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Coastal Plain Oil and Gas Leasing Program Draft Environmental Impact Statement

Volume II: Appendices

December 2018

Prepared by:

US Department of the Interior
Bureau of Land Management

In cooperation with:

US Fish and Wildlife Service
US Environmental Protection Agency
State of Alaska
North Slope Borough
Native Village of Kaktovik
Native Village of Venetie Tribal Government
Venetie Village Council
Arctic Village Council

ed Lead Agency Total
ociated with Developing
Producing this EIS
$1,200,000

The Bureau of Land Management's multiple-use mission is to sustain the health and productivity of the public lands for the use and enjoyment of present and future generations. The Bureau accomplishes this by managing such activities as outdoor recreation, livestock grazing, mineral development, and energy production, and by conserving natural, historical, cultural, and other resources on public lands.

Cover Photo: Northward view in central coastal plain area near the Sadlerochit River showing gently rolling topography typical of the area. Natural oil indications are visible of an oil seep that occurs along the coast (Barter Island). Photo by David Houseknecht (USGS).

DOI-BLM-AK-0000-2018-0002-EIS

BLM/AK/PL-19/002+1610+F020

APPENDICES

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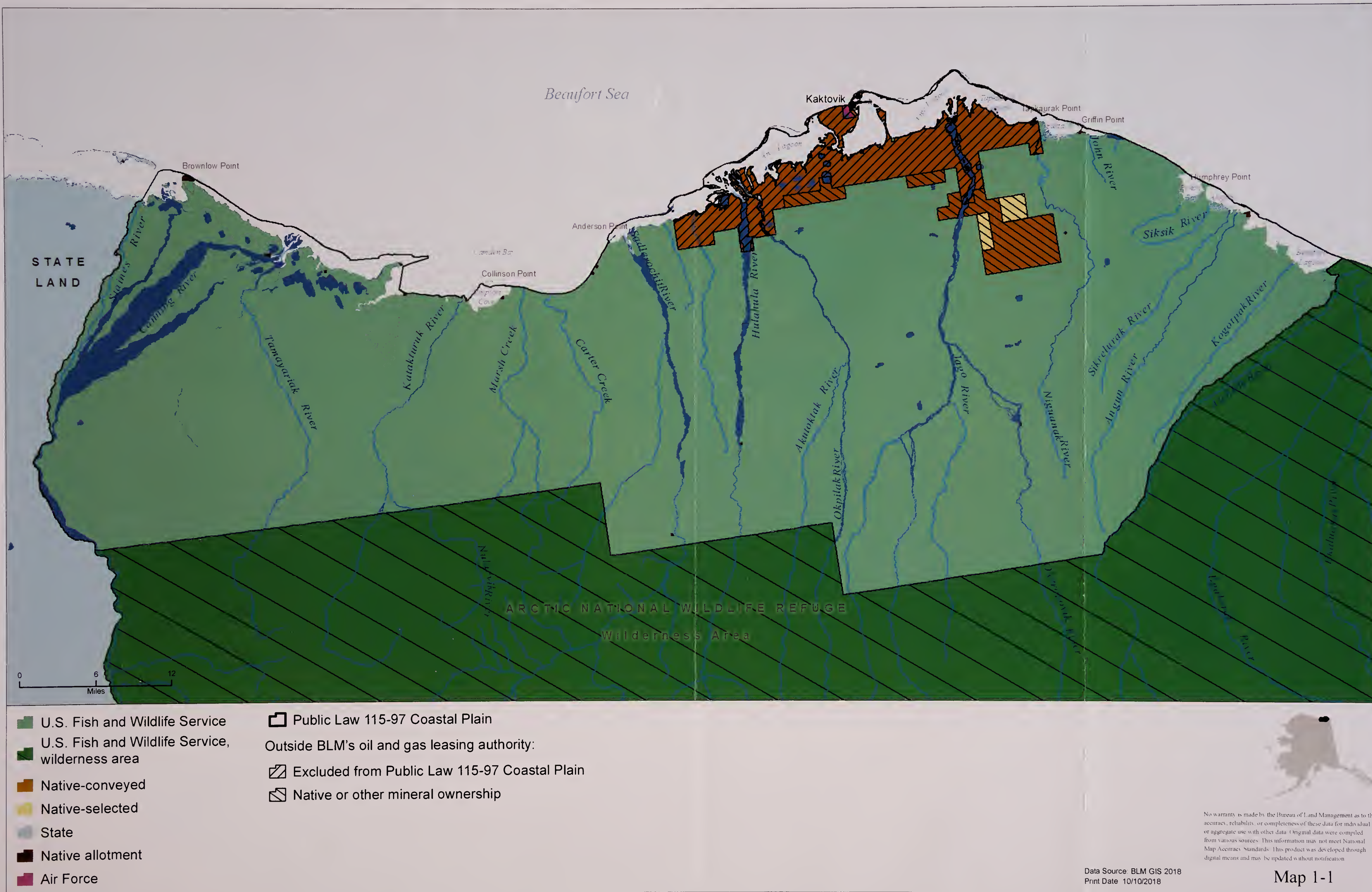
Appendix A
Maps and Figures

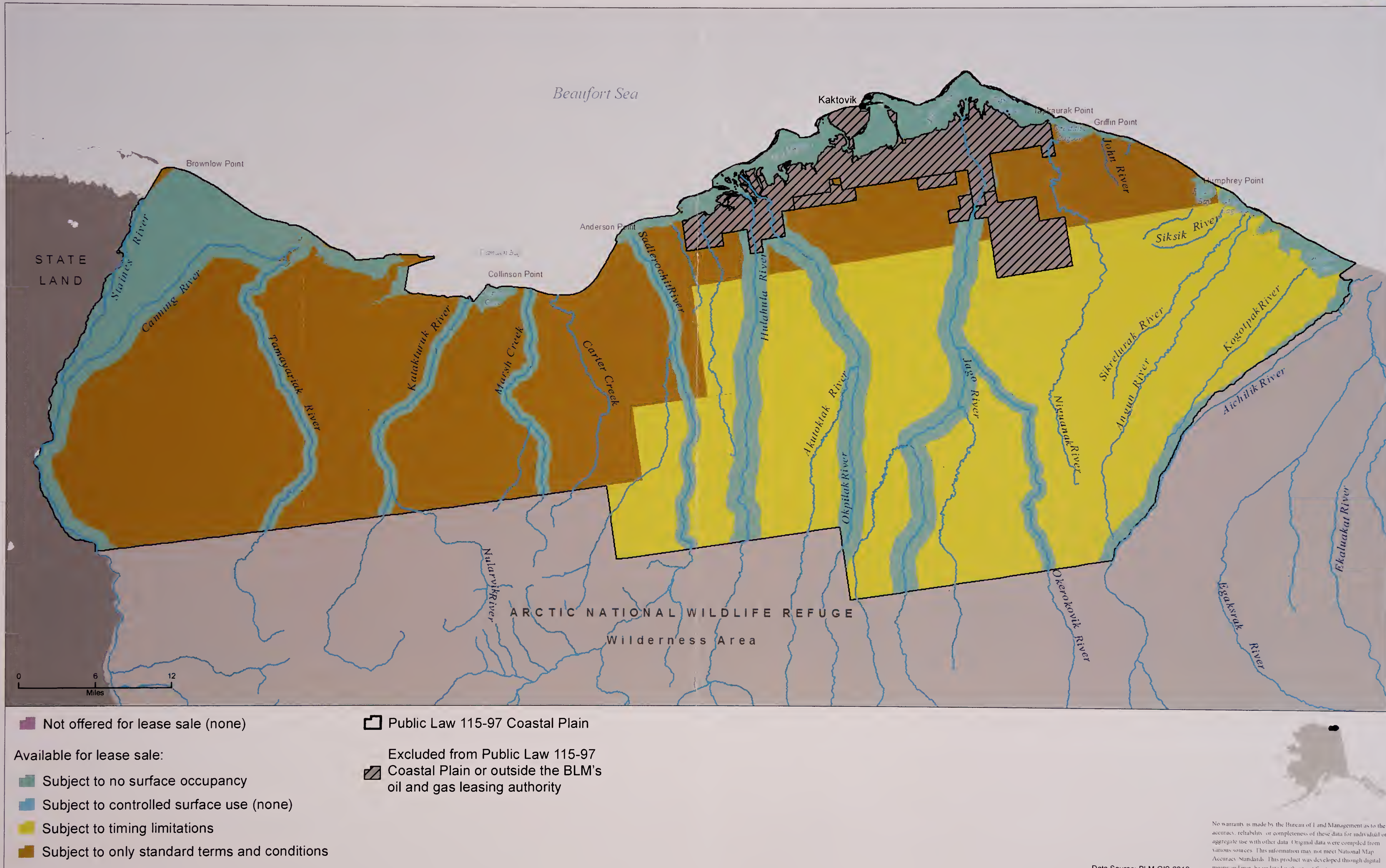
APPENDIX A
Maps

APPENDIX A

Figures

Data from geographic information systems (GIS) have been used in developing acreage calculations and for generating the maps in this appendix. Calculations are dependent upon the quality and availability of data and most calculations in this EIS are rounded to the nearest one hundred acres. Given the scale of the analysis, the compatibility constraints between datasets, and lack of data for some resources, all calculations are approximate and serve for comparison and analytic purposes only. Likewise, the maps in this appendix are provided for illustrative purposes and subject to the limitations discussed above. BLM may receive additional GIS data; therefore, acreages may be recalculated and revised later.


Beaufort Sea
Kaktovik
Brownlow Point
Anderson Point
Collinson Point
Griffin Point
Humphrey Point
STATE LAND
Staines River
Canning River
Tamayariak River
Katakturuk River
Marsh Creek
Carter Creek
Sadlerochit River
Hulahula River
Akutoktak River
Okpilak River
Jago River
Niguanak River
John River
Siksik River
Sikrelurak River
Angun River
Kogotpak River
ARCTIC NATIONAL WILDLIFE REFUGE
Wilderness Area
0
6
12
Miles
U.S. Fish and Wildlife Service
U.S. Fish and Wildlife Service, wilderness area
Native-conveyed
Native-selected
State
Native allotment
Air Force
Public Law 115-97 Coastal Plain
Outside BLM's oil and gas leasing authority:
Excluded from Public Law 115-97 Coastal Plain
Native or other mineral ownership
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.
Data Source: BLM GIS 2018
Print Date: 10/10/2018
Map 1-1


Beaufort Sea
Kaktovik
Griffin Point
Humphrey Point
Brownlow Point
Anderson Point
Collinson Point
STATE LAND
Staines River
Canning River
Tamayariak River
Katakturuk River
Marsh Creek
Carter Creek
Sadlerochit River
Hulahula River
Akutoktak River
Okpilak River
Jago River
Niguanak River
John River
Siksik River
Sikrelurak River
Angun River
Kogotpak River
Aichilik River
Ekaluakat River
Egaksrak River
Okerokovik River
Nularvik River
ARCTIC NATIONAL WILDLIFE REFUGE
Wilderness Area
0
6
12
Miles
Not offered for lease sale (none)
Available for lease sale:
Subject to no surface occupancy
Subject to controlled surface use (none)
Subject to timing limitations
Subject to only standard terms and conditions
Public Law 115-97 Coastal Plain
Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority
Data Source: BLM GIS 2018, FWS GIS 2018
Print Date: 10/15/2018
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Map 2-1

Available for lease sale, subject to no surface occupancy

Lease stipulation 1—rivers and streams

Lease stipulation 4—nearshore marine, lagoon, and barrier island habitat, exploration

Available for lease sale, subject to timing limitations

Lease stipulation 7—Porcupine Caribou calving habitat

Available for lease sale

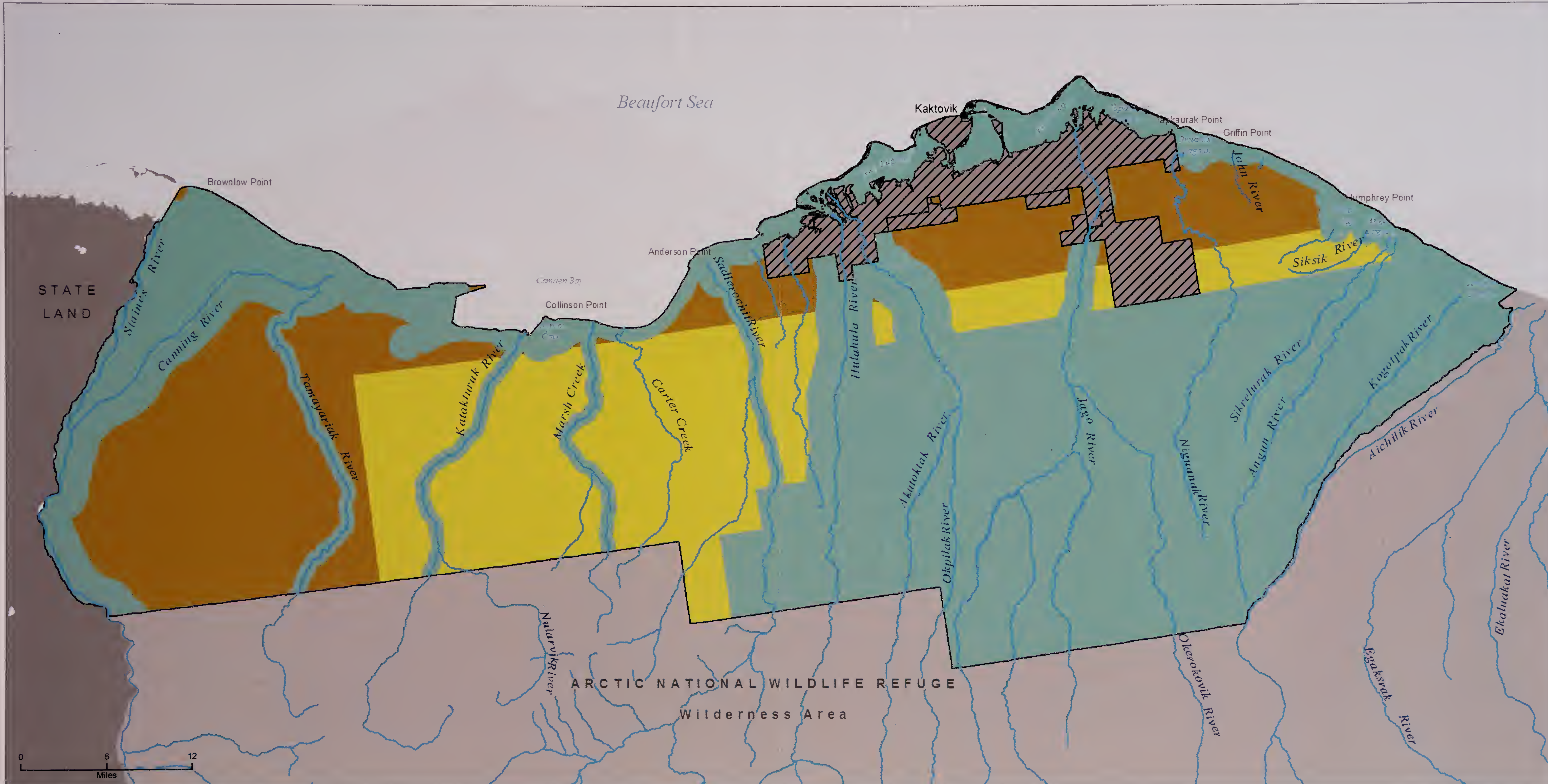
Subject to only standard terms and conditions

Public Law 115-97 Coastal Plain

Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority

Data Source: BLM GIS 2018, FWS GIS 2018
Print Date: 10/29/2018

Map 2-2



Not offered for lease sale (none)

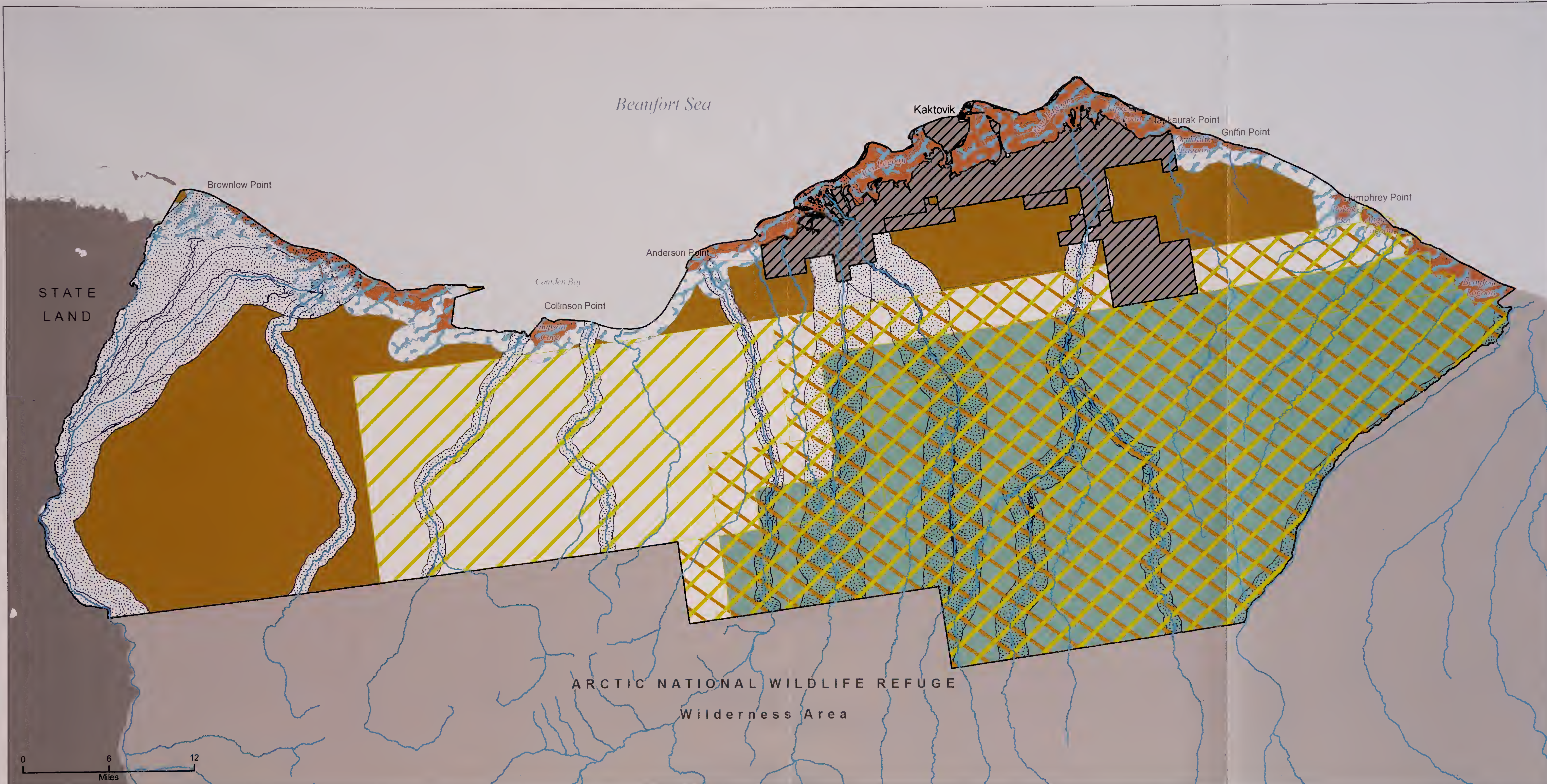
Available for lease sale:
- Subject to no surface occupancy
- Subject to controlled surface use (none)
- Subject to timing limitations
- Subject to only standard terms and conditions

Public Law 115-97 Coastal Plain

Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority

Data Source: BLM GIS 2018, FWS GIS 2018
Print Date: 10/15/2018

Map 2-3



Available for lease sale, subject to no surface occupancy

- Lease stipulation 1—rivers and streams
- Lease stipulation 4—nearshore marine, lagoon, and barrier island habitat, exploration
- Lease stipulation 7—Porcupine Caribou calving habitat
- Lease stipulation 9—coastal area

Available for lease sale, subject to timing limitations

- Lease stipulation 7—Porcupine Caribou calving habitat
- Lease stipulation 8—Porcupine Caribou post-calving habitat

Available for lease sale

- Subject to only standard terms and conditions

Public Law 115-97 Coastal Plain

Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority

Data Source: BLM GIS 2018, FWS GIS 2018
Print Date: 10/29/2018

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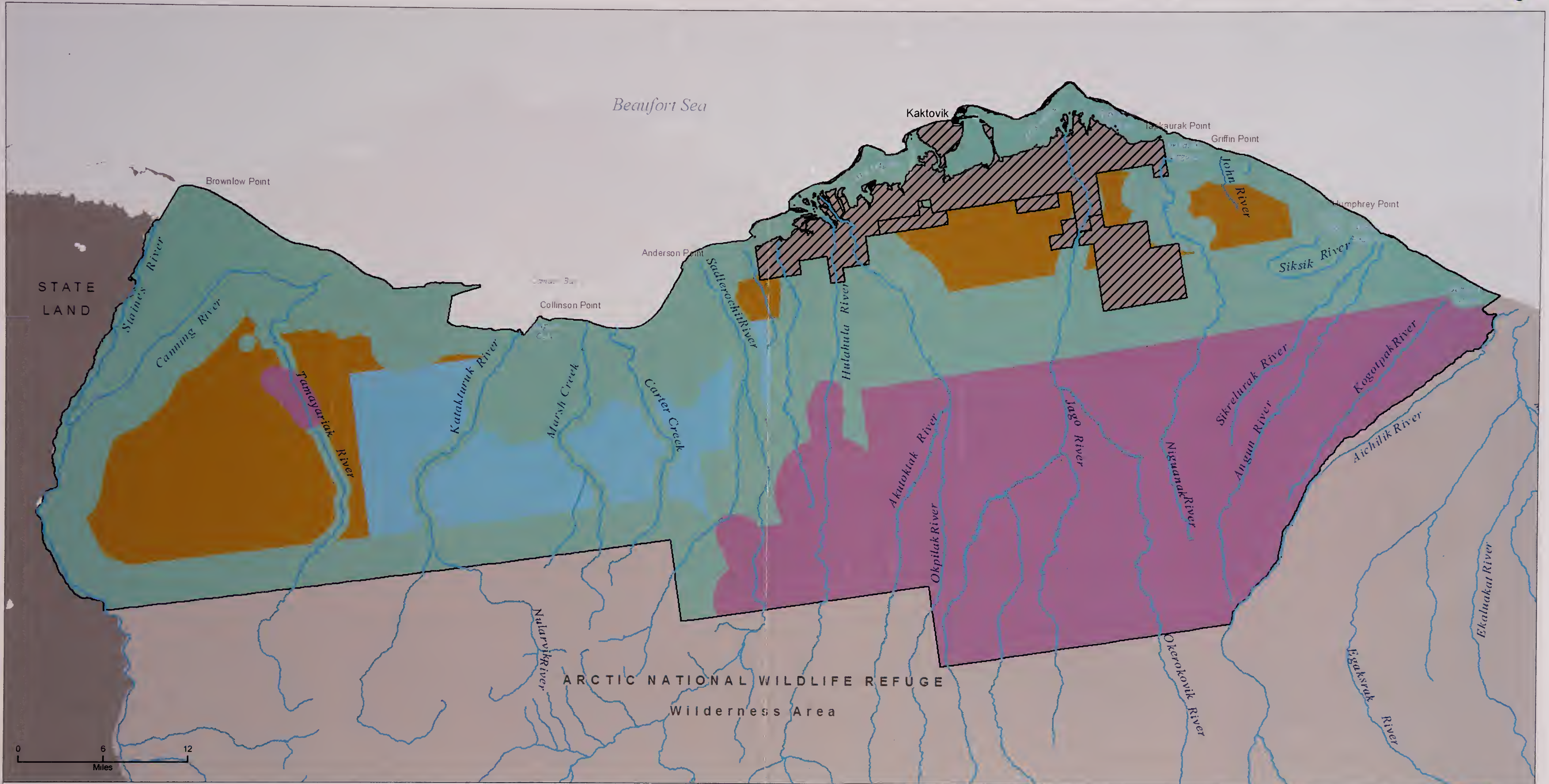
Map 2-4



Not offered for lease sale

Available for lease sale:

Subject to no surface occupancy

Subject to controlled surface use

Subject to timing limitations

Subject to only standard terms and conditions

Public Law 115-97 Coastal Plain

Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority

Data Source: BLM GIS 2018, FWS GIS 2018
Print Date: 10/15/2018

Map 2-5

Alternative D1, Lease Stipulations

Not offered for lease sale and not available for surface occupancy
- Lease stipulation 3—springs/aufeis
- Lease stipulation 7—Porcupine Caribou calving habitat

Available for lease sale, subject to no surface occupancy
- Lease stipulation 1—rivers and streams
- Lease stipulation 2—Canning River delta and lakes
- Lease stipulation 4—nearshore marine, lagoon, and barrier island habitat, exploration
- Lease stipulation 5—coastal polar bear river denning habitat
- Lease stipulation 7—Porcupine Caribou calving habitat
- Lease stipulation 9—coastal area
- Lease stipulation 10—Wilderness boundary

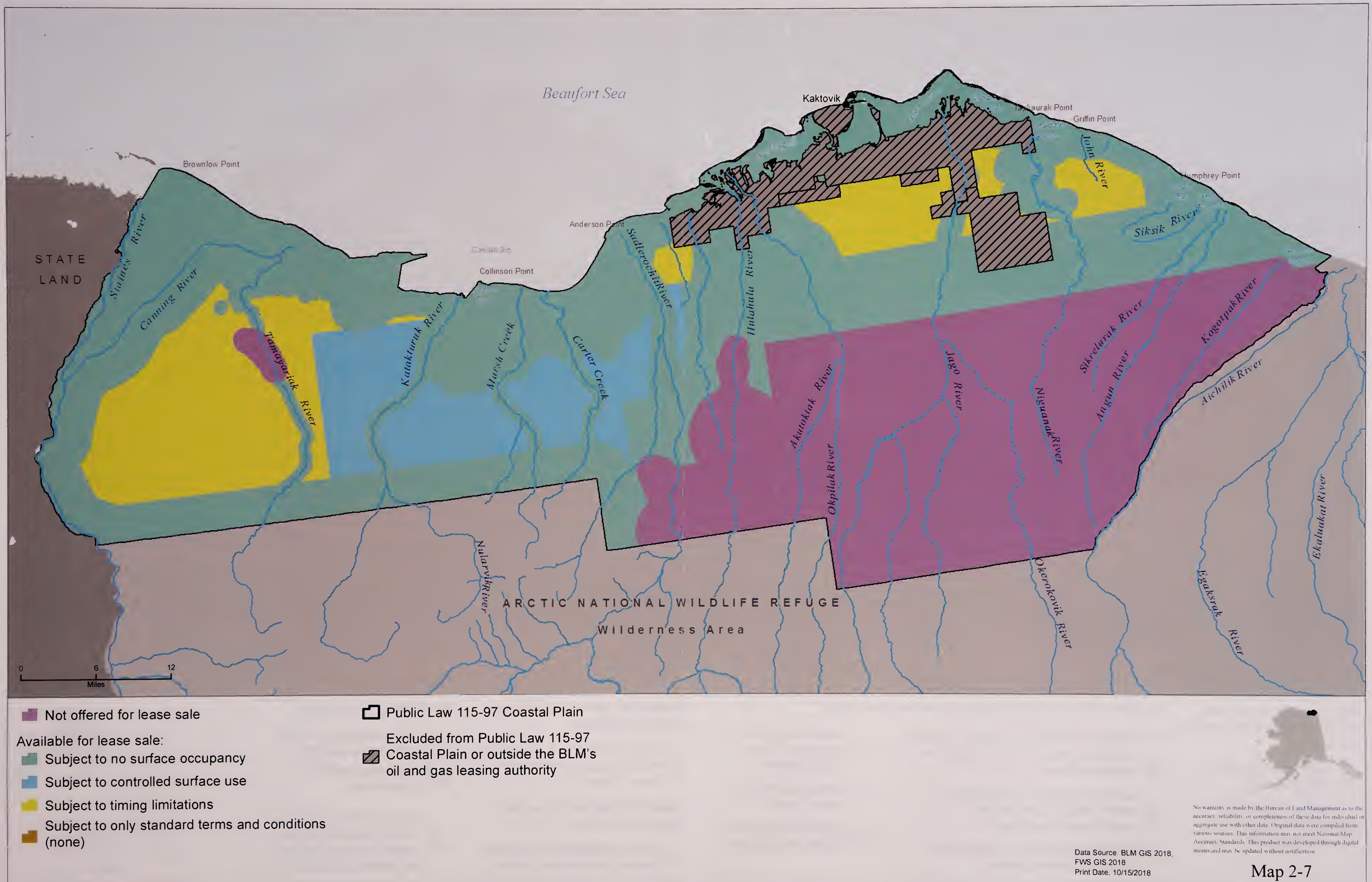
Available for lease sale, subject to timing limitations
- Lease stipulation 4—nearshore marine, lagoon, and barrier island habitat

Available for lease sale, subject to timing limitations
- Lease stipulation 8—Porcupine Caribou post-calving habitat

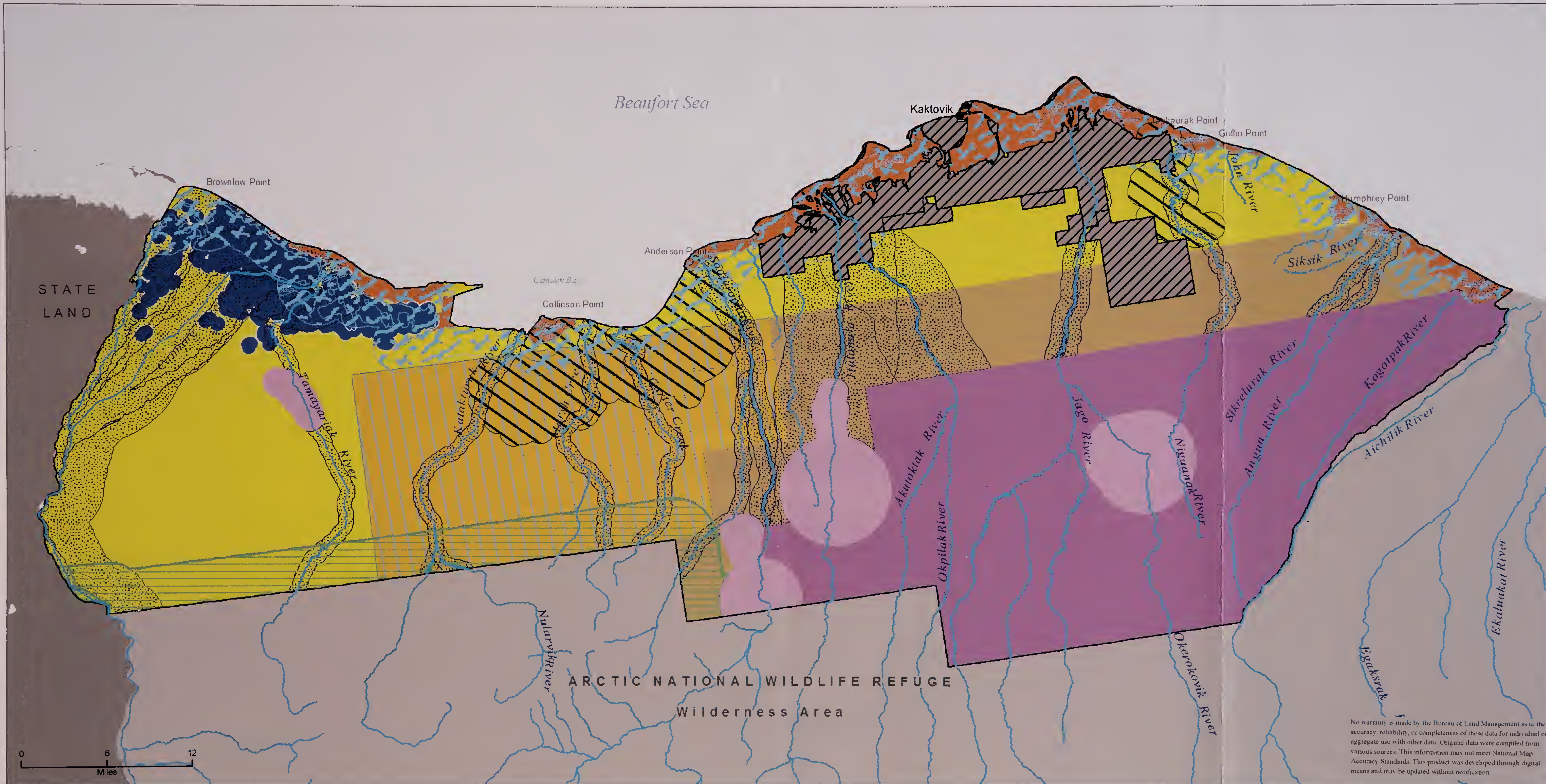
Available for lease sale
- Subject to only standard terms and conditions
- Public Law 115-97 Coastal Plain
- Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority

Data Source: BLM GIS 2018, FWS GIS 2018
Print Date 10/29/2018

Map 2-6


Beaufort Sea
Kaktovik
Griffin Point
Humphrey Point
Brownlow Point
Anderson Point
Collinson Point
STATE LAND
Staines River
Canning River
Tamayariak River
Katakturuk River
Marsh Creek
Carter Creek
Sadlerochit River
Hulahula River
Akutoktak River
Okpilak River
Jago River
Niguanak River
John River
Siksik River
Sikrelurak River
Angun River
Kogotpak River
Aichilik River
Ekaluakat River
Egaksrak River
Okerokovik River
Nularvik River
ARCTIC NATIONAL WILDLIFE REFUGE
Wilderness Area
0 6 12
Miles
Not offered for lease sale
Available for lease sale:
Subject to no surface occupancy
Subject to controlled surface use
Subject to timing limitations
Subject to only standard terms and conditions (none)
Public Law 115-97 Coastal Plain
Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority
Data Source: BLM GIS 2018, FWS GIS 2018
Print Date: 10/15/2018

Map 2-7



Not offered for lease sale and not available for surface occupancy
- Lease stipulation 3—springs/aufeis
- Lease stipulation 7—Porcupine Caribou calving habitat

Available for lease sale, subject to no surface occupancy
- Lease stipulation 1—rivers and streams
- Lease stipulation 2—Canning River delta and lakes
- Lease stipulation 4—nearshore marine, lagoon, and barrier island habitat, exploration
- Lease stipulation 5—coastal polar bear river denning habitat
- Lease stipulation 7—Porcupine Caribou calving habitat
- Lease stipulation 9—coastal area
- Lease stipulation 10—Wilderness boundary

Available for lease sale, subject to controlled surface use
- Lease stipulation 8—Porcupine Caribou post-calving habitat

Available for lease sale, subject to timing limitations
- Lease stipulation 4—nearshore marine, lagoon, and barrier island habitat

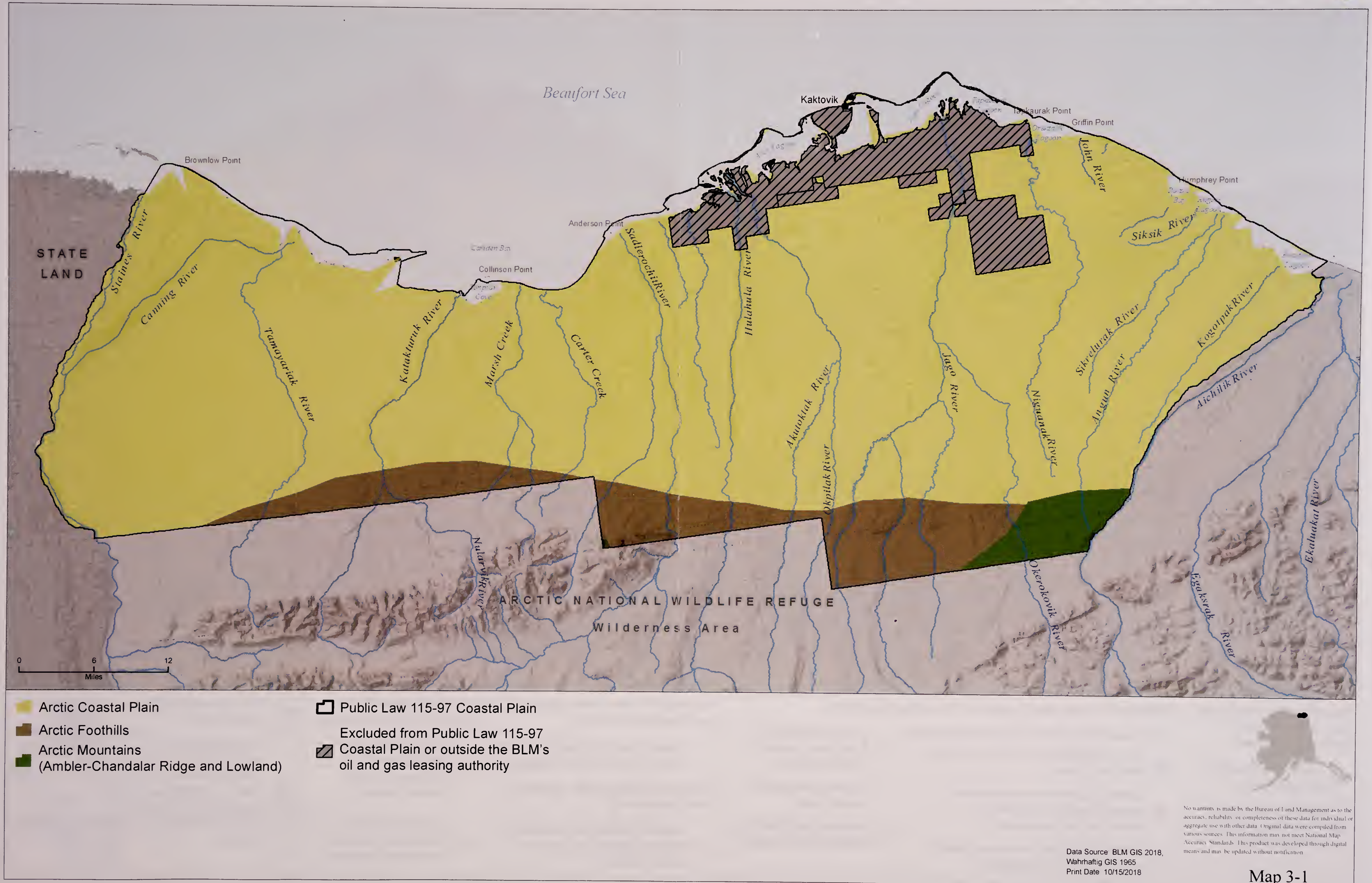
Available for lease sale, subject to timing limitations
- Lease stipulation 6—Central Arctic and Porcupine Herds summer habitat
- Lease stipulation 8—Porcupine Caribou post-calving habitat

Public Law 115-97 Coastal Plain

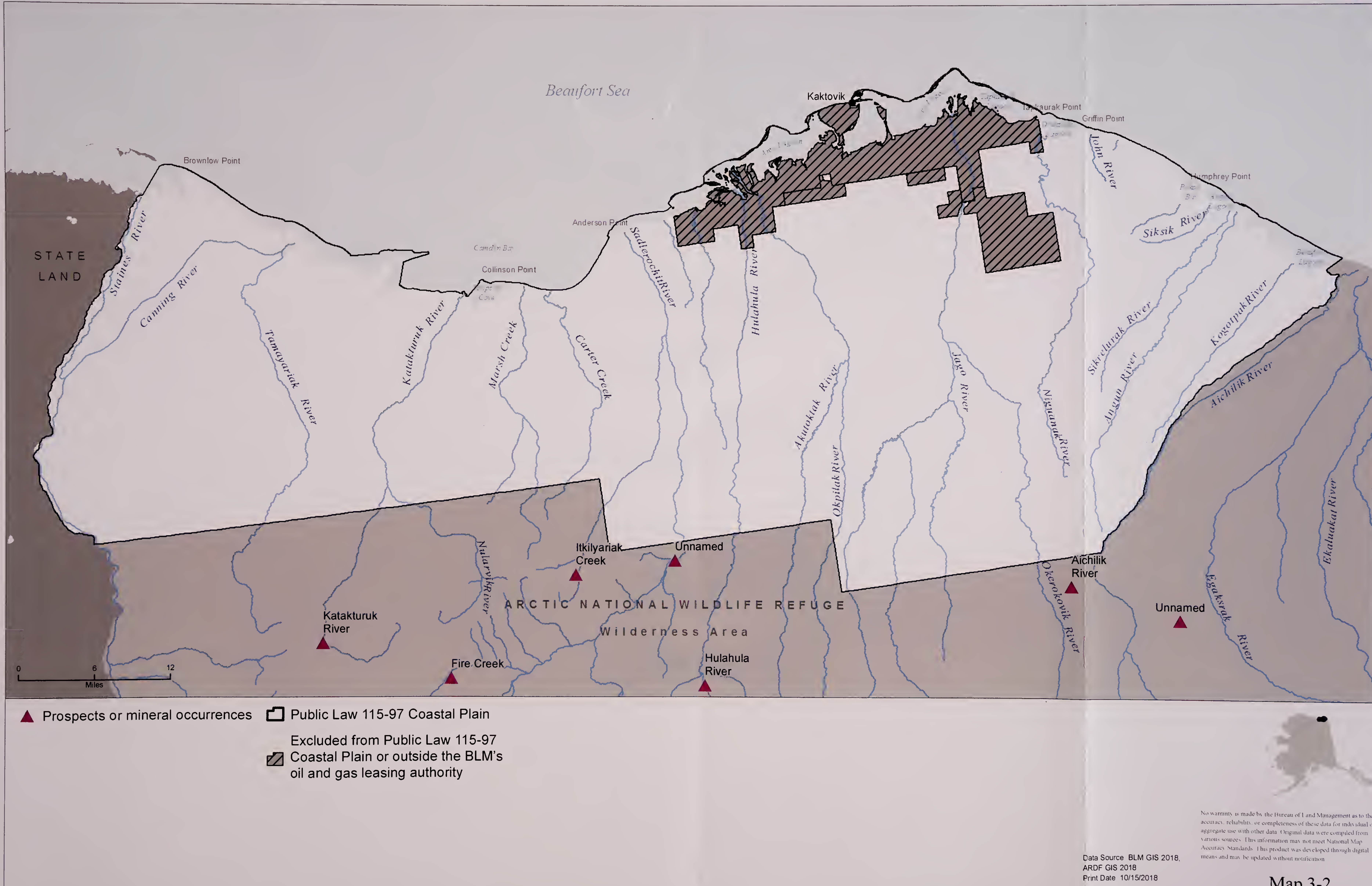
Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority

Data Source: BLM GIS 2018, FWS GIS 2018
Print Date: 10/15/2018

Map 2-8


Beaufort Sea
Kaktovik
Brownlow Point
Anderson Point
Collinson Point
Griffin Point
Humphrey Point
STATE LAND
Staines River
Canning River
Tamayariak River
Katakturuk River
Marsh Creek
Carter Creek
Sadlerochit River
Hulahula River
Akutoktak River
Okpilak River
Jago River
Niguanak River
John River
Siksik River
Sikrelurak River
Angun River
Kogotpak River
Aichilik River
Ekaluakat River
Egaksrak River
Okerokovik River
Nularvik River
ARCTIC NATIONAL WILDLIFE REFUGE
Wilderness Area
0 6 12
Miles
Arctic Coastal Plain
Arctic Foothills
Arctic Mountains (Ambler-Chandalar Ridge and Lowland)
Public Law 115-97 Coastal Plain
Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority
Data Source: BLM GIS 2018, Wahrhaftig GIS 1965
Print Date: 10/15/2018

Map 3-1


Beaufort Sea
Kaktovik
Griffin Point
Humphrey Point
Brownlow Point
Anderson Point
Collinson Point
STATE LAND
Staines River
Canning River
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Akutoakak River
Okpilak River
Jago River
Niguanak River
John River
Siksik River
Sikrelurak River
Angun River
Kogotpak River
Aichilik River
Ekaluakat River
Egaksrak River
Okerokovik River
Nularvik River
Itkilyariak Creek
Unnamed
Katakturuk River
Fire Creek
Hulahula River
Aichilik River
Unnamed
ARCTIC NATIONAL WILDLIFE REFUGE
Wilderness Area
0 6 12
Miles
Prospects or mineral occurrences
Public Law 115-97 Coastal Plain
Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority
Data Source BLM GIS 2018, ARDF GIS 2018
Print Date 10/15/2018

Map 3-2

Wellheads
- Development
- Service
- Exploratory

Airstrip

Above-ground pipeline

Public Law 115-97 Coastal Plain

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Data Source: BLM GIS 2018, AOGCC GIS 2018
Print Date: 10/15/2018

