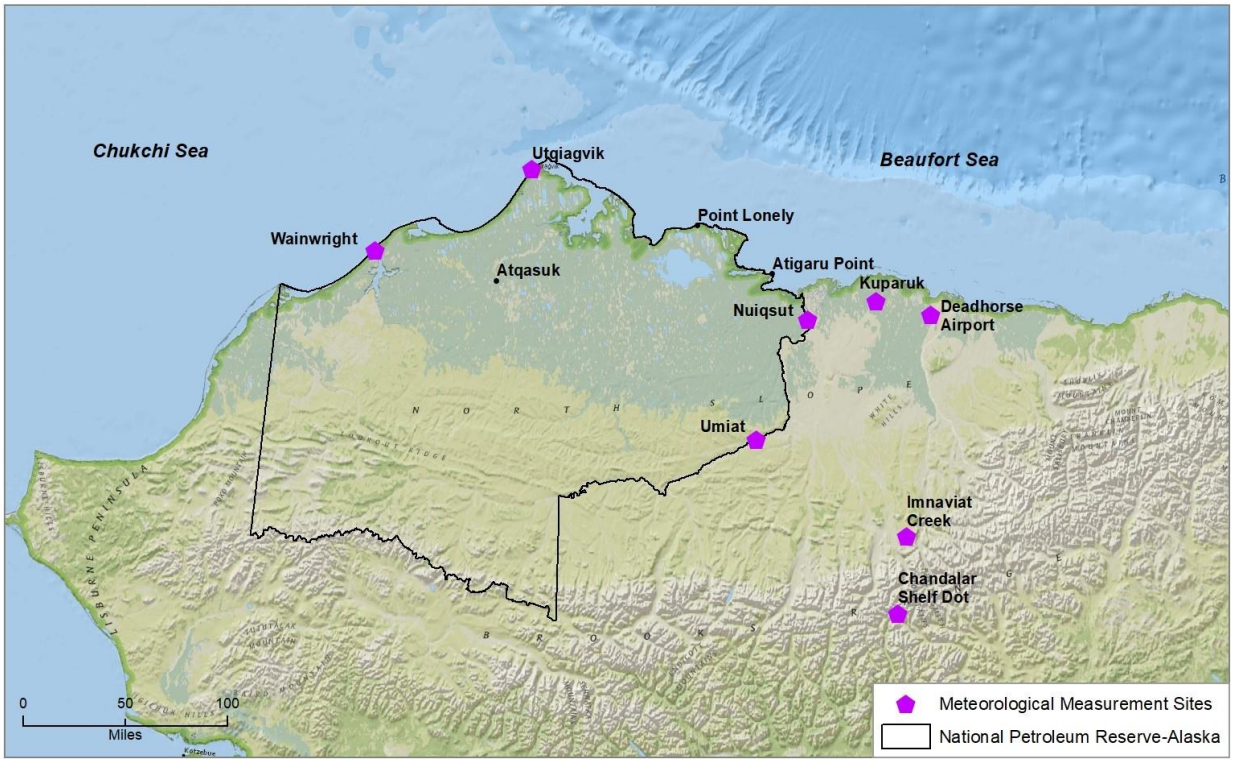

Table G-1
Monthly Climate Summary Data at Monitoring Stations in the North Slope for Air Quality

Utqiagvik [a]	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average max. temperature (°F)	-7.4	-10.6	-7.9	7.0	24.7	38.9	45.8	43.3	34.9	20.7	5.8	-4.4	15.9
Average min. temperature (°F)	-19.9	-22.7	-20.6	-6.8	15.3	30.1	34.1	34	28.2	11.6	-5.4	-16.2	5.1
Average total precipitation [b]	0.18	0.17	0.13	0.18	0.17	0.34	0.91	1.02	0.68	0.49	0.25	0.17	4.7
Average total snowfall [b]	2.4	2.7	2.0	2.8	2.3	0.6	0.3	0.7	4.0	7.7	4.3	2.8	32.5
Average snow depth	9	10	11	11	7	1	0	0	1	4	7	8	6

Kuparuk [a]	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
Average max. temperature (°F)	-11.3	-10.9	-8.4	8.7	28.1	47.4	56	50.8	39.2	21.5	4.0	-4.7	18.4
Average min. temperature (°F)	-23.9	-24.0	-22.6	-6.3	17.0	33.0	39.0	36.9	28.9	10.9	-8.9	-17.8	5.2
Average total precipitation [b]	0.13	0.17	0.08	0.14	0.07	0.32	0.87	1.06	0.48	0.35	0.16	0.13	4.0
Average total snowfall [b]	2.6	2.5	2.2	2.8	1.7	0.5	0.0	0.3	3.0	8.4	4.6	3.5	32.0
Average snow depth	9	9	9	10	5	0	0	0	0	3	6	7	5

Umiat [a]	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
Average max. temperature (°F)	-12.7	-13.8	-6.7	11.5	32.4	57.5	66.2	57.7	41.4	18.2	-0.7	-11.9	19.9
Average min. temperature (°F)	-28.9	-31.2	-26.8	-11.0	15.7	37.0	42.5	37.2	26.1	2.4	-16.8	-28.0	1.5
Average total precipitation (in) [b]	0.38	0.26	0.16	0.21	0.07	0.68	0.79	1.06	0.47	0.68	0.38	0.33	5.5
Average total snowfall [b]	4.5	2.4	2.3	1.9	1.2	0.2	0.0	0.2	2.6	8.5	5.2	4.2	33.2
Average snow depth	14	16	17	17	9	0	0	0	0	5	9	12	8

Nuiqsut	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
Average max. temperature (°F) [c]	-7.1	-9.6	-8.4	10.0	29.6	51.1	58.2	51.6	40.1	21.8	5.1	-2.5	20
Average min. temperature (°F) [c]	-22.9	-23.3	-21.5	-6.0	18.2	35.4	41.6	38.7	31.5	14.2	-8.7	-15.7	6.8
Average total precipitation [b, d]	0.07	0.09	0.03	0.16	0.18	0.29	0.71	0.88	0.39	0.04	0.05	0.09	2.7

Wainwright	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
Average max. temperature (°F) [c]	-6.5	-7.7	-8.6	8.4	27.2	45.1	51.8	48.3	37.4	22.3	7.0	-1.9	18.6
Average min. temperature (°F) [c]	-17.0	-19.3	-19.3	-3.9	19.5	34.8	40.3	39.0	32.2	16.8	-2.6	-12.6	9.0
Average total precipitation [b, d]	0.02	0.02	0.03	0.05	0.17	0.44	0.97	0.91	0.5	0.24	0.1	0.04	4.4

Chandalar Shelf Dot	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
Average max. temperature (°F) [c]	0.3	-0.1	6.6	20.3	38.8	53.9	55.8	49.3	36.2	17.5	5.1	2.7	23.9
Average min. temperature (°F) [c]	-10.6	-9.6	-5.1	6.9	26.2	41.2	43.9	37.6	27.3	9.1	-5.2	-7.7	12.8
Average total precipitation [b, c]	0.71	0.76	0.38	0.55	0.84	1.85	2.07	2.15	1.41	1.01	0.84	0.77	13.3

Deadhorse Airport	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
Average max. temperature (°F) [c]	-9.3	-11.6	-8.2	8.1	27.2	46	53.2	47.9	37.4	20.5	4.7	-3.8	17.7
Average min. temperature (°F) [c]	-23.1	-23.6	-23.1	-7.9	16.1	32.8	38.3	35.8	27.7	12.5	-8.1	-17.2	5.0
Average total precipitation [b, d]	0.05	0.03	0.01	0.09	0.19	0.44	0.84	0.91	0.47	0.2	0.06	0.07	3.14

Imnaviat Creek[e]	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
Average max. temperature (°F)	8.3	12.5	12.4	27.7	41.7	54.9	58.5	50.8	39.4	26.2	13.6	11.2	29.7
Average min. temperature (°F)	-5.9	-3.3	-4.6	9.7	25.9	40.3	45.2	38.7	28.4	15.6	1.7	-4.2	15.2
Average total precipitation [b]	0.37	0.45	0.45	0.4	0.7	1.55	3.21	2.6	1.32	0.88	0.5	0.44	12.6

a. Source: NOAA NWS data, obtained from Western Regional Climate Center (https://wrcc.dri.edu/summary/Climsmak.html). Period of record: Utqiaġvik (1901 to 2016); Umiat (1945 to 2001); Kuparuk (1983 to 2016). Historical records are under Utqiagvik's former name of Barrow.
b. Units of total precipitation are inches of liquid water equivalent; snowfall and snow depth in inches.
c. Source: NOAA NWS data obtained from NOAA National Centers for Environmental Information (https://www.ncdc.noaa.gov/cdo-web/datatools/normals). Period of record: 1981 to 2010.
d. Source: NOAA NWS data, obtained from USDA Natural Resources Conservation Service (http://agacis.rcc-acis.org/?fips=02185). Period of record: 2000 to April 2019.
e. Source: NOAA NWS data, obtained from USDA Natural Resources Conservation Service (http://agacis.rcc-acis.org/?fips=02185). Period of record: 2007 to April 2019.

Note: The average total annual precipitation does not exactly equal the sum of the average monthly precipitation because of differences in completeness requirements for monthly and annual data.

G.1.4 Observed Climate Trends

Arctic

Globally and nationally observed warming impacts are amplified in the Arctic; mean air temperature increases in the Arctic are double the global rate of increase. Average air temperatures in the region have increased by 3°F annually and 6°F in the winter over the past 60 years (Melillo et al. 2014). The annual average air temperature anomaly (meaning the departure from average conditions) for land north of 60°N latitude was the second largest from October 2016 to September 2017 since 1900, after 2015 to 2016 (Richter-Menge et al. 2017).

Spring snow cover extent, observed from satellites, has been decreasing over Arctic land since 2005, especially in May and June (Derksen et al. 2017). In 2017 snow cover extent was the lowest on record for April and May in the North American Arctic, and in 2016 snow cover extent was the lowest on record for June. Decreased snow cover extent and shorter snow cover duration in the Arctic is a reinforcing feedback effect, as more of the sun's energy is absorbed by the dark land surface, and warmer surfaces further reduce snow cover (Melillo et al. 2014).

Winter maximum ice extent in 2017 was the lowest on record, the third consecutive year of record low sea ice extent (Richter-Menge et al. 2017). Recent measurements of sea ice extent are approximately half of the size of sea ice when measurements began in September 1979 (Melillo et al. 2014). The extent of multiyear sea ice (ice that does not melt in summer) has also decreased, now comprising only 21 percent of ice cover in 2017, compared to 45 percent in 1985 (Richter-Menge et al. 2017). Generally, Arctic sea ice extent is two to three times larger at the end of winter (March) than the end of summer (September) (Perovich et al. 2017); however, from 1981 to 2010, anomalies in the ice extent show ice losses of 2.7 percent per decade in March and 13.2 percent per decade in September (Perovich et al. 2017).

Similar to decreases in snow cover extent, decreased sea ice extent also has a feedback effect on climate. An increased amount of the sun's energy is absorbed by the ocean, relative to oceans covered by ice, leading to increased rate of sea ice melting. Summertime sea ice has been decreasing throughout the twenty-first century, with a total loss of summertime sea ice expected by 2050 or earlier (Gunsch et al. 2017; Kolesar et al. 2017). Reductions in sea ice also make the Arctic more accessible by ships for transportation, oil and gas exploration, and tourism. This can lead to increased GHG emissions and other risks, such as oil spills and drilling and maritime-related accidents (Melillo et al. 2014).

Rising air temperatures over land affects the Arctic permafrost layer. Permafrost exists at or below 0°C for at least 2 years, and the active layer is the layer above the permafrost that thaws seasonally. The northern circumpolar permafrost zone stores 1,700 petagrams (billion metric tons) of organic carbon, locked there due to the slow rate of plant material decomposition in the frozen ground (Schuur et al. 2013). With rising temperatures and decreasing snow cover, permafrost extent is predicted to decrease significantly by 2100 (Slater and Lawrence 2013). Thawing permafrost releases carbon dioxide and methane to the atmosphere and delivers organic-rich soils to the bottoms of lakes, resulting in decomposition that releases further methane. These emissions can accelerate climate feedback effects (Markon et al. 2012). Voigt et al. (2017) suggest that thawing permafrost could lead to the release of large amounts of N_2O.

Reduction in sea ice has led to increased primary productivity in the Arctic Ocean (Richter-Menge et al. 2017). Warmer temperatures combined with reduced ice cover have led to tundra greening and increases in soil moisture and the amount of snow water available. These changes have led to increased active layer depth, changes in herbivore activity patterns, and reductions in human usage of the land due to a shorter period of

time when the ground is frozen (Epstein et al. 2017; Clement et al. 2013). Though the greening of the tundra can store carbon as biomass, the effect of these changes in the Arctic has been a net release of carbon into the atmosphere (Richter-Menge et al. 2017; Epstein et al. 2017).