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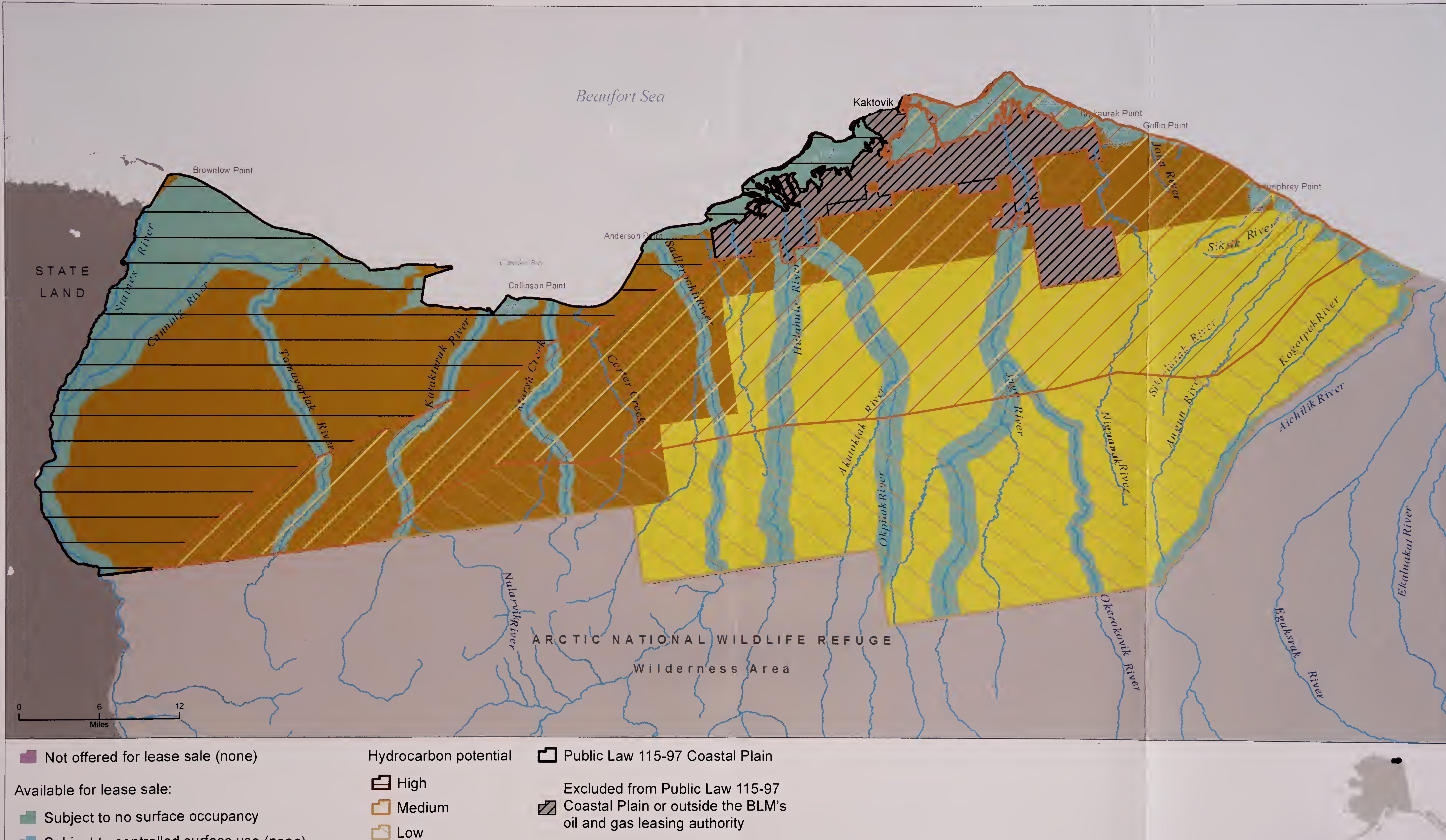
Map 3-3



Data Source BLM GIS 2018, FWS GIS 2018, USGS GIS 1998
Print Date: 10/15/2018

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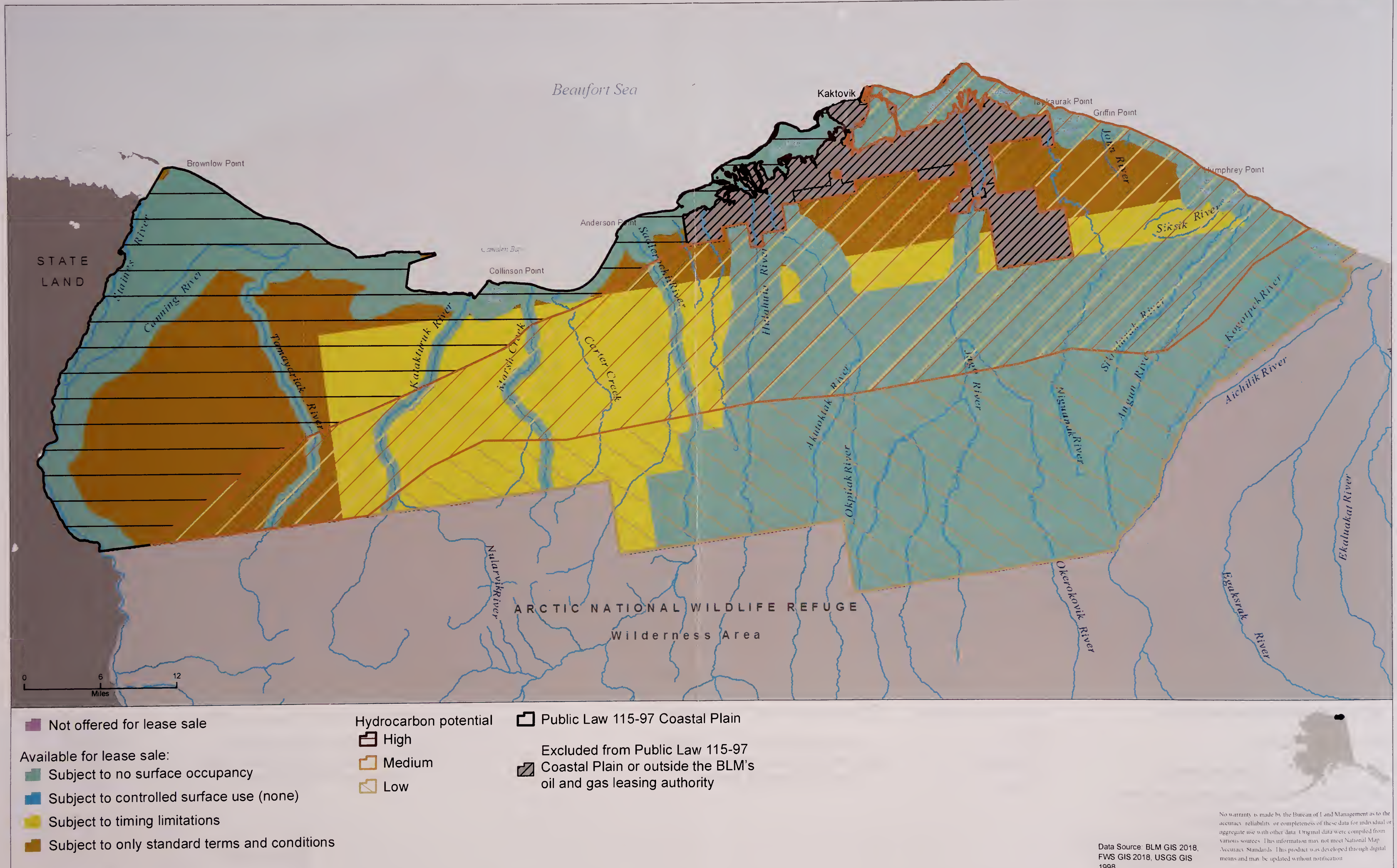
Map 3-4


Beaufort Sea
Kaktovik
Brownlow Point
Anderson Point
Collinson Point
Griffin Point
Humphrey Point
STATE LAND
Canning River
Staines River
Tamayariak River
Katakturuk River
Marsh Creek
Carter Creek
Sadlerochit River
Hulahula River
Akutoak River
Okpilak River
Jago River
Niguanak River
Aurgun River
Sikrelurak River
Kogotpak River
Siksik River
John River
Aichilik River
Egaksrak River
Ekaluakat River
Okerokovik River
Nularvik River
ARCTIC NATIONAL WILDLIFE REFUGE
Wilderness Area
0 6 12
Miles
Not offered for lease sale
Available for lease sale:
Subject to no surface occupancy
Subject to controlled surface use (none)
Subject to timing limitations
Subject to only standard terms and conditions
Hydrocarbon potential
High
Medium
Low
Public Law 115-97 Coastal Plain
Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority
Data Source: BLM GIS 2018, FWS GIS 2018, USGS GIS 1998
Print Date: 10/15/2018
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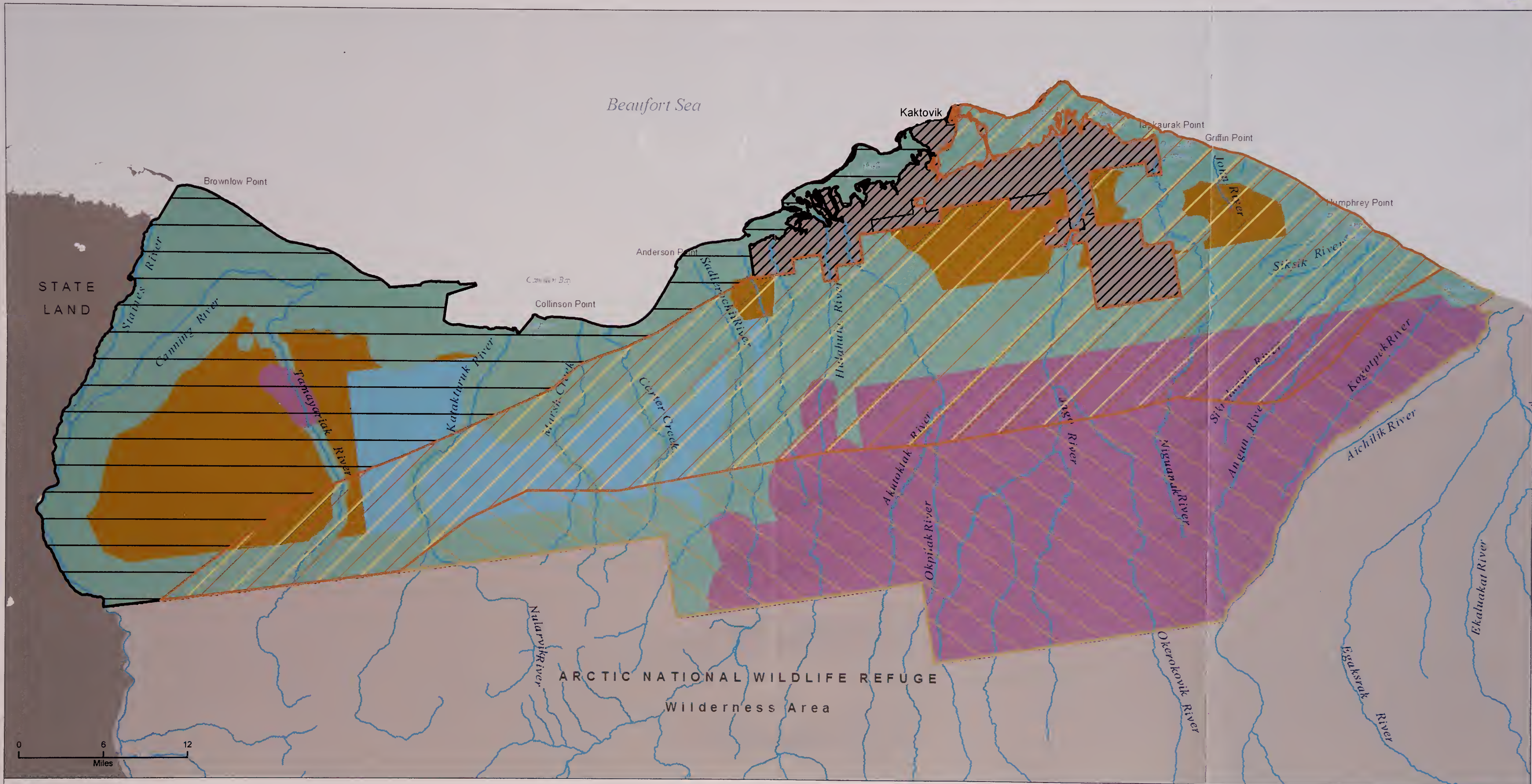
Map 3-5



Not offered for lease sale

Available for lease sale:
- Subject to no surface occupancy
- Subject to controlled surface use
- Subject to timing limitations
- Subject to only standard terms and conditions

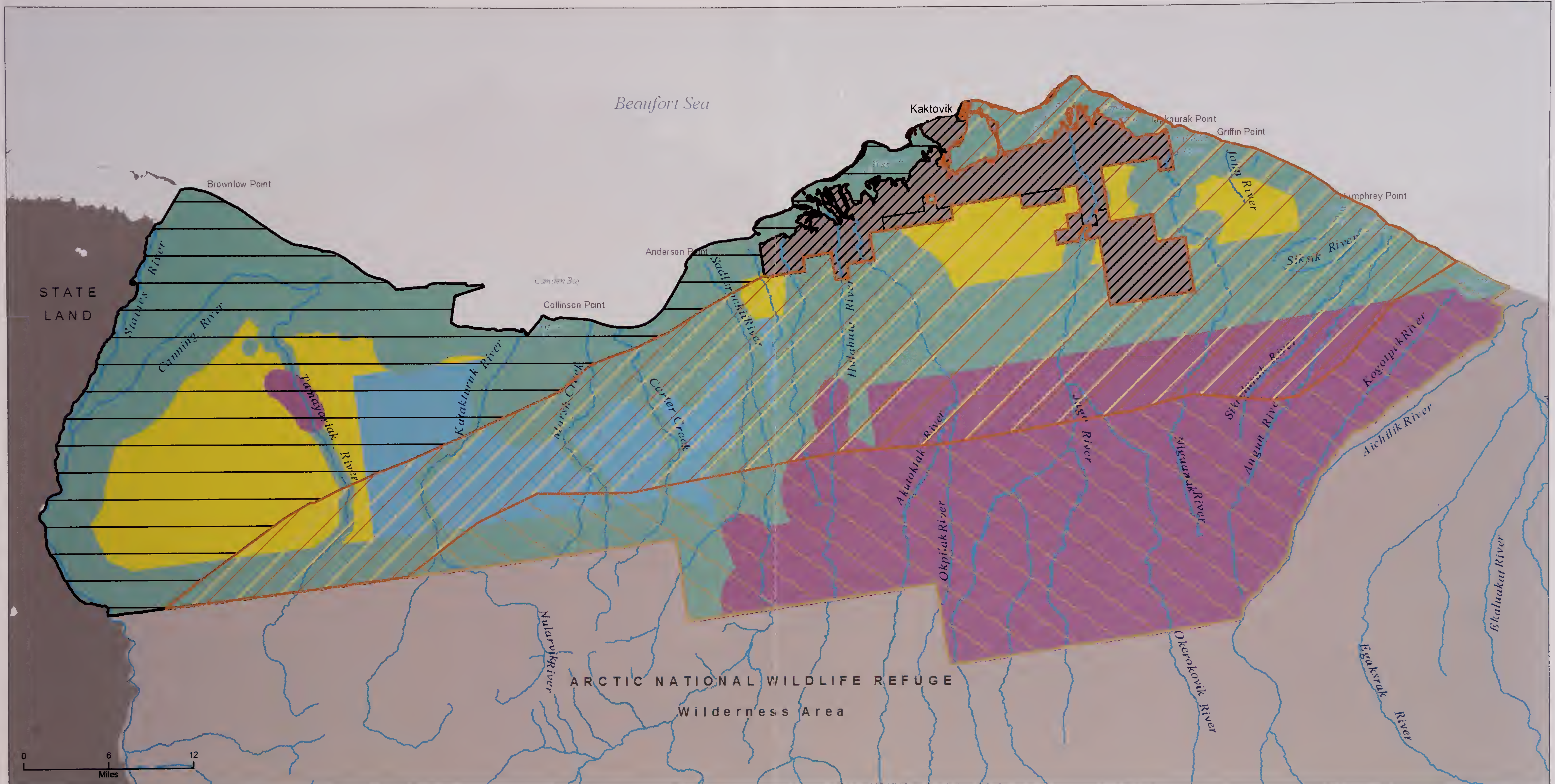
Hydrocarbon potential
- High
- Medium
- Low

Public Law 115-97 Coastal Plain

Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority

Data Source: BLM GIS 2018, FWS GIS 2018, USGS GIS 1998
Print Date: 10/15/2018

Map 3-6



Not offered for lease sale

Available for lease sale:
- Subject to no surface occupancy
- Subject to controlled surface use
- Subject to timing limitations
- Subject to only standard terms and conditions (none)

Hydrocarbon potential
- High
- Medium
- Low

Public Law 115-97 Coastal Plain

Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority

Data Source. BLM GIS 2018, FWS GIS 2018, USGS GIS 1998
Print Date. 10/15/2018

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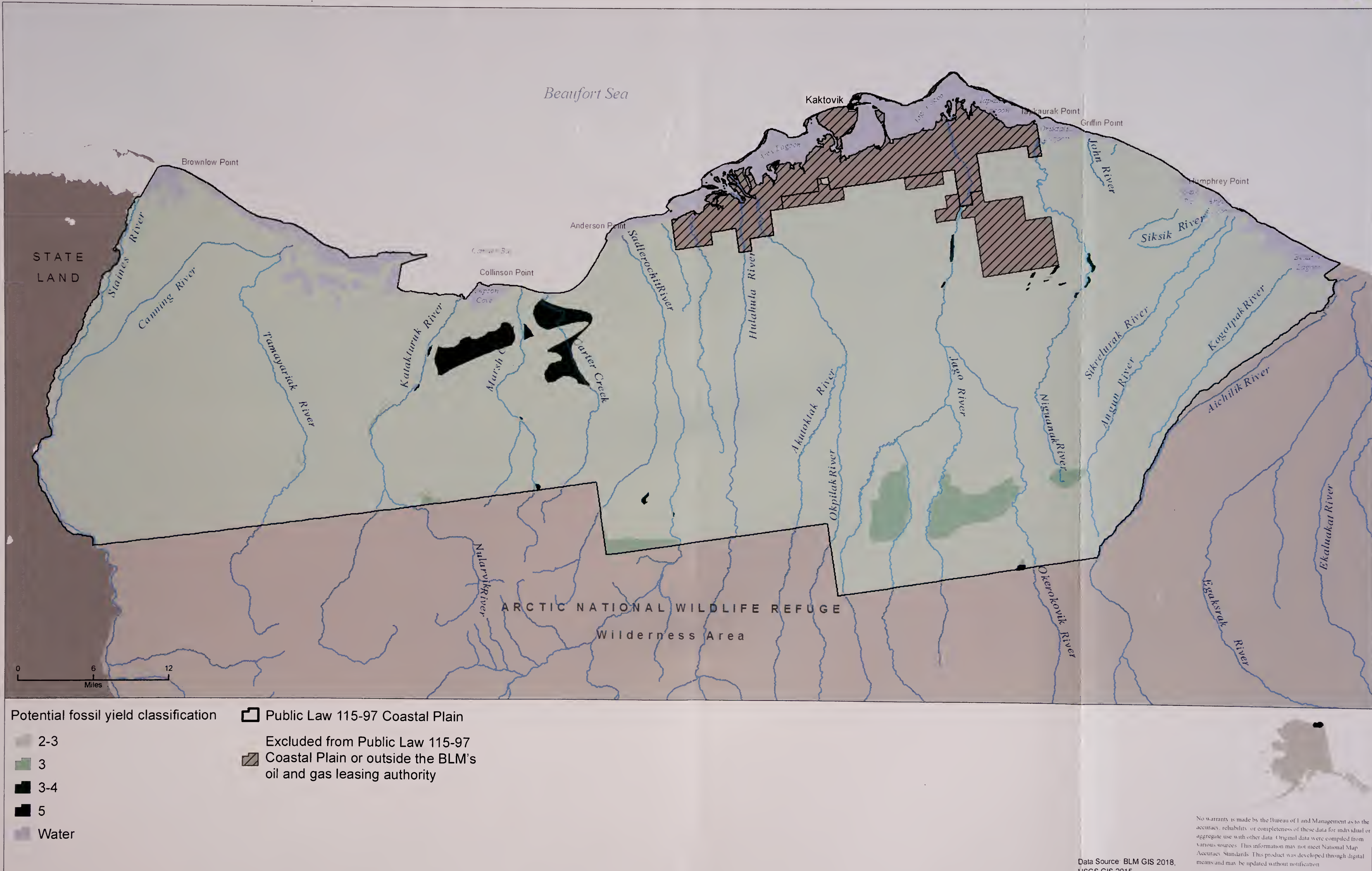
Map 3-7


Beaufort Sea
Kaktovik
Tapkaurak Point
Griffin Point
Humphrey Point
Brownlow Point
Anderson Point
Collinson Point
STATE LAND
Staines River
Canning River
Tamayariak River
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Okpilak River
Jago River
Niguanak River
John River
Siksik River
Sikrelurak River
Angun River
Kogotpak River
Aichilik River
Ekaluakat River
Egaksrak River
Okerokovik River
Nularvik River
ARCTIC NATIONAL WILDLIFE REFUGE
Wilderness Area
0 6 12
Miles
Potential fossil yield classification
2-3
3
3-4
5
Water
Public Law 115-97 Coastal Plain
Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority
Data Source: BLM GIS 2018, USGS GIS 2015
Print Date: 10/15/2018
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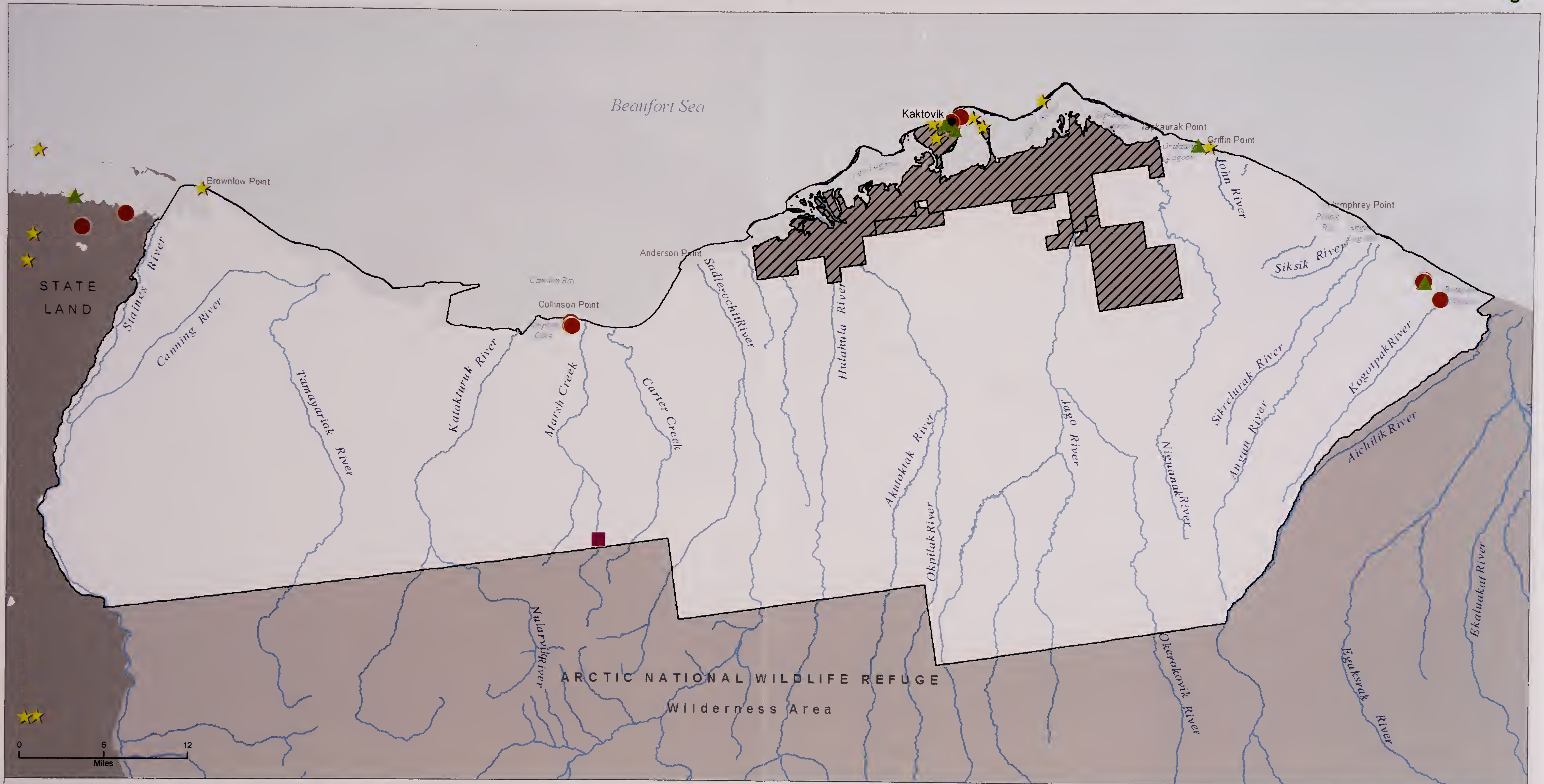
Map 3-8



Alaska Department of Environmental Conservation—contaminated site

- Active
- Clean-up complete
- Informational

Resource Conservation and Recovery Act site

Public Law 115-97 Coastal Plain

Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority

Data Source: BLM GIS 2018, ADEC GIS 2018, EPA GIS 2018
Print Date: 10/15/2018

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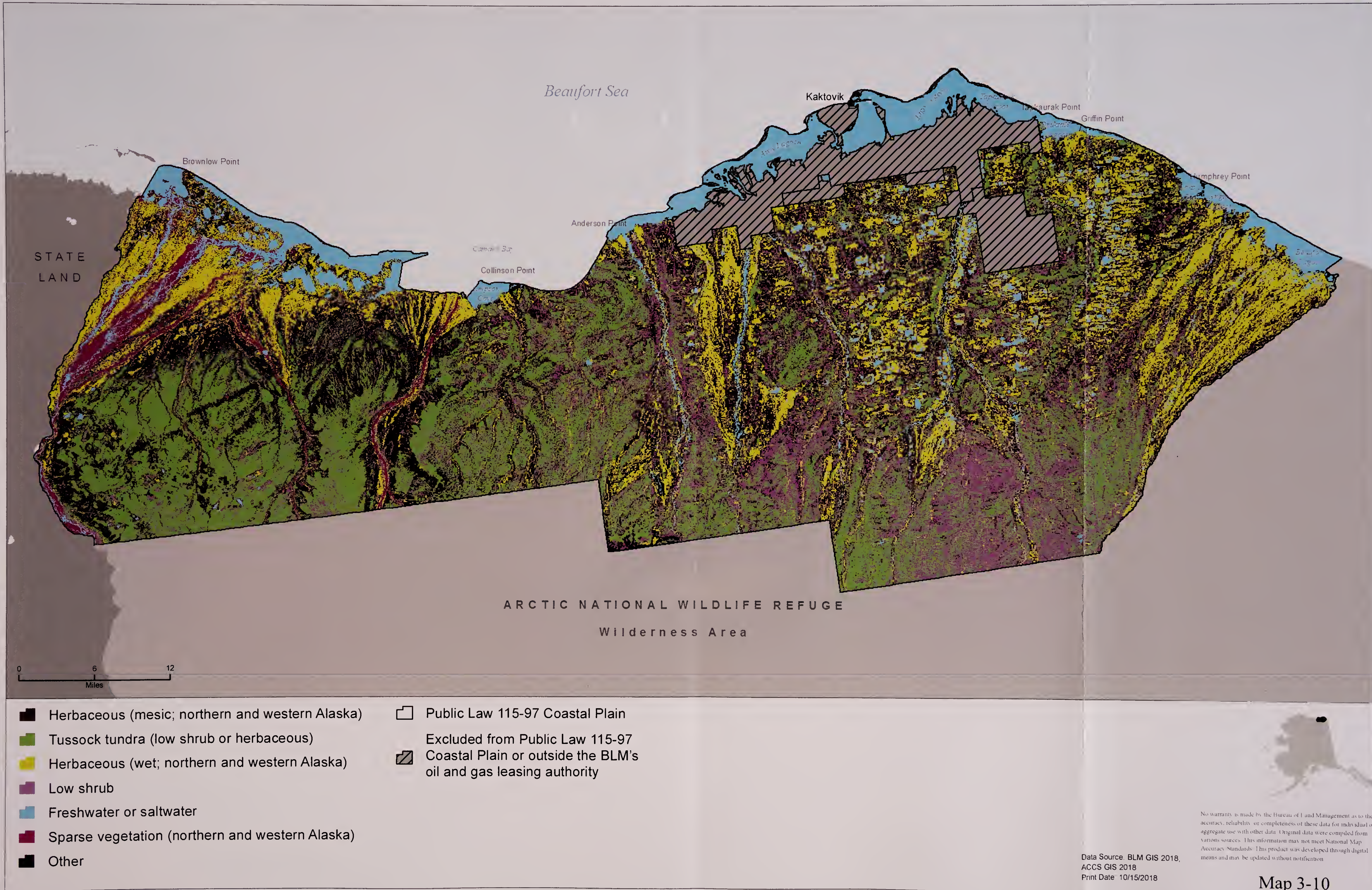
Map 3-9


Beaufort Sea
Kaktovik
Brownlow Point
Anderson Point
Collinson Point
Griffin Point
Humphrey Point
STATE
LAND
ARCTIC NATIONAL WILDLIFE REFUGE
Wilderness Area
0
6
12
Miles
Herbaceous (mesic; northern and western Alaska)
Tussock tundra (low shrub or herbaceous)
Herbaceous (wet; northern and western Alaska)
Low shrub
Freshwater or saltwater
Sparse vegetation (northern and western Alaska)
Other
Public Law 115-97 Coastal Plain
Excluded from Public Law 115-97
Coastal Plain or outside the BLM's
oil and gas leasing authority
Data Source. BLM GIS 2018,
ACCS GIS 2018
Print Date 10/15/2018
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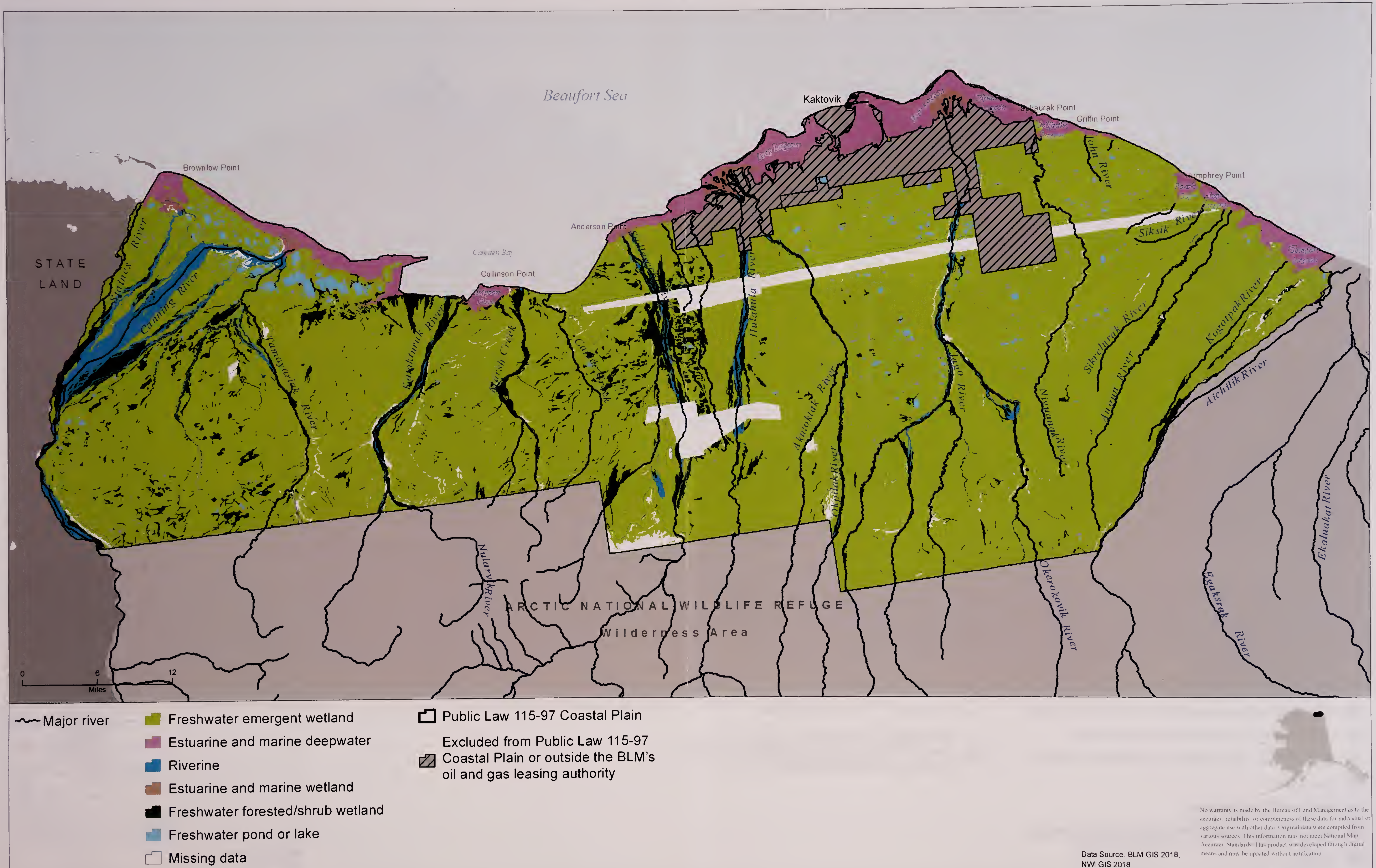
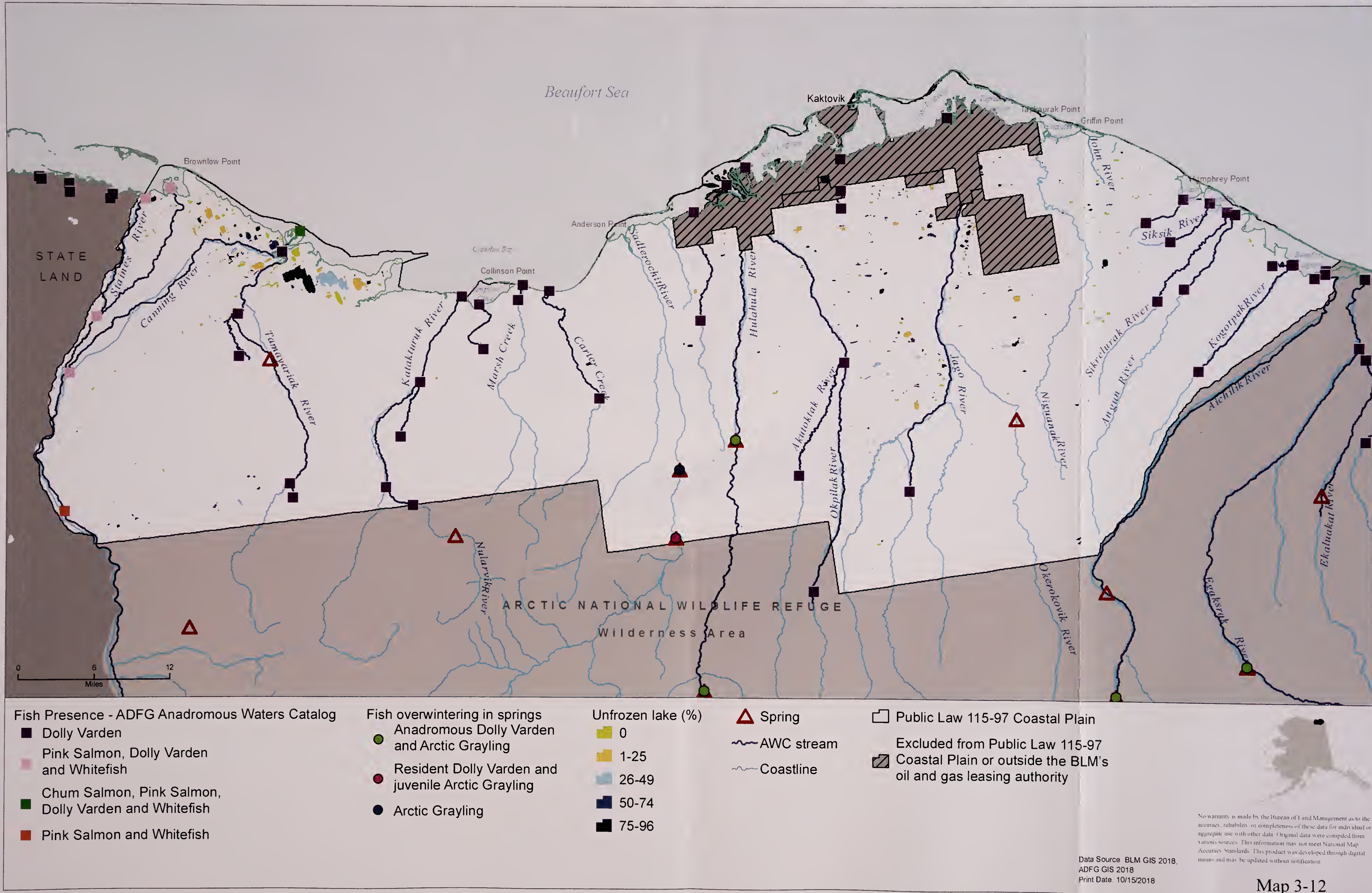
Map 3-10


Beaufort Sea
Kaktovik
Brownlow Point
Anderson Point
Camden Bay
Collinson Point
Griffin Point
Humphrey Point
STATE LAND
Canning River
Tamayariak River
Katakturuk River
Marsh Creek
Hulahula River
Aichilik River
Kogotpak River
Siksik River
Jago River
Niguanak River
Okerokovik River
Egaksrak River
Ekaluakat River
Nularvik River
Okpilak River
Akutoakak River
ARCTIC NATIONAL WILDLIFE REFUGE
Wilderness Area
0 6 12
Miles
Major river
Freshwater emergent wetland
Estuarine and marine deepwater
Riverine
Estuarine and marine wetland
Freshwater forested/shrub wetland
Freshwater pond or lake
Missing data
Public Law 115-97 Coastal Plain
Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority
Data Source BLM GIS 2018, NWI GIS 2018
Print Date 10/15/2018

Map 3-11


Beaufort Sea
Kaktovik
Tapkaurak Point
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Staines River
Canning River
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Okpilak River
Jago River
Niguanak River
Sikrelurak River
Angun River
Siksik River
Kogotpak River
Aichilik River
Ekaluakat River
Egaksrak River
Okerokovik River
Nularvik River
Jago River
ARCTIC NATIONAL WILDLIFE REFUGE
Wilderness Area
0
6
12
Miles
Fish Presence - ADFG Anadromous Waters Catalog
Dolly Varden
Pink Salmon, Dolly Varden and Whitefish
Chum Salmon, Pink Salmon, Dolly Varden and Whitefish
Pink Salmon and Whitefish
Fish overwintering in springs
Anadromous Dolly Varden and Arctic Grayling
Resident Dolly Varden and juvenile Arctic Grayling
Arctic Grayling
Unfrozen lake (%)
0
1-25
26-49
50-74
75-96
Spring
AWC stream
Coastline
Public Law 115-97 Coastal Plain
Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority
Data Source BLM GIS 2018, ADFG GIS 2018
Print Date 10/15/2018
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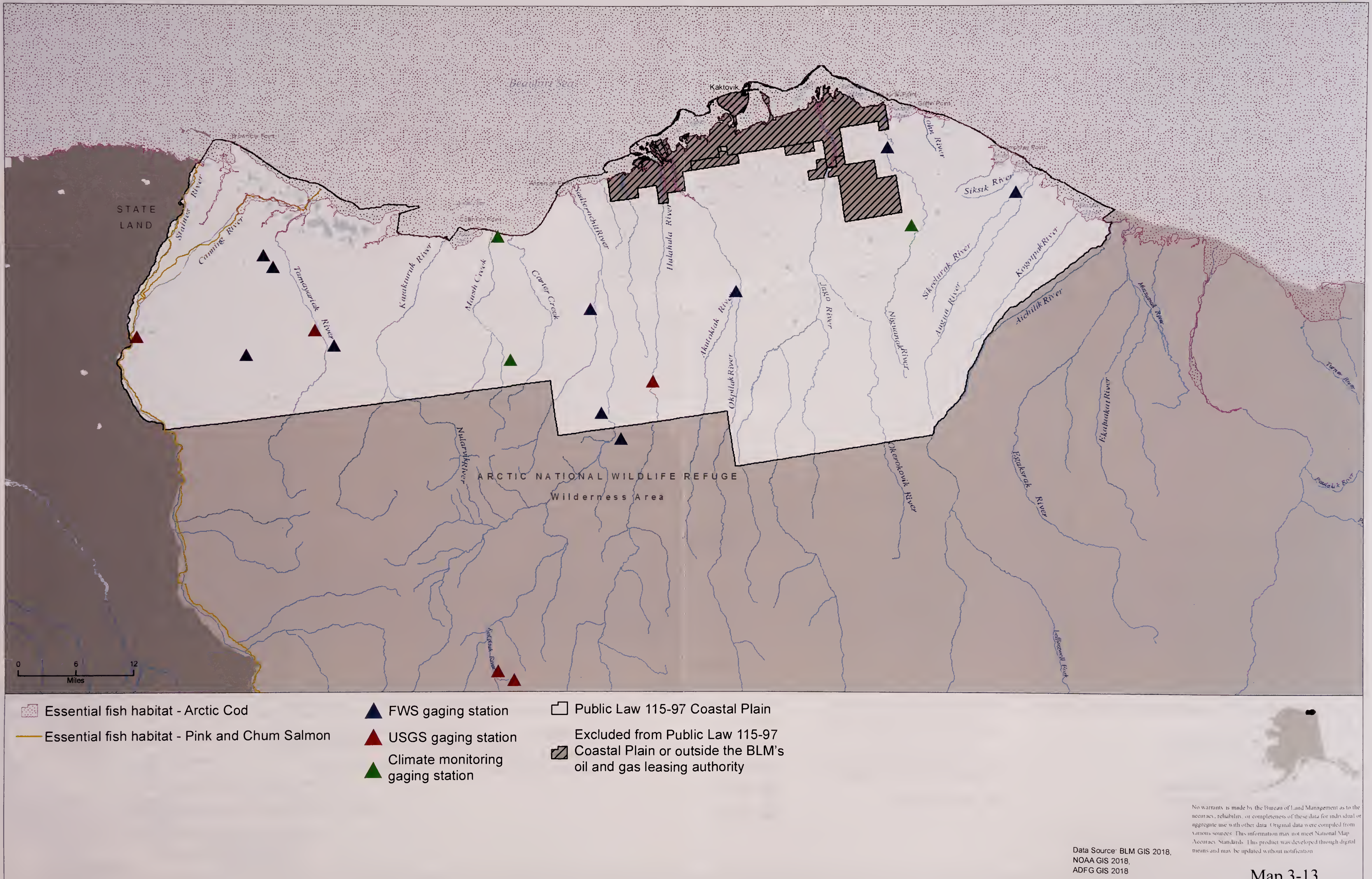
Map 3-12


Beaufort Sea
Kaktovik
STATE LAND
ARCTIC NATIONAL WILDLIFE REFUGE
Wilderness Area
Staines River
Canning River
Tamayariak River
Katakturuk River
Marsh Creek
Carter Creek
Sadlerochit River
Hulahula River
Akutoktak River
Okpilak River
Jago River
Niguanak River
Siksik River
Sikrelurak River
Angun River
Kongakut River
Aichilik River
Okerokovik River
Nularvik River
Egaksrak River
Ekaluakat River
0
6
12
Miles
Essential fish habitat - Arctic Cod
Essential fish habitat - Pink and Chum Salmon
FWS gaging station
USGS gaging station
Climate monitoring gaging station
Public Law 115-97 Coastal Plain
Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority
Data Source: BLM GIS 2018, NOAA GIS 2018, ADFG GIS 2018
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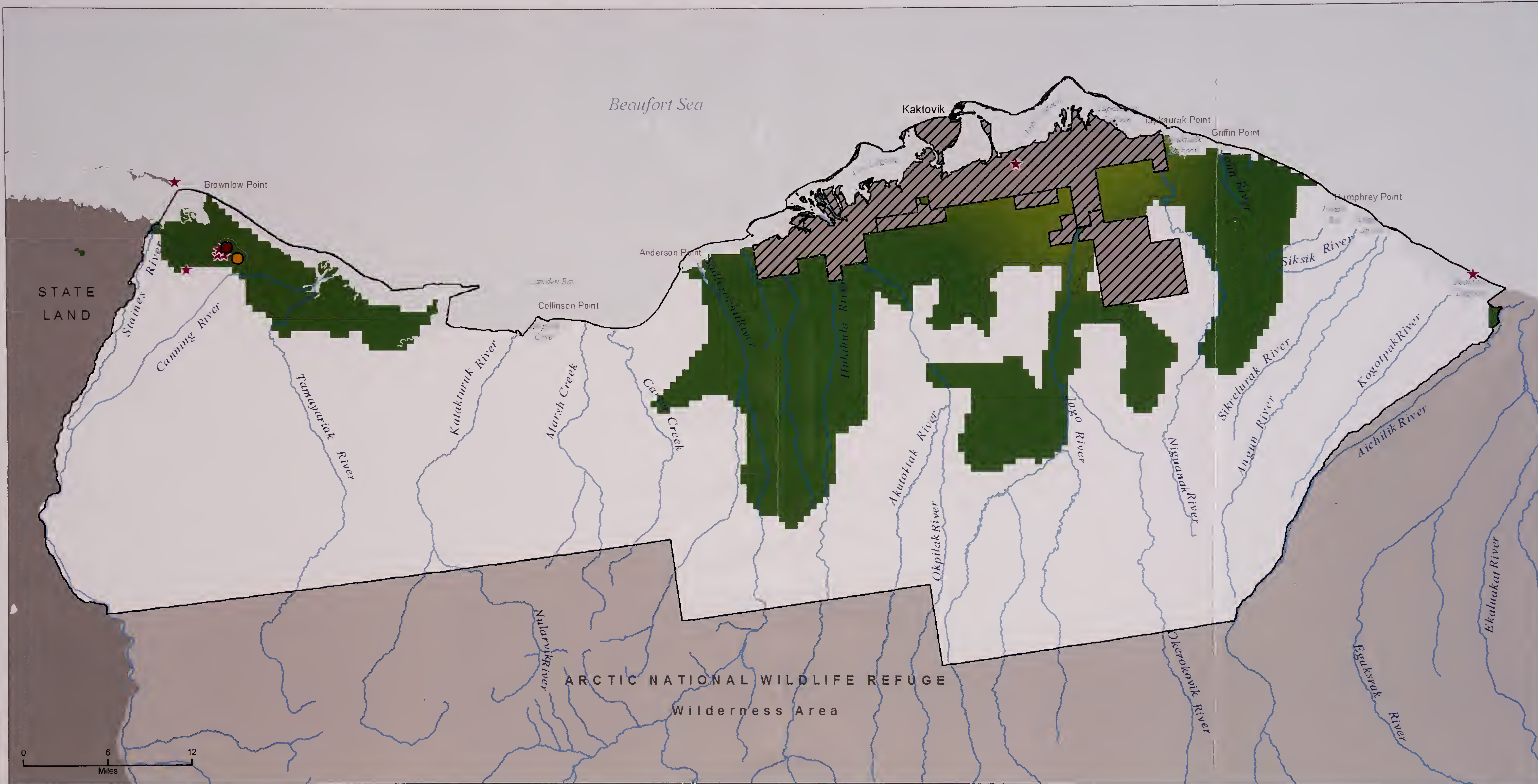
Map 3-13



Spectacled Eider nest site
- 2005
- 2014, 2017

★ All spectacled eider observations from the North Slope Eider aerial survey, 1992-2006, and the Arctic Coastal Plain breeding waterbird aerial survey, 1992-2014, aerial survey sightings 1999-2007

Interpolated density (birds/km²) of spectacled eiders from bird observations collected during the ACP aerial breeding pair waterbird survey, 2012-2015. Birds occured in low to medium low densities within the program area.

High density (0.07)
Low density (0)

Public Law 115-97 Coastal Plain

Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority

Data Source: BLM GIS 2018, FWS GIS 2005, 2014, 2017, FWS ACP GIS 2007
Print Date: 10/15/2018

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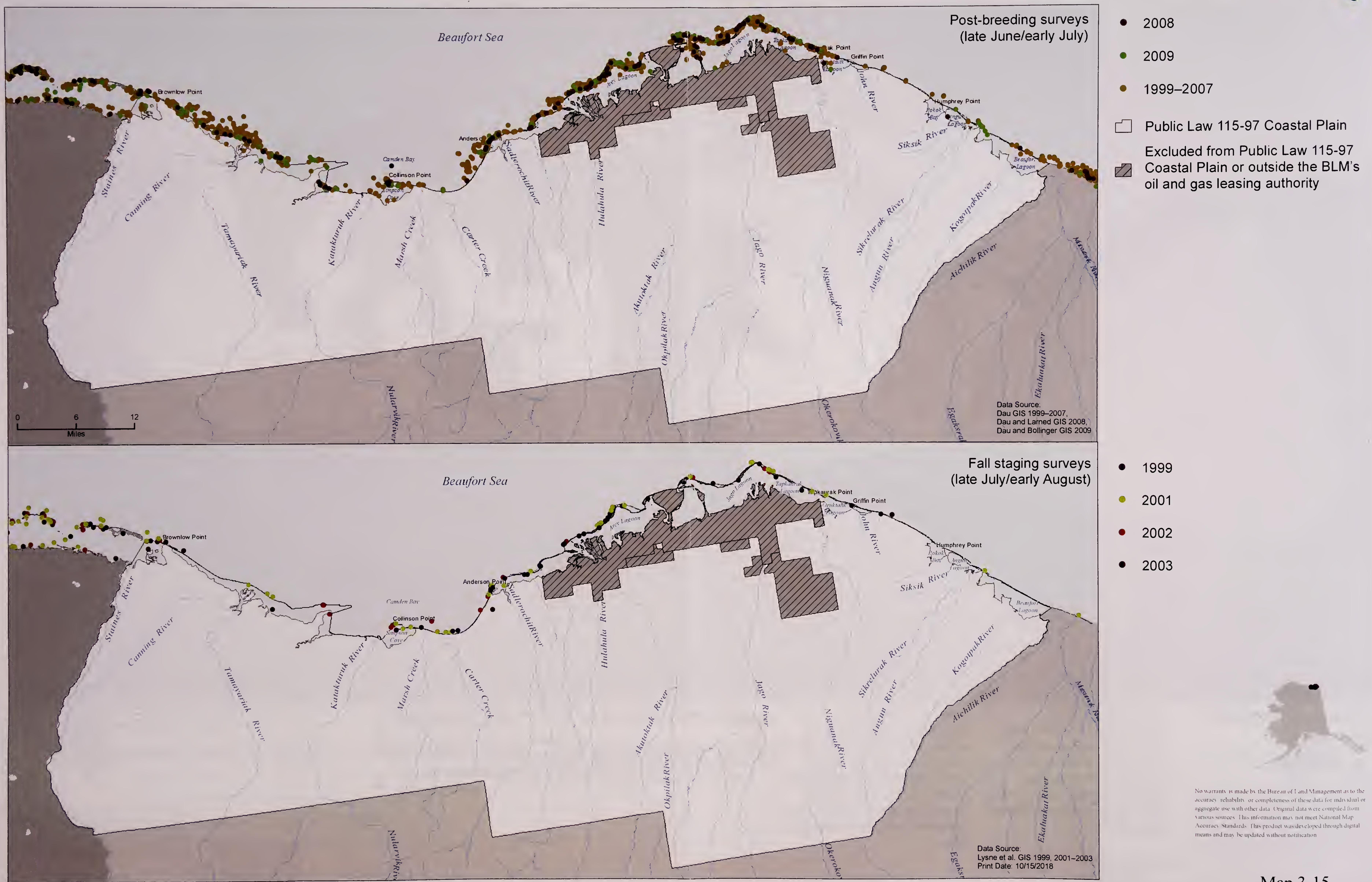
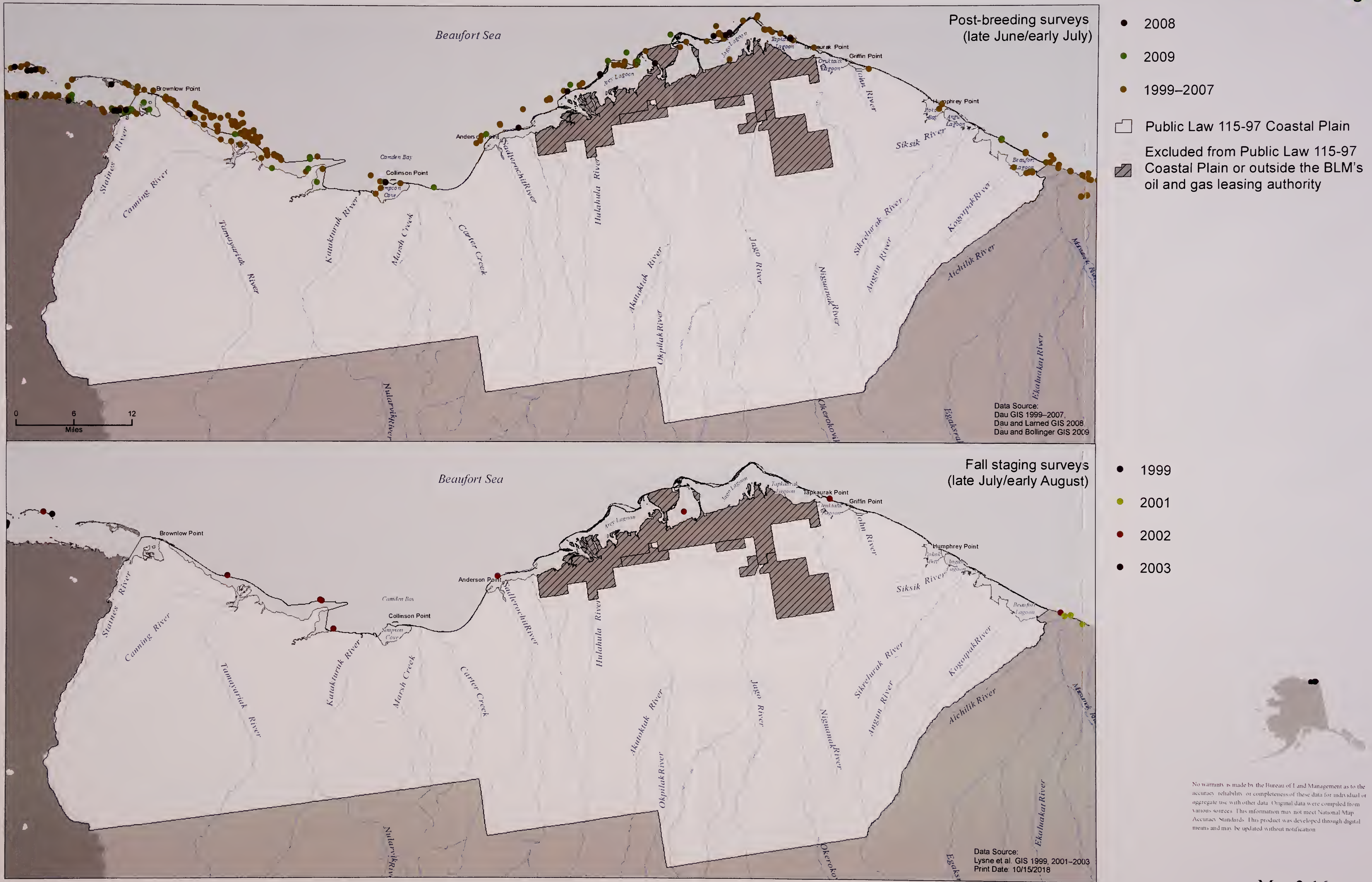
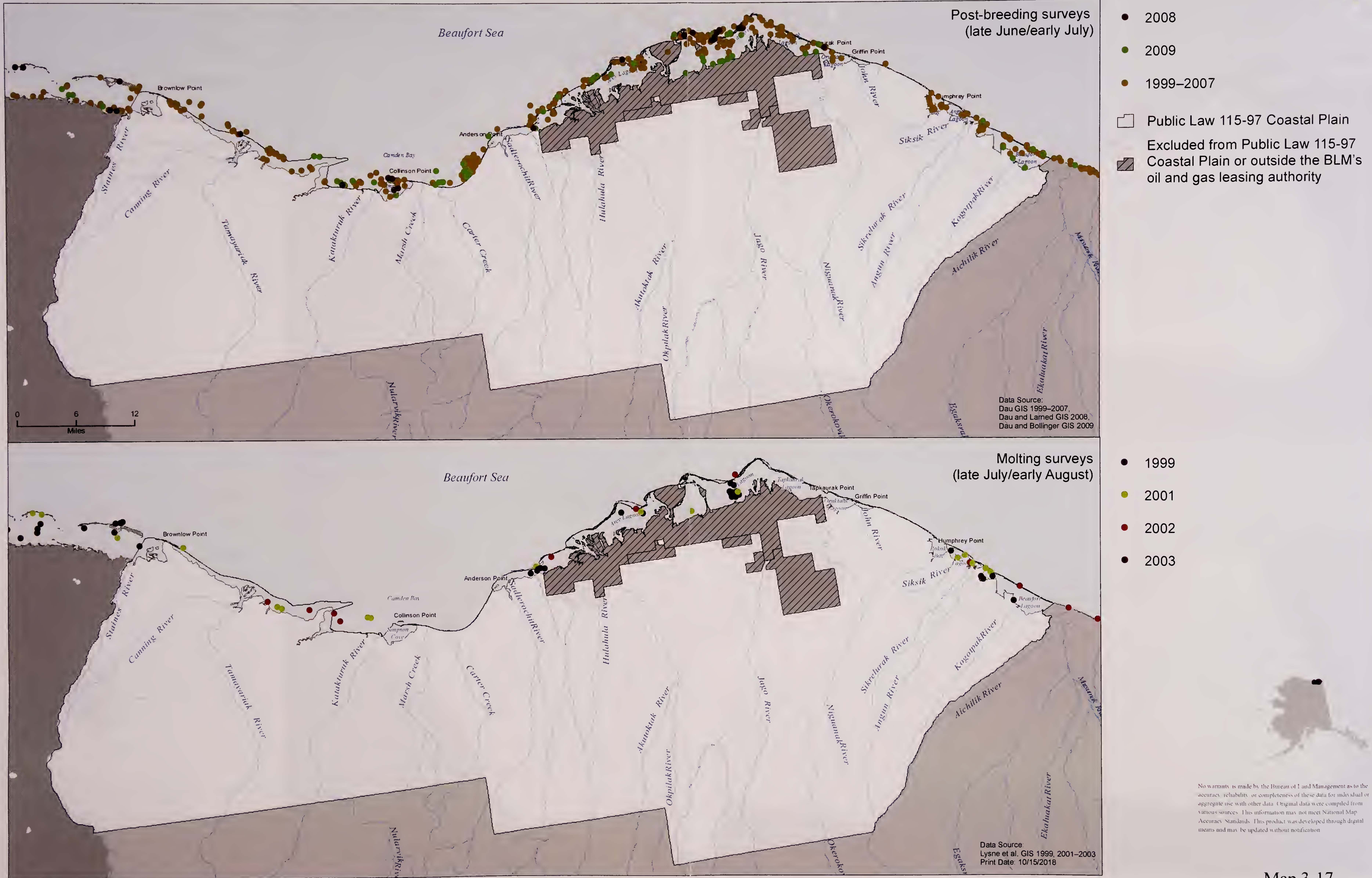
Map 3-14


Post-breeding surveys
(late June/early July)
Beaufort Sea
Brownlow Point
Camden Bay
Collinson Point
Anderson Point
Griffin Point
Humphrey Point
Staines River
Canning River
Tamayariak River
Katakturuk River
Marsh Creek
Carter Creek
Sadlerochit River
Hulahula River
Akutoktak River
Okpilak River
Jago River
Niguanak River
Sikrelurak River
Angun River
Kogotpak River
Aichilik River
Siksik River
Jago Lagoon
Arey Lagoon
Beaufort Lagoon
Nularvik River
Okerokovik River
Egaksrak River
Ekaluakat River
0 6 12
Miles
Data Source:
Dau GIS 1999–2007,
Dau and Larned GIS 2008,
Dau and Bollinger GIS 2009
2008
2009
1999–2007
Public Law 115-97 Coastal Plain
Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority
Fall staging surveys
(late July/early August)
Data Source:
Lysne et al. GIS 1999, 2001–2003
Print Date: 10/15/2018
1999
2001
2002
2003

Map 3-15


Post-breeding surveys
(late June/early July)
Beaufort Sea
Brownlow Point
Camden Bay
Collinson Point
Anderson Point
Tapkaurak Point
Griffin Point
Humphrey Point
Siksik River
Staines River
Canning River
Tamayariak River
Katakturuk River
Marsh Creek
Carter Creek
Sadlerochit River
Hulahula River
Akutoktak River
Okpilak River
Jago River
Niguanak River
Sikrelurak River
Angun River
Kogotpak River
Aichilik River
Ekaluakat River
Nularvik River
0 6 12
Miles
Data Source:
Dau GIS 1999–2007,
Dau and Larned GIS 2008
Dau and Bollinger GIS 2009
2008
2009
1999–2007
Public Law 115-97 Coastal Plain
Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority
Fall staging surveys
(late July/early August)
Data Source:
Lysne et al. GIS 1999, 2001–2003
Print Date: 10/15/2018
1999
2001
2002
2003

Map 3-16


Post-breeding surveys
(late June/early July)
2008
2009
1999–2007
Public Law 115-97 Coastal Plain
Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority
Beaufort Sea
Brownlow Point
Anderson Point
Collinson Point
Camden Bay
Griffin Point
Humphrey Point
Staines River
Canning River
Tamayariak River
Katakturuk River
Marsh Creek
Carter Creek
Sadlerochit River
Hulahula River
Akutoktak River
Okpilak River
Jago River
Niguanak River
Sikrelurak River
Angun River
Siksik River
Kogotpak River
Aichilik River
Ekaluakat River
Okerokovik River
Egaksrak River
Nularvik River
Jokin River
0 6 12
Miles
Data Source:
Dau GIS 1999–2007,
Dau and Larned GIS 2008,
Dau and Bollinger GIS 2009
Molting surveys
(late July/early August)
1999
2001
2002
2003
Tapkaurak Point
Simpson Cove
Data Source:
Lysne et al. GIS 1999, 2001–2003
Print Date: 10/15/2018
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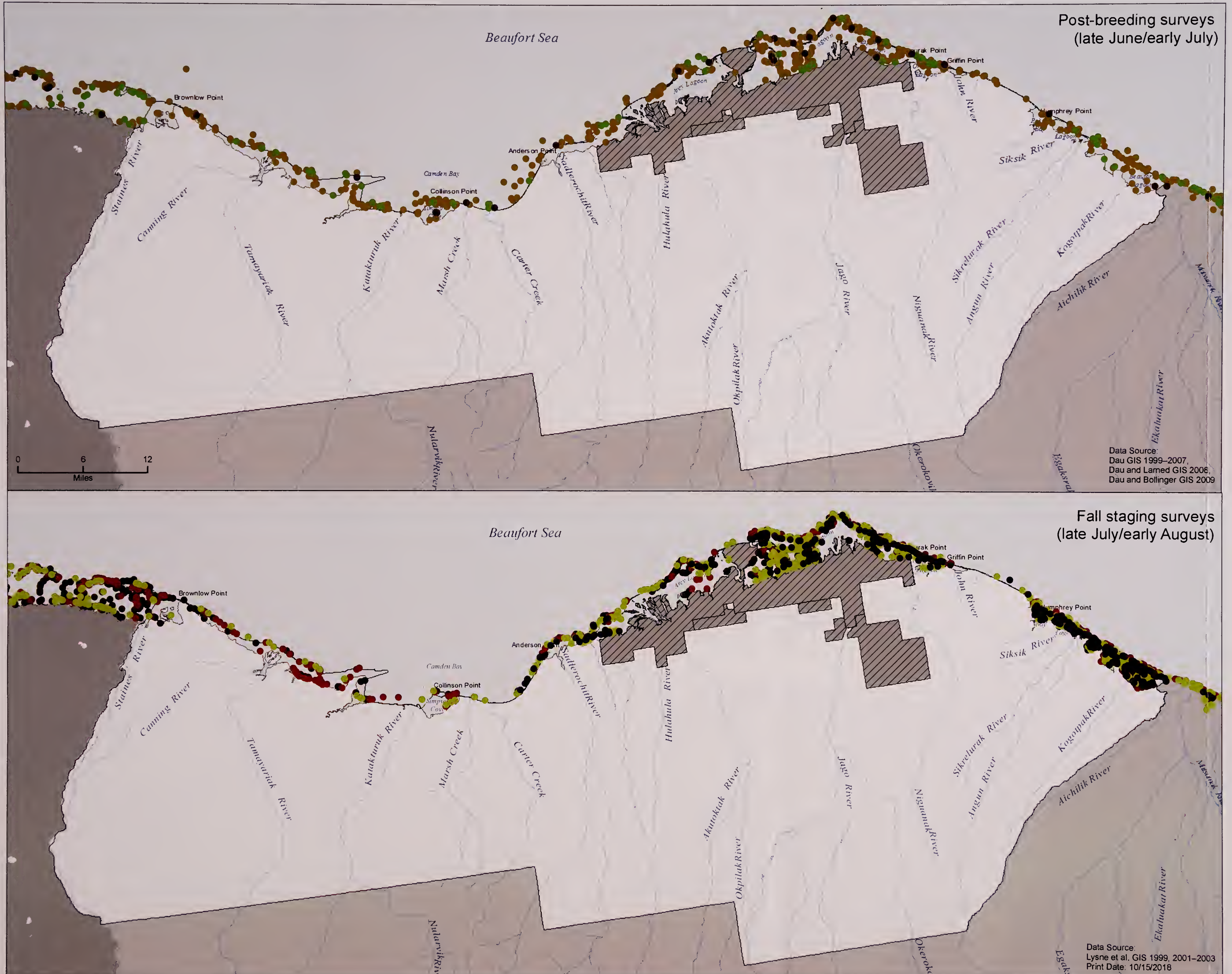
Map 3-17



- 2008
- 2009
- 1999–2007
- Public Law 115-97 Coastal Plain
- Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority

- 1999
- 2001
- 2002
- 2003

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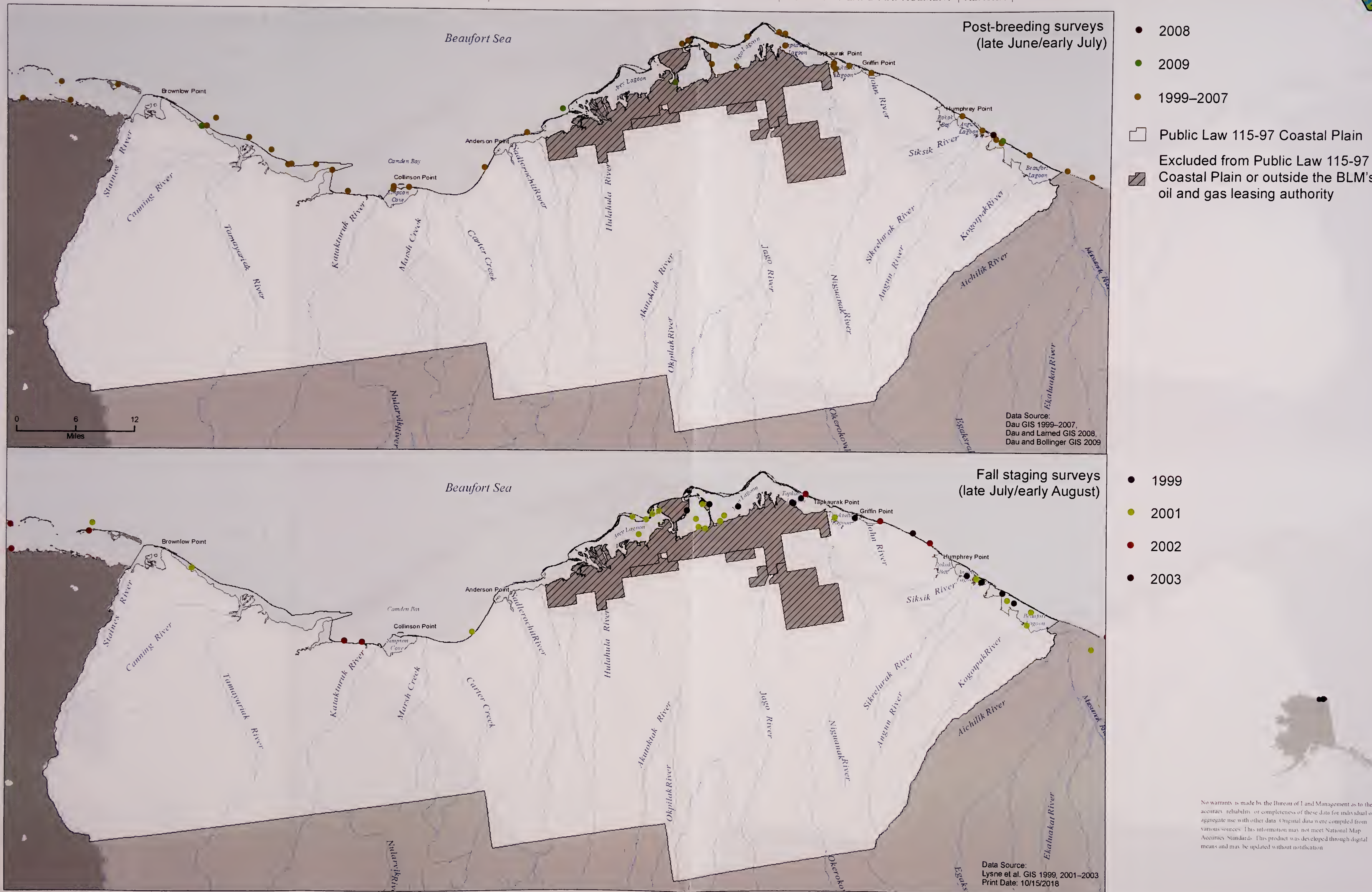
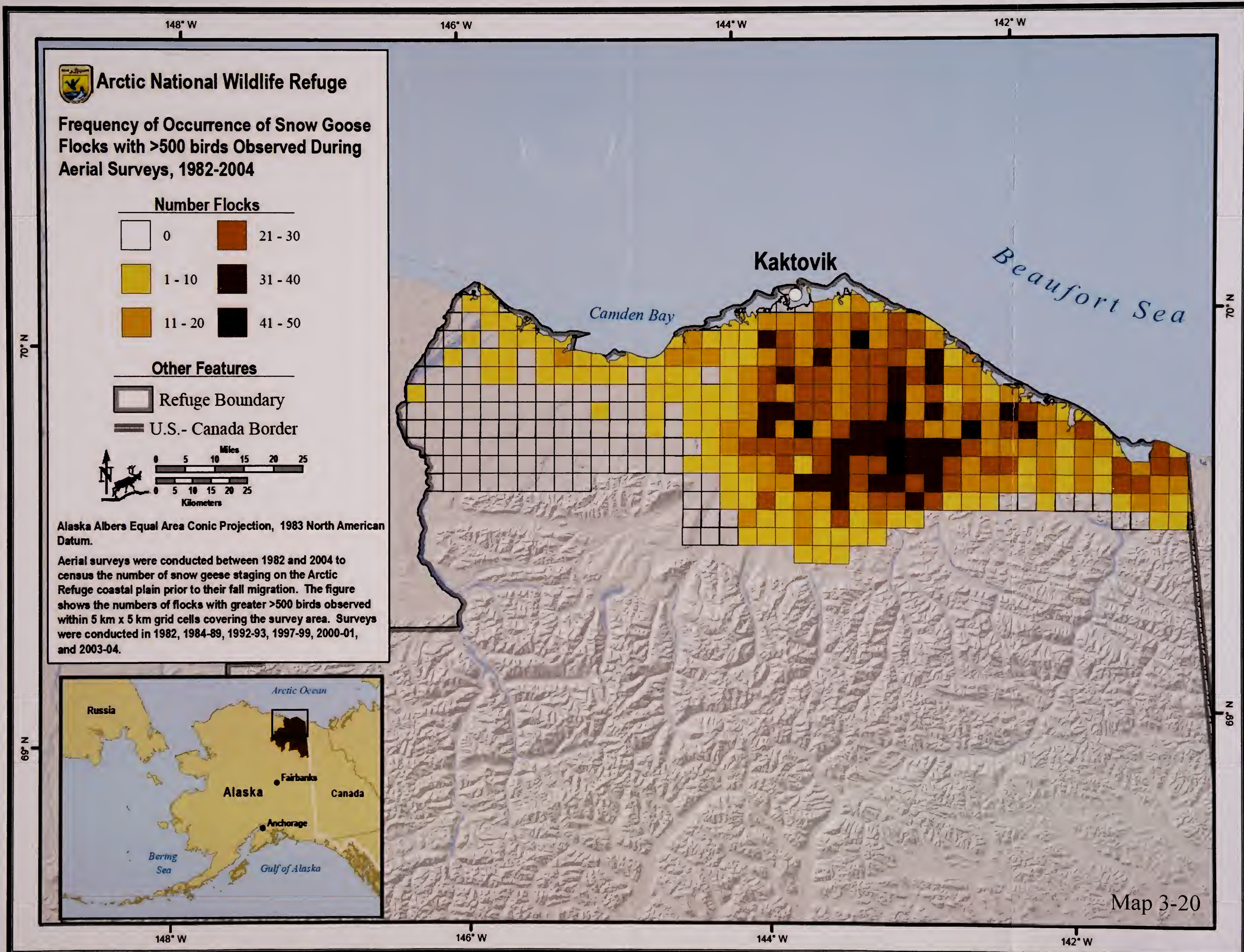
Map 3-18


Post-breeding surveys
(late June/early July)
Beaufort Sea
Brownlow Point
Anderson Point
Camden Bay
Collinson Point
Tapkaurak Point
Griffin Point
Humphrey Point
Staines River
Canning River
Tamayariak River
Katakturuk River
Marsh Creek
Carter Creek
Sadlerochit River
Hulahula River
Akutoktak River
Okpilak River
Jago River
Niguanak River
Sikrelurak River
Angun River
Siksik River
Kogotpak River
Aichilik River
Ekaluakat River
Egaksrak River
Okerokovik River
Nularvik River
Mosquito River
0 6 12
Miles
Data Source:
Dau GIS 1999–2007,
Dau and Larned GIS 2008,
Dau and Bollinger GIS 2009
2008
2009
1999–2007
Public Law 115-97 Coastal Plain
Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority
Fall staging surveys
(late July/early August)
Data Source:
Lysne et al. GIS 1999, 2001–2003
Print Date: 10/15/2018
1999
2001
2002
2003

Map 3-19


148° W
146° W
144° W
142° W
70° N
69° N
Arctic National Wildlife Refuge
Frequency of Occurrence of Snow Goose Flocks with >500 birds Observed During Aerial Surveys, 1982-2004
Number Flocks
0
1 - 10
11 - 20
21 - 30
31 - 40
41 - 50
Other Features
Refuge Boundary
U.S.- Canada Border
Miles
0 5 10 15 20 25
0 5 10 15 20 25
Kilometers
Alaska Albers Equal Area Conic Projection, 1983 North American Datum.
Aerial surveys were conducted between 1982 and 2004 to census the number of snow geese staging on the Arctic Refuge coastal plain prior to their fall migration. The figure shows the numbers of flocks with greater >500 birds observed within 5 km x 5 km grid cells covering the survey area. Surveys were conducted in 1982, 1984-89, 1992-93, 1997-99, 2000-01, and 2003-04.
Kaktovik
Camden Bay
Beaufort Sea
Russia
Arctic Ocean
Fairbanks
Alaska
Canada
Anchorage
Bering Sea
Gulf of Alaska
Map 3-20

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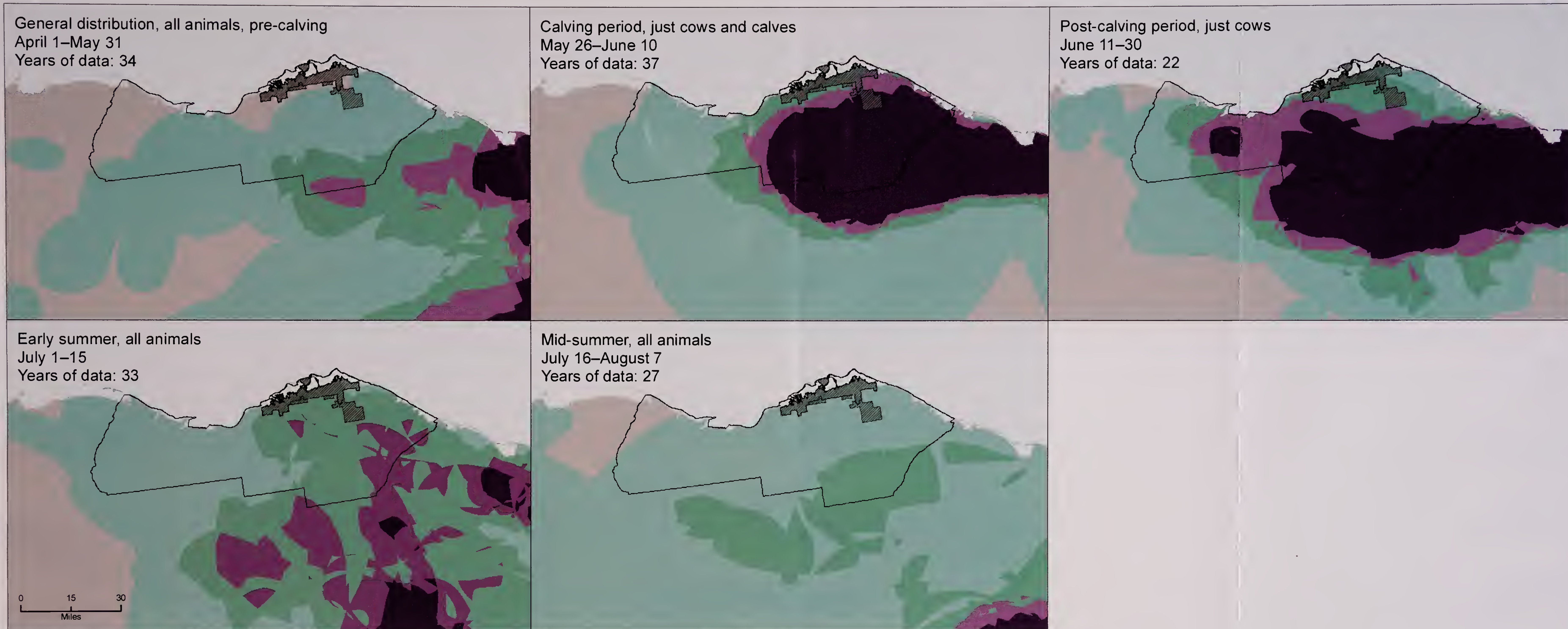


Percent of years that caribou are present

- < 20%
- 20–30%
- 30–40%
- > 40%

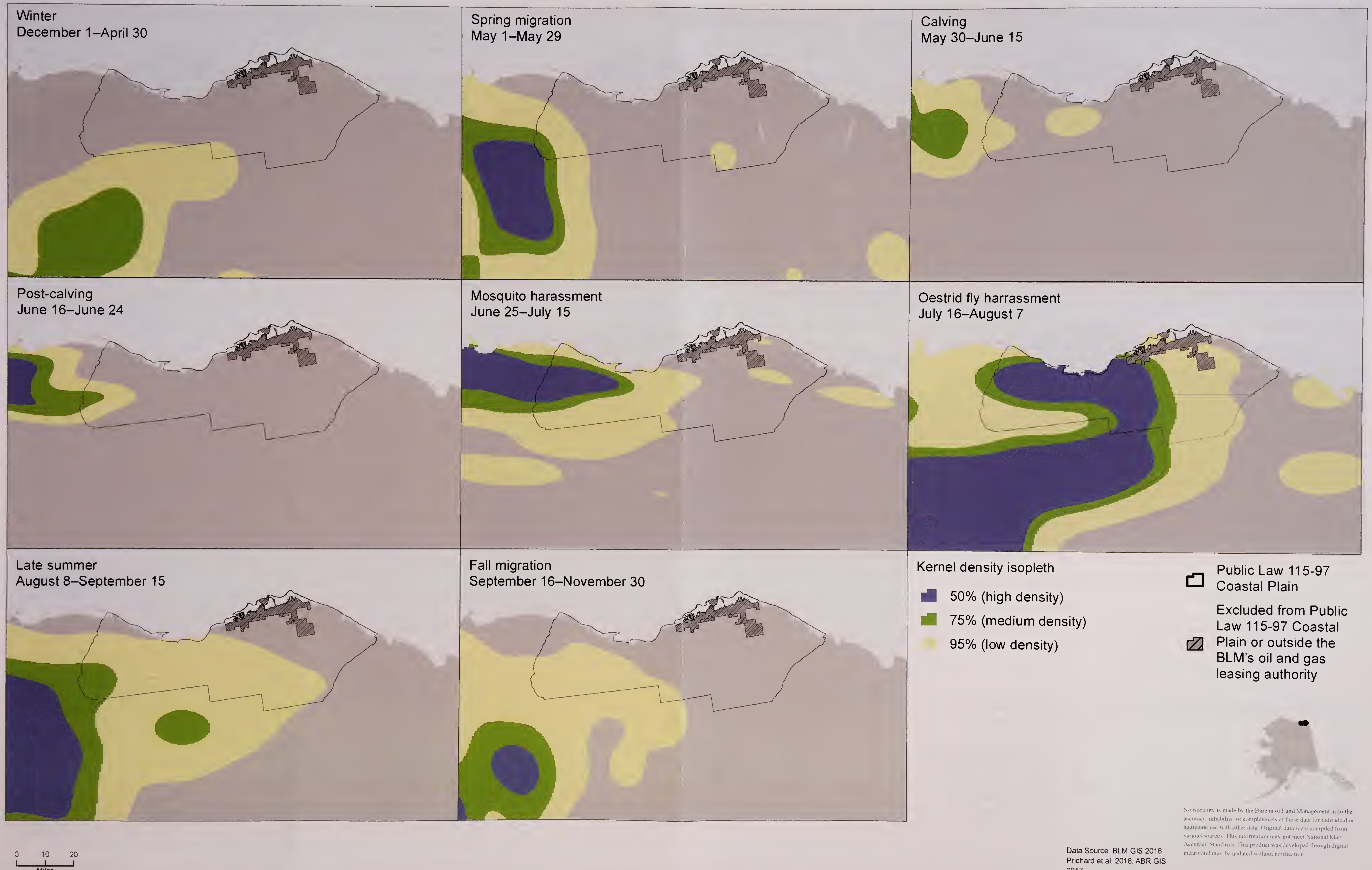
Public Law 115-97 Coastal Plain

Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority

Data Source: BLM GIS 2018, Yukon Environmental GIS 2018
Print Date: 10/15/2018

Map 3-21

Seasonal Distribution of the Central Arctic Herd



Data Source. BLM GIS 2018, Prichard et al. 2018, ABR GIS 2017

Map 3-22

Alternative B:

- Lease stipulation 7—Porcupine Caribou calving habitat, timing limitation, May 20-June 20
- Public Law 115-97 Coastal Plain
- Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority

Percent of years that caribou are present

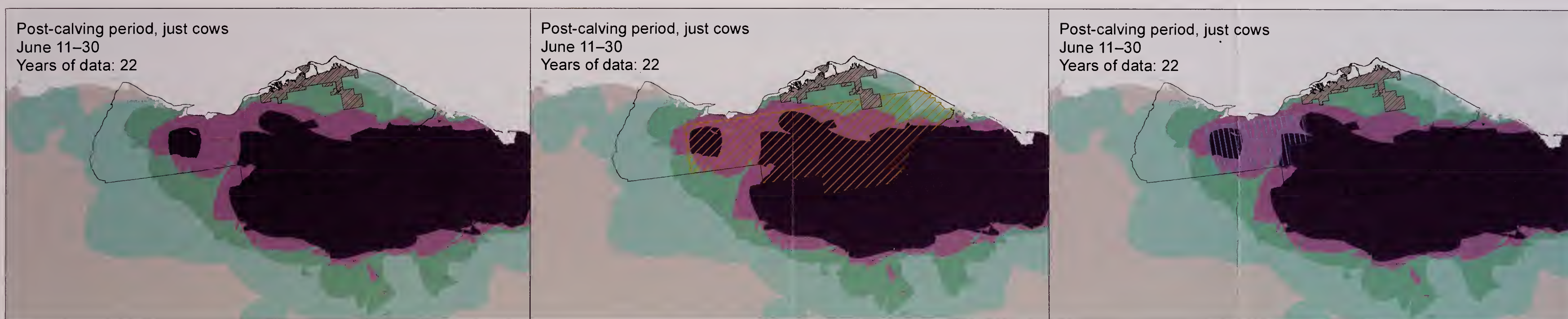
- < 20%
- 20–30%
- 30–40%
- > 40%

Alternative C:

- Lease stipulation 7—Porcupine Caribou calving habitat, not offered for lease sale or no surface occupancy
- Lease stipulation 7—Porcupine Caribou calving habitat, timing limitation, May 20-June 20

Alternatives D1 and D2:

- Lease stipulation 7—Porcupine Caribou calving habitat, not offered for lease sale
- Lease stipulation 7—Porcupine Caribou calving habitat, no surface occupancy



Alternative B:

Lease stipulation 8—Porcupine Caribou post-calving habitat, required operating procedure 23

Alternative C:

- Lease stipulation 8—Porcupine Caribou post-calving habitat, timing limitation, June 15-July 20

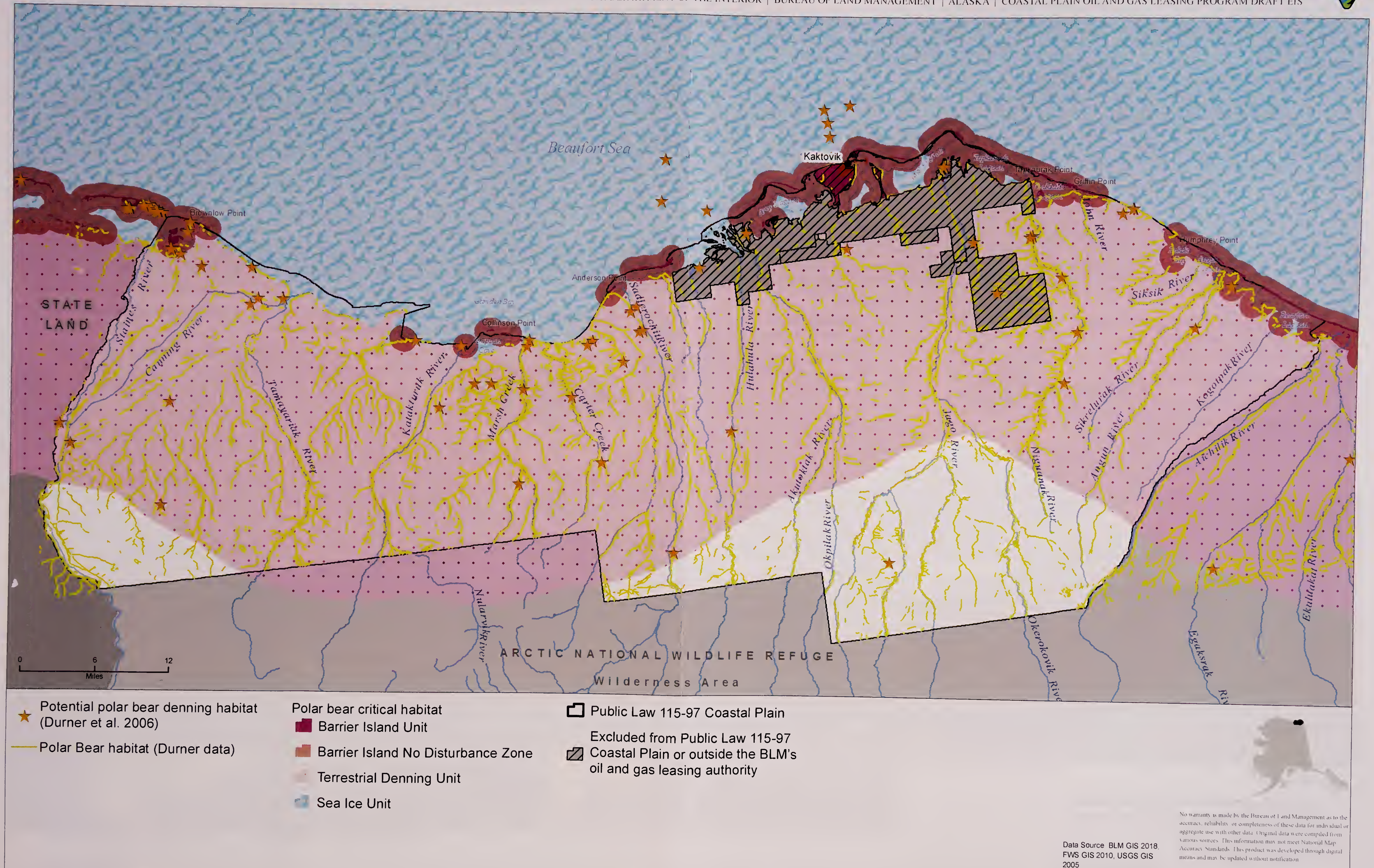
Alternatives D 1 and D2

- Lease stipulation 8—Porcupine Caribou post-calving habitat, controlled surface use and timing limitation, June 15-July 20