Black carbon has a magnified impact on climate in the Arctic due to the snow and ice feedback. This feedback occurs when black carbon settles on top of snow or ice and decreases the reflectivity (albedo) of the surface. This allows more heat to be absorbed by the surface, leading to increased melting, which further decreases the albedo. This feedback is prominent in the Arctic because so much of the surface is snow and ice, both of which have a high albedo.

North Slope

Similar to the Arctic as a whole, the North Slope has experienced increased average temperatures, decreased sea ice and snow cover extent, an expanded growing season, and thawing permafrost. Annual average temperatures in North Slope are expected to be -11.2°F to -9.0°F by the end of this decade (2019), 2.3°F higher than the annual average from 1961 to 1990 (-13.5°F to 11.3°F). By the 2050s, the annual average temperature is expected to be -8.9°F to -6.8°F (Scenarios Network for Alaska and Arctic Planning [SNAP] 2018).

Over the 35-year record (1982–2016) the North Slope has shown substantial increases in tundra greenness (Richter-Menge et al. 2017). A warming climate, in addition to regulatory changes and methods for measuring frost depth, has reduced the tundra travel open season from 200 days in the 1970s to less than 120 days in 2003 (North Slope Borough Oil and Gas Technical Report 2014). With continued climate warming and precipitation changes, the tundra travel season is expected to shorten further.

Since the mid-1980s, Alaskan permafrost on the Arctic coast has warmed between 6 and 8°F at a depth of 3.3 feet. In 2016, the highest temperatures at all but one permafrost observation site recorded at a 20-meter depth on the North Slope. At this depth, temperatures in this region have been increasing by between 0.21°C and 0.66°C per decade since 2000. The active layer depth was at a 210-year maximum in the North Slope in 2016 (Richter-Menge et al. 2017).

Measurements by the United States Geological Survey (USGS) climate and permafrost observing network show that near-surface permafrost has warmed by 3 to 4°C since the 1980s and the warming is ongoing (Urban and Clow 2018). Air temperatures across the Arctic Slope have been warming by approximately 1°C per decade during summer/autumn. Active layer temperatures are warming by about 1°C per decade during all seasons, and the active layer is refreezing later in the autumn, by about 2 to 3 weeks, from mid-November in 1998 to late December in 2017. Consistent with this delay in autumn sea-ice formation, the timing of the snowfall peak shifts from early autumn to December, as more of the precipitation falls as rain during the autumn, resulting in shorter snowpack duration; however, the year-to-year and site-to-site variabilities in snowpack depth and duration are large, and trend toward shorter snowpack duration is weak.

Similar to the effects described for Alaska, the snow and ice albedo feedback from black carbon is magnified on the North Slope. It can come from a variety of sources, including international transport (Stohl 2006; Matsui et al. 2011; Ikeda et al. 2017; Xu et al. 2017; Ding et al. 2018), shipping (Corbett et al. 2010; Lack and Corbett 2012), oil and gas production (Stohl et al. 2013; Ault et al. 2011), and residential combustion (Stohl et al. 2013).

G.1.5 Trends in U.S. Alaska, and Global Greenhouse Gas Emissions

Greenhouse gas emissions in the U.S. are tracked by the U.S. Environmental Protection Agency (EPA) and documented in the Inventory of U.S. Greenhouse Gases and Sinks (EPA 2019). In 2017, 6,457 million metric

tons (MMT) of carbon dioxide equivalents (CO_2e) were emitted in the U.S. The major economic sector contributing to GHG emissions in the U.S. in 2017 was transportation (29 percent). This was followed by electricity generation (28 percent), industry (22 percent), and agriculture (9 percent). Emissions of CO_2 accounted for 82 percent of all GHG emissions in the U.S. in 2017. As the largest source of U.S. GHG emissions, CO_2 from fossil fuel combustion has accounted for approximately 77 percent of U.S. GHG emissions since 1990. From 1990 to 2017, CO_2 emissions from fossil fuel combustion increased by 3.7 percent, and in 2016, the U.S. accounted for 15 percent of global fossil fuel emissions (EPA 2019).

Greenhouse gas emissions in Alaska are documented in the Alaska Greenhouse Gas Emissions Inventory. Emissions are calculated using a top-down approach, where emissions factors are applied to statewide activity data from 1990–2015. In 2015, approximately 41 MMT CO_2e were emitted in Alaska, according to the Alaska Department of Environmental Conservation (ADEC 2018). This is a decrease of approximately 8 percent from 1990 levels and a decrease of approximately 23 percent from the peak emissions in 2005.

The industrial sector, including oil and gas industries, is the major contributor to GHG emissions in Alaska. This is followed by the transportation, the residential and commercial sectors, and the electrical generation sector. The waste, agricultural, and industrial process sectors each contribute less than 1 percent to GHG emissions in Alaska (ADEC 2018). In 2015, Alaska was the 40th U.S. state in terms of total energy-related CO_2 emissions and the 4th highest in terms of per capita emissions (U.S. Energy Information Administration [EIA] 2018). Alaska represented about 0.7 percent of total U.S. GHG emissions in 2015 (EPA 2019) and 0.09 percent of global GHG emissions (IPCC 2014).

The USGS has estimated GHG emissions and carbon sequestration on federal lands for the 10 years from 2005 to 2014 (Merrill et al. 2018). CO_2 emissions associated with the combustion and extraction of fossil fuels from U.S. federal lands increased from 1,362 MMT CO_2e in 2005 to 1,429 MMT CO_2e in 2010; it then decreased to 1,279 MMT CO_2e in 2014. CH_4 and N_2O emissions from federal lands also decreased over the 10-year period. Less than 1 percent of the CO_2 and CH_4 emissions on federal lands was associated with fuel produced in Alaska. When the federal lands fossil fuel extraction and combustion emissions are combined with the ecosystems emissions and sequestration estimates, the net carbon emissions from Alaska range from -14.1 MMT CO_2e to -16.8 MMT CO_2e, indicating a net carbon sequestration from Alaska federal lands.

Total global GHG emissions in 2017 were estimated to be 50,900 MMT CO_2e (Olivier and Peters 2018). This represented an annual growth rate of 1.3 percent from 2016, after 2 years of virtually no growth (0.2 percent in 2015 and 0.6 percent in 2016). Present GHG emissions are approximately 55 percent higher than in 1990 and 40 percent higher than in 2000. CO_2 emissions are the largest source of global GHG emissions, with a share of about 73 percent, followed by CH_4 (18 percent), N_2O (6 percent), and fluorinated gases (3 percent). The U.S. accounts for approximately 13 percent of worldwide emissions. In 2017, the increase in global CO_2 emissions was due to a rise in global consumption of coal and oil and natural gas. In particular, global consumption of oil products and natural gas increased by 1.4 percent and 2.6 percent in 2017.