Data Source. BLM GIS 2018, Yukon Environmental GIS 2018, Print Date 10/15/2018

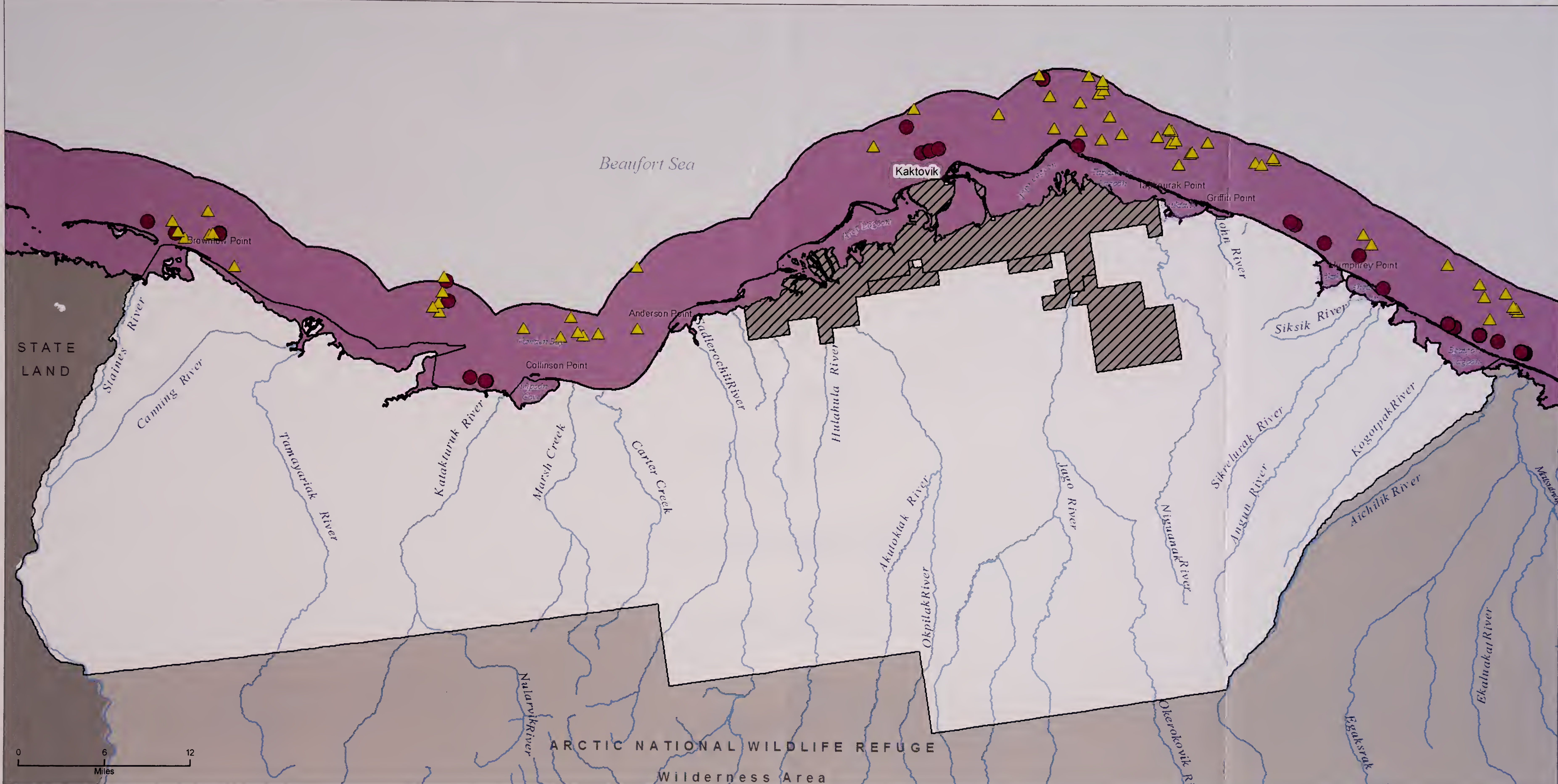
Map 3-23

Polar Bear Habitat



Map 3-24

Bowhead and Beluga Whale Sightings



Bowhead whale sighting (2012–2016)

Beluga whale sighting (2012–2016)

5-mile coastal buffer

Public Law 115-97 Coastal Plain

Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority

Data Source: BLM GIS 2018, ASAMM GIS 2016
Print Date: 10/15/2018

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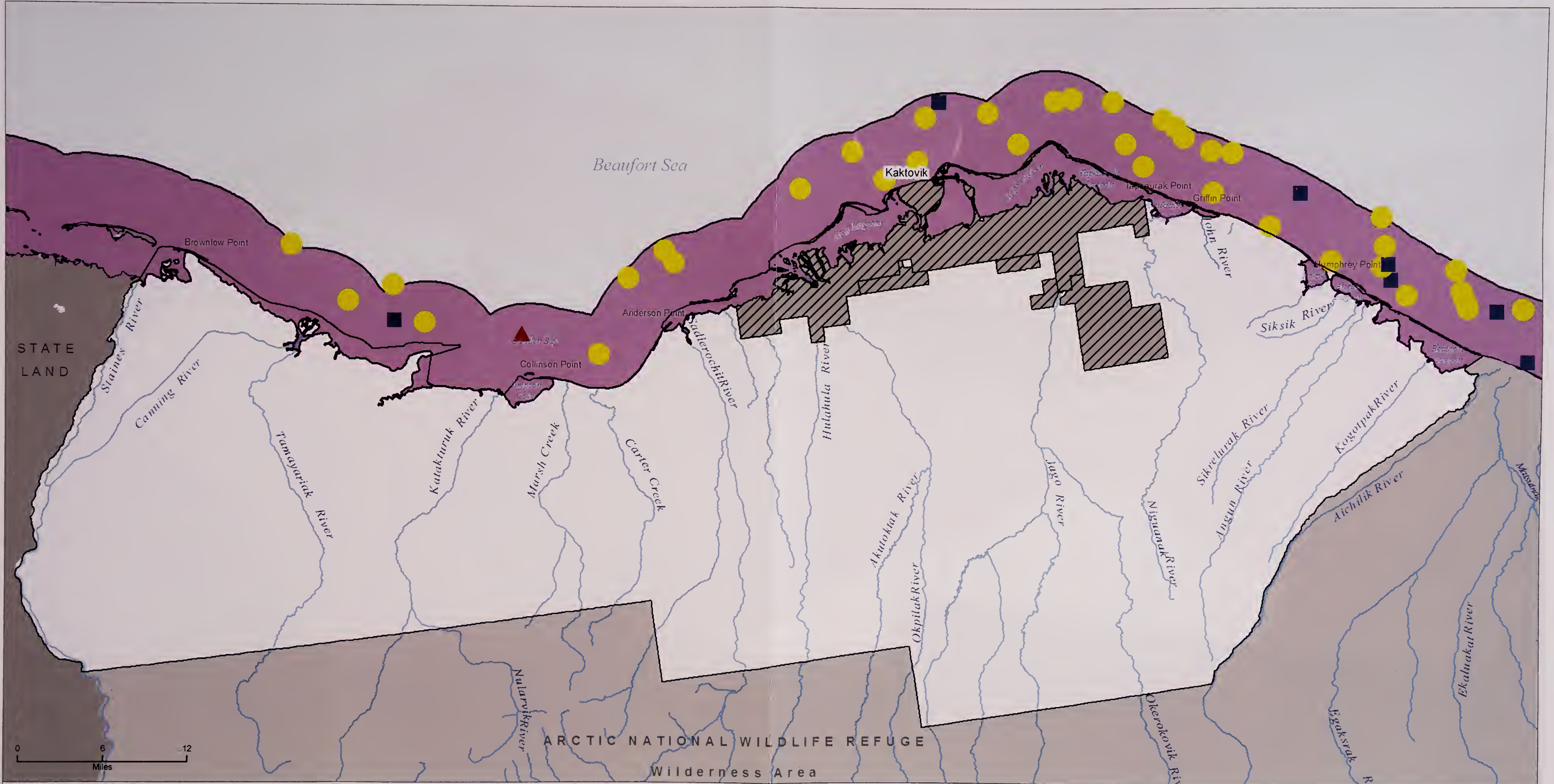
Map 3-25



Bearded seal
Small unidentified pinniped
Unidentified pinniped
5-mile coastal buffer
Public Law 115-97 Coastal Plain
Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority

Data Source: BLM GIS 2018, ASAMM GIS 2016
Print Date: 10/15/2018

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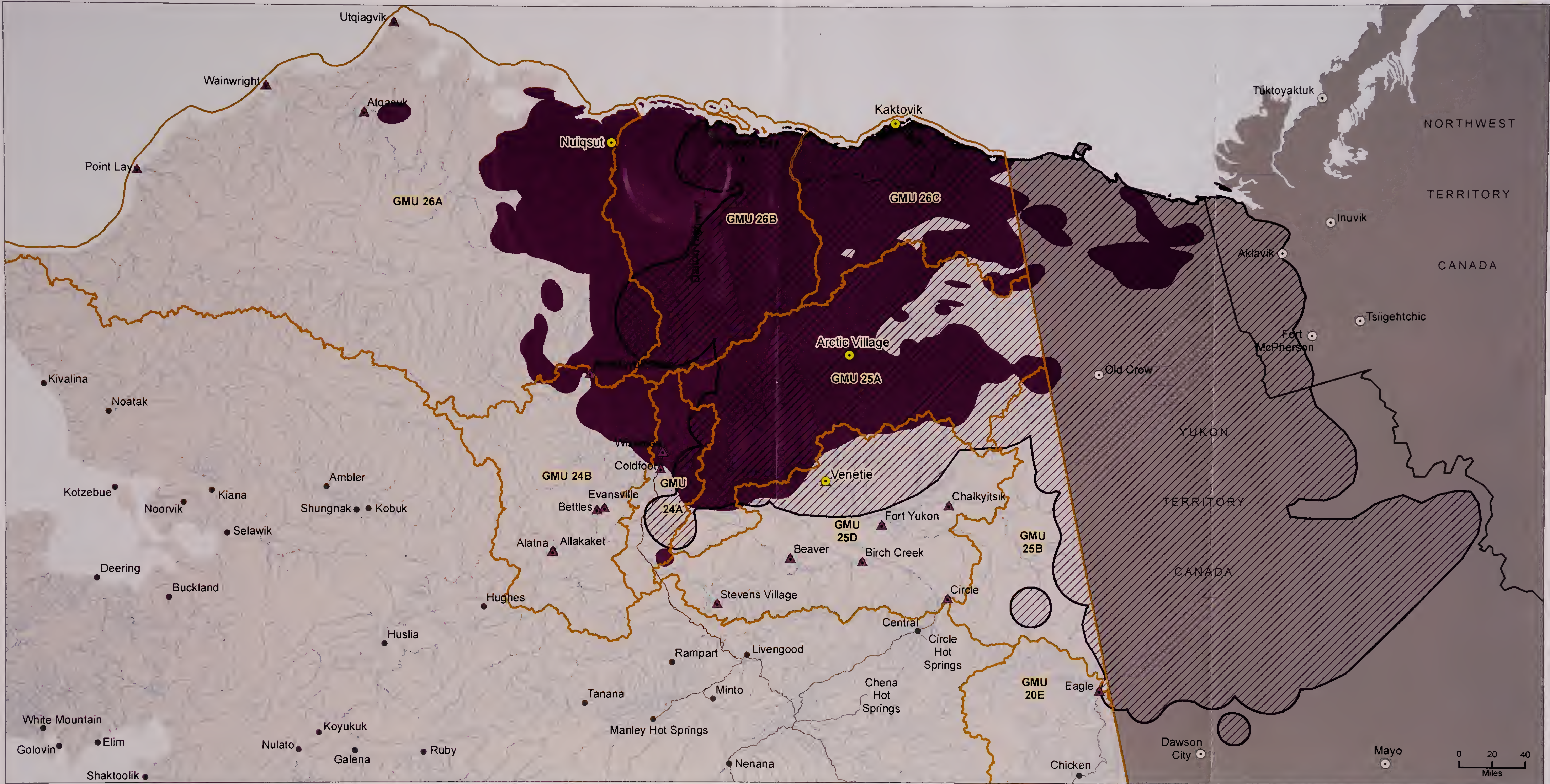
Map 3-26

Coastal Plain EIS Subsistence Study Communities



- Subsistence study community
- Canadian study community
- Caribou study community
- Other community
- Game management unit (Alaska Department of Fish and Game)
- Central Arctic Herd range
- Porcupine Herd range
- Public Law 115-97 Coastal Plain
- Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority

Data Source. BLM GIS 2018

Map prepared by: Stephen R Braund & Associates
Print Date 09/26/2018

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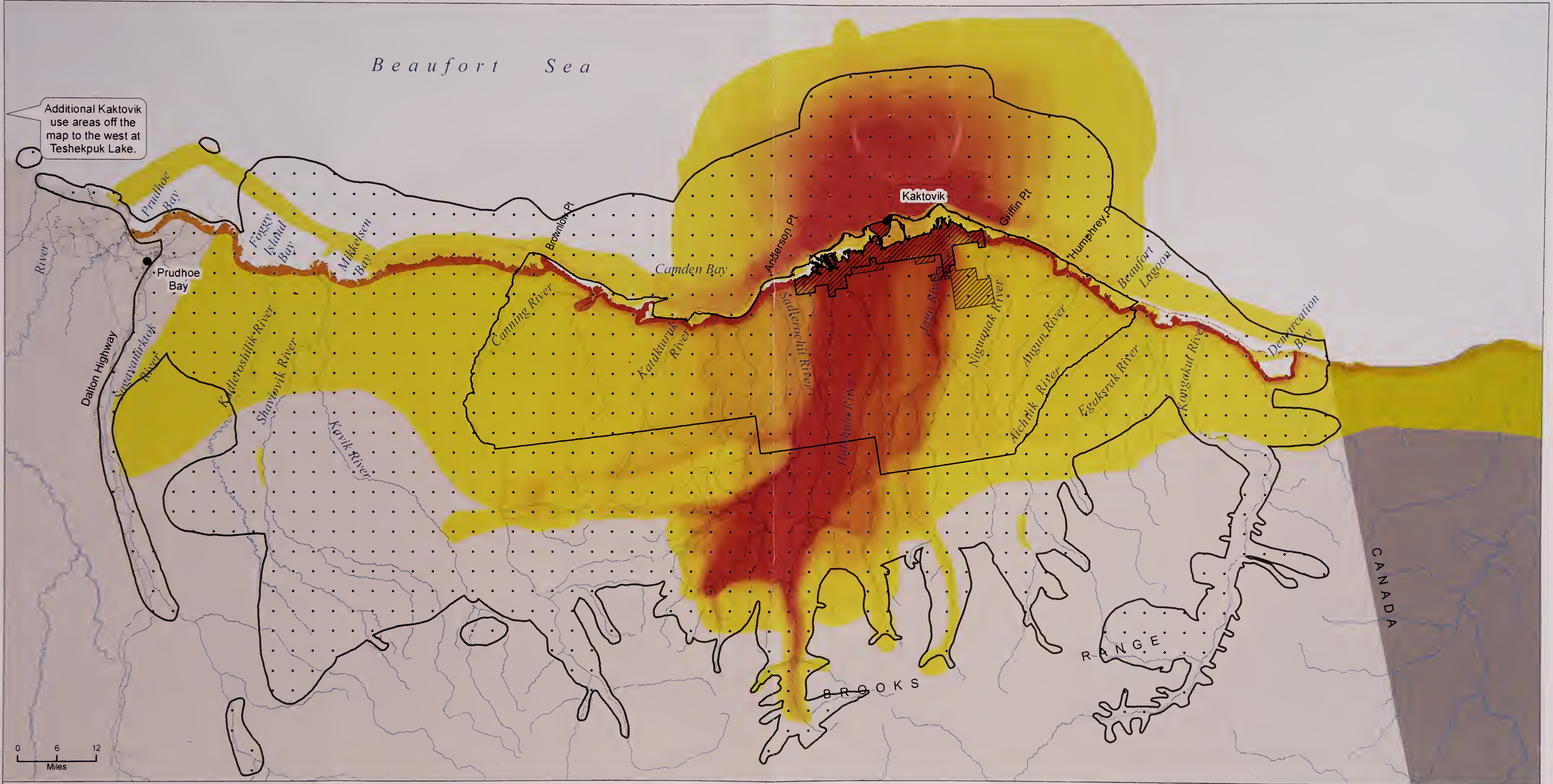
Map 3-27

Kaktovik Subsistence Use Areas

U.S. DEPARTMENT OF THE INTERIOR | BUREAU OF LAND MANAGEMENT | ALASKA | COASTAL PLAIN OIL AND GAS LEASING PROGRAM DRAFT EIS



All resources, lifetime prior to 1979 [1]

Overlapping [2] subsistence use areas all resources, 1996–2006 (High / Low)

Public Law 115-97 Coastal Plain

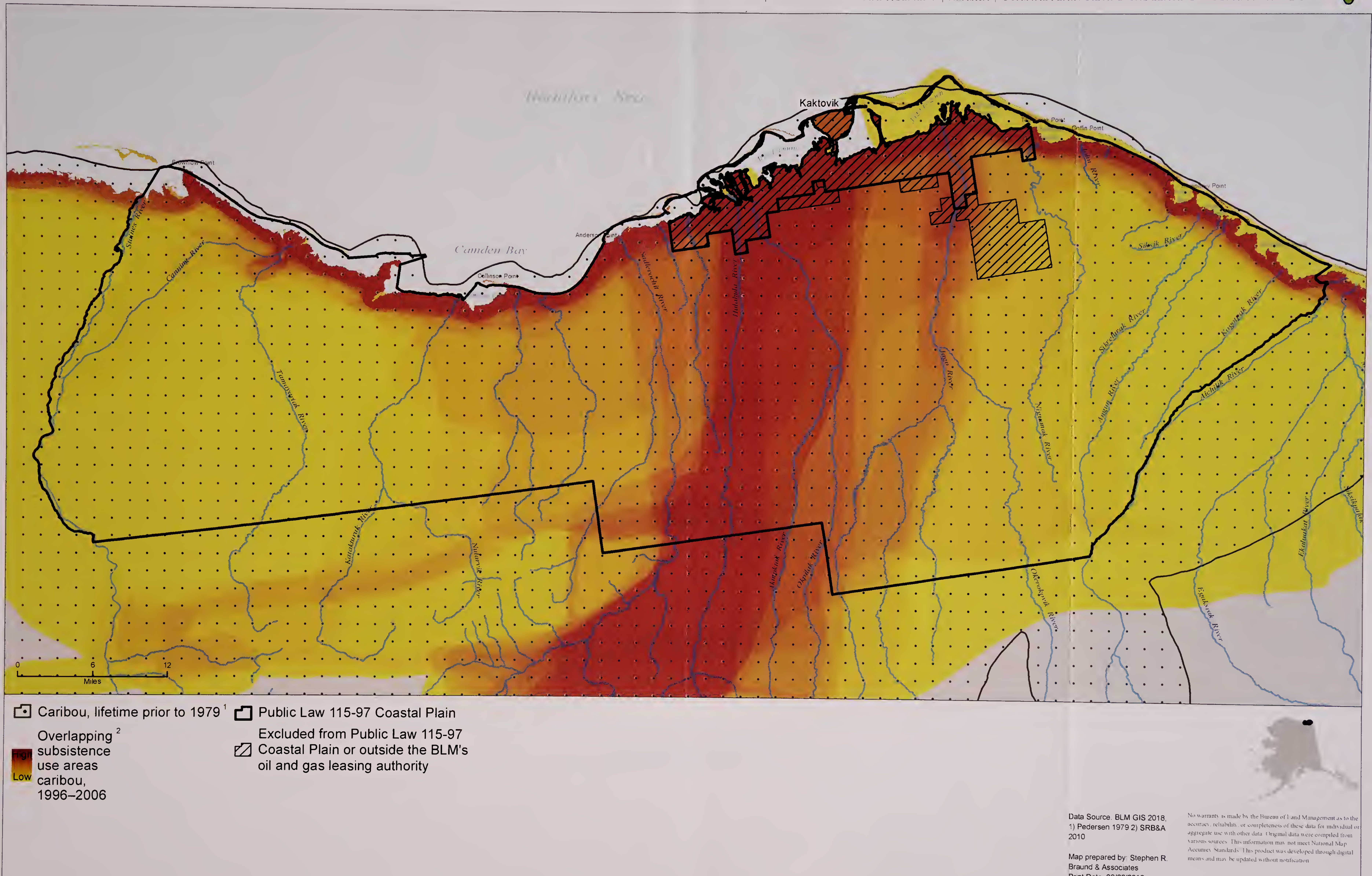
Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority

Data Source. BLM GIS 2018, 1) Pedersen 1979 2) SRB&A 2010

Map prepared by Stephen R Braund & Associates
Print Date. 09/06/2018

Map 3-28

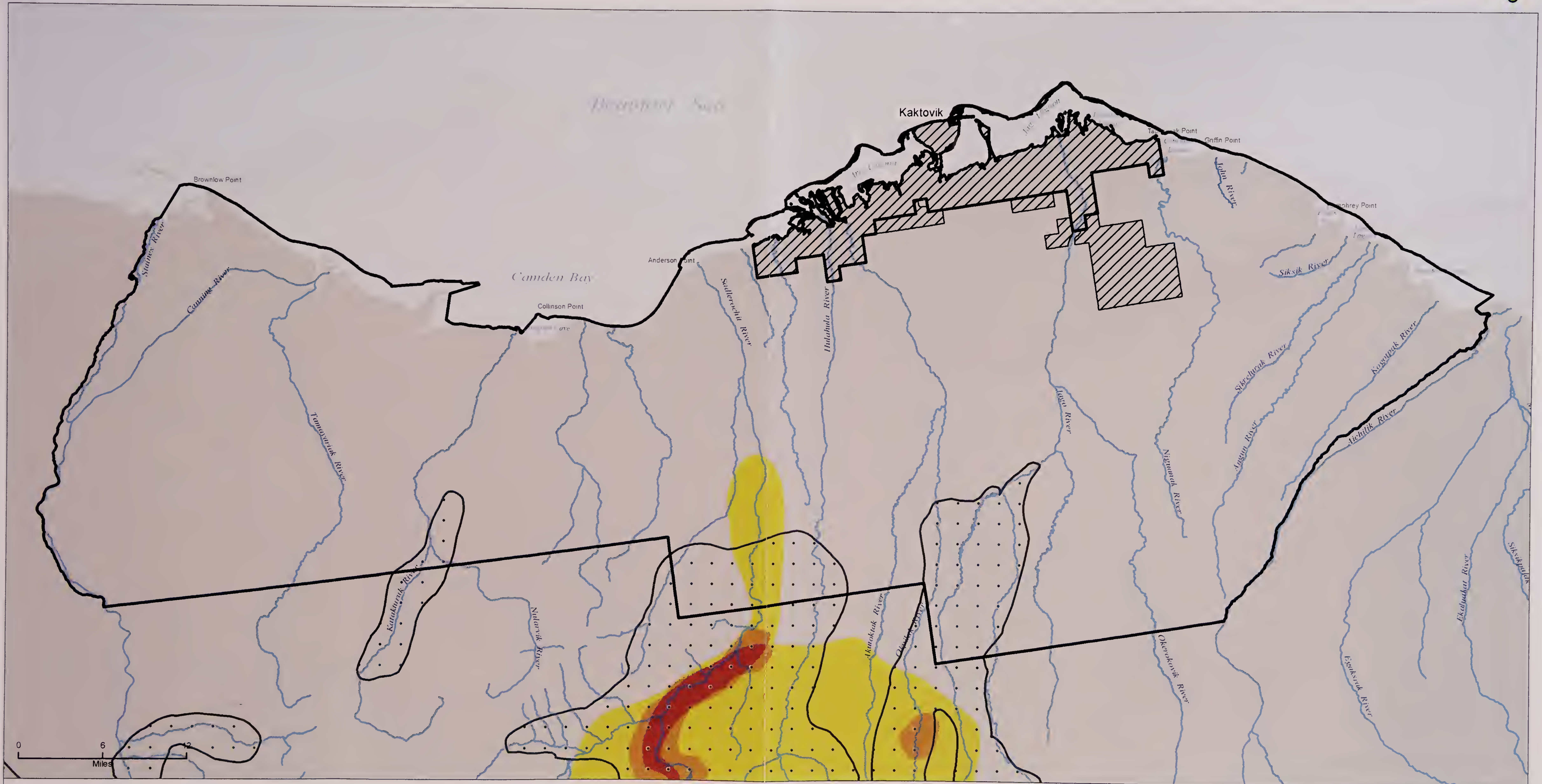
Kaktovik Caribou Subsistence Use Areas in Coastal Plain



Map 3-29

Kaktovik Moose Subsistence Use Areas in Coastal Plain

U.S. DEPARTMENT OF THE INTERIOR | BUREAU OF LAND MANAGEMENT | ALASKA | COASTAL PLAIN OIL AND GAS LEASING PROGRAM DRAFT EIS



Moose, lifetime prior to 1979 [1]

Overlapping subsistence use areas moose, 1996–2006 [2]

High

Low

Public Law 115-97 Coastal Plain

Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority

Data Source: BLM GIS 2018, 1) Pedersen 1979 2) SRB&A 2010

Map prepared by: Stephen R Braund & Associates
Print Date: 09/06/2018

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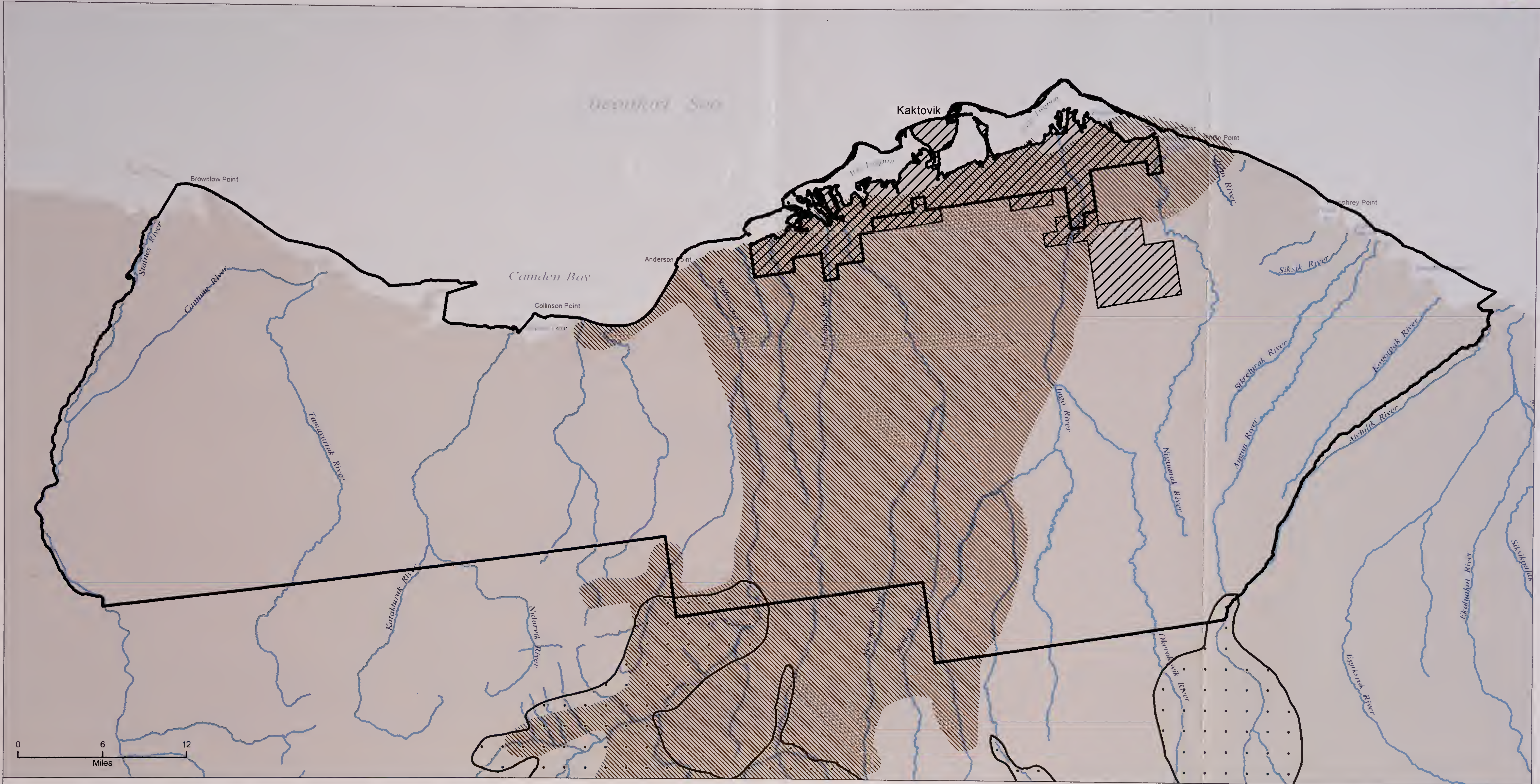
Map 3-30

Kaktovik Grizzly and Sheep Subsistence Use Areas in Coastal Plain

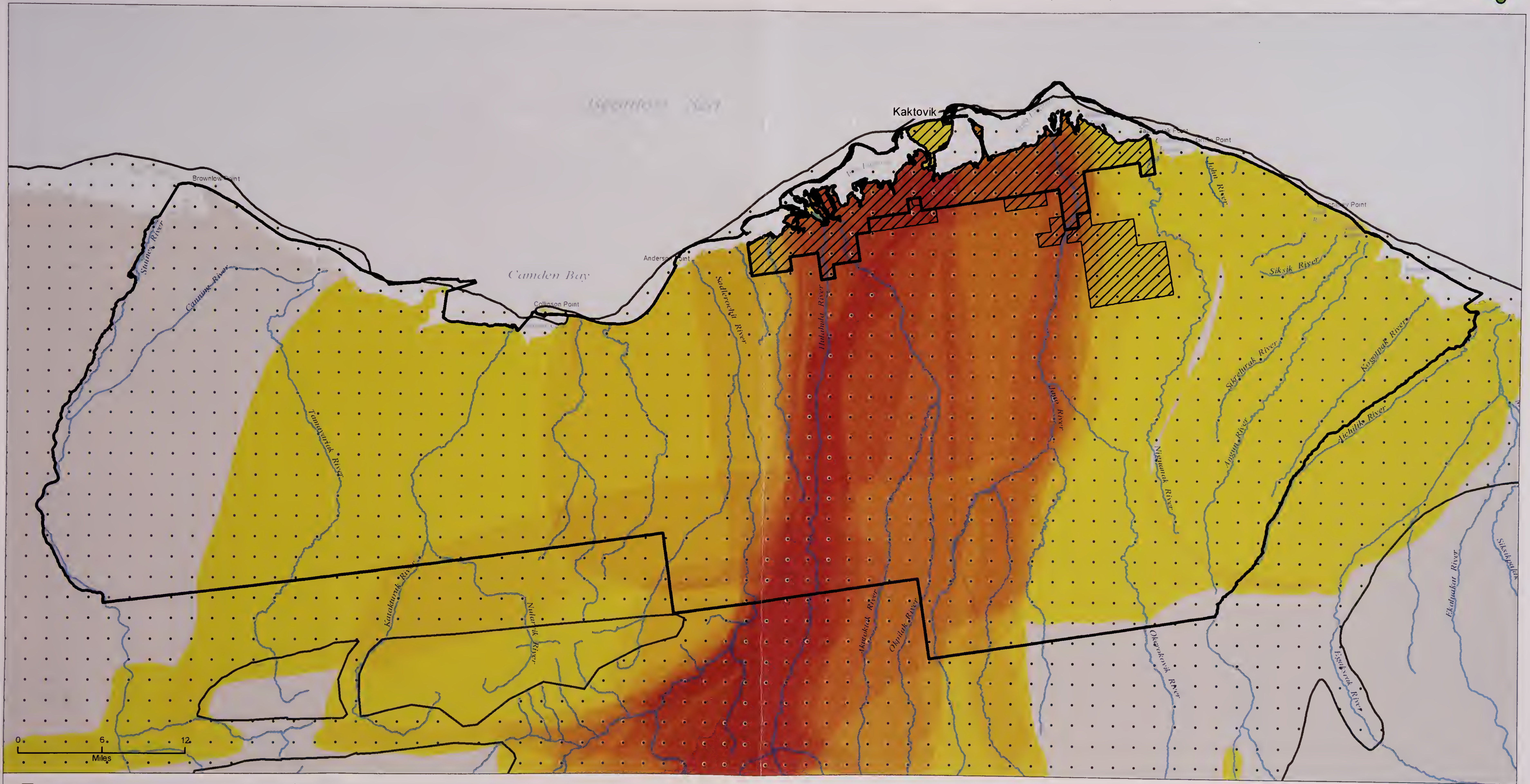


Sheep, lifetime prior to 1979[1]
Grizzly, lifetime prior to 1979[1]
Public Law 115-97 Coastal Plain
Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority

Data Source: BLM GIS 2018,
1) Pedersen 1979

Map prepared by: Stephen R Braund & Associates
Print Date: 09/06/2018

Map 3-31



Furbearer Hunting, Circa 1923-1983[1]

Overlapping[2] subsistence use areas wolf and wolverine, 1996–2006

High

Low

Public Law 115-97 Coastal Plain

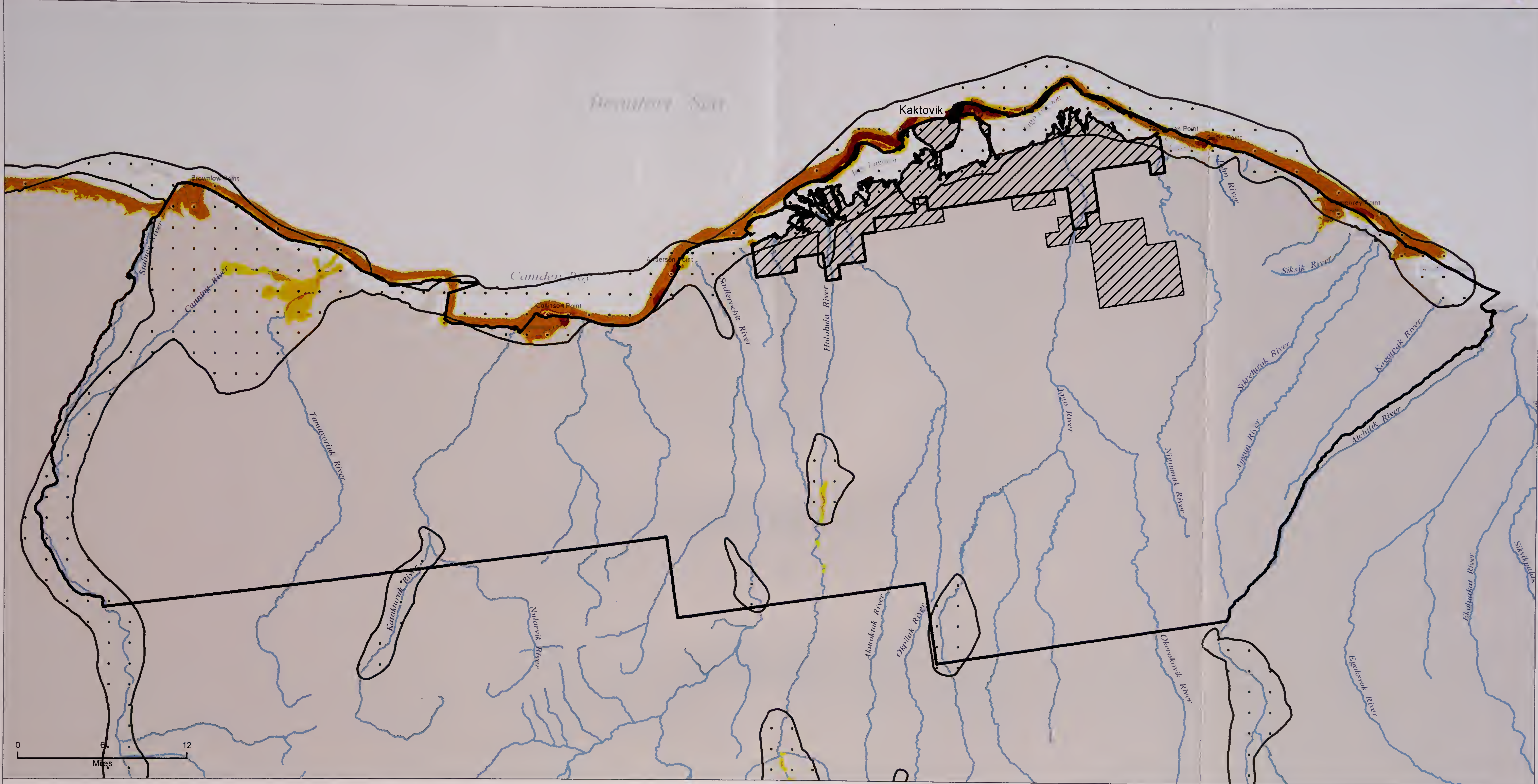
Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority

Data Source. BLM GIS 2018, 1) Pedersen, Coffing and Thompson 1985 2) SRB&A 2010

Map prepared by: Stephen R. Braund & Associates
Print Date 09/06/2018

Map 3-32

Kaktovik Fish Subsistence Use Areas in Coastal Plain



Fishing, lifetime prior to 1979[1]

Overlapping[2] subsistence use areas fish, 1996–2006

High

Low

Public Law 115-97 Coastal Plain

Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority

Data Source: BLM GIS 2018, 1) Pedersen 1979 2) SRB&A 2010

Map prepared by: Stephen R Braund & Associates
Print Date: 09/06/2018

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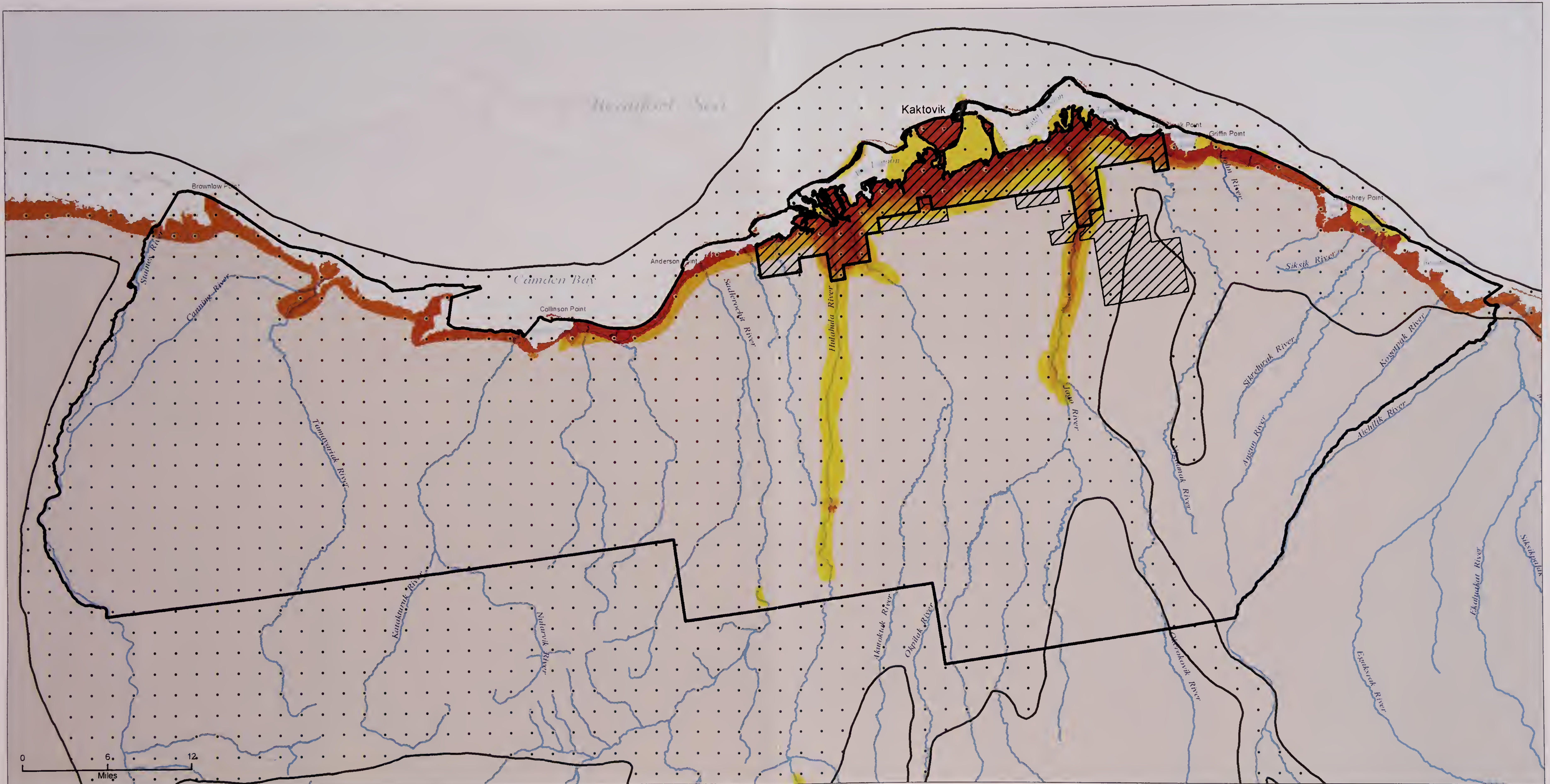
Map 3-33



Wildfowl, lifetime prior to 1979[1]

Overlapping[2] subsistence use areas eider and goose, 1996–2006

High

Low

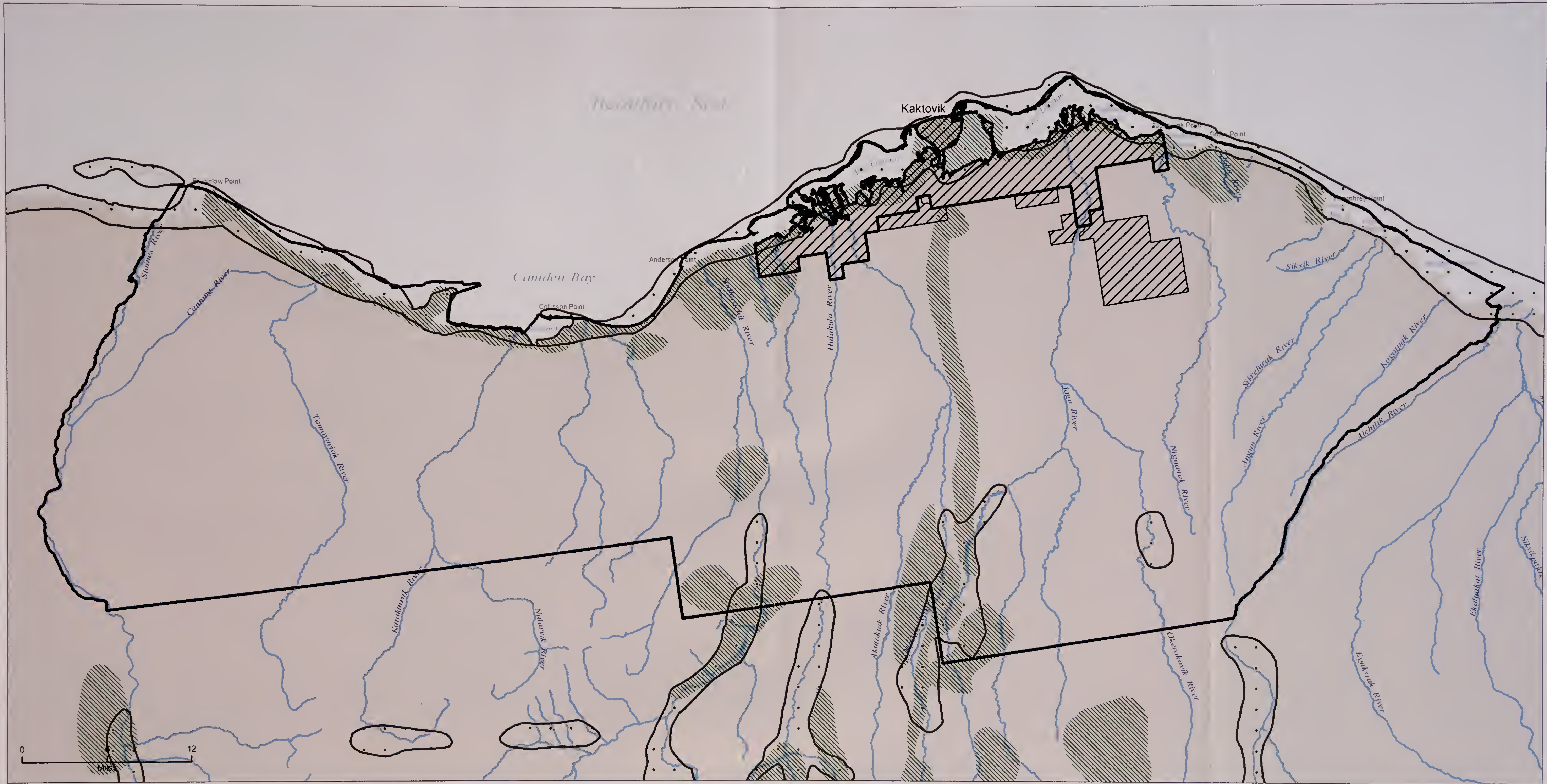
Public Law 115-97 Coastal Plain

Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority

Data Source BLM GIS 2018, 1) Pedersen 1979 2) SRB&A 2010

Map prepared by: Stephen R Braund & Associates
Print Date: 09/06/2018

Map 3-34



Vegetation, lifetime prior to 1979[1]

Wood, lifetime prior to 1979[1]

Public Law 115-97 Coastal Plain

Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority

Data Source. BLM GIS 2018,
1) Pedersen 1979

Map prepared by: Stephen R. Braund & Associates
Print Date. 09/06/2018

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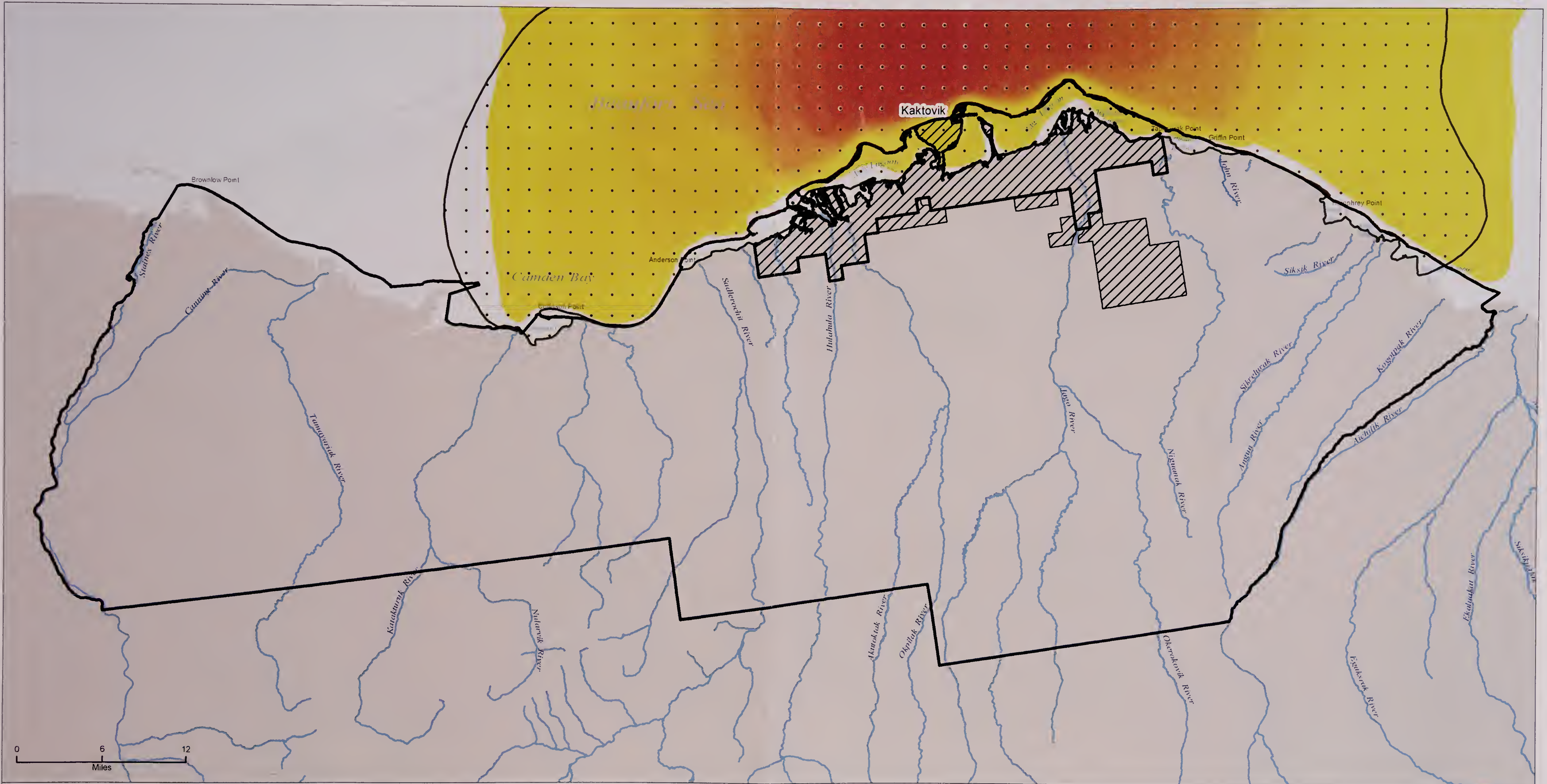
Map 3-35

Kaktovik Whale Subsistence Use Areas in Coastal Plain



Whale, lifetime prior to 1979 [1]

Overlapping [2] subsistence use areas bowhead, 1996–2006

High

Low

Public Law 115-97 Coastal Plain

Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority

Data Source BLM GIS 2018, 1) Pedersen 1979 2) SRB&A 2010

Map prepared by: Stephen R. Braund & Associates
Print Date 09/06/2018

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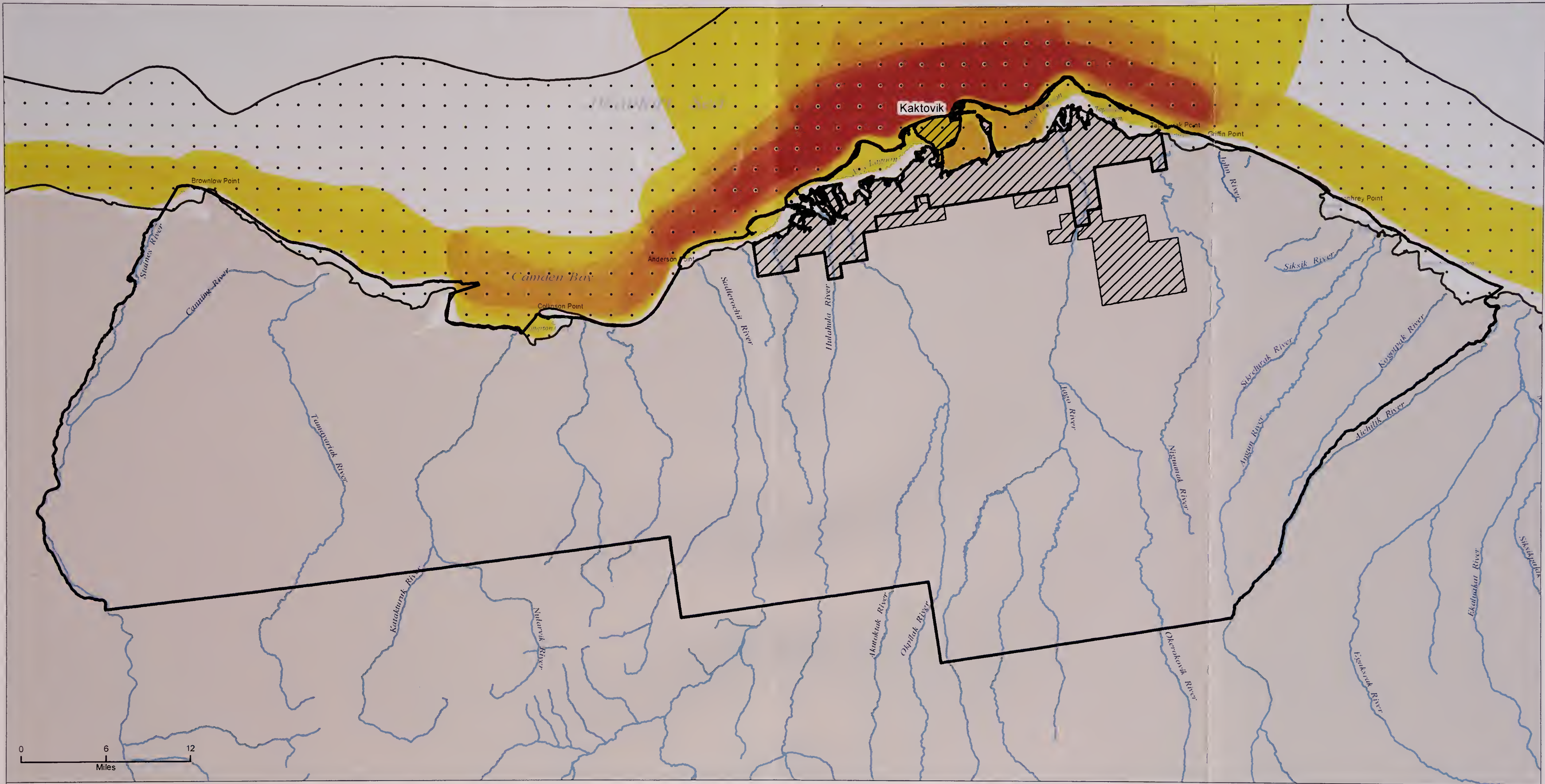
Map 3-36

Kaktovik Seal Subsistence Use Areas in Coastal Plain



Seal, lifetime prior to 1979[1]

Overlapping[2] subsistence use areas seal, 1996–2006 (High – Low)

Public Law 115-97 Coastal Plain

Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority

Data Source BLM GIS 2018, 1) Pedersen 1979 2) SRB&A 2010

Map prepared by: Stephen R. Braund & Associates
Print Date 09/06/2018

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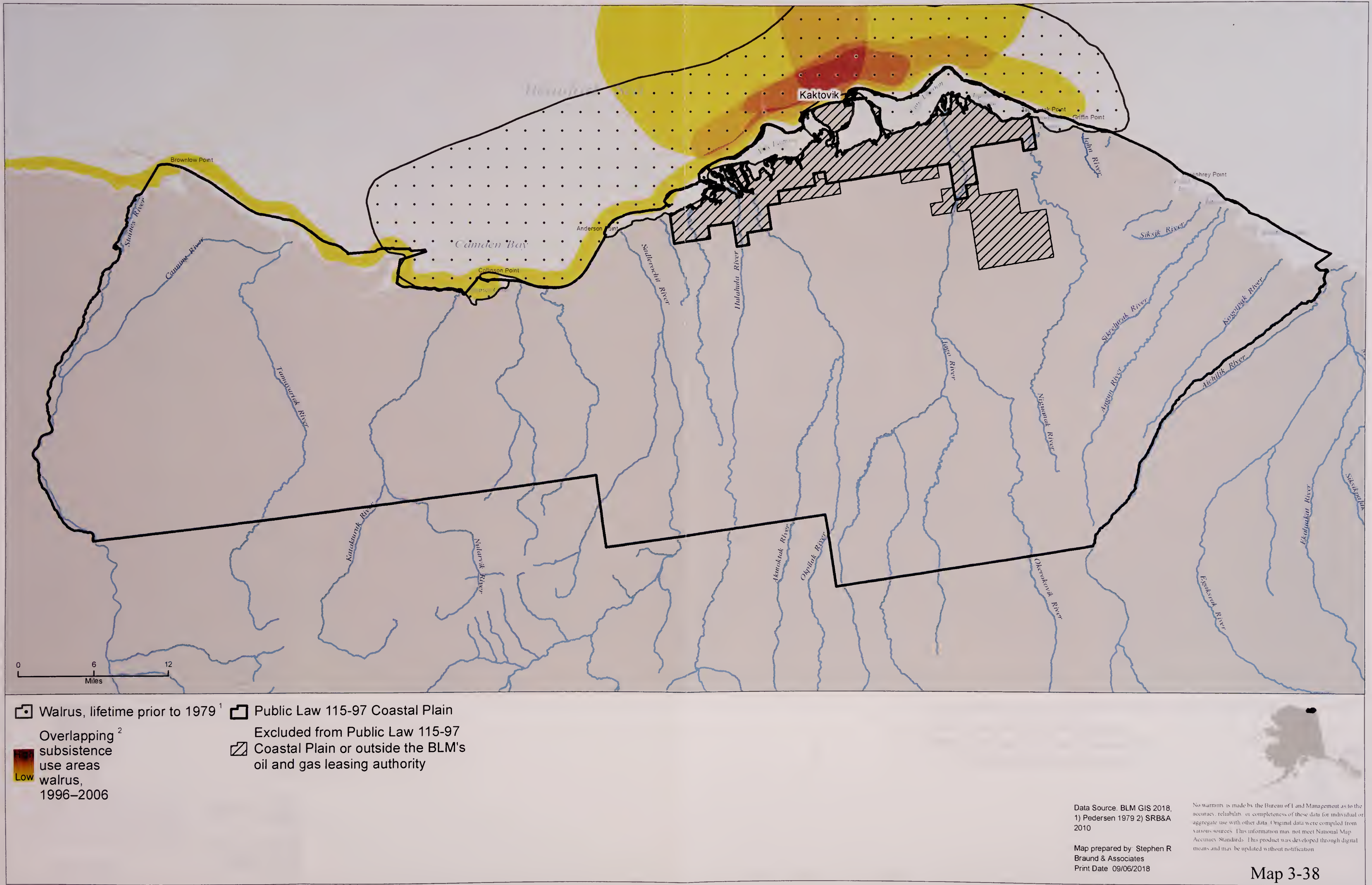
Map 3-37

Kaktovik Walrus Subsistence Use Areas in Coastal Plain



Map 3-38

Kaktovik Polar Bear Subsistence Use Areas in Coastal Plain

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Polar bear, lifetime prior to 1979 [1]

Public Law 115-97 Coastal Plain

Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority

Data Source: BLM GIS 2018, [1]) Pedersen 1979

Map prepared by: Stephen R Braund & Associates
Print Date 09/06/2018

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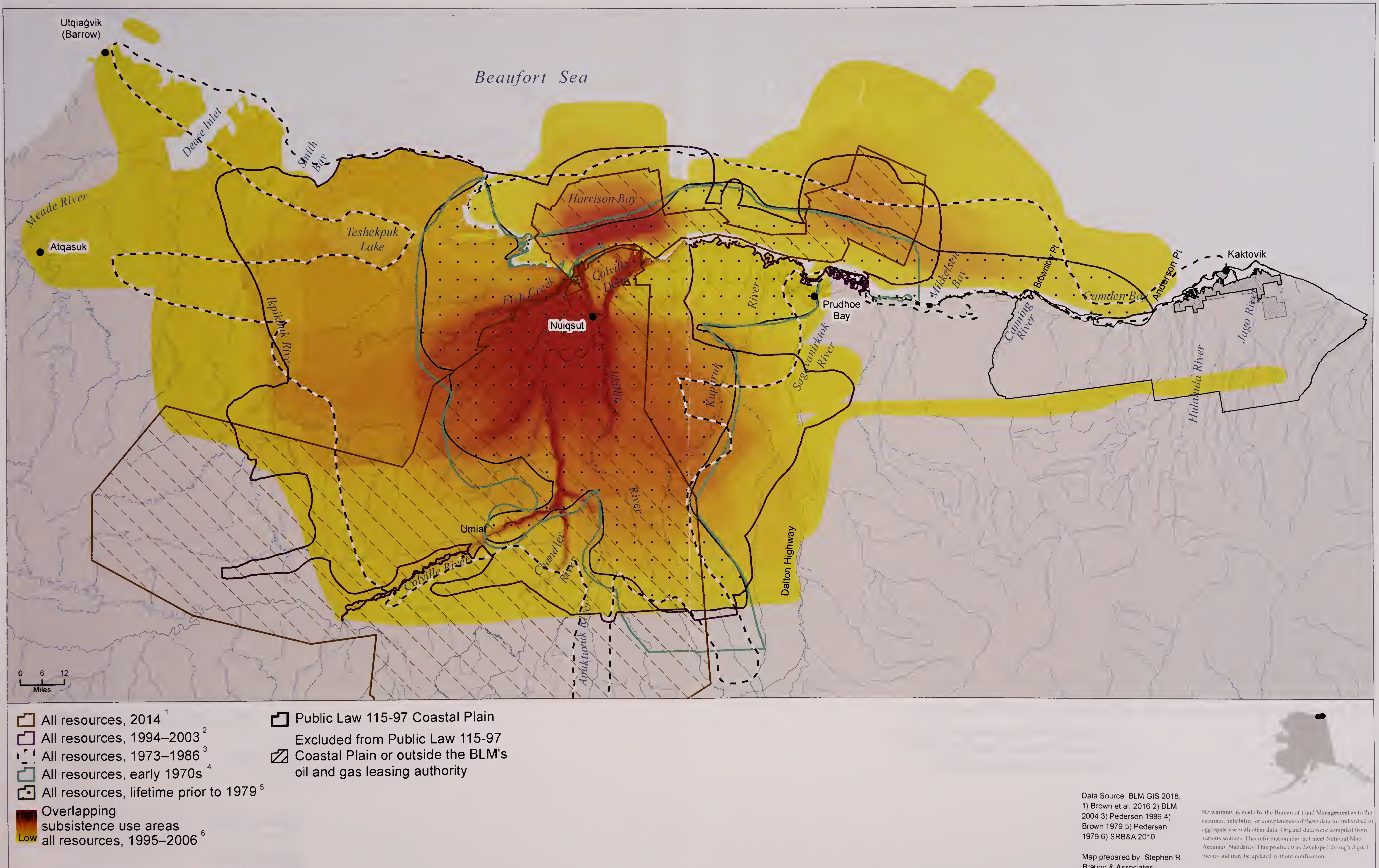
Map 3-39


Utqiagvik (Barrow)
Beaufort Sea
Dease Inlet
Smith Bay
Meade River
Atqasuk
Teshekpuk Lake
Harrison Bay
Ikpikpuk River
Fish Creek
Colville Delta
Nuiqsut
Itkillik
Kuparuk
River
River
Prudhoe Bay
Sagavanirktok River
Mikkelsen Bay
Brownlow Pt
Camden Bay
Anderson Pt
Kaktovik
Canning River
Hulahula River
Jago River
Dalton Highway
Umiat
Colville River
Chandler River
Anaktuvuk River
0 6 12
Miles
All resources, 2014 1
All resources, 1994–2003 2
All resources, 1973–1986 3
All resources, early 1970s 4
All resources, lifetime prior to 1979 5
Overlapping subsistence use areas all resources, 1995–2006 6
High
Low
Public Law 115-97 Coastal Plain
Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority
Data Source: BLM GIS 2018, 1) Brown et al. 2016 2) BLM 2004 3) Pedersen 1986 4) Brown 1979 5) Pedersen 1979 6) SRB&A 2010
Map prepared by Stephen R. Braund & Associates
Print Date. 09/06/2018
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Map 3-40

Nuiqsut Whales Subsistence Use Areas in Coastal Plain

U.S. DEPARTMENT OF THE INTERIOR | BUREAU OF LAND MANAGEMENT | ALASKA | COASTAL PLAIN OIL AND GAS LEASING PROGRAM DRAFT EIS

Whaling, 1973–1986[1]

Whales, lifetime prior to 1979[2]

Overlapping[3] subsistence use areas bowhead, 1995–2006 (High – Low)

Public Law 115-97 Coastal Plain

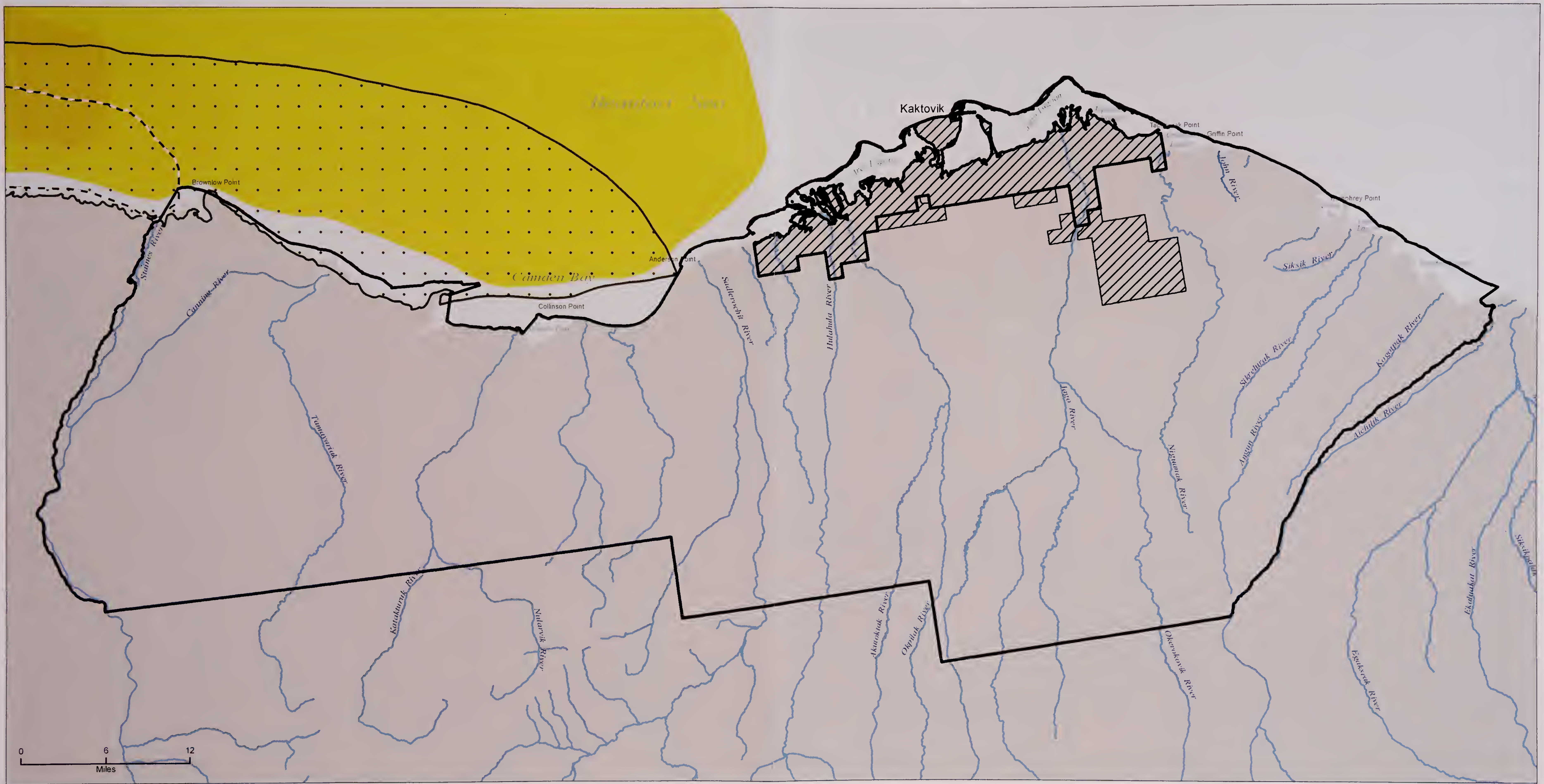
Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority

Data Source: BLM GIS 2018, 1) Pedersen 1986 2) Pedersen 1979 3) SRB&A 2010

Map prepared by: Stephen R. Braund & Associates
Print Date: 09/06/2018

Map 3-41

Nuiqsut Seal Subsistence Use Areas in Coastal Plain



Seal, 1973–1986[1]

Seal, lifetime prior to 1979[2]

Overlapping[3] subsistence use areas seal, 1995–2006

High

Low

Public Law 115-97 Coastal Plain

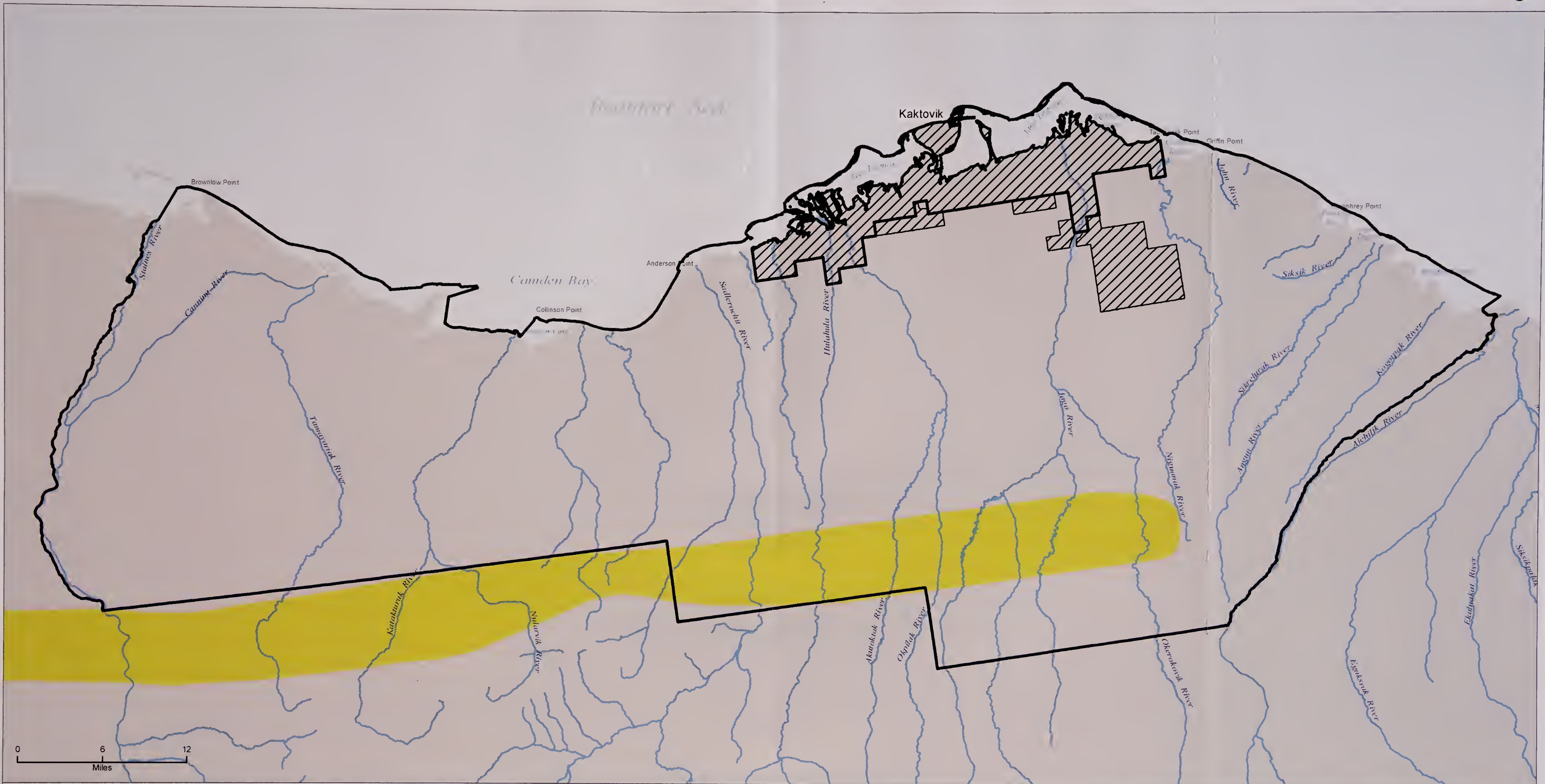
Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority

Data Source. BLM GIS 2018, 1) Pedersen 1986 2) Pedersen 1979 3) SRB&A 2010

Map prepared by: Stephen R. Braund & Associates
Print Date 09/06/2018

Map 3-42

Nuiqsut Wolf and Wolverine Subsistence Use Areas in Coastal Plain



Overlapping subsistence use areas wolf and wolverine, 1995–2006[1]

High

Low

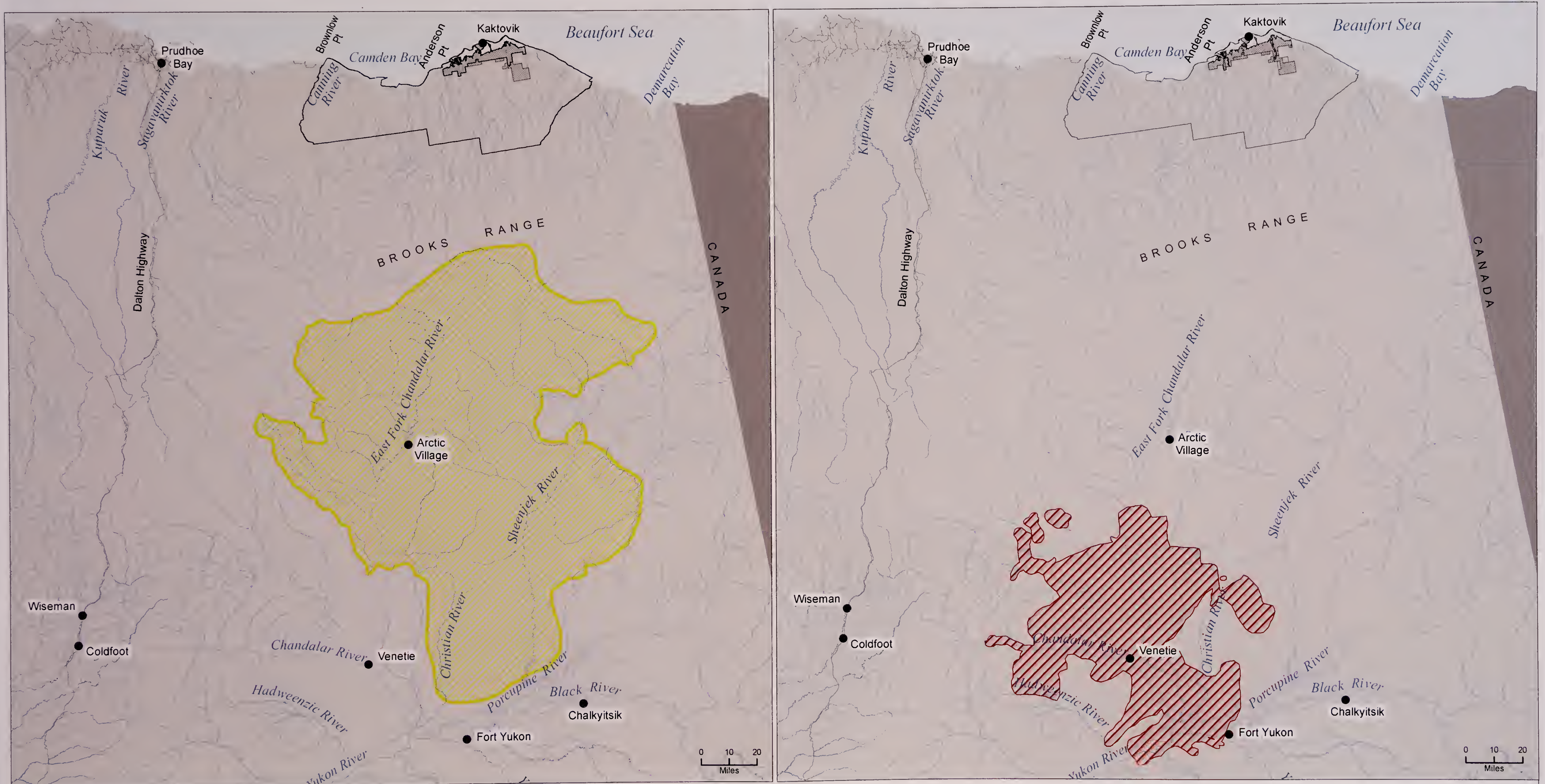
Public Law 115-97 Coastal Plain

Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority

Data Source. BLM GIS 2018, 1) SRB&A 2010

Map prepared by: Stephen R. Braund & Associates
Print Date: 09/06/2018

Map 3-43



Arctic Village, all resources, lifetime prior to 1980 [1]
Venetie, all resources, lifetime prior to 1981 [1]
Public Law 115-97 Coastal Plain
Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority

Data Source. BLM GIS 2018,
1) Caulfield 1983

Map Prepared By: Stephen R Braund & Associates
Print Date. 09/06/2018

Map 3-44

Kaktovik Subsistence Use Areas and Areas of Hydrocarbon Potential

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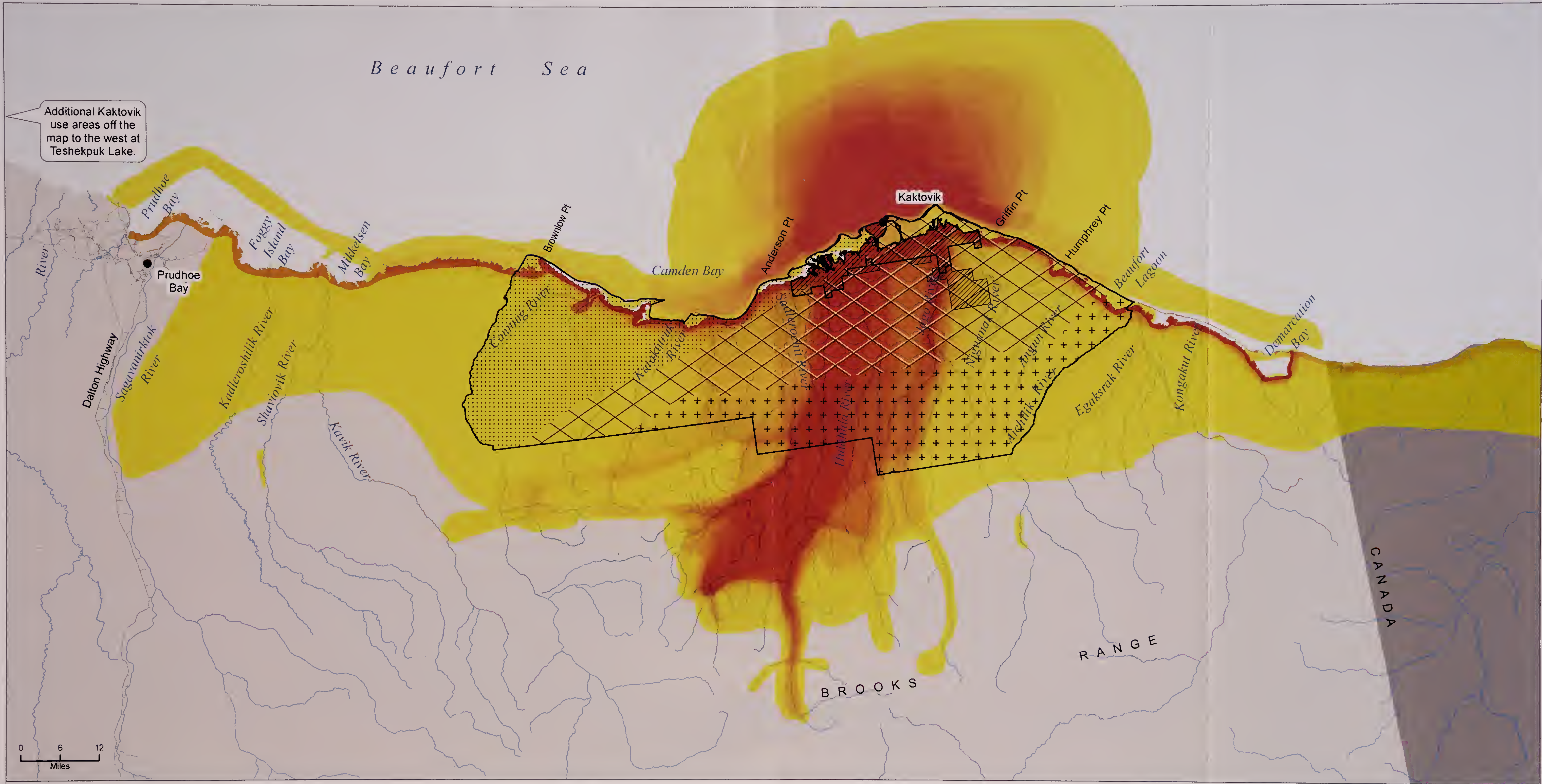

Overlapping[1] subsistence use areas all resources, 1996–2006 (High – Low)

Public Law 115-97 Coastal Plain

Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority

High hydrocarbon potential

Medium hydrocarbon potential

Low hydrocarbon potential

Data Source. BLM GIS 2018,
1) SRB&A 2010

Map prepared by: Stephen R. Braund & Associates
Print Date 09/06/2018

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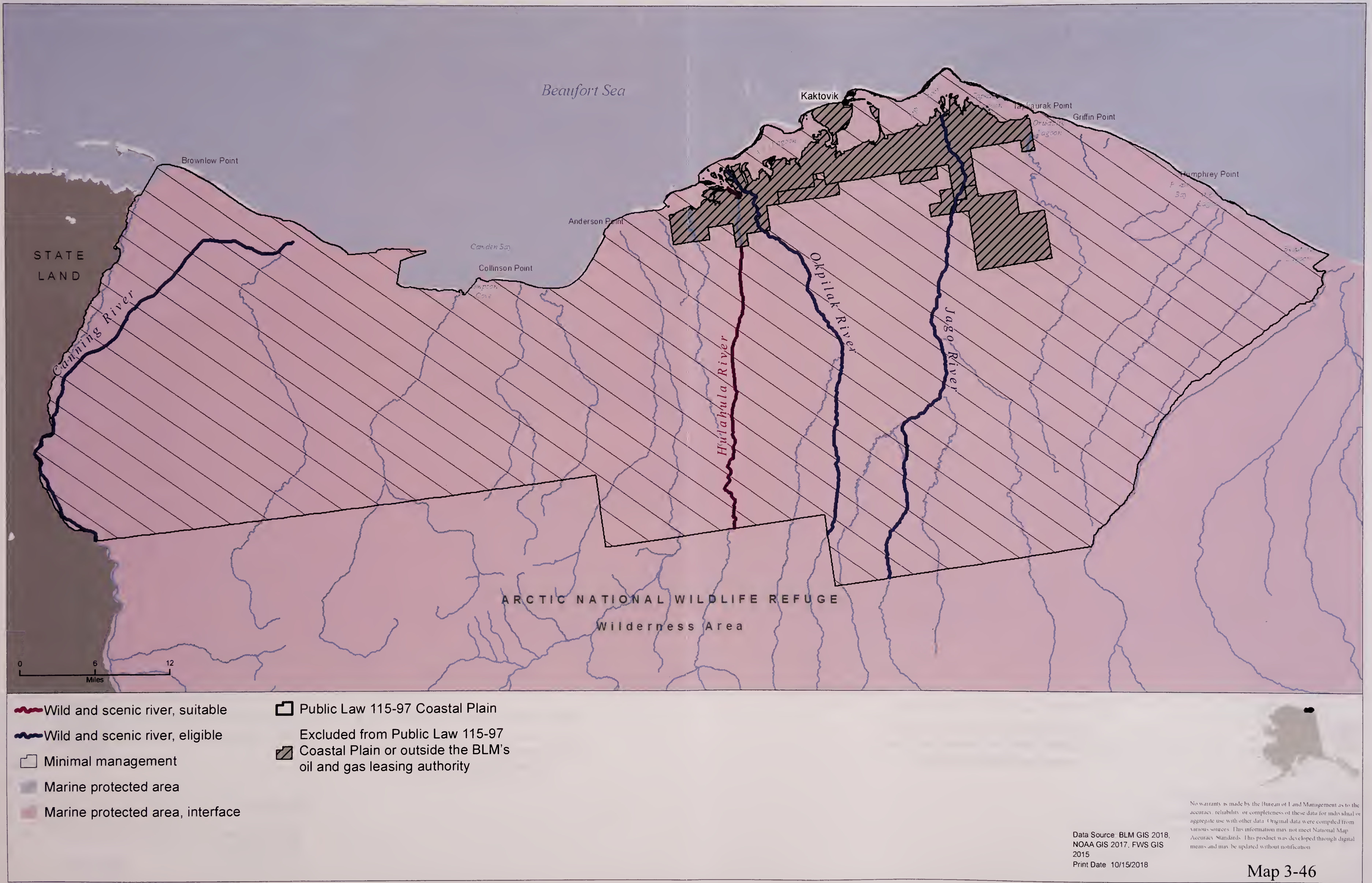
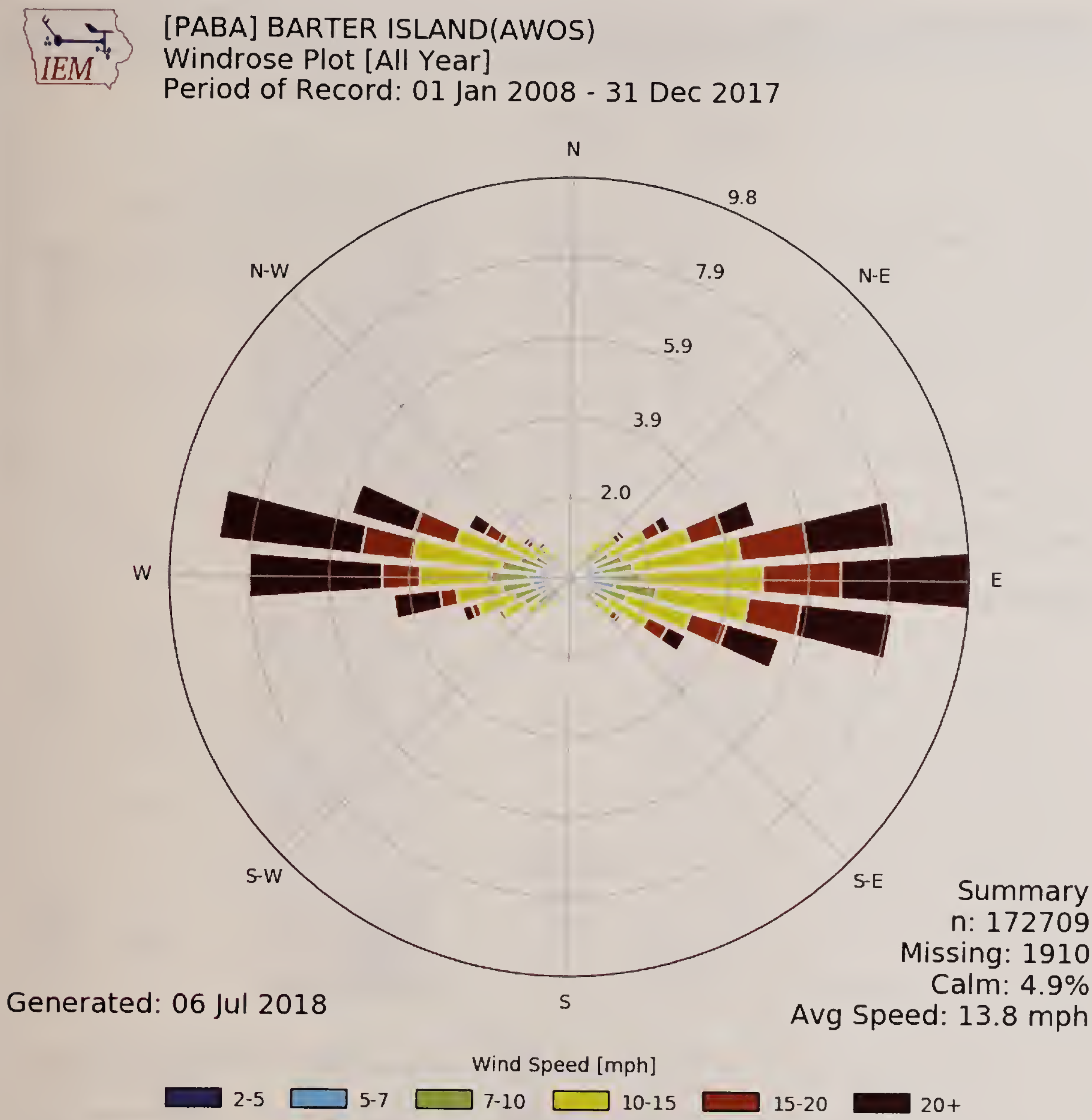
Map 3-45