G.1.6 Projected Climate Trends and Impacts

Snow cover duration in Alaska is expected to drop with a later date of first snowfall and earlier snowmelt (Markon et al. 2012). Models predict that permafrost will continue to thaw, with some models predicting that large parts of Alaska will lose all near-surface permafrost by the end of the century. This will affect rural Alaskan communities by likely disrupting sewage systems and community water supplies.

The increasing trend in the Alaska growing season length is also projected to continue. This change will reduce water storage and increase the risk and extent of wildfires and insect outbreaks in the region. Warmer

temperatures, wetland drying, and increased summer thunderstorms have increased the number of wildfires in Alaska. The annual area burned is projected to double by mid-century and triple by the end of the century, releasing more carbon to the atmosphere (Melillo et al. 2014).

Warmer temperatures in the project study area will lead to a deeper active layer, which would affect the surrounding ecosystem. It would allow improved water drainage and the migration of deeper-rooted plant communities farther north. Changes in plant communities would also be driven by the expanded growing season and warmer, drier soils. These vegetation changes would promote soil formation as root development and organic matter in the soil profile increase.

As the active layer deepens, damage from traffic over the surface during non-frozen periods would likely increase, due to accelerated erosion and subsidence of permafrost. Permafrost thawing could also lead to thermokarst, or slumping, resulting in increased nutrient loading and suspended sediment in lakes and rivers. Warmer temperatures may increase the frequency of lake-tapping (sudden drainage), as degrading ice wedges integrate into drainage channels at lower elevation.

Arctic fish species will be affected by increased water temperatures, as air temperatures increase, but this impact is difficult to predict. Arctic bird species will be affected by habitat loss as aquatic and semiaquatic habitats are converted into drier habitats. A reduction in available habitat would likely cause changes in bird distributions, increased competition for resources, and declines in productivity.

Paleontological resources could be adversely affected by climate change, but the impact is difficult to determine. Paleontological sites may more rapidly decompose in a warmer climate, and sites on hillsides, bluff faces, riverbanks, and terraces may be destroyed by mass wasting; however, erosion may lead to increased exposure of known paleontological sites. Many known paleontological sites in the project study area have been exposed due to erosion.

As with paleontological resources, cultural resources in the North Slope could also be affected by mass wasting, warmer temperatures, and erosion. In addition, as the permafrost thaws and the active layer deepens, cultural resources may be incorporated into the active layer. These sites would then be exposed to cryoturbation (frost mixing) and vertical disturbances, which may allow sites at different vertical layers to become mixed. These disturbances can occur in both vertical directions; this is because seasonal frost cracking can cause downward movement, and frost heaving and sorting, ice wedging, and involutions can push fossils upwards.

Climate change may affect the accessibility of mineral material deposits in the North Slope. While the existence and location of these deposits would not be affected, the excavation process may be made easier, due to the thawing permafrost; however, it could become more difficult because developing deposits in areas with thawed permafrost may require water removal or ground excavation in swampy conditions.

G.2 SOCIAL COST OF CARBON

A protocol to estimate what is referred to as the "social cost of carbon" (SCC) associated with GHG emissions was developed by the federal Interagency Working Group on Social Cost of Carbon (IWG). It assists agencies in addressing Executive Order 12866, which requires federal agencies to assess the cost and the benefits of proposed regulations as part of their regulatory impact analyses. The SCC is an estimate of the economic damages associated with an increase in carbon dioxide emissions and is intended to be used as part of an economic cost-benefit analysis for proposed rules. As explained in the Executive Summary of the 2010 SCC Technical Support Document "[t]he purpose of the [SCC] estimates . . . is to allow agencies to incorporate the

social benefits of reducing carbon dioxide (CO_2) emissions into cost-benefit analyses of regulatory actions that have small, or 'marginal,' impacts on cumulative global emissions" (IWG 2010). While the SCC protocol was created to meet the requirements for regulatory impact analyses during rulemakings, the BLM has received requests to expand the use of SCC estimates for program and project-level National Environmental Policy Act (NEPA) analyses.

The BLM decided not to expand the use of the SCC protocol for the Integrated Activity Plan action discussed in this environmental impact statement (EIS) for several reasons. Most notably, this action is not rulemaking, for which the SCC protocol was originally developed. Second, on March 28, 2017, the President issued EO 13783; among other actions, it directed that the IWG be disbanded and that the technical support documents on which the protocol was based be withdrawn as no longer representative of governmental policy. The EO further directed agencies to ensure that estimates of the SCC and GHGs used in regulatory analyses "are based on the best available science and economics" and are consistent with the guidance contained in Office of Management and Budget Circular A-4, "including with respect to the consideration of domestic versus international impacts and the consideration of appropriate discount rates" (EO 13783, Section 5(c)).

In compliance with the Office of Management and Budget Circular A-4, interim protocols have been developed for use in the rulemaking context; however, the circular does not apply to non-rulemaking program or project decisions, so there is no EO requirement to apply the SCC protocol to management planning decisions, such as those in this EIS.

Further, NEPA does not require a cost-benefit analysis (40 CFR 1502.23), although it does require consideration of economic and social effects (40 CFR 1508.8(b)). The economic analysis in the Final IAP/EIS is discussed in Section 3.4.11. Any increased economic activity that is expected to occur with the proposed action is simply an economic impact, rather than an economic benefit. Some people may perceive increased economic activity as a positive impact; whereas another person may view increased economic activity as negative or undesirable due to a potential increase in local population, competition for jobs, and concerns that changes in population will change the quality of the local community. Economic impacts are distinct from economic benefits, as defined in economic theory and methodology (Watson et al. 2007; Kotchen 2011), and the socioeconomic impact analysis required under NEPA is distinct from an economic cost-benefit analysis, which is not required.

Potential climate impacts are analyzed in this IAP. Readers are referred to Section 3.2.1 of the Final IAP/EIS and **Sections G.1.2**, **G.1.4**, and **G.1.6** of this appendix for descriptions of climate change trends in the Arctic and on the North Slope and for a discussion of the potential effects of climate change on the region.