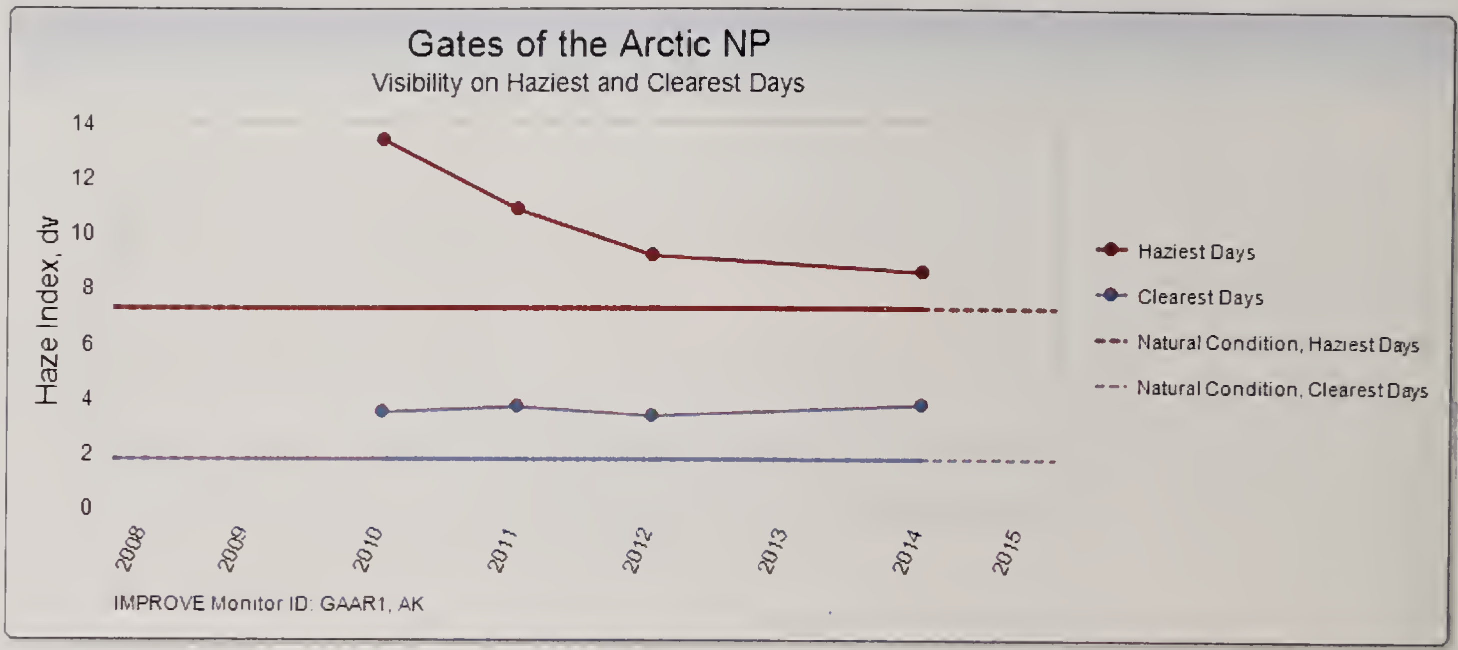

Beaufort Sea
Kaktovik
Tapkaurak Point
Griffin Point
Brownlow Point
Humphrey Point
Anderson Point
Collinson Point
STATE LAND
Canning River
Hulahula River
Okpilak River
Jago River
ARCTIC NATIONAL WILDLIFE REFUGE
Wilderness Area
0
6
12
Miles
Wild and scenic river, suitable
Wild and scenic river, eligible
Minimal management
Marine protected area
Marine protected area, interface
Public Law 115-97 Coastal Plain
Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority
Data Source BLM GIS 2018, NOAA GIS 2017, FWS GIS 2015
Print Date 10/15/2018
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 3-46



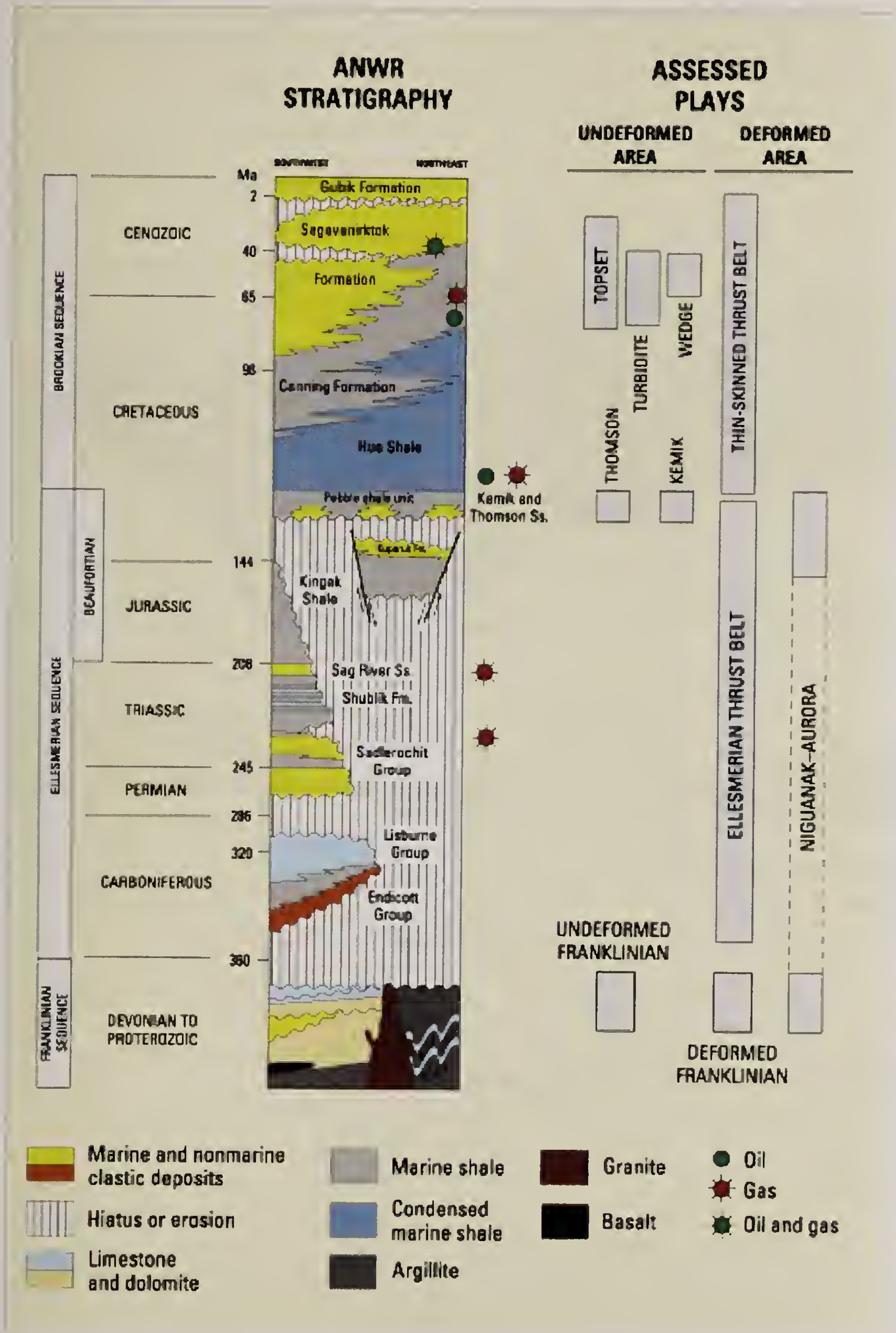
Source: Iowa State University (copyright: used with permission), Iowa Environmental Mesonet (IEM) website: http://mesonet.agron.iastate.edu/

Figure 3-1: Wind Rose Plot for Barter Island, Kaktovik, Alaska



Source: IMPROVE 2018a

Figure 3-2: Visibility Data for Gates of the Arctic National Park

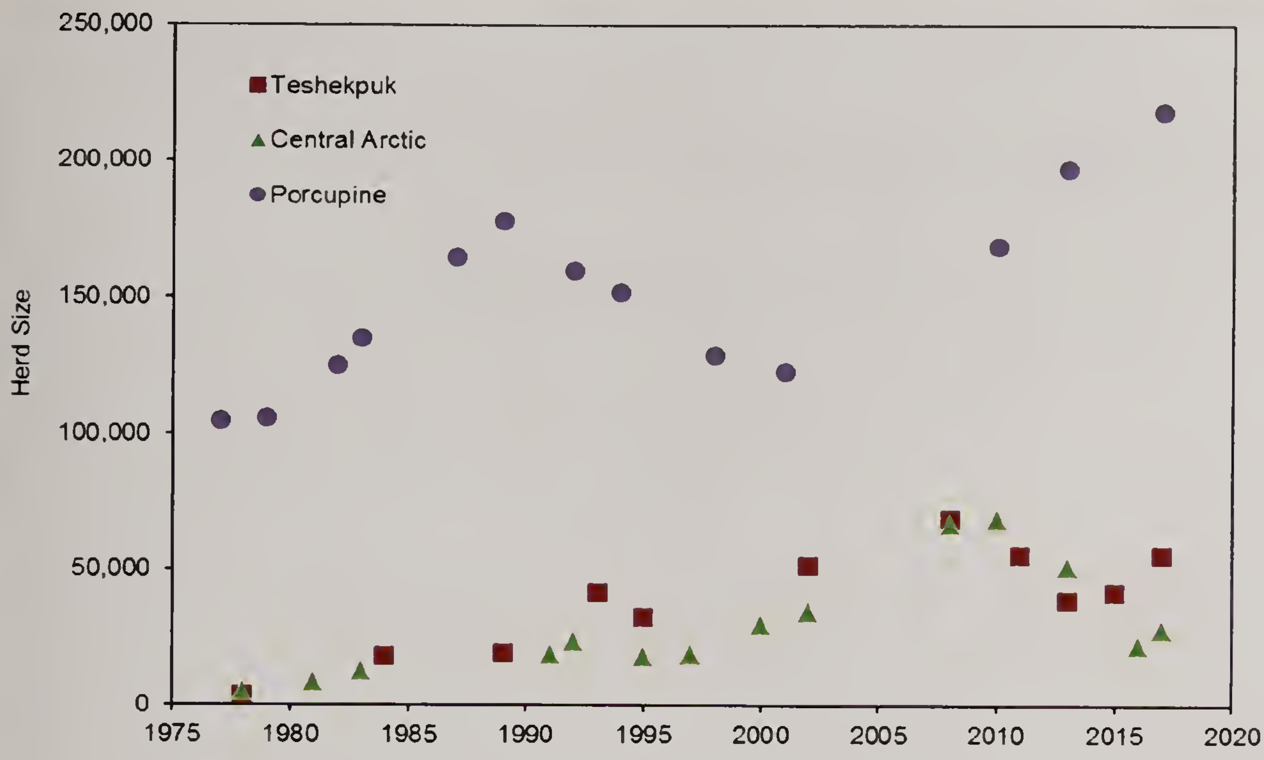


Source: US Geological Survey (USGS 1998b) Fact Sheet 0028-02 Figure 3

Figure 3-3: Stratigraphy of the Coastal Plain

Source: Clough et al. 1987

Figure 3-4: Generalized Surficial Deposits of the Coastal Plain Area



Source: Lenart 2018

Figure 3-5: Population Size of Three Caribou Herds in Arctic Alaska, 1977-2017

Figure 3-9: Visual Resources Photo 2

Typical layout for exploration well with ice pad and ice road (Stoneyhill site in NPR-A).

Appendix B

Reasonably Foreseeable Development Scenario for Oil and Gas Resources in the Public Law 115-97 Coastal Plain, Alaska

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TABLES

FIGURES

MAP

Acronyms and Abbreviations

Acronyms and Abbreviations	Full Phrase
3D	three-dimensional
Arctic Refuge	Arctic National Wildlife Refuge
BBO	billion barrels of oil
CFR	Code of Federal Regulations
Coastal Plain	Public Law 115-97 Coastal Plain
CPF	central processing facility
EIA	Energy Information Administration
EIS	environmental impact statement
Leasing EIS	Coastal Plain Oil and Gas Leasing Program Environmental Impact Statement
NEPA	National Environmental Policy Act
NPR-A	National Petroleum Reserve Alaska
ROD	Record of Decision
TAPS	Trans-Alaska Pipeline System
TCF	trillion cubic feet
USGS	United States Geological Survey
VSM	vertical support member

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Appendix B. Reasonably Foreseeable Development Scenario for Oil and Gas Resources in the Public Law 115-97 Coastal Plain, Alaska

B.1 Summary

This hypothetical development scenario represents a good faith effort to project reasonably foreseeable oil and gas exploration, development, production, and abandonment in accordance with the Tax Cuts and Jobs Act of 2017, Public Law 115-97 (Dec. 22, 2017) (PL 115-97) Coastal Plain (Coastal Plain), and 40 Code of Federal Regulations (CFR) 1508.8(b). Estimating the level of future oil and gas activity in this area is difficult at best. Timing and location of future commercially viable discoveries cannot be more accurately projected until these undiscovered resources are explored. The hypothetical baseline scenario projects development under standard lease terms and encompasses restrictions in the enacting legislation. Scenarios by alternative incorporate the management considered in the Coastal Plain Oil and Gas Leasing Program Environmental Impact Statement (Leasing EIS) into the hypothetical projections.

The Coastal Plain encompasses approximately 1,563,500 acres of federal land in the northernmost end of the Arctic National Wildlife Refuge (Arctic Refuge). Alaska Native allotment lands and Alaska Native lands that are patented or interim conveyed are excluded from the program area.

Very little oil and gas exploration has occurred in this area, and there are no proven plays[1] at this point. The United States Geological Survey (USGS) estimated that there is a 95 percent probability that the 1002 Area (as per ANILCA) of the Arctic Refuge[2] contains a technically recoverable volume of least 5.92 billion barrels of oil (BBO). It says there is a 5 percent probability that the technically recoverable volume of oil could exceed 15.16 BBO. The mean estimate of technically recoverable oil for the ANILCA 1002 Area of the Arctic Refuge is 10.35 BBO. Of this, 90 percent was estimated to be economically recoverable at $55 per barrel (2005 dollars, approximately $70 in 2018 dollars; Attanasi 2005). Alaska North Slope crude is currently priced around $65 per barrel (ycharts.com 2018), and the US Energy Information Administration (EIA) projects that crude oil prices will continue to rise in the next 20 years (EIA 2018). More recent estimates published by the EIA estimate mean oil production in the Coastal Plain at 3.4 BBO produced by 2050 (Van Wagner 2018).

Technically recoverable associated and unassociated natural gas resources are estimated at 7.04 trillion cubic feet (TCF; Attanasi 2005). Proposed gas pipelines connecting the North Slope to potential markets would first connect to better understood and established fields before connecting to the Coastal Plain. There are estimated to be 225 million barrels of natural gas liquids in the program area; some amount of natural gas liquids would be produced as a byproduct of oil production in some formations.

---

[1]A play is a group of oil fields or prospects in the same region that are controlled by the same set of geological circumstances.
[2]Similar in area and boundary, but not identical to the Coastal Plain program area boundary.

B.2 Introduction

This hypothetical development scenario provides an estimate of the levels of petroleum-related activities and associated surface disturbances under an unconstrained baseline scenario. It is also a discussion of how those projected activities may vary under each alternative. In addition, this document presents a description of the geology and the oil and gas resource estimates in the Coastal Plain and identifies the assumptions used to develop hypothetical projections.

The petroleum-related activities projected in this hypothetical development scenario is useful only in a general sense. This is because the timing and location of future commercial-sized discoveries cannot be accurately predicted until exploration drilling begins; however, it is reasonable to expect that new technologies and designs developed in the future will augment exploration and development and will enhance the safety and efficiency of operations, while minimizing the effects of oil activity on the environment. To minimize the chance that the resultant impact analysis will understate potential impacts, the hypothetical scenarios described in this document represent optimistic high-production, successful discovery and development scenarios in a situation of favorable market prices.

Current state-of-the-art technologies, methods, and designs are used to project hypothetical scenarios for future petroleum development. Petroleum-related activities include such major undertakings as conducting seismic operations; constructing ice roads and snow trails for transporting equipment and supplies for winter drilling of exploration wells; drilling exploration and delineation wells; constructing gravel pads, roads connecting production pads to main facilities, and landing strips; drilling production and service wells; installing pipelines; and constructing oil and gas processing facilities.

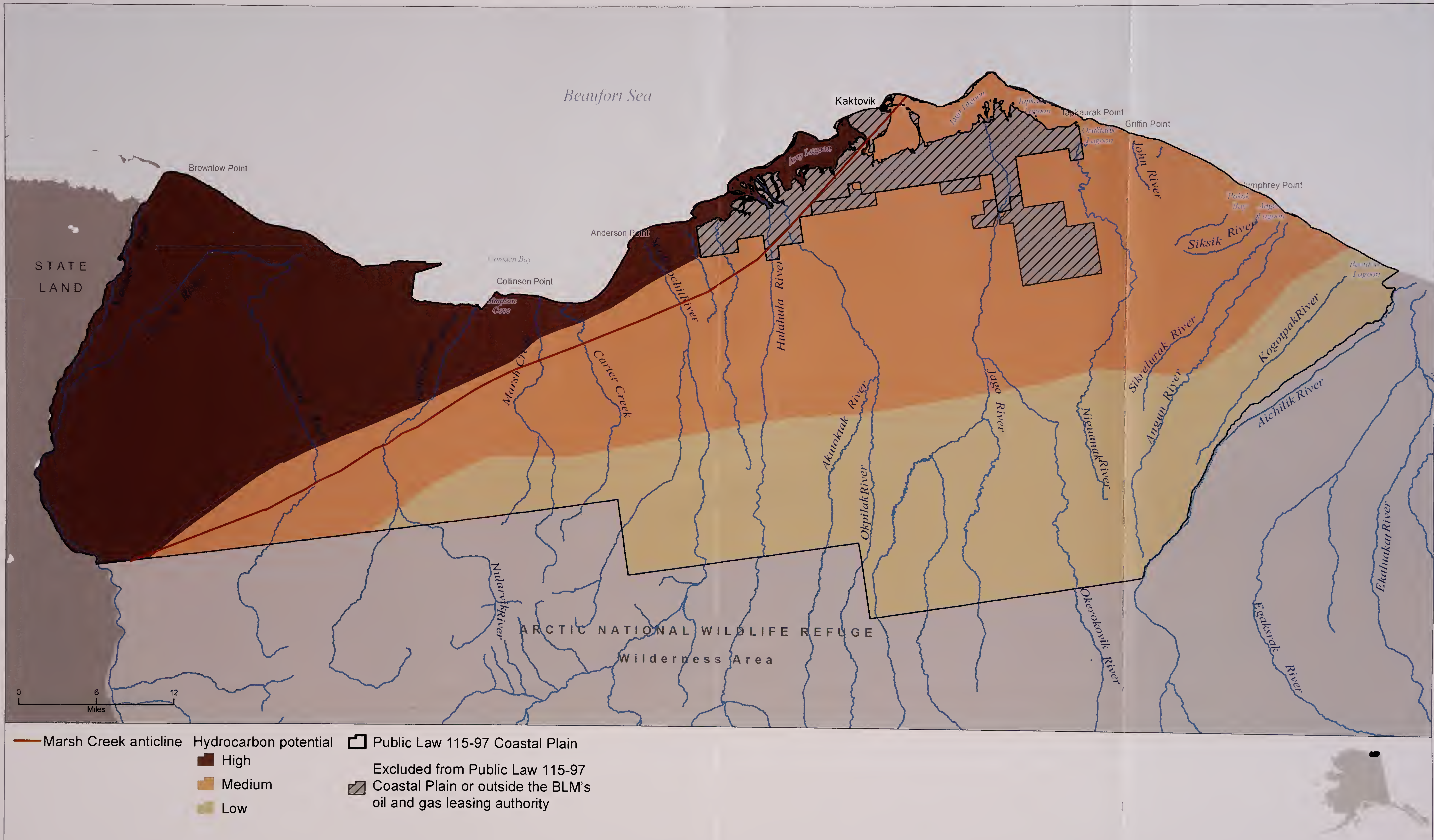
Potential impacts caused by the extraction of energy resources cannot be assessed without estimating future activity on at least a hypothetical level. A fundamental assumption of these scenarios is that the level of future activities is directly related to the petroleum resource potential made available for leasing and development; however, industry's interest in exploring for new resources is influenced by profit motives, where opportunities for new production in northern Alaska must compete with projects elsewhere. Consequently, future development and associated potential impacts are influenced by several factors, including the perceptions of economic potential of the area, the areas available for leasing, industry's ability to identify prospects to drill, and the competitive interest in exploring for new fields.

Until a transportation system to move gas to market is constructed, it is assumed that comingled gas produced with oil would be separated and reinjected into the formation as part of the reservoir enhanced recovery process.

B.3 Description of Geology

A thin layer of deposits covers the bedrock geology in most places in the Coastal Plain; therefore, information and understanding of the bedrock geology has been obtained primarily from geophysical remote sensing, observations in the mountains south of the area, and wells drilled west and north of the area (Bird 1999). As a result, localized geology is not as well understood as it is in most oil fields, where data collected from wells are used to inform geologic understanding.

The geology of the Coastal Plain is split into undeformed and deformed areas, demarcated by the Marsh Creek anticline, which runs northeast-southwest across the Coastal Plain (see **Map B-1**, Hydrocarbon Potential). Northwest of the Marsh Creek anticline, the undeformed area rocks are generally gently



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Data Source: BLM GIS 2018
Print Date: 10/31/2018

Map B-1

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dipping to nearly horizontal. Southeast of the anticline, the deformed area rocks show significantly more folding and faulting. Rocks with petroleum potential in the Coastal Plain area are mostly younger than Devonian and are divided into the Ellesmerian sequence of Mississippian to Triassic age, the Beaufortian sequence of Jurassic to Early Cretaceous age, and the Brookian sequence of Early Cretaceous to Cenozoic age (USGS 1998). The Ellesmerian sequence is up to two-thirds of a mile thick, primarily composed of equal amounts of carbonate and clastic rocks. The Brookian sequence consists of up to 4 miles of marine and nonmarine siliciclastic deposits originating from the ancestral Brooks Range.

The most likely petroleum reservoir rocks beneath the Coastal Plain are intrabasement carbonate rocks, Beaufortian sandstone similar to that of the Kemik sandstone or Thomson sand of local usage, and Brookian turbidite sandstone in the Canning Formation or deltaic sandstone in the Sagavanirktok and Jago River Formations. The timing of hydrocarbon generation relative to the formation of traps is judged to be favorable for the retention of oil in the Coastal Plain. Structural traps are believed to have formed before, during, and after oil generation and migration (Bird and Magoon 1987).

B.3.1 Undeformed Area

Approximately 80 percent of petroleum resources are estimated to be in the undeformed northwestern portion of the ANILCA 1002 Area (USGS 1998). The identified potential plays in this area, in order of greatest to least potential, are the Topset play, Turbidite play, Wedge play, Thompson play, Undeformed Franklinian play, and Kemik play. Total undiscovered, technically recoverable resources from these plays are estimated to be 6.420 BBO (Attanasi 2005).

Table B-1, below, gives estimates of recoverable petroleum resources in the undeformed area. Development is expected to begin in the Topset play, which is estimated to contain over half the recoverable undiscovered oil in the program area. Initial interest is expected to be in test wells drilled in areas where seismic data reveals traps or where the formation is particularly thick. Areas where multiple plays overlap are also expected to receive early exploration and development interest.

Table B-1
Estimated Mean Undiscovered Petroleum Resources in the Undeformed ANILCA 1002 Area

Play Name	Oil (BBO)	Gas (TCF)	Natural Gas Liquids (Billion Barrels of Liquid)
Topset	4.325	1.193	0.010
Turbidite	1.279	1.12	0.065
Wedge	0.438	0.226	0.005
Thompson	0.246	0.47	0.039
Kemik	0.047	0.116	0.010
Undeformed Franklinian	0.085	0.30	0.029
Total	**6.420**	**3.424**	**0.159**

Source: Attanasi 2005

Note: Totals are technically recoverable amounts.
Note: The ANILCA 1002 Area is similar in area and boundary, but not identical to the Coastal Plain program area boundary.

B.3.2 Deformed Area

Potential plays in the deformed area, in order of greatest to least potential, are the Thin-Skinned Thrust belt play, Niguanak/Aurora play, Deformed Franklinian play, and Ellesmerian Thrust Belt play. Total undiscovered resources from these plays are estimated to be 1.267 BBO (Attanasi 2005). **Table B-2**, below, gives estimates of recoverable petroleum resources in the deformed area. Plays there are expected to be developed only in localized areas if seismic data and test wells indicate a very promising field.

Table B-2
Estimated Mean Undiscovered Petroleum Resources in the Deformed ANILCA 1002 Area

Play Name	Oil (BBO)	Gas (TCF)	Natural Gas Liquids (Billion Barrels of Liquid)
Thin-Skinned Thrust Belt	1.038	1.608	0.017
Ellesmerian Thrust Belt	0.000	0.876	0.018
Deformed Franklinian	0.046	0.86	0.046
Niguanak/Aurora	0.183	0.273	0.016
Total	**1.267**	**3.617**	**0.096**

Source: Attanasi 2005

Note: Totals are estimated technically recoverable amounts.
Note: The ANILCA 1002 Area is similar in area and boundary, but not identical to the Coastal Plain program area boundary.

B.4 Past Oil Exploration

Due to a prohibition on oil and gas leasing until the passage of PL 115-97, very little exploration has occurred in the Coastal Plain. A single oil and gas exploratory well was drilled within the boundary of the Coastal Plain (although it was drilled on Kaktovik Inupiat Corporation surface estate, which is excluded from the PL 115-97 definition of the Coastal Plain). Results of the KIC#1 exploration well drilled in 1985/1986 have been maintained strictly confidential by the data owners, which are Chevron, BP, and Arctic Slope Regional Corporation. A two-dimensional seismic survey was conducted by an industry group in the winters of 1984/1985 and 1985/1986 (DOI 1987). The data collected have contributed to every analysis of oil and gas potential in the Coastal Plain since.

B.5 Oil Occurrence and Development Potential

Estimates of oil occurrence and development potential were developed based on the locations of the plays discussed above in *Description of Geology*. Areas where plays with larger estimated undiscovered resources overlap were considered as high occurrence potential, areas where only one or two plays with significant undiscovered resources overlap were considered moderate potential, and areas with only minor plays were considered low potential. The highest estimated potential areas are in the western and northern part of the Coastal Plain. See **Map B-1**, above, for a depiction of potential areas.

Since no infrastructure exists in the Coastal Plain, developers are expected to follow oil occurrence potential very closely, rather than trying to build off existing infrastructure, as might occur in a field with existing development; however, the closest infrastructure outside the Coastal Plain is near the northwest border of the area. This coincides with the area of highest occurrence potential. Moving farther from the existing infrastructure near the northwest border of the Coastal Plain, areas would be increasingly less economical to reach; therefore, estimated development potential (which accounts for economic considerations in addition to resource occurrence) coincides with estimated occurrence potential for the Coastal Plain.

B.6 Method and Assumptions for Hypothetical Development Scenario Projections

There are many uncertainties associated with projecting future petroleum exploration and development. These uncertainties include the amount and location of technically and economically recoverable oil; the timing of oil field discoveries and associated development; the future prices of oil and gas, and, more to the point, the many exploration companies' individual assessment of future prices and other competitive calculations that play into corporate investment decisions; and the ability of industry to find petroleum and to mobilize the requisite technology to exploit it.

To address these uncertainties, the BLM has made reasonable assumptions based on the previous two-dimensional seismic exploration of the Coastal Plain, the history of development in the National Petroleum Reserve-Alaska (NPR-A) and other North Slope developments, its own knowledge of the almost entirely unexplored petroleum endowment of the Coastal Plain and current industry practice, and professional judgment. In making these assumptions, the BLM has striven to minimize the chance that the resultant impact analysis will understate potential impacts; therefore, the hypothetical scenarios are intended to represent optimistic high-production, successful discovery, and development scenarios in a situation of favorable market prices.

The amount of infrastructure that would be necessary to develop the projected amount of oil is also estimated at upper, but reasonable, limits. For example, the assumption is that each satellite production pad could disturb approximately 12 acres and contain 30 wells (approximately 2.5 wells per acre); however, as ConocoPhillips develops newer well pads in the Colville River Unit (commonly referred to as Alpine) and the Greater Moose's Tooth Unit, this suggests that, on average, pad sizes for that many wells may be closer to 10 acres (approximately 3.3. wells per acre).

These estimates account for advances in technology that have allowed development on the North Slope to become less impactful on the surrounding environment. For example, the older well pads in Alpine had a ratio of 1.6 to 2.2 wells per acre.

The time frame used for the hypothetical development scenarios is the estimated minimum amount of time in which development of the Coastal Plain could reach the 2,000-acre threshold discussed below. Because there are very little data on and no infrastructure in the Coastal Plain, there would be a lag time between the first lease sale and the beginning of production in the area. The activities that are projected to occur and the estimated timing of those activities are further described in the *Hypothetical Baseline Scenario*, below. The overall minimum time anticipated for all wells to be completed in the Coastal Plain under any hypothetical scenario is approximately 50 years, recognizing the timeframe for production could be more or less than 50 years given the speculative nature of the development scenarios. Because it is unlikely that all projected wells would be producing at the same time, peak production from the Coastal Plain is anticipated at some point before 50 years, potentially as early as 20 years after the first lease sale. Once peak production is reached, production from a field is anticipated to continue for up to another 35 years, depending on resource production, market forces, and operator financial decisions; therefore, it could be 85 years or more after the first lease sale before all facilities described in the scenarios are abandoned and reclaimed. However, just as development is expected to occur in phases, reclamation would occur in phases. The first field to be developed could be reclaimed long before the last field is abandoned.

Additional assumptions, some of which also tend to support an optimistic set of hypothetical development scenarios, are as follows:

- Multiple lease sales would be held, with the first sale within first year after the signing of the Record of Decision (ROD).
- Processed area-wide three-dimensional (3D) seismic data would be available for licensing to all potential bidders at the time of the first lease sale.
- Industry would aggressively lease and explore the tracts offered.
- Economic conditions (particularly oil and gas prices) would be high enough to support development in the Coastal Plain.
- Undiscovered oil deposits would be discovered in all potential areas (high, medium, and low).
- Several industry groups would independently explore and develop new fields in the Coastal Plain.
- Operators would enter agreements to share road and pipeline infrastructure, where feasible.
- Discoveries could be announced any time during a 10-year period (primary lease term) following lease sale, or during a subsequent 10-year lease renewal period (per 43 CFR 3135.1-6).
- Up to three anchor fields, with a minimum of 400 million barrels of proven producible reserves in each, would be discovered.
- Future oil production would use existing North Slope infrastructure, including the Trans-Alaska Pipeline System (TAPS).
- A plant for compressing produced natural gas into liquid natural gas would be located outside of the Coastal Plain.
- Production wells would likely have horizontal wellbores, with the lateral portion coinciding with the target formation.
- Each producing horizontal oil well would require a horizontal injection well.
- Once all wells are online for a field, the projected yield would be 100,000 barrels of oil per day (peak production) for approximately 3 years, with an 8 percent annual production decline.[3]
- The maximum production range from CPF to satellite pads is an approximately 35-mile radius.
- Production activities would continue year-round for approximately 10 to 50 years, depending on field size.
- Production would end when the value of production cannot meet operating expenses.
- Fuel for equipment operation would be barged or hauled overland.
- Gas would be vented or flared only in emergency situations.

B.6.1 Surface Disturbance Limitations

Section 20001(c)(3) of PL 115-97 states:

[3]Peak production estimate is based on production projections for Willow and Pikka Nanushuk developments on the North Slope. Decline estimate is based on standard decline estimates from the State of Alaska and the estimates used in NPR-A analyses.

> SURFACE DEVELOPMENT—In administering this section, the Secretary shall authorize up to 2,000 surface acres of Federal land on the Coastal Plain to be covered by production and support facilities (including airstrips and any area covered by gravel berms or piers for support of pipelines) during the term of the leases under the oil and gas program under this section.

The BLM interprets this provision of PL 115-97 as limiting to 2,000 the total number of surface acres of *all* Federal land across the Coastal Plain, regardless of whether such land is leased, which may be covered by production and support facilities *at any given time*. BLM is applying this acreage limit to non-leased Federal lands because Section 20001(c)(2) of PL 115-97 provides for the issuance of rights-of-way or easements across the Coastal Plain regardless of lease status and since in some cases production and support facilities (e.g., pipelines) may be constructed pursuant to such rights-of-way or easements. BLM is applying this limit to the total acreage of production and support facilities existing at any given moment in time, as opposed to the cumulative total acreage of production and support facilities that may ever exist, because the language "during the term of the leases" in Section 20001(a)(3) indicates a temporal limit was intended by Congress. Under this interpretation the reclaimed acreage of Federal land formerly containing production and support facilities would no longer count towards the 2,000-acre limit.

The BLM interprets this limitation to generally refer to acres of land directly occupied by facilities that are primarily used for development, production, and transportation of oil and gas in and from the Coastal Plain. In applying that standard, 1) "facility" is given its ordinary dictionary definition which is, something that is built, installed, or established to serve a particular purpose; here, the development, production, and transportation of oil and gas in and from the Coastal Plain; 2) the limitation does not apply to surface disturbance indirectly related to or resulting from those facilities, as those surface acres are not "covered by" the facilities themselves; and 3) given the explicit language of PL 115-97 relating to "piers" for supporting pipelines, the limitation applies only to those portions of oil and gas facilities that actually touch the land's surface. Thus, BLM interprets the types of "production and support" facilities that will count toward the 2,000-acre limit as including any type of gravel or other fill constructed facility which touches the land's surface, to include: gravel pads used for processing facilities (including wells), production facilities, or pump or compressor stations; gravel airstrips or roads; and any other area covered by gravel berms or piers for support of pipelines. Examples of types of facilities or disturbance that will not count toward the 2,000-acre limit include facilities constructed with snow or ice (e.g., ice roads/pads) and the portion of facilities that do not touch the land's surface (e.g., elevated pipelines). Facilities constructed with snow or ice have a fleeting existence, and thus this aspect of BLM's interpretation is consistent with the temporal limit intended by Congress. Moreover, inclusion of such facilities would make Congress's clear purpose – establishment of an oil and gas program on the Coastal Plain – impracticable. By referencing "piers for support of pipelines" as counting towards the 2,000-acre limit, PL 115-97 strongly implies that the elevated portion of pipelines that do not touch the ground do not count towards the limit. In addition, the BLM interprets "production and support facilities" to exclude gravel mines given that they supply raw materials for construction of oil and gas facilities but are not themselves oil and gas facilities any more than are mills that supply steel for construction of pipelines and other facilities.

The BLM employs this interpretation of Section 20001(c)(3) of PL 115-97 as an assumption in each of the action alternatives analyzed in the EIS. This interpretation limits surface use in any instance where the construction of facilities substantially disturbs the tundra surface but does not restrict the use of winter snow/ice surfaces which melt away each summer and leave the tundra surface largely undisturbed. It also appropriately conserves surface resources and provides an incentive to rapidly reclaim impacted land while still allowing for a reasonable amount of practical and feasible oil and gas development to occur.

B.7 Hypothetical Baseline Scenario

This hypothetical baseline scenario projects an estimated projection of activity in the Coastal Plain, assuming all potentially productive areas will be open to leasing, subject to standard terms and conditions. The exception is those areas designated as closed to leasing by law, regulation, or executive order. The activities and methods described in the hypothetical baseline scenario are based on the activities typically associated with oil and gas operations on the North Slope of Alaska.

For a further description of typical activities and methods in the North Slope, see Section 4.2.1.2 of the National Petroleum Reserve-Alaska Final Integrated Activity Plan/Environmental Impact Statement (IAP/EIS) (BLM 2012).

The baseline hypothetical development scenario is meant to convey the most likely unconstrained development scenario, with no management restrictions except those mandated by law. The hypothetical scenario provides the mechanism to analyze the effects that discretionary management decisions under the Leasing EIS alternatives would have on estimated future oil activity. Development activities and methods are not projected to vary from the hypothetical baseline scenario unless noted in the descriptions of individual hypothetical alternatives scenarios.

Table B-3, below, describes the general time frames in which hypothetical exploration, development, and production might occur in the Coastal Plain. As described in *Method and Assumptions for Hypothetical Development Scenario Projections*, a time lag of at least 8 years is expected between the first lease sale and the beginning of production. As previously discussed, the time frames below represent an optimistic, aggressive hypothetical scenario. Activities projected to occur within 5 years after the signing of the ROD are considered short term; activities projected to occur more than 5 years after ROD signature are considered long term.

Table B-3
Estimated Hypothetical Development Time Frames

Project Phase	Estimated Time from ROD Signature	Projected Activities
3D seismic exploration	Complete by the time ROD is published	Area-wide 3D seismic exploration
Leasing	Within 1 year of ROD	First lease sale
Exploration	2 years after ROD (winter)	• First application for permit to drill submitted for exploration well • First exploration well drilled • Assumes discovery with first exploration well

Project Phase	Estimated Time from ROD Signature	Projected Activities
Additional seismic exploration	3 years after ROD (winter)	• Seismic exploration on lease block with discovery to locate future delineation exploration wells • Process seismic data and determine location of delineation wells to be drilled the following winter
Additional exploration wells	4 years after ROD (winter)	Drill 3 to 5 additional wells to define the prospect and identify satellite pad locations
Master development plan and EIS	5 to 6 years after ROD	• Conduct NEPA analysis on master development plan for anchor field • Continue drilling 2 to 3 exploration wells to identify CPF and satellite pad locations
Development	7 years after ROD	• Begin laying gravel for anchor pad, begin CPF construction • Continue drilling 2 to 3 exploration wells to identify satellite pad locations • Begin drilling production wells on anchor pad
Production begins	8 years after ROD	• First production from anchor pad • Winter gravel and construction on satellite pads
Production increases	9 to 40 years after ROD	• All wells completed on anchor pad • All wells completed on satellite pads
Development of additional fields	11 to 85 years after ROD	• Construct facilities and drill wells in additional fields • Production continues for approximately 35 years after reaching peak production in each field
Abandonment and reclamation	19 to 130 years after ROD	• Plug wells that are no longer economically productive • Remove retired equipment, dig up vacant gravel pads and roads and reclaim the area

B.7.1 Leasing

PL 115-97 mandates two lease sales: the first within 4 years and the second within 7 years. Under this hypothetical scenario, the assumption is that the first sale would occur within a year of the publication of the ROD for the Leasing EIS. Another assumption is that 3D seismic studies would have been completed by the time the ROD is published. A final assumption is that industry would lease areas offered and would follow up with an aggressive exploration and development schedule.

B.7.2 Exploration

The BLM estimates that approximately 900 square miles would be surveyed by 3D seismic vehicles.[4] This would require travel by vibroseis seismic vehicles and smaller support vehicles. Vibroseis trucks are mounted on rubber tracks to minimize ground pressure. No air-guns or dynamite are expected to be used. Multiple vehicles could be used simultaneously miles apart to conduct vibroseis exploration, or convoys of four to five trucks could travel in a line, which is less common.

It is assumed that cable-less geophone receivers (autonomous recording nodes) would be placed in lines perpendicular to source lines. Source and receiver lines would be typically 330 to 1,320 feet apart. Seismic operations would be accompanied by ski-mounted camp buildings towed by bulldozers or other tracked vehicles. There could be two to three strings with four to eight modular buildings in each string. Camps are assumed to move weekly. Seismic exploration will be further detailed in the seismic environmental assessment, which is in preparation. All seismic operations would be conducted in the winter to minimize impacts on the tundra (BLM 2018).

Exploration wells are expected to be drilled to confirm fields indicated by seismic results. Initial exploration wells would likely be drilled vertically to the basement (approximately 13,000 to 15,000 feet) to define the entire stratigraphic column. Water needed for ice pad construction and drilling muds could be imported from nearby lakes and rivers or from snowmelt; water demand would vary based on the site geology and the density of drilling mud required.

A typical ice pad for exploration drilling is 1 foot thick and requires 500,000 gallons of water (DOI 2005). Current drilling technology is self-contained, so there are no reserve pits that could leak or pose an attractive nuisance to wildlife. Traditionally, drilling muds and cuttings are placed in surface waste disposal impoundments, known as reserve pits.

Using grind and inject technology, cuttings are now crushed and slurried with seawater in a ball mill, then combined with the remaining drilling muds and reinjected into confining rock formation 3,000 to 4,000 feet underground in an approved injection well (DOI 2005). This reduces the environmental impacts of disposing of drill cuttings because it avoids the need to bury cuttings on-site or haul them to a landfill. Drilling muds and additives are reconditioned and recycled to the extent possible. Drilling an exploration well in a previously unexplored area may take weeks or months, depending on depth, data collection program, and borehole conditions. Once the well is completed, additional down-well testing and characterization can take up to a month (DOI 2005).

Following a promising discovery in an exploration well, delineation wells may be drilled to further characterize the discovery. These wells require similar resource commitments and require about the same time for drilling as an initial exploration well. After drilling, logging, and other downhole evaluation activities are complete, exploration and delineation wells may either be completed and suspended for future use or plugged and abandoned according to regulatory requirements, with all wastes removed from the site (DOI 2005).

[4]The 900-square-mile estimate is the size of a typical 3D survey, as witnessed in NPR-A and on adjacent state lands.

B.7.3 Development

For the purposes of this hypothetical scenario, the assumption is that economic conditions would remain favorable to produce oil from the program area. Another assumption is that economically feasible oil accumulations would be discovered in all potential areas and that multiple anchor fields (each containing at least 400 million barrels of proven producible reserves) would be discovered. Further, it is assumed that several different operators would independently explore and develop new fields in the Coastal Plain. See **Figure B-1**, Conceptual Layout of a Stand-Alone Oil Development Facility, for a conceptual rendering of a hypothetical anchor field and associated facilities.

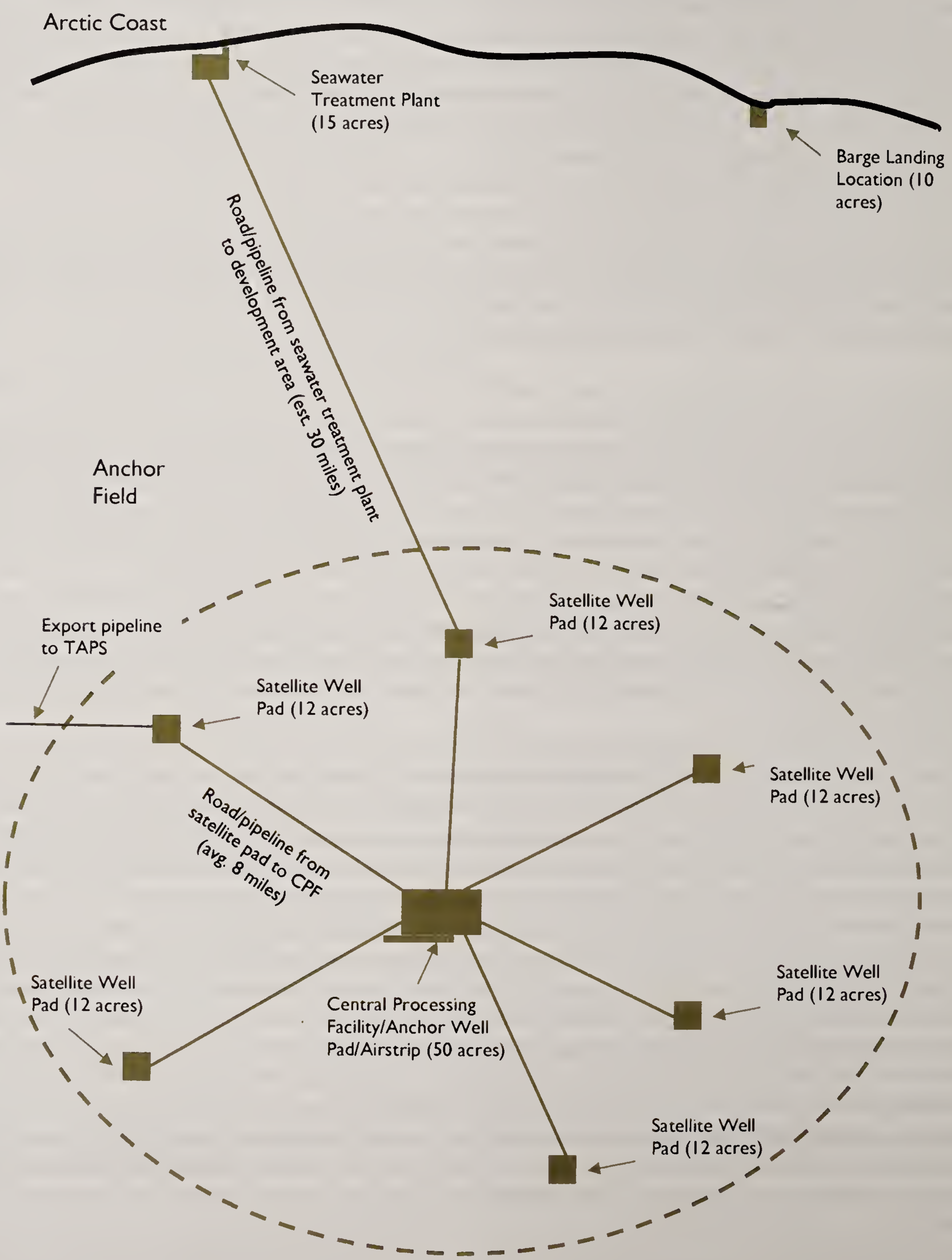
In caribou areas, potential roads would be built on north-south and east-west orientations to the extent possible to limit interference with caribou migration. **Figure B-2**, Conceptual Layout of a Caribou Area Stand-alone Oil Development Facility, shows how the hypothetical layout could be adjusted for caribou mitigation if deemed appropriate by permitting agencies.

To protect the tundra, potential ice roads would be most likely used for most development activities. Ice roads are constructed seasonally and are used to transport drill rigs, modular units, and other large or heavy equipment for central processing facilities (CPFs) and other supplies. They are constructed by compacting snow using low-ground pressure vehicles (approximately 1 to 2 pounds per square inch). The compacted tracks capture more snow blown by wind until they are compacted again after a week or two of accumulation. Once accumulation is complete, larger tracked vehicles with higher ground pressure or wheeled vehicles, such as a water truck or front-end loader, compact the snow to the desired road width. Water is then dispersed on the compacted snow to create ice buildup. The rate of ice buildup in cold conditions is approximately 1.5 inches per day. Using ice chips shaved from frozen lakes can increase the buildup rate to 4.5 inches per day and reduce the amount of water needed by approximately 75 percent. The minimum ice depth for use by full-size vehicles is 6 inches, and roads are typically 35 feet wide.

Ice road construction uses approximately 1 million gallons of water per mile, although use of ice chips can reduce water use substantially. Crews can construct about 1 mile per day (BLM 2012). Construction of ice roads for specific projects using traditional techniques may be limited by freshwater availability in the program area. Innovative techniques that minimize use of freshwater resources or identify additional water sources could allow for additional construction. Examples of these alternative sources and techniques are naturally deep lakes and pools along rivers that do not freeze to the bottom in winter, melting lake and river ice, trapping and melting snow, creating water reservoirs by excavating deep pools in lakes or along stream channels in conjunction with gravel removal operations, and desalinating marine water obtained beyond the barrier islands. Additional NEPA analysis at the site-specific level would assess water needs and measures to address water supply issues.

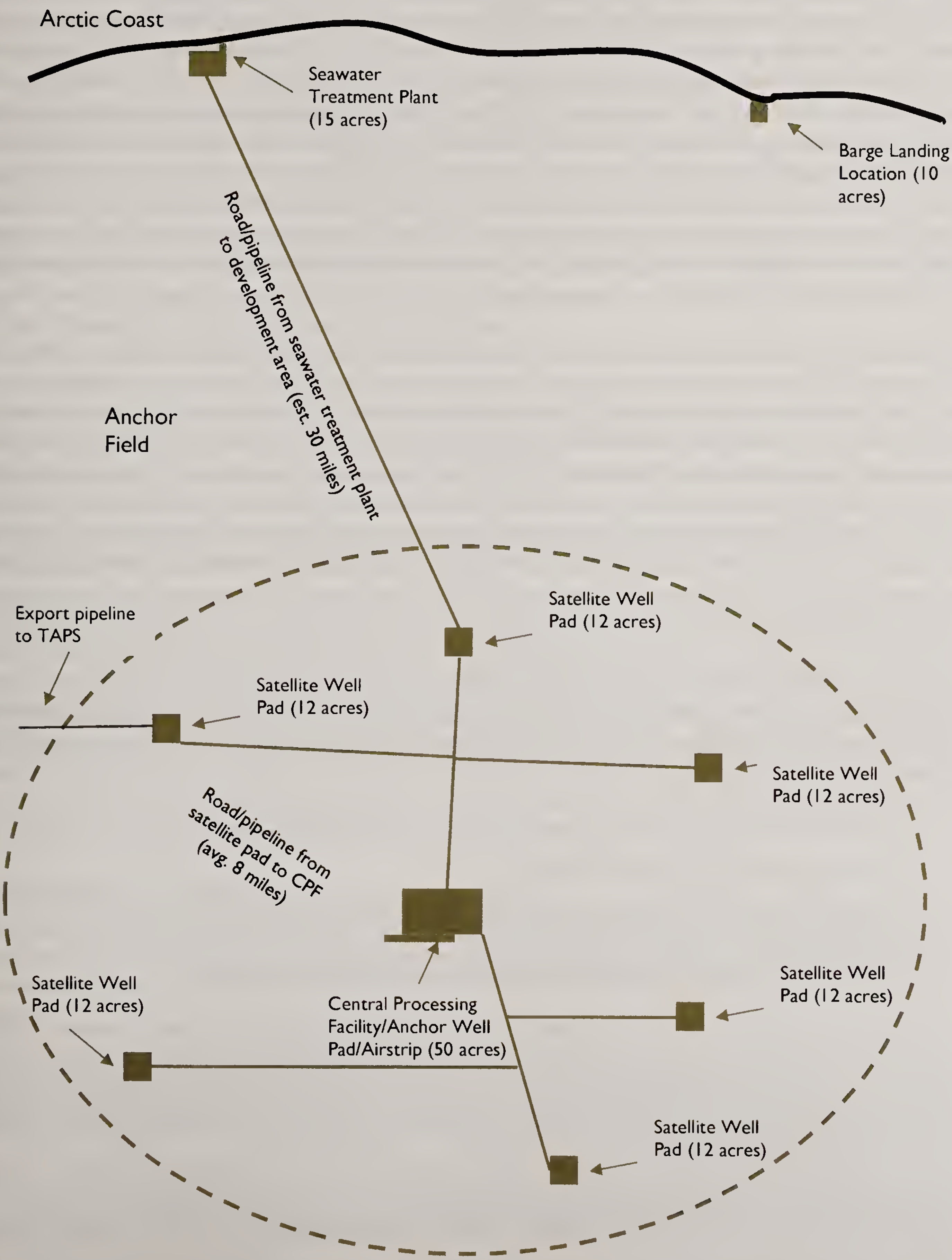
Potential snow trails could be used for smaller equipment, such as seismic trucks, camps, and maintenance vehicles. Low-ground pressure vehicles are used to pre-pack snow and groom trails if needed. Snow trails are typically thinner than ice roads and are wide enough for one vehicle only. If snow trail maintenance is necessary, a tracked vehicle would tow a rounded groomer to smooth out the trail.

Figure B-1. Conceptual Layout of a Stand-Alone Oil Development Facility*



*Facility locations and sizes are conceptual and are not to scale

Figure B-2. Conceptual Layout of a Caribou Area Stand-alone Oil Development Facility*



*Facility locations and sizes are conceptual and are not to scale

In this hypothetical scenario, potential development would start following the discovery of an anchor field. The first anchor field discovered is expected be in the western half of the Coastal Plain, most likely in the Topset play. Potential development would likely begin with the construction of a gravel pad for wells, CPF, airstrip, storage tanks, communications center, waste treatment unit, and a camp for workers. Typically, these facilities occupy a total of approximately 50 acres (BLM 2012). Most equipment for construction, including the modules for a CPF, would be transported to the anchor field on ice roads from a barge landing. Camden Bay has been identified as the most likely location for a barge landing (DOI 1987), although it is possible that operators could use existing landing facilities at Point Thomson. A barge landing and an associated staging pad to store equipment and modules until ice roads can be constructed would typically disturb approximately 10 acres, including the barge landing and a gravel staging pad. An average of two barge transports per year is anticipated; the number of transports would vary based on ice conditions and the large equipment needed for upcoming development phases.

A seawater treatment plant could also be constructed along the coast, if needed, to source saline water for waterflooding, reservoir pressure support, or other subsurface uses. Groundwater aquifers or local lakes and rivers are typically the preferred water sources, due to the cost and maintenance requirements of a seawater desalination plant; however, due to the limited information about groundwater resources in the Coastal Plain, those sources may not be sufficient to meet water needs. Thus, for the purpose of analysis, it is assumed that a seawater treatment plant would be required. Seawater treatment plants from other Arctic developments require approximately 15 acres of surface disturbance.[5] A road and seawater transport pipeline would be constructed from the seawater treatment plant to the CPF. Typical gravel roads in the Arctic require 7.5 acres of surface disturbance per mile (BLM 2012).

Following the construction of a gravel anchor pad for a potential CPF, airstrip, wells, and worker camp, facility construction and production drilling is expected to begin. A CPF is the long-term operational center for production activities in an anchor field. It generally contains equipment for processing oil, gas, and water, as follows:

- Separators for oil, gas, and water, with an output of sales-quality oil
- Filters for produced oil to extract solids
- Processors to remove water and natural gas liquids from associated gas, followed by gas compression and reinjection into the reservoir through gas injection wells
- Compressors for gas and pumps for water injection back into the reservoir

In addition to a potential CPF, it is expected that a potential generator, airstrip, storage tanks, a communications center, waste treatment units, and a maintenance shop would be constructed on the anchor pad. Living quarters and offices may or may not be constructed on an anchor pad with the rest of the facilities. All potential buildings would be supported aboveground on pilings to accommodate ground settling or frost heaving.

Potential production wells would extend horizontally in the target formation and could take approximately 45 to 60 days to drill. This rate of drilling allows approximately eight wells to be drilled

[5]The seawater treatment plant and gravel support pad at Prudhoe Bay measure 15 acres.

per year, thus taking about 4 years to drill the total of 30 wells on the average pad. Depending on drill rig availability, drilling could take place on multiple well pads at the same time. Drilling and completing each potential well would require anywhere from 420,000 to 1.9 million gallons of water (BLM 2012). Wells are expected to be hydraulically fractured for initial stimulation; however, this process requires less water than the multi-stage hydraulic fracturing used in unconventional reservoirs. Water flooding using parallel injection wells would increase oil recovery by pushing oil toward producer wells and to maintain reservoir pressure. 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 barrels of oil per day would require approximately 2 million gallons of water per day. The potential anchor pad is expected to have a Class I or Class II disposal well, or both, which are used to dispose of industrial wastes and fluids associated with oil and gas production, respectively (EPA 2018). Solid, unburnable waste would be disposed of in large trash receptacles or other approved containers and hauled to approved off-site landfills. On-site burial of solid wastes is not anticipated.

It is anticipated that a potential production pipeline would be constructed to connect a CPF to the TAPS to move produced oil to market. Vertical support members (VSMs) are counted as ground disturbance at a rate of approximately 0.04 acres per mile (USACE 2017). Potential pipelines would also connect each potential satellite pad to the nearest potential CPF. It is assumed that potential pipelines for water, fuel, and electric cables to supply satellite pads would also be run on the same VSMs. A potential pipeline to transport future petroleum production from native lands south of Kaktovik could be constructed across the northern Coastal Plain to connect to TAPS or other export infrastructure.

Following the completion of a potential anchor pad, development is expected to begin on potential satellite pads around the anchor field. Potential satellite pads would consist of wells and the minimum amount of required equipment and pump production back to the nearest CPF via pipeline for processing. Potential satellite pads in the Coastal Plain are each anticipated to contain approximately 30 wells and occupy approximately 12 acres of surface disturbance.[6] In this analysis, satellite pads could be used to produce from areas of the anchor field that are not accessible from the anchor pad; alternatively, they could be used to produce from smaller fields that would not be economically viable if they needed a dedicated CPF.

Natural Gas Development

The most probable use of natural gas in the near term would be if Kaktovik were to build a pipeline to transport excess gas from nearby wells to replace imported diesel or fuel oil as the primary source of power and heat to the village. In the longer term, gas could be exported to markets outside the North Slope.

The State of Alaska is pursuing a plan to build a liquid natural gas transport pipeline from the North Slope to markets in Asia. The Chinese oil industry has expressed interest in partial funding of the project in exchange for a share of gas from the pipeline. Additionally, memoranda of understanding to sell gas to companies in Japan, South Korea, and Vietnam have been secured. The pipeline is scheduled to come online in 2025 (Energywire 2018). Gas transported through the pipeline is expected to come from established fields with proven reserves initially. If proven gas resources are discovered in the

[6]Nanushuk DEIS measured 2.75 acres of pad per well; Alpine well-head area is approximately 2.5 acres per well for newer well pads (USACE 2017).

Coastal Plain they could be connected to the pipeline to maintain capacity as the primary fields are depleted. Estimated potential natural gas production from the Coastal Plain ranges from 0 to 7 TCF of gas produced (Attanasi 2005). These production estimates do not include gas that would be reinjected into the formation to maintain reservoir pressure.

If natural gas resources were to be developed, the addition of potential gas compression equipment to existing CPF pads in oil fields would result in an approximately 13 additional acres of ground disturbance per CPF for gas compression and pumping equipment. Potential gas pipelines are expected to be installed on the same VSMs as oil pipelines, so no additional acres for potential gas pipelines would be disturbed.

Unconventional Development

No unconventional development is anticipated in the Coastal Plain in the period analyzed in this hypothetical development scenario. There is currently no unconventional oil and gas production on Alaska's North Slope; due to the high costs of and difficult operating conditions in the Arctic, the viability of hydraulic fracturing to produce from unconventional petroleum resources has not been proven, from a technology or commercial viability standpoint (BLM 2012). Coal bed methane potential appears low, and its production is unlikely due to a lack of infrastructure to transport methane gas from northern Alaska to market.

B.7.4 Production

Once all wells in a development are online, production is anticipated to peak at an estimated 100,000 barrels per day[7] from each field after 3 years. From that point onward, production is estimated to decline at a rate of approximately 8 percent per year.[8] Produced resources would be processed at a CPF to separate water and gas from salable oil and natural gas liquids. Water and gas would be reinjected into the formation to enhance oil recovery; oil and natural gas liquids would be shipped to market, likely via TAPS.

Field production can last from 10 to 50 years before abandonment (BLM 2012). In the Coastal Plain, assuming the 100,000 barrel-per-day peak production and the 8 percent decline per year, it would take an estimated 35 years after reaching peak production to get to the point of abandoning a potential field. Reinjecting produced gas and water helps maintain oil reservoir energy and improve hydrocarbon recovery efficiency by pushing oil toward the production wells, increasing the ultimate oil recovery. Associated gas and water injection wells are needed where no gas sales line exists and where water disposal is not allowed at the surface (BLM 2012).

Depending on market forces, the size and number of fields discovered, and the timing of development, the projected ultimate recovery in the Coastal Plain is estimated to be anywhere from 1.5 BBO to 10 BBO, based on the estimated daily production rate for the two to four main developments. Hypothetical production rates and estimated ultimate recovery are not expected to change significantly under any of the alternatives. This is because the management under the alternatives is expected to change the configuration of facilities but not the total amount of production. Minor changes in the amount and time

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[7]Estimate based on production projections for Willow and Pikka Nanushuk developments on the North Slope.
[8]Estimate based on standard decline estimates from the State of Alaska and the estimates used in NPR-A analyses.

sequence of production cannot be predicted at this time, given the limited data on the formations, reservoirs, and resources in the Coastal Plain.

B.7.5 Abandonment and Reclamation

Abandonment and reclamation occur once a well pad or field is no longer producing enough oil to cover costs. Typically, abandonment and reclamation take from 2 to 5 years following the termination of production (BLM 2012). Wells are plugged with cement to prevent fluid migration between formations, and the well casing is cut and plugged below the surface and buried. On-site equipment, facilities, and solid wastes are removed from the site. Gravel from pads and roads would be removed and reused in other areas or placed back in the gravel mine it was extracted from. Gravel pits that are not refilled would have side slopes constructed and would be reclaimed as wildlife ponds. Pipelines and VSMs would be removed and scrapped or reused in other developments.

Once all satellite pads feeding to a CPF are no longer producing or when the flow of produced oil is reduced to the point that operation is no longer economically viable, the CPF would be decommissioned. Following reclamation, the acreage would be regained against the 2,000-acre surface disturbance limit. This could allow for additional development of future fields as initial development is reclaimed.

B.8 Coastal Plain Oil and Gas Leasing Program EIS Alternatives Hypothetical Scenarios

B.8.1 Alternative A

Under Alternative A (the No Action Alternative), no federal minerals in the Coastal Plain would be offered for future oil and gas lease sales following the ROD for the Leasing EIS. Alternative A would not include the direction under PL 115-97 to establish and administer a competitive oil and gas program for leasing, developing, producing, and transporting oil and gas in and from the Coastal Plain in the Arctic Refuge. Under this alternative, current management actions would be maintained, and resource trends would continue, as described in the Arctic National Wildlife Refuge Revised Comprehensive Conservation Plan (USFWS 2015). Alternative A is being considered to provide a baseline for the comparison of impacts under the action alternatives.

Because no leasing, exploration, or development would occur under this alternative, no production would occur, and no surface would be disturbed.

B.8.2 Alternative B

Due to minimal restrictions and stipulations under this alternative, hypothetical development would be expected to occur in approximately the same manner as the hypothetical baseline scenario. In the long term, four CPFs are projected to be built. Hypothetically, this could include two in the high potential area, one in the medium potential area south of Kaktovik, and one in the low potential area. This hypothetical scenario includes the possibility that one CPF could be located on state or native lands. Approximately 17 satellite pads are projected to be developed (in addition to the four production pads associated with the CPFs), and it is estimated that approximately 208 miles of gravel road would be needed to connect facilities.

It is projected that one seawater treatment plant and at least one barge landing and storage pad would be needed under this hypothetical scenario. It is possible that one or more of the CPF development clusters under the hypothetical scenario would be roadless. This would entail an expanded airstrip at the CPF with the capacity to handle the larger cargo planes that would be required. In a hypothetical roadless development scenario, it is expected that service roads would still connect satellite pads to the central CPF, so no airstrips would be required at satellites.

An ice road would be constructed each winter under this hypothetical scenario to transport larger and heavier supply items required for the coming year. Any equipment or supplies not transported during the winter would need to be flown in. Additional flights would be needed, compared to a hypothetical roaded development. Roadless development would depend on sufficient water resources for the construction of ice roads each winter. Under the hypothetical development scenario for this alternative, it is expected that the 2,000-acre surface disturbance cap would be reached. See *Surface Disturbance Due to Oil and Gas*, below, for more details on the surface disturbance projected to be created under the hypothetical development scenario for this alternative.

B.8.3 Alternative C

Under this alternative, hypothetical development would be expected to occur in approximately the same manner as the hypothetical baseline scenario. In the long term, three CPFs are projected to be built under a hypothetical scenario. This could include two in the high potential area and one in the medium potential area south of Kaktovik. Approximately 18 satellite pads are projected to be developed under a hypothetical scenario, in addition to the three production pads associated with the CPFs. It is estimated that approximately 213 miles of gravel road would be needed to connect facilities, and one seawater treatment plant and one barge landing and storage pad would be needed under a hypothetical scenario. Under the hypothetical development scenario for this alternative, it is expected that the 2,000-acre surface disturbance cap would be reached. See *Surface Disturbance Due to Oil and Gas*, below, for more details on the surface disturbance projected to be created under the hypothetical development scenario for this alternative.

B.8.4 Alternative D1

Due to restrictions and stipulations under this alternative, the potential locations for drill pads and CPFs under a hypothetical development scenario could be limited, and pad configurations could change. In the long term, two CPFs are projected to be built under a hypothetical scenario. Typically, this could include one in the high potential area and one in the medium potential area south of Kaktovik. The assumption is that approximately 21 satellite pads would be developed under this hypothetical scenario, in addition to the two production pads associated with the CPFs. It is estimated that approximately 218 miles of gravel road would be needed to connect facilities, and one seawater treatment plant and one barge landing and storage pad would be needed under a hypothetical scenario. Under the hypothetical development scenario for this alternative the 2,000-acre surface disturbance cap is expected to be reached. See *Surface Disturbance Due to Oil and Gas*, below, for more details on the surface disturbance projected to be created under the hypothetical development scenario for this alternative.

B.8.5 Alternative D2

Due to restrictions and stipulations under this alternative, the potential locations for drill pads and CPFs under a hypothetical development scenario could be limited, and pad configurations could change. In the long term, two CPFs are expected to be built under a hypothetical scenario. Typically, this could include one in the high potential area and one in the medium potential area south of Kaktovik. The assumption is that approximately 21 satellite pads would be developed under a hypothetical development scenario, in addition to the two production pads associated with the CPFs. It is estimated that approximately 217 miles of gravel road would be needed to connect facilities, and one seawater treatment plant and one barge landing and storage pad would be needed under a hypothetical scenario. Under the hypothetical development scenario for this alternative, the 2,000-acre surface disturbance cap is expected to be reached. See *Surface Disturbance Due to Oil and Gas*, below, for more details on the surface disturbance projected to be created under the hypothetical development scenario for this alternative. Because a timing limitation stipulation would be applied to the entire Coastal Plain under this alternative, the time frames for reaching peak production could be extended, compared with the other action alternatives.

B.9 Surface Disturbance Due to Potential Future Oil Development

B.9.1 Production Facilities

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 50 acres (BLM 2012). Similar projects estimate gravel needs at 10,000 cubic yards per acre (BLM 2012), for a total of 500,000 cubic yards per 50-acre CPF.

A typical satellite well pad associated with potential future development in the Coastal Plain is projected to have approximately 30 wells and occupy approximately 12 acres. A well pad of this size would require approximately 120,000 cubic yards of gravel.[9] Pads would be constructed to a thickness sufficient to maintain a stable thermal regime. This hypothetical scenario assumes an approximately 5-foot thickness, based on data from Point Thomson (USACE 2012).

B.9.2 Support Facilities

A seawater treatment plant supplies 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 future pad of this size would require approximately 150,000 cubic yards of gravel.

B.9.3 Roads and Pipelines

Roads from similar oil and gas developments create a ground disturbance of approximately 7.5 acres per mile (BLM 2012). Roads are projected to be the greatest source of disturbance associated with potential future petroleum development in the Coastal Plain. Depending on the hypothetical development scenario for each alternative, anywhere from an estimated 1,550 to 1,650 acres of road could be built. Road requirements are somewhat elastic in that operators could route roads through Native or State lands or even build some roadless developments if there were a possibility of the 2,000-acre disturbance cap being exceeded.

Potential pipelines would be used to transport oil to the potential CPFs and eventually to TAPS. They are also used to transport water, fuel, and electricity to satellite pads. Pipeline VSMs are counted toward the 2,000-acre disturbance cap, but spans are not. VSMs in the Arctic create approximately 0.04 acres of surface disturbance per pipeline mile (BLM 2012). The estimate is that approximately 210 to 250 miles of pipeline would be constructed in the Coastal Plain under the hypothetical development scenarios for each alternative, depending on field design; this would disturb approximately 8.4 to 10 acres of ground.

[9]Based on gravel need estimates from NPR-A IAP/EIS (BLM 2012).

B.9.4 Gravel Mines

Potential pits would be constructed to supply gravel needs for pads and roads related to potential future development. It is estimated that between 12,600,000 and 12,900,000 cubic yards of gravel would be required to construct roads, airstrips and pads for wells, CPFs, seawater treatment plants and storage under the hypothetical development scenarios for each alternative. Gravel could be sourced from hard rock or unconsolidated sand and gravel deposits, depending on what sources are available in the area surrounding development. Due to the number of outcrops and surface deposits in the Coastal Plain, potential pits are expected to be constructed next to facilities or roads used for satellite access, and additional road construction is not expected to be needed to access potential gravel mines.

In estimating potential gravel mine sizes, a low-disturbance case was created, assuming that potential pits would be excavated to a 50-foot depth as is industry standard practice. A maximum-disturbance case assumes an average pit depth of 25 feet in the case of technical challenges, such as water infiltration or material not adhering well enough in side slopes to reach full excavation depth.

In the low-disturbance case, factoring in additional acreage for side slopes and overburden storage, it is estimated that approximately 165 to 176 acres of surface disturbance would be required to supply all Coastal Plain gravel needs from potential development in the future; in the maximum-disturbance case, up to 320 acres of surface disturbance could be required.

The BLM's interpretation of PL 115-97 is that gravel mines are not oil and gas production or support facilities, so they would not count toward the 2,000-acre surface disturbance cap.

B.9.5 Potential Surface Disturbance Estimates

Tables B-4 and **B-5**, below, show potential surface disturbance estimates for the construction of potential oil and gas production facilities and infrastructure.

Table B-4
Estimated Surface Disturbance by Facility

Baseline Facility Sizes[10]	Acres of Estimated Surface Disturbance
CPF, airstrip, anchor well pad	50
Satellite pads	12
Gravel roads connect CPF to satellites	7.5 per mile
VSMs	0.04 per mile
Seawater treatment plant	15
Barge landing and equipment storage	10

Sources: BLM 2004, 2012; USACE 2017

[10]Baseline facility sizes were determined based on facility sizes from comparable North Slope projects, such as Alpine, and the professional expertise of BLM and Alaska Department of Natural Resources staff.

Table B-5
Hypothetical Projected Facilities and Estimated Surface Disturbance by Alternative[1]

Facility Type	Alternative B		Alternative C		Alternatives D1 and D2 (and Baseline Scenario)	
	Number of Potential Facilities	Estimated Acres of Disturbance	Number of Potential Facilities	Estimated Acres of Disturbance	Number of Potential Facilities	Estimated Acres of Disturbance
CPF, airstrip, anchor well pad	4	200	3	150	2	100
Satellite pads	17	204	18	216	21	252
Roads: CPF to satellites	208 miles	1,560	213 miles	1,598	218 miles	1,635
VSMs	279 miles	11	282 miles	11	289 miles	11
Seawater treatment plant	1	15	1	15	1	15
Barge landing and storage	1	10	1	10	1	10
Total (approximate)	-	**2,000**	-	**2,000**	-	**2,000**

Sources: BLM 2004, BLM 2012, USACE 2017

[1]All potential facility numbers and surface disturbance acreages are general hypothetical estimates and are not based on specific project proposals. Acreages are approximate and rounded to the nearest acre.
- = not applicable

B.10 Economic Impacts

Issuance of an oil and gas lease under the directives of Section 20001(c)(1) of PL 115-97 has no direct impacts on the environment; however, it is a commitment of oil and gas resources for potential future exploration and development, subject to environmental review and permits, that would result in future indirect impacts from exploration and development activities. Indirect impacts because of a lease sale include direct and indirect impacts from post-lease activities, including seismic and drilling exploration, development, and transportation of oil and gas in and from the Coastal Plain. Therefore, an analysis is provided of the potential direct and indirect impacts that may follow a leasing decision along with the potential cumulative impacts throughout the entire program area.

Following issuance of an oil and gas lease, subsequent potential future development of oil and gas resources in the Coastal Plain would have direct and indirect economic impacts on the economy. **Table B-6**, below, estimates the number of direct and indirect jobs that would be created because of potential future exploration, development, and production in the Coastal Plain.

Direct and indirect income projected to be created by potential future Coastal Plain development is shown in **Table B-7**, below.

Table B-6
Projected Direct and Indirect Jobs: Potential Exploration, Development, and Production Phases

Effects	Jobs (average number of part-time and full-time jobs)	Annual Average	Peak
Direct	Exploration	250	650
	Development	480	680
	Production	730	1,150

Effects	Jobs (average number of part-time and full-time jobs)	Annual Average	Peak
Indirect	Exploration	190	560
	Development	3,180	4,570
	Production	3,160	4,970

Source: Northern Economics estimates, based on the following models and data sources: i) Alaska Department of Natural Resources Cash Flow model (modified for use in this analysis), ii) MAG-PLAN model (used to estimate some of the capital expenditures); iii) Spring 2018 Revenue Forecast published by the Alaska Department of Revenue (for data on transportation costs); iv) Annual Energy Outlook 2018 published by the Energy Information Administration (for data on oil price projections); v) IMPLAN model (used to estimate direct, indirect, induced effects); vi) Attanasi and Freeman 2009 (used to estimate some capital expenditures of petroleum development)

Table B-7
Projected Direct and Indirect Labor Income: Potential Exploration, Development, and Production Phases

Effects	Labor Income (in Millions of 2017 Dollars)	Annual Average	Peak
Direct	Exploration	$29	$77
	Development	$97	$140
	Production	$125	$197
Indirect	Exploration	$10	$30
	Development	$214	$307
	Production	$212	$307

Source: Northern Economics estimates based on the following models and data sources: i) Alaska Department of Natural Resources Cash Flow model (modified for use in this analysis), ii) MAG-PLAN model (used to estimate some of the capital expenditures); iii) Spring 2018 Revenue Forecast published by the Alaska Department of Revenue (for data on transportation costs); iv) Annual Energy Outlook 2018 published by the Energy Information Administration (for data on oil price projections); v) IMPLAN model (used to estimate direct, indirect, induced effects); vi) Attanasi and Freeman 2009 (used to estimate some capital expenditures of petroleum development)

Government revenues projected to be created by leasing and potential future Coastal Plain development are shown in **Table B-8**, below. These revenues represent estimates of the taxes and royalties that would be collected from leasing, developing, producing, and transporting oil and gas resources from the Coastal Plain. These estimates are based on the hypothetical baseline scenario detailed in **Section B.5.** Additionally, local governments could experience increased economic activity and revenues from an increase in hotel/bed tax collections.

The stipulations applied under Alternatives B, C, D1, and D2 could result in unquantifiable diversions from the hypothetical baseline scenario presented above. The impacts associated with stipulations could result in additional consultations with stakeholders, studies for permitting, delays for timing limitations, and construction of additional facilities and infrastructure. Some of these actions could result in higher employment and income effects due to additional expenditures that would be necessary to comply with the required operating procedure, including additional spending on consultation and studies. Some of these actions could also delay exploration, development, and production and would therefore also delay potential employment and income effects and revenues that could accrue to the local, state, and federal governments.

Table B-8
Projected North Slope Borough, State, and Federal Government Revenues

Government Revenues (in Millions of 2017 Dollars)	Annual Average	Total
North Slope Borough property taxes	$52	$1,192
State royalties	$894	$21,463
State taxes	$2,151	$49,473
Federal royalties	$894	$21,463
Federal taxes	$462	$11,082

Source: Northern Economics estimates based on the following models and data sources: i) Alaska Department of Natural Resources Cash Flow model (modified for use in this analysis), ii) MAG-PLAN model (used to estimate some of the capital expenditures); iii) Spring 2018 Revenue Forecast published by the Alaska Department of Revenue (for data on transportation costs); iv) Annual Energy Outlook 2018 published by the Energy Information Administration (for data on oil price projections); v) Attanasi and Freeman 2009 (used to estimate some capital expenditures of petroleum development)

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Appendix C. Collaboration and Coordination

C.1 List of Preparers

Preparer	Name	Role/Responsibility
BLM Interdisciplinary Team	Nicole Hayes	Project Manager
	Cathy Hillis	GIS
	Cindy Hamfler	GIS
	Erin Julianus	Section 810 Preliminary Evaluation; Subsistence Uses and Resources
	Scott Guyer	Climate and Meteorology; Soil Resources; Vegetation and Wetlands
	Alan Peck	Air Quality; Water Resources
	Steve Masterman (Alaska Department of Natural Resources)	Physiography
	Paul Decker (Alaska Department of Natural Resources)	Geology and Minerals
	Rob Brumbaugh	Petroleum Resources
	Jessie Chmielowski	Petroleum Resources
	Brent Breithaupt	Paleontological Resources
	Joe Galluzzi	Sand and Gravel Resources
	Richard Kemnitz	Water Resources
	Mike McCrum	Solid and Hazardous Waste
	Melody Debenham	Solid and Hazardous Waste
	Matt Whitman	Fish and Aquatic Species
	Casey Burns	Birds; Terrestrial Mammals; Marine Mammals
	Jack Winters (State of Alaska)	Terrestrial Mammals
	Craig Perham (Bureau of Ocean Energy Management)	Marine Mammals
	Donna Wixon	Land Ownership and Uses
	Bob King	Cultural Resources
	Joe Keeney	Cultural Resources
	Randy Goodwin	Recreation; Special Designations (includes Marine Protected Areas, Wild and Scenic Rivers, and Wilderness Characteristics, Qualities, and Values); Visual Resources; Transportation
	Tom Bickauskus	Recreation; Special Designations (includes Marine Protected Areas, Wild and Scenic Rivers, Wilderness Characteristics, Qualities, and Values)
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	James Lima (Bureau of Ocean Energy Management)	Sociocultural Systems; Environmental Justice
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Preparer	Name	Role/Responsibility
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	Jenna Jonker	GIS
	Alex Dierker	GIS
	Francis Craig	GIS; Reasonably Foreseeable Development Scenario
	Angie Adams	Special Designations Team Lead
	Zoe Ghali	Social Systems Team Lead
	Katie Patterson, JD	Nonrenewable Resources Team Lead; Petroleum Resources; Reasonably Foreseeable Development Scenario
	Sean Cottle	CARA/Comment Analysis Lead; Special Designations (includes Marine Protected Areas, Wild and Scenic Rivers, Wilderness Characteristics, Qualities, and Values)
	Sarah Crump	Decision File/Administrative Record Lead; ePlanning Lead
	Katlyn Lonergan	Decision File/Administrative Record
	Kate Krebs	Facilitator
	Amy Cordle	Air Quality; Climate and Meteorology; Acoustics
	Kevin Doyle	Paleontological Resources; Cultural Resources
	Derek Holmgren	Soil Resources; Water Resources; Visual Resources; Public Health and Safety
	Meredith Zaccherio	Vegetation and Wetlands
	Lindsay Chipman, PhD	Fish and Aquatic Species
	Kevin Rice	Birds; Terrestrial Mammals; Marine Mammals
	Peter Gower, AICP, CEP	Landownership and Use; Recreation; Transportation
	Matthew Smith	Public Health and Safety
	Randy Varney	Technical Editing
	Cindy Schad	Word Processing / 508 Compliance
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	Terry Schick	Vegetation and Wetlands
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	Adrian Gall	Birds; Marine Mammals
	Alexander Prichard	Terrestrial Mammals; Marine Mammals
	Brian Lawhead	Terrestrial Mammals; Marine Mammals
DOWL	Keri Nutter	Soil Resources; Sand and Gravel Resources
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	Leyla Arsan	Fish and Aquatic Species
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	Michael Downs, PhD	Environmental Justice

Preparer	Name	Role/Responsibility
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	Paul Lawrence	Cultural Resources; Subsistence Uses and Resources; Sociocultural Systems; Section 810 Preliminary Evaluation
	Elizabeth Sears	Subsistence Uses and Resources; Sociocultural Systems; Section 810 Preliminary Evaluation
	Jake Anders	Cultural Resources

C.2 GOVERNMENT-TO-GOVERNMENT CONSULTATION

Location	Date	Tribal Government
Arctic Village	May 23, 2018	Arctic Village Council and Native Village of Venetie
Venetie	June 11, 2018	Native Village of Venetie, Venetie Village Council, Arctic Village Council
Kaktovik	June 13, 2018	Native Village of Kaktovik
Fort Yukon	August 30, 2018	Beaver Village Council, Chalkyitsik Village Council
Arctic Village	October 2, 2018	Native Village of Venetie, Venetie Village Council, Arctic Village Council
Kaktovik	October 9, 2018	Native Village of Kaktovik
Anchorage	October 17, 2018	Beaver Village Council

C.3 ANCSA CORPORATION CONSULTATION

Corporation	Date
Arctic Slope Regional Corporation	April 25, May 18, June 16, July 27, and October 19, 2018
Doyon Limited	July 6, 2018
Kaktovik Inupiat Corporation	June 13, and October 9, 2018

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Appendix D
Laws and Regulations

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Appendix D. Laws and Regulations

Requirements of federal, state, and local laws and regulations associated with future development in the Coastal Plain are provided below.

D.1 International Agreements

D.1.1 International Porcupine Caribou Herd Agreement

In 1987, the United States and Canadian governments signed the Agreement between the Government of the United States of America and the Government of Canada on the Conservation of the Porcupine Caribou Herd. This bilateral agreement recognizes that the Porcupine caribou herd (PCH) regularly migrates across the international boundary between Canada and the United States. It further recognizes that the herd should be conserved according to ecological principles that emphasize the importance of conserving habitat, including calving, post-calving, migrating, wintering, and seeking insect relief habitat.

The main objectives of the agreement are to conserve the PCH and its habitat through international cooperation and coordination so that the risk of irreversible damage or long-term adverse effects, including cumulative effects, as a result of use of caribou or their habitat is minimized. It also ensures opportunities for customary and traditional uses of the PCH. The agreement set up the International Porcupine Caribou Board, composed of representatives from both countries, who give advice and recommendations to the countries on the conservation and management of the herd. The International Porcupine Caribou Board, in turn, set up the Porcupine Caribou Technical Committee, composed of biologists from each country, to advise them in their recommendations. This agreement was signed by the United States on July 17, 1987, in Ottawa, Canada, and entered into force in this country at that time.

D.1.2 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. It recognizes the responsibilities of circumpolar countries for coordinating actions to protect polar bears. The agreement prohibits hunting, killing, and capturing polar bears, except for bona fide scientific and conservation purposes, preventing serious disturbance to the management of other living resources, and by local people under traditional rights. 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 United States on November 15, 1973, in Oslo, Norway; it was ratified on September 30, 1976, and went into force in this country on November 1, 1976.

D.1.3 Inuvialuit-Iñupiat Polar Bear Management Agreement (I–I 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 I–I Agreement is a voluntary user-to-user agreement between Inuvialuit (in Canada) and Inupiat (in Alaska) hunters. It provides for annual quotas, hunting seasons, protection of bears in or during construction of dens, females accompanied by cubs-of-the-year and yearlings, collection of information and specimens to monitor harvest composition, and annual meetings to exchange information on the harvest, research, and management. The I-I also establishes a joint commission to implement the I-I Agreement, and a technical advisory committee, consisting of biologists from agencies in the US 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

The following summarizes federal laws and regulations relevant to the oil and gas leasing program on the Coastal Plain. Some obligations would be placed directly on the applicant. Others would be required of federal agencies before they would grant authorizations to oil and gas companies.

D.2.1 Bureau of Land Management (BLM)

- The National Environmental Policy Act of 1969 (NEPA) sets out policy and provides the means by which the federal government, including the 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 (EIS) (42 United States Code [USC] 4321 et seq.).
- Section 28 of the Mineral Leasing Act of 1920 (30 USC 185; 43 Code of Federal Regulations [CFR] 2880), provides the BLM with the authority to issue right-of-way grants for oil and natural gas pipelines and related facilities (not authorized by appropriate leases).
- Section 810 of the Alaska National Interest Lands Conservation Act (ANILCA) 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 USC 3120).
- The Tax Cuts and Jobs Act of 2017 (Section 20001(c)(1) of Public Law [PL] 115-97, December 22, 2017) directs the Secretary of the Interior, acting through the BLM, to establish and administer a competitive oil and gas program for the leasing, development, production, and transportation of oil and gas in and from the Coastal Plain in the Arctic National Wildlife Refuge (Arctic Refuge). PL 115-97 amends ANILCA Section 1003 to authorize oil and gas leasing in the Coastal Plain and authorizes the BLM to issue rights-of-way or easements across the Coastal Plain for the exploration, development, production, or transportation necessary to carry out the oil and gas leasing program.
- The BLM issues geophysical permits to conduct seismic activities, as described in 43 CFR 3150.
- The BLM reviews and approves applications for permit to drill (including drilling plans and surface-use plans of operations) and subsequent well operations, as prescribed in 43 CFR 3160, for development and production on federal leases.
- As described in 43 CFR 3130 and 3180, 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.
- Section 106 of the National Historic Preservation Act of 1966 (PL 89-66) requires the BLM to consider the effects of federal undertakings on historic properties.
- The BLM consults with the US Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS) regarding the effects of its actions on threatened and endangered species and designated critical habitat.

- The BLM conducts Executive Order (EO) 13075 tribal consultation and consultation under the Alaska Native Claims Settlement Act of 1971.
- Under the Magnuson-Stevens Fishery Conservation and Management Act, the BLM conducts an essential fish habitat consultation with NMFS regarding authorized, funded, or undertaken actions that may adversely affect essential fish habitat.
- The BLM issues material sale permits.

D.2.2 US Fish and Wildlife Service

- The USFWS manages the Arctic Refuge, as defined under Section 303(2) of ANILCA, which establishes the Arctic National Wildlife Refuge and additions as part of the National Wildlife Refuge System. The purposes for which the Arctic Refuge is established and is managed are as follows: (i) to conserve fish and wildlife populations and habitats; (ii) to fulfill the international treaty obligations of the United States with respect to fish and wildlife and their habitats; (iii) to provide, in a manner consistent with the purposes set forth above in (i) and (ii), the opportunity for continued subsistence uses by local residents; and (iv) to ensure, to the maximum extent practicable and in a manner consistent with the purposes set forth in (i), water quality and necessary water quantity win the refuge. PL 115-97 amended Section 303(2)(B) of ANILCA to add as a purpose of the Arctic Refuge "to provide for an oil and gas program on the Coastal Plain."
- The mission of the National Wildlife Refuge System Administration Act, as amended through the National Wildlife Refuge Improvement Act, is "to administer a network of lands and waters for the conservation, management and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans." Under the National Wildlife Refuge System Administration Act, each refuge shall adhere to the mission of the National Wildlife Refuge System. The USFWS is required to monitor the status and trends of fish, wildlife, and plants in each refuge.
- 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 (ESA) states that all federal agencies shall, in consultation with and with the assistance of the Secretary of the Interior or Commerce (Secretary), ensure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered species 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 USC 1538) of the ESA identifies prohibited acts related to endangered species and prohibits all persons, including all federal, state, and local government employees, from taking listed species of fish and wildlife, except as specified under provisions for exemption (16 USC 1535(g)(2) and 1539). Generally, the USFWS manages land and freshwater species, while NMFS manages marine species, including anadromous salmon; however, the USFWS is responsible for some marine animals, such as nesting sea turtles, walrus, polar bears, sea otters, and manatees.
- All marine mammals are protected under the Marine Mammal Protection Act of 1972 (MMPA) (16 USC 1361 et seq.). Jurisdiction of the MMPA is shared by NMFS and the USFWS, depending on the species being considered. Under the MMPA, the taking of marine mammals without a

permit or exception is prohibited. "Take" under the MMPA, 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 (16 USC 703-712) 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 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, the USFWS provides consultation on impacts on fish and wildlife resources.

D.2.3 Environmental Protection Agency (EPA)

The EPA's authority to regulate oil and gas development is contained in the Clean Water Act of 1972 (CWA) (33 USC 1251 et seq.), Clean Air Act of 1963 (CAA) (42 USC 7401 et seq.), and the Safe Drinking Water Act of 1974 (42 USC 300f et seq.). These authorities are discussed below.

- Under Section 402 of the CWA (33 USC 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 US for facilities, including oil and gas, operating within state jurisdiction. Point-source discharges that require an Alaska Pollutant Discharge Elimination System (APDES) 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 US 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 (42 USC 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 cover injection of nonhazardous and hazardous waste through a permitting process for fluids that are recovered from down hole. Also covered are municipal waste, stormwater, and other fluids that did 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, which 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).

- Under Section 311 of the CWA, as amended (33 USC 1321, 40 CFR 112), the EPA requires a "spill prevention containment and countermeasure plan" for storage of 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 USC 40; FRP Rule; 40 CFR 112, Subpart D, Sections 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 USC 7475) and 502 of the CAA (42 USC 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 maintains oversight authority of the State's program.
- Under Section 309 of the CAA (42 USC 7609), the EPA requires a review and evaluation of the draft and final EIS for compliance with Council on Environmental Quality guidelines.
- The EPA retains oversight authority over the APDES program.

D.2.4 National Marine Fisheries Service

NMFS is responsible for the stewardship of national marine resources. The agency conserves and manages fisheries to promote sustainability and prevent lost economic potential associated with overfishing, declining species, and degraded habitats.