In addition to the qualitative climate change discussions discussed above, the BLM quantified the GHG emissions from production as well as the downstream GHG emissions from refining and consumption associated with the four alternatives (see Final IAP/EIS Section 3.2.1 and **Section G.3** in this appendix). Furthermore, **Section G.1.5** provides an inventory of recent GHG emissions at various geographic scales, in units of million MMT per year. Production and downstream emissions are compared to the MMT per year in Section 3.2.1 of the Final IAP/EIS. This is to provide an estimate of the relative contribution of such emissions under each alternative at various geographic scales.

The BLM referenced climate change trends and potential climate impacts at different scales and calculated production and downstream GHG emissions. It did this because climate change and potential climate impacts, in and of themselves, are often not well understood by the public (Etkin and Ho 2007; NRC 2009); therefore, the BLM has provided data and information in a manner that follows many of the guidelines for effective

climate change communication developed by the National Academy of Sciences (NRC 2010) by making the information more readily understood and relatable to the decision-maker and the public. This approach recognizes that there are adverse environmental impacts associated with the development and use of fossil fuels. It discusses potential impacts qualitatively and effectively informs the decision-maker and the public of the potential for GHG emissions and the potential implications of climate change.

Finally, the SCC protocol does not measure the actual incremental impacts of a project on the environment and does not include all damages or benefits from carbon emissions. The SCC protocol estimates economic damages associated with an increase in carbon dioxide emissions, typically expressed as a 1 metric ton increase in a single year. It includes potential changes in net agricultural productivity, human health, and property damages from increased flood risk over hundreds of years. The estimate is developed by aggregating results "across models, over time, across regions and impact categories, and across 150,000 scenarios" (Rose et al. 2014). The dollar cost figure arrived at based on the SCC calculation represents the value of damages avoided if, ultimately, there is no increase in carbon emissions; however, the dollar cost figure is generated in a range and provides little benefit in assisting the BLM Authorized Officer's decision for program or project-level analyses. This is especially the case, given that there are no current criteria or thresholds that determine a level of significance for SCC monetary values.

G.3 DIRECT AND INDIRECT IMPACTS

Emissions of the GHGs, CO_2, CH_4, and N_2O from future NPR-A projects will affect the climate. GHGs have lifetimes of 10 to 100 years or more before they are chemically broken down or otherwise removed from the atmosphere through absorption or deposition. Because GHGs are relatively stable, changes in GHG emissions have long-lasting effects on the climate. Also, because GHGs absorb infrared radiation emitted from the earth's surface, they block heat from escaping to space and warm the earth's atmosphere. **Section G.1.1** provides details on the role of GHGs in influencing the climate.

Black carbon, which is a by-product of incomplete combustion, can also influence climate, although it is not a GHG and has a shorter lifetime. As discussed in **Section G.1.1**, black carbon affects the climate by absorption and scattering solar radiation and by influencing cloud properties. Black carbon emitted onto ice and snow can increase melting and worsen warming, and darker and more absorbent land and water surfaces are exposed as a result.

Although there are large uncertainties in the estimates of black carbon's effect on climate, the 2015 Arctic Monitoring and Assessment Programme Assessment (AMAP 2015) states that there is a "very high probability that black carbon emissions . . . have a positive forcing and warm the climate." In addition, the IPCC has stated that black carbon emissions must fall by at least 35 percent across all sectors from 2010 levels by 2050 to limit global warming to 1.5°C (Rogelj et al. 2018).

In Alaska's North Slope, black carbon sources can come from international transportation sources (Matsui et al. 2011; Stohl 2006; Xu et al. 2017), biomass burning (Creamean et al. 2018; Stohl 2006; Xu et al. 2017), shipping (Corbett et al. 2010; Lack and Corbett 2012), oil and gas production activities (Creamean et al. 2018; Stohl et al. 2013), and residential combustion (Stohl et al. 2013). In particular, black carbon emitted from shipping can be deposited directly onto sea ice, and ice breakers can deposit black carbon onto the ice pack itself (Brewer 2015).

GHG emissions are generated by construction and operations of future development activities (production GHG emissions), while downstream GHG emissions are those generated by refining and consumption of the

produced and sold oil. With construction in the Arctic, black carbon will be emitted as part of the $PM_{2.5}$[1] emissions from diesel-fired equipment, including engines, boilers, heaters, pumping units, and other equipment, such as aircraft and flares.

It is difficult to quantify the effects of future oil and gas development in the NPR-A on global climate change. Instead, GHG emissions due to these activities are calculated and used as a proxy for understanding the potential impacts of future NPR-A development on climate change.

Black carbon emissions are not explicitly quantified in this assessment of climate impacts. The effect of black carbon on the Arctic climate is complex and is still an active area of research. There are still many uncertainties to be resolved by the scientific community to better understand the complex mechanisms and feedback between black carbon and its effect on Arctic climate; however, black carbon is a component of $PM_{2.5}$ and black carbon emissions are included in the $PM_{2.5}$ emissions that are quantified in the air quality analysis (Section 3.2.2 of the Final IAP/EIS).

Emission metrics facilitate multi-component climate policies by allowing emissions of different GHGs and other climate-forcing agents to be expressed in a common unit (CO_2-equivalent, or CO_2e emissions) (IPCC 2014). The global warming potential (GWP) was introduced in the IPCC First Assessment Report, where it was also used to illustrate the difficulties in comparing components with differing physical properties using a single metric. Each GHG has a GWP that accounts for the intensity of the GHG's heat trapping effect and its longevity in the atmosphere.

The 100-year GWP was adopted by the United Nations Framework Convention on Climate Change (IPCC 2014) and its Kyoto Protocol. In addition, the EPA uses the 100-year time horizon in the Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2017 (EPA 2019). The 100-year GWP is only one of several possible emission metrics and time horizons. The IPCC presented updated 100-year and 20-year GWPs in the Fifth Assessment Report (AR5) (IPCC 2014), which the BLM used in this EIS, as discussed below.

As noted by IPCC (2014), the choice of emission metric and time horizon depends on the type of application and policy context; hence, no single metric is optimal for all policy goals. All metrics have shortcomings, and choices contain value judgments, such as the climate effect considered and the weighting of effects over time (which explicitly or implicitly discounts impacts over time), the climate policy goal, and the degree to which metrics incorporate economic or only physical considerations.

There are significant uncertainties related to metrics, and the magnitudes of the uncertainties differ across metric type and time horizon. In general, the uncertainty increases for metrics along the cause-effect chain from emissions to effects. The weight assigned to non-CO_2 climate forcing agents relative to CO_2 depends strongly on the choice of metric and time horizon (IPCC 2014). GWP compares components based on radiative forcing, integrated up to a chosen time horizon.

In this EIS, all GHG emissions were converted to units of CO_2e for ease of comparison using the two sets of GWP values shown in **Table G-2**. The choice of time horizon considerably affects the weighting of short-lived climate forcing agents, such as methane.

[1] Particulate matter with a diameter of less than 2.5 micrometers.

Table G-2
Global Warming Potentials

Time Horizon	CO_2	CH_4	N_2O	Rationale for Time Horizon
100 years	1	28	265	Used by IPCC in its climate change synthesis report of the AR5 (IPCC 2014)
20 years	1	84	264	Same as above.

Source: IPCC (2014)

The GHG emissions associated with the alternatives are discussed below. Alternative A is the No Action Alternative; Alternative B is more restrictive than Alternative A; Alternatives C, D, and E are less restrictive than Alternative A. For each alternative, there are three reasonably foreseeable development scenarios: low, medium, and high. Emissions were calculated for the low and high development scenarios; emissions for the medium development scenario are expected to be between the low and high scenarios.

Production GHG emissions from construction and operation associated with oil and gas extraction were estimated for the IAP low and high development scenarios. They based on peak barrels of oil per day production for each scenario by scaling emissions from a representative project. The Willow Master Development Plan (BLM 2019) includes such features as five drill pads, a central processing facility, gravel roads, airstrip, pipeline, module transfer island. The BLM assumed it to be representative of a future project in the NPR-A. Note that the Willow project is in the high development potential zone, so its emissions are anticipated to be most representative of development in that zone.

Development in the medium or low development potential zones of the NPR-A could have different production levels, equipment, infrastructure needs, and transportation; all of these would affect the GHG emissions estimates. No information is available to quantitatively assess GHG production emissions for the medium or low development potential zones; however, if development occurs in these areas, GHG production emissions would be greater than they are currently. The peak production from the Willow project and corresponding annual GHG emissions are shown in **Table G-3**. These data were used to estimate production GHG emissions in the hypothetical developments under all alternatives for peak annual production and production over 70 years.

The downstream GHG emissions from refining and consuming oil were estimated by the Bureau of Ocean Energy Management (BOEM) using its greenhouse gas lifecycle model (Wolvovsky and Anderson 2016; BOEM 2019; see Appendix X.1B) updated using 2019 emissions and consumption data. Downstream emissions were estimated for peak annual production and over 70 years. Market effects that would lower the downstream emission estimates were not considered in the calculation of downstream emissions, so the estimated downstream emissions are likely an overestimate.

Table G-3
Peak Production Rate and Corresponding Production Greenhouse Gas Emissions for the Representative Project, Willow, in Thousand Metric Tons/Year

Peak Barrels of Oil Per Day	CO_2	CH_4	N_2O	CO_2e (100-year GWP)	CO_2e (20-year GWP)
131,000	902.963	0.370	0.0022	913.914	934.646

Source of data: BLM (2019)

Note: Numbers may not add up exactly, due to rounding.

G.3.1 Impacts Common to All Alternatives

Community infrastructure projects, such as roads, power lines, fuel pipelines/infrastructure, and communications systems, may be permitted under all alternatives, with appropriate mitigation measures in areas closed to oil and gas leasing and development. These and other non-oil and gas components discussed in Section 2.2.1 of the Final IAP/EIS could also result in climate change impacts due to GHG release during construction and operation.

G.3.2 Alternative A—No Action Alternative

Under Alternative A, approximately 52 percent (11.8 million acres) of the NPR-A's subsurface would be available for oil and gas leasing, including some lands closest to existing leases centered on the Greater Mooses Tooth and Bear Tooth units and Umiat. Lands near Teshekpuk Lake would be unavailable for oil and gas leasing.

Table G-4 summarizes the peak emission estimates from production for the development scenarios under Alternative A; **Table G-5** summarizes the peak production downstream GHG emissions for the low and high development scenarios under Alternative A; and **Table G-6** provides the 70-year lifetime production GHG emissions for the Alternative A low and high development scenarios; **Table G-7** provides lifetime downstream GHG emissions for the two development scenarios.

Table G-4
Production Greenhouse Gas Emissions (Thousand Metric Tons per Year) from Peak Production Under Alternative A

Development Scenario	Peak Production BOPD*	CO_2	CH_4	N_2O	CO_2e (100-year GWP)	CO_2e (20-year GWP)
Low	61,529	424	0.174	0.0010	429	439
High	256,369	1,767	0.725	0.0043	1,789	1,829

Note: Values for CO_2e may not add up, due to rounding.
*barrels of oil per day

Table G-5
Downstream Greenhouse Gas Emissions (Thousand Metric Tons per Year) from Peak Production Under Alternative A

Development Scenario	CO_2	CH_4	N_2O	CO_2e (100-year GWP)	CO_2e (20-year GWP)
Low	7,239	0.5	0.1	7,268	7,293
High	30,162	1.9	0.3	30,283	30,388

Note: Values for CO_2e may not add up, due to rounding.

Table G-6
Production Greenhouse Gas Emissions (Thousand Metric Tons per Year) from Lifetime Production Under Alternative A

Development Scenario	Total Barrels	CO_2	CH_4	N_2O	CO_2e (100-year GWP)	CO_2e (20-year GWP)
Low	322,938,221	6,099	2.50	0.0149	6,172	6,313
High	1,345,575,921	25,410	10.42	0.0619	25,719	26,302

Note: Values for CO_2e may not add up, due to rounding.

Table G-7
Downstream Greenhouse Gas Emissions (Thousand Metric Tons per Year) from Lifetime Production Under Alternative A

Development Scenario	CO_2	CH_4	N_2O	CO_2e (100-year GWP)	CO_2e (20-year GWP)
Low	104,652	6.5	0.9	105,071	105,437
High	436,050	27.3	3.7	437,798	439,321

Note: Values for CO_2e may not add up due to rounding

G.3.3 Alternative B

Alternative B is more restrictive than Alternative A and provides more specific guidance pertaining to activities unrelated to oil and gas. The same areas that are unavailable for oil and gas leasing under Alternative B would be closed to new infrastructure. The area unavailable for leasing and closed to new infrastructure would be increased from that under Alternative A to account for new resource-related data. **Table G-8** summarizes the peak emission estimates for the development scenarios under Alternative B, while **Table G-9** summarizes the peak production downstream GHG emissions for the low and high development scenarios.

Table G-10 presents the 70-year lifetime production GHG emissions for the Alternative B low and high development scenarios, while **Table G-11** shows the lifetime downstream GHG emissions for the two development scenarios. Production and downstream emissions for Alternative B are approximately 9 percent and 10 percent higher than those for Alternative A, respectively, due to higher projected production rates.

Table G-8
Production Greenhouse Gas Emissions (Thousand Metric Tons per Year) from Peak Production Under Alternative B

Development Scenario	Peak Production BOPD	CO_2	CH_4	N_2O	CO_2e (100-year GWP)	CO_2e (20-year GWP)
Low	67,026	462	0.189	0.0011	468	478
High	279,275	1,925	0.789	0.0047	1,948	1,992

Note: Values for CO_2e may not add up, due to rounding.

Table G-9
Downstream Greenhouse Gas Emissions (Thousand Metric Tons per Year) from Peak Production Under Alternative B

Development Scenario	CO_2	CH_4	N_2O	CO_2e (100-year GWP)	CO_2e (20-year GWP)
Low	7,949	0.5	0.1	7,980	8,008
High	33,119	2.1	0.3	33,252	33,368

Table G-10
Production Greenhouse Gas Emissions (Thousand Metric Tons per Year) from Lifetime Production Under Alternative B

Development Scenario	Total Barrels	CO_2	CH_4	N_2O	CO_2e (100-year GWP)	CO_2e (20-year GWP)
Low	354,598,831	6,696	2.75	0.0163	6,778	6,931
High	1,477,495,129	27,902	11.44	0.0680	28,240	28,881

Table G-11
Downstream Greenhouse Gas Emissions (Thousand Metric Tons per Year) from Lifetime Production Under Alternative B

Development Scenario	CO_2	CH_4	N_2O	CO_2e (100-year GWP)	CO_2e (20-year GWP)
Low	114,912	7.2	1	115,373	115,774
High	478,800	29.9	4.1	480,719	482,392

G.3.4 Alternative C

Alternative C is less restrictive than Alternative A and would increase the total number of acres open to leasing, compared with Alternatives A and B. This would be accomplished by reducing the areas closed to leasing in the Teshekpuk Lake and Utukok River Uplands Special Areas. Both special areas would retain a core that is unavailable for leasing and closed to new infrastructure. The southern and eastern portions of the Utukok River Uplands Special Area would be available for new infrastructure.

Table G-12 summarizes the peak GHG emission estimates from production for the development scenarios under Alternative C; **Table G-13** summarizes the peak production downstream GHG emissions for the low and high development scenarios; **Table G-14** shows the 70-year lifetime production GHG emissions for the low and high development scenarios under Alternative C; and **Table G-15** provides the lifetime downstream GHG emissions for the two development scenarios.

Production emissions and downstream emissions under Alternative C are approximately 46 percent and 47 percent higher than those for Alternative A, due to higher projected production rates.

Table G-12
Production Greenhouse Gas Emissions (Thousand Metric Tons per Year) from Peak Production Under Alternative C

Development Scenario	Peak Production BOPD	CO_2	CH_4	N_2O	CO_2e (100-year GWP)	CO_2e (20-year GWP)
Low	90,073	621	0.255	0.0015	628	643
High	375,306	2,587	1.061	0.0063	2,618	2,678

Note: Values for CO_2e may not add up, due to rounding.

Table G-13
Downstream Greenhouse Gas Emissions (Thousand Metric Tons per Year) from Peak Production Under Alternative C

Development Scenario	CO_2	CH_4	N_2O	CO_2e (100-year GWP)	CO_2e (20-year GWP)
Low	10,645	0.7	0.1	10,688	10,725
High	44,356	2.8	0.4	44,534	44,689

Table G-14
Production Greenhouse Gas Emissions (Thousand Metric Tons per Year) from Lifetime Production Under Alternative C

Development Scenario	Total Barrels	CO_2	CH_4	N_2O	CO_2e (100-year GWP)	CO_2e (20-year GWP)
Low	474,909,149	8,968	3.68	0.0219	9,077	9,283
High	1,978,788,120	37,369	15.32	0.0911	37,822	38,680

Table G-15
Downstream Greenhouse Gas Emissions (Thousand Metric Tons per Year) from Lifetime Production Under Alternative C

Development Scenario	CO_2	CH_4	N_2O	CO_2e (100-year GWP)	CO_2e (20-year GWP)
Low	153,900	9.6	1.3	154,517	155,055
High	641,251	40.1	5.5	643,820	646,061

G.3.5 Alternative D

Alternative D would make more land open to leasing and new infrastructure than Alternatives A, B, and C. The management of the Utukok River Uplands, Kasegaluk Lagoon, and Peard Bay Special Areas is the same as that under Alternative C. Under Alternative D, all of the Teshekpuk Lake Special Area would be available for leasing. No pipeline corridors would be needed in there because more areas would be open to new infrastructure.

Leasing management under this alternative would result in higher estimated oil production than Alternatives A, B, and C. **Table G-16** summarizes the peak production and GHG emission estimates from production for the development scenarios under Alternative D, and **Table G-17** summarizes the peak production downstream GHG emissions for the low and high development scenarios.

Table G-16
Production Greenhouse Gas Emissions (Thousand Metric Tons per Year) from Peak Production Under Alternative D

Development Scenario	Peak Production BOPD	CO_2	CH_4	N_2O	CO_2e (100-year GWP)	CO_2e (20-year GWP)
Low	120,000	827	0.339	0.0020	837	856
High	500,000	3,446	1.413	0.0084	3,488	3,567

Note: Values for CO_2e may not add up, due to rounding.

Table G-17
Downstream Greenhouse Gas Emissions (Thousand Metric Tons per Year) from Peak Production Under Alternative D

Development Scenario	CO_2	CH_4	N_2O	CO_2e (100-year GWP)	CO_2e (20-year GWP)
Low	14,194	0.9	0.1	14,251	14,300
High	59,141	3.7	0.5	59,378	59,585

Table G-18 provides the 70-year lifetime production GHG emissions for the low and high development scenarios in Alternative D, while **Table G-19** lists the lifetime downstream GHG emissions for the two scenarios. Production and downstream emissions for Alternative D are approximately 95 percent and 96 percent higher than those for Alternative A, due to an increase in the hypothetical production rates.

Table G-18
Production Greenhouse Gas Emissions (Thousand Metric Tons per Year) from Lifetime Production Under Alternative D

Development Scenario	Total Barrels	CO_2	CH_4	N_2O	CO_2e (100-year GWP)	CO_2e (20-year GWP)
Low	633,212,198	11,958	4.90	0.0291	12,103	12,377
High	2,638,384,159	49,825	20.43	0.1214	50,429	51,573

Table G-19
Downstream Greenhouse Gas Emissions (Thousand Metric Tons per Year) from Lifetime Production Under Alternative D

Development Scenario	CO_2	CH_4	N_2O	CO_2e (100-year GWP)	CO_2e (20-year GWP)
Low	205,200	12.8	1.7	206,023	206,739
High	855,001	53.5	7.3	858,427	861,414

G.3.6 Alternative E

Alternative E would open the most land to leasing and new infrastructure. The management of the Kasegaluk Lagoon and Peard Bay Special Areas would be the same as that under Alternatives C and D. Under Alternative E, all of the Teshekpuk Lake Special Area would be available for leasing. No pipeline corridors would be needed there under Alternative E because more areas would be open to new infrastructure. Leasing management under this scenario would result in the same amount of estimated oil production as Alternative D.

Table G-20 summarizes the peak production and GHG emission estimates from production for the development scenarios in under Alternative E, and **Table G-21** summarizes the peak production downstream GHG emissions for the low and high development scenarios.

Table G-20
Production Greenhouse Gas Emissions (Thousand Metric Tons per Year) from Peak Production Under Alternative E

Development Scenario	Peak Production BOPD	CO_2	CH_4	N_2O	CO_2e (100-year GWP)	CO_2e (20-year GWP)
Low	120,000	827	0.339	0.0020	837	856
High	500,000	3,446	1.413	0.0084	3,488	3,567

Note: Values for CO_2e may not add up, due to rounding

Table G-21
Downstream Greenhouse Gas Emissions (Thousand Metric Tons per Year) from Peak Production Under Alternative E

Development Scenario	CO_2	CH_4	N_2O	CO_2e (100-year GWP)	CO_2e (20-year GWP)
Low	14,194	0.9	0.1	14,251	14,300
High	59,141	3.7	0.5	59,378	59,585

Table G-22 provides the 70-year lifetime production GHG emissions for the low and high development scenarios under Alternative E, while **Table G-23** lists the lifetime downstream GHG emissions for the two scenarios. Production and downstream emissions for Alternative E are approximately 95 percent and 96 percent higher than those for Alternative A, due to an increase in the hypothetical production rates.

Table G-22
Production Greenhouse Gas Emissions (Thousand Metric Tons per Year) from Lifetime Production Under Alternative E

Development Scenario	Total Barrels	CO_2	CH_4	N_2O	CO_2e (100-year GWP)	CO_2e (20-year GWP)
Low	633,212,198	11,958	4.90	0.0291	12,103	12,377
High	2,638,384,159	49,825	20.43	0.1214	50,429	51,573

Table G-23
Downstream Greenhouse Gas Emissions (Thousand Metric Tons per Year) from Lifetime Production Under Alternative E

Development Scenario	CO_2	CH_4	N_2O	CO_2e (100-year GWP)	CO_2e (20-year GWP)
Low	205,200	12.8	1.7	206,023	206,739
High	855,001	53.5	7.3	858,427	861,414

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Attachment G-1. Greenhouse Gas Downstream Emissions Estimates for the BLM's National Petroleum Reserve-Alaska IAP/EIS

G-1.1 OVERVIEW

The IAP/EIS for the NPR-A includes an analysis on climate change that has been drafted with support from BOEM. The BLM used the BOEM model, the Greenhouse Gas Lifecycle Model (GHG Model) to help estimate carbon emissions from the consumption of the oil expected to be produced under the Final IAP/EIS. This attachment provides a comparison of the mid- and downstream emissions from the Final IAP/EIS alternatives.

The analysis for the Final IAP/EIS is limited to the mid- and downstream emissions associated with the processing and consumption of the oil from the project. This analysis does not include any estimated emissions from the actual production of resources (upstream, or what this paper refers to as on-site emissions) related to the NPR-A Final IAP/EIS.

G-1.2 GHG MODEL

The GHG Model was developed to estimate emissions that could be anticipated from the consumption of newly produced offshore oil and natural gas. For the NPR-A Final IAP/EIS, the BLM used the GHG Model to estimate emissions from oil refining and consumption. The full GHG Model documentation is entitled OCS Oil and Natural Gas: Potential Lifecycle Greenhouse Gas Emissions and Social Cost of Carbon.[2]

G-1.2.1 Adaptation of the GHG Model

The GHG Model calculates the impacts of consumption of oil, gas, and coal and is not specific to the domestic onshore, domestic offshore, or imports of the fuel consumed. As such, it is appropriate for calculating the GHG emissions from the consumption of oil and gas from the NPR-A Final IAP/EIS.

To reiterate, on-site emissions associated with the production of oil are not calculated in this analysis. To estimate these on-site emissions, a separate model would be required, designed to analyze GHG emissions from the onshore equipment and facilities.

Since publishing the above-cited technical documentation, the annual emissions from refineries and natural gas processing and storage systems have been updated, along with updates to reflect oil and gas consumption patterns in the U.S. as of 2019. In addition, the BLM is using GWPs recommended by the Intergovernmental Panel on Climate Change Fifth Assessment, where CH_4 has 28 times the GWP of CO_2, and N_2O has 265 times the GWP of CO_2.

[2]E. Wolvovsky and W. Anderson. 2016. OCS Oil and Natural Gas: Potential Lifecycle Greenhouse Gas Emissions and Social Cost of Carbon. BOEM OCS Report 2016-065. Internet website: https://www.boem.gov/OCS-Report-BOEM-2016-065/.

G-1.2.2 GHG Model Results

The GHG Model estimates only the emissions from the mid- and downstream activities for the Final IAP/EIS alternatives. The results of the GHG Model are shown in **Table G-1-1**.

Table G-1-1
Mid- and Downstream GHG Emissions for the NPR-A Alternatives

Alternatives	Scenario	Program				Peak Year			
		CO_2e	CO_2	CH_4	N_2O	CO_2e	CO_2	CH_4	N_2O
A	High	437,798	436,050	27	3	30,283	30,162	2	—
	Low	105,071	104,652	7	1	7,268	7,239	—	—
B	High	480,719	478,800	30	4	33,251	33,119	2	—
	Low	115,373	114,912	7	1	7,980	7,949	—	—
C	High	643,820	641,251	40	5	44,534	44,356	3	—
	Low	154,451	153,900	10	1	10,688	10,645	1	—
D/E	High	858,427	855,001	53	7	59,378	59,141	4	1
	Low	206,022	205,200	13	2	14,250	14,194	1	—

Note: Emissions estimates in thousands of metric tons; an em dash represents values greater than 0 but less than 500 metric tons.