- Provides consultation under the ESA, Section 7(a)(2) on the effects on threatened or endangered species
- Provides consultation under the Fish and Wildlife Coordination Act on the effects on fish and wildlife resources
- Provides consultation under the MMPA on the effects on marine mammals; issues Incidental Harassment Authorization under the MMPA for incidental takes of protected marine mammals (bowhead whales and ringed seals)
- Provides consultation under the Magnuson-Stevens Fishery Conservation and Management Act 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 US 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 US, including wetlands, and for work or structures in, on, over, or under navigable waters of the US. These USACE authorities are set forth as follows.

- Under Section 404 of the CWA (33 USC 1251 et seq.), the USACE regulates discharges of dredge and fill material in waters of the US, including wetlands.
- Under Section 10 of the Rivers and Harbors Act of 1899 (33 USC 403), the USACE has regulatory authority for work and structures performed in, on, over, or under navigable waters of the US.
- Under Section 103 of the Marine Protection Research and Sanctuaries Act of 1972 (33 USC 1413), the USACE issues Section 103 ocean dumping permits for transport of dredged material for ocean disposal.

D.2.6 Bureau of Ocean Energy Management

The Bureau of Ocean Energy Management provided subject matter expertise in the drafting and review of this NEPA document as part of the BLM Interdisciplinary Team. The Interagency Working Group on Coordination of Domestic Energy Development and Permitting in Alaska, established under EO 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 EOs may apply, as follows: EOs 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 temporary water use and water rights permits, permits for cultural resource surveys, cultural resource concurrences, 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 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 plan for exploration and development. Additional State authorities are presented below.

D.4.1 Alaska Department of Natural Resources

- Issues rights-of-way and land use permits for use of State land, ice road construction on State land, and State freshwater bodies under Alaska Statute (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 Alaska cultural resource permits for surveys under the Alaska Historic Preservation Act (AS 41.35.080)
- Issues cultural resources concurrences for development on State land (but not on federally managed land) that may affect historic or archaeological sites under the National Historic Preservation Act of 1966, as amended (16 USC 470 et seq.), and the Alaska Historic Preservation Act (AS 41.35.010 through .240)
- Adjudicates instream flow reservations and other applications for reserved water rights under AS 46.15.145, Reservation of Water; permissible in-stream uses are 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 State Historic Preservation Officer (SHPO); the National Historic Preservation Act Section 106 requires federal agencies to avoid or minimize impacts on properties listed on or eligible for listing on the National Register of Historic Places and requires federal agencies to check for sites that may be eligible and determine eligibility. This consultation is done through the SHPO.

D.4.2 Alaska Department of Environmental Conservation

- Issues an APDES "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 USC 1342); AS 46.03.020, .100, .110, .120, and .710; 18 Alaska Administrative Code (AAC) Chapters 15 and 70, and Section 72.500; these permits may include a mixing zone approval where appropriate; in addition to developing, issuing, modifying, and renewing permits, the APDES program includes the Storm Water Program, Compliance and Enforcement, Federal Facilities, and the Pretreatment Program
- Issues a certificate of reasonable assurance for permits issues by the USACE under Section 404 of the CWA; these permits may include discharge of dredge and fill material into Waters of the US
- Issues a Class I well wastewater disposal permit for underground injection of non-domestic wastewater under AS 46.03.020, .050, and .100
- Reviews and approves all public water systems, including plans, monitoring programs, and operator certifications under AS 46.03.020, .050, .070, and .720, 18 AAC, Section 80.005
- Approves domestic wastewater collection, treatment, and disposal plans for domestic wastewaters (18 AAC, Chapter 72)
- Approves financial responsibility for cleanup of oil spills (18 AAC, Chapter 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, Chapter 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 Chapter 50)

- Issues solid waste disposal permits for State lands under AS 46.03.010, 020, 100, and 110; AS 46.06.080; 18 AAC Section 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, 010, and 020 and 18 AAC, Section 60.430
- Approves the siting of hazardous waste management facilities

D.4.3 Alaska Department of Fish and Game

- AS 16.05.841—The Fishway Act, deals exclusively with fish passage; applies to streams with documented resident fish use and without documented use by anadromous fish
- AS 16.05.871—The Anadromous Fish Act, 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
- AS 16.05.841 and AS 16.05.871—Issues "fish habitat permits" for activities in streams used by fish that the agency determines could represent impediments to fish passage or for travel in, excavation of, or culverting of anadromous fish streams
- Issues public safety permit 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 Resource or, via the Fish and Wildlife Coordination Act, to federal permitting agencies

D.4.4 Alaska Oil and Gas Conservation Commission

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

D.4.5 Alaska Department of Public Safety

- Fire marshal approval

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.

Appendix E
ANILCA Section 810 Preliminary Evaluation

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Map

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Appendix E. ANILCA Section 810 Preliminary Evaluation

E.1 Subsistence Evaluation Factors

Section 810(a) of the Alaska National Interest Lands Conservation Act (ANILCA), 16 United States Code (USC) 3120(a), requires that an evaluation of subsistence uses and needs be completed for any federal determination to "withdraw, reserve, lease, or otherwise permit the use, occupancy, or disposition of public lands." As such, an evaluation of potential impacts on subsistence under ANILCA Section 810(a) must be completed for the Coastal Plain Oil and Gas Leasing Program Environmental Impact Statement (Leasing EIS or EIS). ANILCA requires that this evaluation include findings on three specific issues, as follows:

- The effect of use, occupancy, or disposition of public lands on subsistence uses and needs
- The availability of other lands for the purposes sought to be achieved
- Other alternatives that would reduce or eliminate the use, occupancy, or disposition of public lands needed for subsistence purposes

Per Bureau of Land Management (BLM) Instruction Memorandum No. AK-2011-008 (BLM 2011), three factors are considered when determining if a significant restriction of subsistence uses and needs may result from the proposed action, alternatives, or in the cumulative case, as follows:

- Reduction in the *abundance* of harvestable resources used for subsistence purposes
- Reduction in the *availability* of resources used for subsistence caused by alteration of their distribution, migration patterns, or location
- Legal or physical limitations on *access* of subsistence users to harvestable resources

Each alternative must be analyzed according to these criteria. ANILCA Section 810 also requires that cumulative impacts be analyzed. This approach helps the reader separate subsistence restrictions that could be caused by activities proposed under the five alternatives from those that could be caused by past, present, or future activities that have occurred or could occur in the surrounding area.

An alternative would be considered to significantly restrict subsistence uses if, after consideration of protection measures, such as lease stipulations or required operating procedures, it can be expected to substantially reduce the opportunity to use subsistence resources (BLM 2011). Substantial reductions are generally 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.

If the analysis determines that the proposed action, alternatives, or the cumulative case may significantly restrict subsistence uses, the BLM is required to notify the State of Alaska and appropriate regional and local subsistence committees. It also must conduct ANILCA Section 810 hearings in potentially affected communities.

It is possible that the finding may be revised to "will not significantly restrict subsistence uses" based on changes to alternatives, new information, or new mitigation measures resulting from the hearings. If the significant restriction remains, the BLM may prohibit the action or finalize the evaluation by making the following determinations:

- A significant restriction of subsistence uses would be necessary, consistent with sound management principles for the use of public lands
- The proposed activity would involve the minimal amount of public land necessary to accomplish the purpose of the use, occupancy, or other disposition
- Reasonable steps would be taken to minimize adverse effects on subsistence uses and resources resulting from such actions (Section 810(a)(3))

The BLM can then authorize use of the public lands.

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

This ANILCA Section 810 preliminary evaluation relies primarily on the information contained in the Leasing EIS. **Chapter 3** describes areas and resources important for subsistence, and specific communities' degree of dependence on various fish and wildlife resources. It also describes the environmental consequences anticipated under each alternative, which the BLM uses to determine whether each alternative and the cumulative case would cause a significant restriction to subsistence uses. Consistent with NEPA and Council on Environmental Quality (CEQ) guidance, this preliminary evaluation does not analyze or present impacts under a worst-case scenario. Rather, it discusses impacts under each alternative based on the assumptions and discussion in the hypothetical development scenario (**Appendix B**).

Issuance of oil and gas leases under the directives of Section 20001(c)(1) of Public Law (PL) 115-97 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, a lease does grant the lessee certain rights to drill for and extract oil and gas subject to further environmental review and reasonable regulation, including applicable laws, terms, conditions, and stipulations of the lease. The impacts of such future exploration and development activities that may occur because of the issuance of leases 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 Coastal Plain. Therefore, the analysis in Chapter 3 is of potential direct, indirect, and cumulative impacts from on-the-ground post-lease activities.

The Leasing EIS uses a hypothetical development scenario (see **Appendix B**) to inform the impact analysis for each alternative; however, additional National Environmental Policy Act (NEPA) and ANILCA Section 810 analyses would occur with future site-specific proposals. The regulations governing leasing and development provide for multiple decision stages prior to any ground-disturbing activities being authorized and require further compliance with applicable laws, including NEPA, during post-leasing decision stages. Until the BLM receives and evaluates an application for an exploration permit, permit to drill, or other authorization that includes site-specific information about a particular project, impacts of actual exploration and development that might follow lease issuance are speculative, as so much is unknown as to location, scope, scale, and timing of that exploration and development. At each decision stage, the BLM retains the authority to approve, deny, or reasonably condition any proposed on the ground-disturbing activity based on compliance with applicable laws and policies. Therefore, the analysis of effects of exploration and development in this Leasing EIS necessarily reflects a more general, programmatic approach than could occur at the post-lease project-specific stage.

The EIS focuses on describing potential subsistence impacts to four communities: Kaktovik, Nuiqsut, Arctic Village, and Venetie. Kaktovik and Nuiqsut engage in subsistence activities in and around the program area. Kaktovik uses the program area to procure most of the resources they harvest (**Map 3-28** through **Map 3-39** in **Appendix A**). Nuiqsut's marine mammal and furbearer use areas overlap the program area (**Map 3-40** through **Map 3-43** in **Appendix A**). Arctic Village and Venetie subsistence use areas do not overlap the program area, but these communities rely heavily on resources that use the program area, specifically caribou from the Porcupine Caribou Herd (PCH) (**Map 3-44** in **Appendix A**).

While the EIS describes potential impacts to subsistence use of all resources, this preliminary evaluation focuses on impacts to subsistence use of fish, marine mammals (bowhead and beluga whales, bearded seals), and caribou. Other resources such as waterfowl, polar bears, and furbearers may be culturally important to residents of these communities, but they do not comprise the majority of the wild foods consumed by residents of Kaktovik, Nuiqsut, Arctic Village, or Venetie (**Section 3.4.3**, Subsistence Uses and Resources). Residents of Kaktovik and Nuiqsut rely most heavily on fish, marine mammals, and caribou. Combined, these resources make up 98 percent of the harvest for Kaktovik and 97 percent of the harvest for Nuiqsut (**Tables 3-32** and **3-33** in **Chapter 3**). Fish and large mammals (caribou and moose) make up 86 percent of the harvest for Venetie (**Table 3-35** in **Chapter 3**). Nineteen percent of Venetie's annual harvest is caribou, although they receive appreciably more through sharing with other communities (Van Lanen et al. 2012; Kofinas et al. 2016). Detailed harvest data for Arctic Village is not available but it is likely similar to the harvest documented for Venetie.

In addition to Kaktovik, Nuiqsut, Arctic Village, and Venetie, 18 communities have positive customary and traditional use determinations for the PCH and/or the Central Arctic Herd (CAH) (**Map 3-27**, Subsistence Study Communities, in **Appendix A**). These 22 communities, referred to in the EIS as the caribou study communities, could be affected by impacts on caribou abundance and availability, and were therefore included in **Chapter 3**. Those communities with the greatest reliance (where caribou accounts for greater than 10 percent of the annual subsistence harvest, and on average over 50 percent of households use caribou) include Alatna, Anaktuvuk Pass, Bettles, Coldfoot, Eagle, Kaktovik, Nuiqsut, Point Lay, Utqiagvik, Venetie, Wainwright, Wiseman, and likely Arctic Village (although detailed harvest data is not available for this community). Alatna, Bettles, Point Lay, Utqiagvik and Wainwright harvest caribou primarily from the Western Arctic Herd, and Eagle harvests caribou primarily from the Fortymile Herd. These herds would not be impacted by development in the program area. Coldfoot, and Wiseman harvest primarily CAH caribou. The majority of Nuiqsut's harvest consists of Teshekpuk Lake Caribou Herd animals, although Nuiqsut also harvests caribou from the CAH. Anaktuvuk Pass harvests a combination of Western Arctic, Teshekpuk Lake, and CAH caribou. Teshekpuk Lake caribou would not be impacted by future oil and gas exploration, development, and production activities in the program area, and potential impacts on CAH caribou are expected to be low for Alternatives B, C, D1, and D2. Kaktovik, Arctic Village and Venetie rely heavily on PCH caribou. Therefore, Kaktovik, Arctic Village, and Venetie are the only communities that may be appreciably affected by changes in the abundance or availability of PCH caribou. For these reasons, caribou-related discussion in this preliminary evaluation focuses exclusively on impacts on the PCH caribou from future on-the-ground activities and consequent impacts on subsistence use of them by these three communities.

E.2.1 Evaluation and Finding for Alternative A: No Action

Alternative A would not comply with the directive in Section 20001 of PL 115-97 to establish and administer a competitive oil and gas program for leasing, developing, producing, and transporting oil and gas in and from the Arctic Refuge Coastal Plain. There would be no oil and gas lease sales in the program area. Current management actions and resource trends would continue in the program area, as described in the Arctic Refuge Revised Comprehensive Conservation Plan (CCP) (USFWS 2015). Existing impacts on subsistence uses and resources, described in **Section 3.4.3**, Subsistence Uses and Resources, would continue along current trends.

E.2.1.1 Evaluation of the Effect of Use, Occupancy, or Disposition on Subsistence Uses and Needs

The United States (US) Fish and Wildlife Service (USFWS) determined that the preferred alternative selected in the Record of Decision (ROD) for the Arctic Refuge Revised CCP (USFWS 2015) and subsequent cumulative effects would not significantly restrict subsistence use of resources in the program area.

E.2.1.2 Evaluation of the Availability of Other Lands for the Purpose Sought to be Achieved

Alternative A does not propose the disposition or use of public lands with regard to the proposed action; therefore, evaluating the availability of other lands is not applicable.

E.2.1.3 Evaluation of Other Alternatives that would Reduce or Eliminate the Use, Occupancy, or Disposition of Public Lands Needed for Subsistence

Alternative A would eliminate the use of public lands needed for subsistence purposes, but it does not meet the purpose of the proposed action, nor does it comply with PL 115-97.

E.2.1.4 Findings

Alternative A will not result in a significant restriction in subsistence uses. A positive determination pursuant to ANILCA Section 810 is not required.

E.2.2 Evaluation and Finding for Alternative B

Section B.8.2, Alternative B in **Appendix B**, speculates up to four central processing facilities (CPFs) would be built under Alternative B: two CPFs would be built in the high potential area, one CPF would be built in the medium potential area on State or native lands, or just south of Kaktovik, and one CPF would be built in the low potential area. Under this scenario, three or four production pads, 17 satellite pads, and 208 miles of road, a seawater treatment plant, and at least one barge landing and storage pad would be built. The 2,000-acre surface disturbance limit would be reached under Alternative B.

The hypothetical development scenario anticipates that future development would occur in the same manner as the baseline scenario described in **Appendix B** under Alternative B. The entire Coastal Plain would be offered for lease sale, and when compared to the other action alternatives, this alternative has the largest amount of acres where only Required Operating Procedures (ROPs) would apply (**Table 2-1** in **Chapter 2**). Approximately 359,400 acres would be subject to a no surface occupancy (NSO) stipulation to protect caribou calving habitat, fish and hydrologic resources, and subsistence activities adjacent to major rivers. There would be zero acres subject to controlled surface use (CSU), and 585,400 acres would be subject to timing limitations (TLs). Only standard terms and conditions would apply to approximately 618,700 acres. **Map 2-1**, Alternative B and **Map 2-2**, Alternative B, Lease Stipulations (**Appendix A**) illustrate where NSO, TLs, and standard terms and conditions would be adopted.

E.2.2.1 Evaluation of the Effect of Use, Occupancy, or Disposition on Subsistence Uses and Needs

This preliminary evaluation summarizes potential impacts on major subsistence resources (fish, marine mammals, and caribou) for residents of Kaktovik, Nuiqsut, Arctic Village, and Venetie before a discussion of other issues, such as impacts on resource access anticipated under Alternative B. **Table E-2** classifies each impact as minor, moderate, or major, based on the discussion in the EIS and BLM policy guidance (BLM 2011). **Table E-3** summarizes the extent to which impacts on access would affect subsistence users.

Fish

Section 3.3.2, Fish and Aquatic Species, describes potential impacts on non-salmon fish (primarily Dolly Varden and Bering cisco), which are important subsistence resources for residents of Kaktovik (**Table 3-32**). Impacts from future oil and gas exploration, development, and production that may affect subsistence harvest of non-salmon fish are as follows:

- Habitat loss or alteration
- Disturbance or displacement
- Injury or mortality due to noise, entrainment, or contaminants

Select streams listed in **Chapter 2** would have 0.5- to 1-mile setbacks for surface development under Alternative B; all other fish-bearing streams would have a 500-foot setback, and all of the nearshore marine, lagoon, and barrier island habitats of the Southern Beaufort Sea (within the boundary of the Arctic Refuge) would be subject to NSO. In addition, an impact and conflict avoidance and monitoring plan to assess, minimize and mitigate the effects of infrastructure on coastal habitats would be required. Numerous mitigation measures would be implemented to address impacts on fish and fish habitat, namely Lease Stipulations 1, 3, 4, and 9, and ROPs 3, 8, 9, 12, 13, 14, 15, 16, 18, 19, 20, 22, 24, 40, and 41. While potential impacts on fish would be most pronounced under this alternative, it is likely that the proposed mitigation measures would effectively reduce impacts on fish that are important to residents of Kaktovik. Dolly Varden or Bering cisco abundance or availability would not likely be affected to the extent that subsistence use of these fish would be significantly impaired.

Marine Mammals

Section 3.3.5, Marine Mammals, describes potential impacts on bowhead whales and ringed/bearded seals, which are important subsistence resources for residents of Kaktovik and Nuiqsut (**Tables 3-32** and **3-33**). Impacts from future oil and gas exploration, development, and production that may affect subsistence harvest of marine mammals are mortality or injury due to vessel strikes and disturbance or displacement due to vessel traffic or noise and activity associated with onshore infrastructure.

Whales and seals could be injured or killed by vessel strikes, although such events would be highly unlikely. Collisions with whales are rare for slow-moving vessels such as barges, and ringed/bearded seals are able to avoid oncoming vessels (George et al. 1994; Laist et al. 2001). There is no indication that vessel strikes would be a major source of mortality for whales or bearded/ringed seals during marine transport associated with future on-the-ground activities in the program area.

Large vessel traffic in the vicinity of Kaktovik could temporarily disturb or displace whales or bearded/ringed seals. These animals demonstrate habituation to noise and activity associated with vessel traffic and onshore infrastructure when disturbance does not result in physical injury, discomfort, or social stress (NRC 2003). This impact would not have population-level effects.

Potential impacts on marine mammals important for subsistence would be minor or effectively mitigated under Alternative B. Specifically, Lease Stipulation 4 would require NSO in nearshore marine, lagoon and barrier island habitats, Lease Stipulation 9 would require that lessees implement a conflict avoidance and monitoring plan for coastal areas. In addition, the standard terms and conditions that would apply under Alternative B would sufficiently mitigate residual impacts to subsistence use of bowhead whales and seals by residents of Kaktovik and Nuiqsut.

Caribou

Table 3-22 lists potential impacts on terrestrial mammals, including caribou. Impacts from future oil and gas exploration, development, and production that may affect subsistence use of caribou are as follows:

- Habitat loss or alteration
- Mortality or injury due to vehicle collisions
- Altered movement patterns due to linear infrastructure
- Altered caribou behavior due to aircraft traffic
- Displacement of maternal caribou during calving

Direct habitat loss associated with future on-the-ground activities would occur on 2,000 acres in the program area. Additional habitat in the vicinity of infrastructure would be affected by dust deposition, gravel spray, thermokarst, flow alteration, and impoundments. Direct habitat loss would reduce forage availability for caribou. Aside from concentrations of the high-quality tussock tundra and moist sedge-willow tundra vegetation types, which are a critical feature of the PCH primary calving grounds, foraging habitat is abundant across the program area.

Development in the PCH calving grounds may have behavioral effects on maternal caribou which could affect population size (described below); nevertheless, it is not likely that development on 2,000 acres in the calving grounds, insect relief habitat, or general summer habitat would reduce forage enough to affect caribou health or body fat reserves on a large scale. Caribou would be displaced from areas that no longer have suitable forage, but displacement is not expected to be widespread. Caribou could still forage within the total footprint of a CPF and its associated satellite well pads, for example. Caribou abundance or availability and the subsistence use thereof would not likely be affected as a result of direct habitat loss.

Small numbers of PCH caribou could be killed or injured due to vehicle collisions associated with future oil and gas exploration, development, and production in the program area during construction, drilling, and operations. Collision risk would be highest during insect harassment, when caribou move unpredictably and often seek relief on gravel pads, roads, and airstrips. Alternative B proposes a number of mitigation measures to reduce vehicle collisions with caribou. ROP 23 would require that lessees design and implement a traffic management and vehicle use plan, and ROP 42 would prohibit chasing wildlife (specifically caribou) with vehicles. These measures sufficiently mitigate mortality risk to caribou on the North Slope (A. Prichard, pers. comm.[1]). Residual mortality would likely be very low and would not significantly affect the abundance of caribou for subsistence use.

Movement patterns could be altered due to future linear infrastructure under Alternative B. The most common source of disturbance associated with roads is vehicle traffic. Traffic volumes greater than 15 vehicles per hour have been shown to deflect caribou or delay their road crossings (Curatolo and Murphy 1986; Cronin et al. 1994). Caribou crossing success would vary by season, behavioral motivation, level of habituation, and activity levels. Movements in response to insect harassment between late June and mid-August would be most likely to be affected.

Caribou are highly motivated to seek relief in coastal areas during insect harassment (Cronin et al. 1994; Murphy and Lawhead 2000). Thus, they are less likely to be affected by roads and vehicle traffic from mid- to late summer if appropriate mitigation measures are used. Some deflection or movement delays may occur prior to PCH habituation to development but is not expected to be widespread. The mitigation measures proposed under Alternative B (Lease Stipulations 3, 4, 7 and 9, and ROPs 23 and 42) would be adequate to maintain caribou passage to coastal areas. Caribou would still be available to subsistence hunters along the coast during traditional timeframes.

A CPF or one or more satellite pads could be located south of Kaktovik in the area bounded by the Hulahula and Jago Rivers. This is an important subsistence use area for residents of Kaktovik (**Map 3-28**, Kaktovik Subsistence Use Areas in **Appendix A**). The majority of Kaktovik's subsistence use area that is bounded by the Hulahula and Jago Rivers would be subject to NSOs or TLs. Development would not significantly affect the availability of caribou for subsistence use.

Caribou behavior could be altered by future oil and gas exploration, development, and production, specifically from aircraft traffic (see **Section 3.3.4**, Terrestrial Mammals). Responses vary depending on the season, degree of habituation, aircraft type, altitude, flight patterns, weather conditions, frequency of overflights, and the sex and age composition of caribou groups. Low-level flights or maneuvering in the presence of unhabituated caribou can elicit increased speed and abrupt direction change. Alternatively, caribou can become habituated to aircraft, particularly when aircraft pilots maintain altitudes greater than 500 feet above ground level and do not haze or harass the caribou (Valkenburg and Davis 1983). The EIS describes potential impacts of aircraft associated with future on-the-ground activities on caribou and caribou behavior in detail. In general, caribou responses to aircraft adhering to effective stipulation measures tend to be short-lived (Fullman et al. 2017).

Although short-lived, caribou responses to aircraft can affect subsistence hunters. Residents of Nuiqsut consistently highlight aircraft disturbance of caribou as a concern and state that aircraft activity makes animals more wary and harvest more difficult (Stinchcomb 2017). The extent of this potential impact is highly contingent on the location of frequently used flight paths, which would depend on the locations of CPFs and other major facilities. Air traffic in the vicinity of Kaktovik associated with future oil and gas

[1]A. Prichard, [ABR, Inc. – Environmental Research and Services Senior Scientist], personal communication with E. Julianus [BLM Wildlife Biologist], EMPSi, [27 July 2018].

activities would increase under Alternative B, and could increase further if one or more CPF development clusters were roadless, as is described in **Appendix B**. If a CPF development cluster is either along the coast or in the area bounded by the Hulahula and Jago Rivers (**Map 3-29**, Kaktovik Caribou Subsistence Use Areas, in **Appendix A**), which would be permissible under Alternative B, caribou could be more difficult to harvest. Arctic Village and Venetie would not be affected by this short-term impact; however, this could affect the availability of caribou for residents of Kaktovik.

ROPs 34, 36 and 40 would require lessees to follow numerous mitigation measures to ensure that the effects of aircraft on caribou and caribou hunting would be minimized. These strict operating procedures are used on BLM-administered lands in the National Petroleum Reserve-Alaska (NPR-A) and are generally successful in reducing most impacts. ROP 36 would also apply under Alternative B. It would require that lessees, operators, and contractors work closely with residents of Kaktovik during all phases of project application, design, and implementation. If done effectively, this consultation would assist permittees in the design and orientation of facilities, including airstrips, such that frequent, low-level traffic in caribou subsistence use areas would be nonexistent or considered minor to moderate (**Table E-2**). It is likely that residual impacts associated with future on-the-ground activities would not significantly affect caribou availability for residents of Kaktovik, if these requirements are followed closely.

Displacement of maternal caribou during calving was one of the primary issues raised during scoping. Oil and gas development on the Coastal Plain of the Arctic Refuge and its potential impact on the PCH calving grounds has been the subject of much discussion for decades. As a result, PCH habitat, movement, and population dynamics have been well studied. Studies on the CAH and others have shown that maternal caribou with young calves would avoid infrastructure by up to 2.49 miles (Lawhead et al. 2004; Haskell and Ballard 2004). The literature generally suggests that calving would most likely shift to the east or southeast if displacement of maternal caribou occurs during the calving season (Griffith et al. 2002). This could result in reduced calf survival, as areas east of the program area are characterized by suboptimal forage and, as a result, higher calf mortality and lower pregnancy rates (Russell et al. 1996). These areas also have higher predation rates, which contributes to higher calf mortality (Young et al. 2002).

The likelihood or extent to which impacts to PCH caribou abundance could occur depends largely on the extent of surface development associated with future on-the-ground activities happening within important calving grounds. The EIS defines important calving grounds as the high-use PCH calving area (area used in greater than 40 percent of years). This area spans 2,745,109 acres across northeastern Alaska and Canada (Yukon Environmental 2018, Map C-1). More surface development within this area could result in greater displacement of maternal caribou during calving, and thus could contribute to lower pregnancy rates and lower calf survival rates (Griffith et al. 2002). Alternatively, less or no surface development in this area, and the calving grounds in general, would result in less, negligible, or no displacement.

A total of 592,800 acres (22 percent) of the total high-use calving area could be leased and subject to surface occupancy under Alternative B (**Table J-12** in **Appendix J**; **Table E-1**). Development on all of the acres subject to surface occupancy within the high-use calving area is not possible given the 2,000-acre surface disturbance limit mandated by PL 115-97. All of this area would be subject to TLs. Research has demonstrated that TLs effectively mitigate the majority of impacts to caribou, but they do not effectively mitigate the displacement of maternal caribou during calving. Thus, caribou could still be displaced within areas subject to TLs.

Under Alternative B, a maximum of two CPFs and associated well pads and roads could potentially be located within the medium and low hydrocarbon potential areas, with one CPF potentially sited on private lands and one within or partially within the high-use PCH calving area. Surface disturbance associated with one CPF in the high-use PCH calving area could total up to 488 acres based on **Figure B.2.**, Conceptual Layout of a Caribou Area Stand-alone Oil Development Facility, in **Appendix B**. Depending on the configuration of the oil field, displacement of maternal caribou around 488 acres of surface disturbance could total up to 118,500 acres (4 percent) of the high-use calving area based on 2.49 miles of observed displacement around infrastructure during calving. However, the precise location of infrastructure, and thus the extent of overlap between surface disturbance and the high-use PCH calving area, is unknown. It is likely that there would be no or very little surface disturbance within the high-use PCH calving area, given that the hypothetical development scenario suggests that future development would move from west to east, would be concentrated along the coast, and that lessees would attempt to minimize lengthy travel from coastal and existing infrastructure, and between CPFs. It is also possible that the access to CPFs could be roadless, thereby further reducing potential surface disturbance within important caribou habitat.

Griffith et al. (2002) modeled calf survival under development scenarios outlined by Tussing and Haley (1999). They predicted an 8 percent decline in annual calf survival if full development of the program area occurred. The 2,000-acre surface disturbance limit was not used in the model. While the full development described by Tussing and Haley (1999) and Griffith et al. (2002) would not occur under Alternative B, displacement on up to 4 percent of the high-use calving area is possible. The hypothetical development scenario suggests that future development within the high-use area would be either nonexistent or well below levels that would cause 4 percent displacement. It is not likely that widespread displacement would occur under Alternative B. Therefore, while the PCH caribou population size would continue to fluctuate, potential impacts to herd size as a result of displacement of maternal caribou would be negligible. Caribou abundance for Kaktovik, Arctic Village, and Venetie would not be significantly impacted.

Subsistence Access

Kaktovik and Nuiqsut are the only communities whose subsistence use areas overlap the program area. Thus, they are the only communities that could be legally or physically prohibited from accessing these areas. Potential impacts on subsistence access from future oil and gas exploration, development, and production are as follows:

- Loss of subsistence use areas due to direct overlap with infrastructure
- Physical obstruction of subsistence users or activities by infrastructure
- Legal or regulatory barriers

Under Alternative B, numerous lease stipulations and ROPs would ensure that Kaktovik and Nuiqsut residents' ability to access resources is maintained. These include Lease Stipulations 1, 3, 4, 7, 9 and ROPs 23, 34, 36, 37, 39, 40, 41, and 42. Legal and physical access to subsistence resources may be altered, depending on the locations of CPFs and industry-established safety areas; however, it is likely that large-scale access to subsistence resources would be maintained.

E.2.2.2 Evaluation of the Availability of Other Lands for the Purpose Sought to be Achieved

Section 1003 of ANILCA, 16 USC 3143, deferred the decision to conduct leasing in the program area until authorized by Congress. PL 115-97 provides that decision, and requires the Secretary of the Interior, acting through the BLM, to conduct leasing in the program area. The purpose of the EIS is to inform the BLM's implementation of PL 115-97; Alternative B would fulfill this purpose. Lands outside the program area are not subject to PL 115-97 and would therefore not fulfill this purpose.

E.2.2.3 Evaluation of Other Alternatives that would Reduce or Eliminate the Use, Occupancy, or Disposition of Public Lands Needed for Subsistence

Alternatives that would reduce or eliminate the use of public lands needed for subsistence are those that make more land in the program area unavailable for oil and gas leasing or those that would not allow oil and gas activity. Alternatives C, D1, and D2 would make more land in the program area unavailable for oil and gas leasing. Alternative A would not allow oil and gas leasing to occur. The purpose of the EIS is to inform the BLM's implementation of PL 115-97; Alternatives C, D1, and D2 would fulfill this purpose. Alternative A would not fulfill this purpose.

E.2.2.4 Findings

Alternative B will not result in a significant restriction to subsistence uses. Potential impacts on subsistence resources and access from future oil and gas exploration, development, and production would be minimal or would be adequately mitigated by stipulations or ROPs under which lessees must operate. PCH caribou abundance may be affected due to minor displacement of maternal caribou, but large-scale displacement and consequent large decreases in the abundance of PCH caribou available for subsistence use is unlikely. A positive determination pursuant to ANILCA Section 810 is not required.

E.2.3 Evaluation and Finding for Alternative C

Section B.8.3, Alternative C in **Appendix B** anticipates that three CPFs would be built under Alternative C: 2 CPFs would be built in the high potential area and one CPF would be built in the medium potential area sound of Kaktovik. Under this hypothetical scenario, two production pads, 21 satellite pads, and 217 miles of road, a seawater treatment plant, and one barge landing and storage pad would be built. The 2,000-acre surface disturbance cap would be reached within the high and medium potential areas.

Under Alternative C, approximately 932,500 acres would be subject to NSO which would protect caribou calving habitat, in addition to other resources and uses (**Table 2-1** in **Chapter 2**). 317,100 acres would be subject to TLs, and 313,900 would be subject to the ROPs or standard terms and conditions. **Map 2-3**, Alternative C and **Map 2-4**, Alternative C, Lease Stipulations, in **Appendix A** illustrate where NSOs, TLs, and areas subject only to standard terms and conditions would be adopted.

E.2.3.1 Evaluation of the Effect of Use, Occupancy, or Disposition on Subsistence Uses and Needs

Fish

Potential impacts on subsistence fish species from future oil and gas exploration, development, and production under Alternative C would be similar to that described under Alternative B, although facility locations may differ due to the lands available for lease. Similar mitigation measures would be used, although lands along the coast would be designated as NSO (Lease Stipulations 1, 4 and 9). Minor impacts on fish are not anticipated to affect fish availability or abundance for residents of Kaktovik.

Marine Mammals

The potential impacts of disturbing and displacing bowhead whales and ringed seals from future oil and gas activities under Alternative C would be similar to that described under Alternative B; however, facility locations may differ, due to the lands available for lease. These minor impacts are not anticipated to affect bowhead whale or ringed seal availability or abundance.

Caribou

Direct habitat loss or alteration from future oil and gas activities would be similar to that described under Alternative B, because development of 2,000 acres in the program area would not vary by alternative. Direct habitat loss or alteration would not appreciably affect the availability or abundance of caribou for subsistence use.

Mortality or injuries from vehicle collisions would be similar to that described under Alternative B. ROP 23 would apply under Alternative C and would sufficiently address collision risk. Low-incidence mortality would not significantly affect the abundance of caribou for subsistence use.

Altered movement patterns due to linear infrastructure associated with future on-the-ground activities would be minor under Alternative C. The mitigation measures proposed under Alternative C would reduce impacts on caribou movement. The majority of Kaktovik's subsistence use area that is bounded by the Hulahula and Jago Rivers would be subject to NSOs or TLs. Altered movement patterns would not significantly affect the availability of caribou for subsistence use by Kaktovik. Altered PCH caribou movement patterns during spring and summer would not affect residents of Arctic Village or Venetie.

Altered caribou behavior due to aircraft traffic associated with future on-the-ground activities would be the same as that described under Alternative B. Aircraft traffic associated with Kaktovik would be the same as that described under Alternative B and would likely cause some caribou disturbance in the vicinity of Kaktovik; however, additional CPFs, airstrips, and heavily used flight paths would also be located outside Kaktovik's primary subsistence use areas. Additionally, ROPs 34, 36, and 40 would also apply under Alternative C, further reducing adverse impacts on hunters. Minor impacts of aircraft on caribou behavior would not significantly affect caribou availability for residents of Kaktovik.

Under Alternative C, the majority of the high-use calving area within the program area could be leased but would be subject to NSO (**Table J-12** in **Appendix J**; **Table E-1**). Eighty-three thousand four hundred acres (3 percent) would be subject to TLs and 13,700 acres (0.5 percent) would be subject to standard terms and conditions only. As discussed under Alternative B, caribou could still be displaced within areas subject to TLs.

Under Alternative C, a maximum of one CPF and associated well pads and roads could potentially be located within the medium hydrocarbon potential area. This CPF could likely be sited on private lands. If so, the CPF would be located north of the high-use calving area. Some maternal caribou could be displaced as a result of the CPF, but displacement would not be widespread. If a CPF were sited on private lands, one to two well pads could be located within the high-use calving area. If two well pads were located within this area, surface disturbance could total up to 24 acres. Displacement of maternal caribou around two well pads could total up to 26,648 acres (less than 1 percent) of the high-use calving area based on 2.49 miles of observed displacement around infrastructure during calving.

As discussed under Alternative B, the precise location of future oil and gas-related infrastructure, and thus the extent of overlap between surface disturbance and the high-use calving area, is unknown. The majority of the high-use calving area would be NSO under Alternative C. In addition, it is likely that there would be no or very little surface disturbance within the high-use calving area, given that the hypothetical development scenario suggests that future development would move from west to east, would be concentrated along the coast, and that a CPF in the medium potential hydrocarbon area would likely be sited on private lands. Based on these assumptions, potential impacts to herd size as a result of displacement of maternal caribou would be negligible. Caribou abundance for Kaktovik, Arctic Village, and Venetie would not be significantly impacted.

Subsistence Access

Access to subsistence resources would be similar to Alternative B, and, in general, this access would be maintained.

E.2.3.2 Evaluation of the Availability of Other Lands for the Purpose Sought to be Achieved

Evaluation of the availability of other lands is identical to that described under Alternative B (see **Section E.2.2.2**, above).

E.2.3.3 Evaluation of Other Alternatives that would Reduce or Eliminate the Use, Occupancy, or Disposition of Public Lands Needed for Subsistence

Evaluation of other alternatives is identical to that described under Alternative B (see **Section E.2.2.3**, above).

E.2.3.4 Findings

Alternative C will not result in a significant restriction to subsistence uses. Potential impacts on subsistence resources and access from future oil and gas exploration, development, and production would be minimal or would be adequately mitigated by stipulations or ROPs under which lessees must operate. A positive determination pursuant to ANILCA Section 810 is not required.

E.2.4 Evaluation and Finding for Alternative D1

Section B.8.4, Alternative D1 in **Appendix B** anticipates that two CPFs would be built: one CPF would be built in the high potential area and one in the medium potential area south of Kaktovik. Under this scenario, two production pads, 21 satellite pads, and 218 miles of road, a seawater treatment plant, and one barge landing and storage pad would be built. The 2,000-acre surface disturbance cap would be reached in the high and medium potential areas.

Approximately 526,300 acres would be closed to leasing to protect caribou calving habitat under Alternative D1 (**Table 2-1** in **Chapter 2**). Of the remaining 1,037,200 acres available for leasing, 708,600 would be subject to NSO, 123,900 would be subject to CSU, 0 would be subject to TLs, and 204,700 would be subject to standard terms and conditions only. **Map 2-5**, Alternative D1 and **Map 2-6**, Alternative D1, Lease Stipulations, in **Appendix A** illustrate where NSO, CSU, and standard terms and conditions would be adopted.

E.2.4.1 *Evaluation of the Effect of Use, Occupancy, or Disposition on Subsistence Uses and Needs*

Fish

Potential impacts on subsistence fish species would be similar to those described under Alternatives B and C, although future facility locations may differ due to the lands available for lease. More extensive mitigation measures would be used, a 0.5- to 4-mile setback for surface development would apply on all streams and waterbodies, and NSO would apply along the coast. While minor impacts on fish could still occur from future oil and gas exploration, development, and production, they are not anticipated to affect fish availability or abundance for residents of Kaktovik.

Marine Mammals

Disturbance and displacement of bowhead whales and ringed seals associated with future on-the-ground activities would be similar to that described under Alternatives B and C, although future facility locations may differ due to the lands available for lease. These potential minor impacts are not anticipated to affect bowhead whale or ringed seal availability or abundance.

Caribou

Direct habitat loss or alteration from future oil and gas exploration, development, and production would be similar to that described under Alternatives B and C, as development of 2,000 acres in the program area would not vary by alternative. Direct habitat loss or alteration from future on-the-ground activities would not affect the availability or abundance of caribou for subsistence use.

Mortality or injuries due to vehicle strikes associated with future oil and gas development in the Coastal Plain would be similar to that described under Alternatives B and C. ROP 23 would apply under Alternative D1 as well and would sufficiently address collision risk. Low-incidence mortality would not significantly affect the abundance of caribou for subsistence use.

Altered movement patterns due to roads and pipelines associated with future oil and gas development in the Coastal Plain would be similar to what is expected to occur under Alternative C, but the extent of this impact would be lessened. This is because the areas important for caribou movement would be largely subject to NSO, TLs, or would not be offered for lease sale. This would apply to spring migration and movements to and from the coast in response to insect harassment, and potentially to fall migration. Although some delays and deflections while crossing roads and pipelines are expected, PCH caribou movements would be relatively undisturbed and would not significantly affect the availability of caribou for subsistence use by residents of Kaktovik.

A total of 14,300 acres (0.5 percent) of the high-use calving area could be leased and subject to surface occupancy under Alternative D1 (**Table J-12** in **Appendix J**; **Table E-1**). 5,400 acres (0.2 percent) would be subject to CSU and 8,900 acres (0.3 percent) would be subject to standard lease terms and conditions only. Caribou could be displaced within these areas.

Similar to Alternative C, a maximum of one CPF and associated well pads and roads could potentially be located within the medium hydrocarbon potential area under Alternative D1. This CPF would likely be sited on private lands. Since these assumptions are identical to Alternative C, impacts to maternal caribou would likewise be the same. Displacement would not be widespread and could occur on up to 26,648 acres (less than 1 percent) of the high-use calving area if one to two well pads were constructed in this area. Based on these assumptions, potential impacts to herd size as a result of displacement of maternal caribou from future on-the-ground activities would be small or negligible. Caribou abundance for Kaktovik, Arctic Village, and Venetie would not be significantly impacted.

Subsistence Access

Access to subsistence resources would be similar to Alternative B. In general, access to subsistence resources would be maintained.

E.2.4.2 Evaluation of the Availability of Other Lands for the Purpose Sought to be Achieved

Evaluation of the availability of other lands would be similar to Alternative B (see **Section E.2.2.2,** above).

E.2.4.3 Evaluation of Other Alternatives that would Reduce or Eliminate the Use, Occupancy, or Disposition of Public Lands Needed for Subsistence

Evaluation of other alternatives is identical to that described under Alternative B (see **Section E.2.2.3**, above).

E.2.4.4 Findings

Alternative D1 will not result in a significant restriction in subsistence uses. Potential impacts on subsistence resources and access from future oil and gas exploration, development, and production would be minimal or would be adequately mitigated by stipulations or ROPs under which lessees must operate. A positive determination pursuant to ANILCA Section 810 is not required.

E.2.5 Evaluation and Finding for Alternative D2

Alternative D2 would place TLs on 204,700 acres in lieu of standard terms and conditions, which would be implemented under Alternative D1 as described above. TLs would restrict activity during caribou calving and post-calving when caribou are present, between May 15 and July 30. **Map 2-7**, Alternative D2, and **Map 2-8**, Alternative D2, Lease Stipulations, in **Appendix A** illustrate where NSO, CSU, TLs, and areas subject to standard terms and conditions only would be adopted.

Section B.8.5, Alternative D2 in **Appendix B** anticipates that two CPFs would be built under Alternative D2: one CPF would be built in the high-potential area and one in the medium-potential area sound of Kaktovik. Under this scenario, two production pads, 21 satellite pads, and 217 miles of road, a seawater treatment plant, and one barge landing and storage pad would be built. The 2,000-acre surface disturbance cap would be reached in the high- and medium- potential areas.

E.2.5.1 Evaluation of the Effect of Use, Occupancy, or Disposition on Subsistence Uses and Needs

Fish

Potential impacts on fish would be identical to those described under Alternative D1 (see **Section E.2.4.1**, above).

Marine Mammals

Potential impacts on marine mammals would be identical to those described under Alternative D1 (see **Section E.2.4.1**, above).

Caribou

Direct habitat loss or alteration from future oil and gas exploration, development, and production would be similar to that described under Alternatives B, C, and D1, as development of 2,000 acres in the program area would not vary by alternative. Direct habitat loss or alteration from future activities in the Coastal Plain would not affect the availability or abundance of caribou for subsistence use.

Mortality or injuries due to vehicle strikes associated with future oil and gas development in the Coastal Plain would be similar to those described under Alternatives B, C, and D1. ROP 23 would apply under Alternative D2, and Lease Stipulation 6 would be adopted as part of a suite of mitigation measures. These measures would sufficiently address collision risk. Low-incidence mortality from future activities would not significantly affect the abundance of caribou for subsistence use.

Alteration of movement patterns associated with future oil and gas development in the Coastal Plain would be similar to that expected under Alternative D1. Caribou movement would be relatively undisturbed and would not significantly affect the availability of caribou for subsistence use by Kaktovik residents.

Displacement of maternal caribou associated with future oil and gas development in the Coastal Plain would be similar to that expected under Alternative D1. Potential impacts to caribou abundance as a result of maternal caribou displacement would be small or negligible. Caribou abundance for Kaktovik, Arctic Village, and Venetie would not be significantly impacted.

Subsistence Access

Access to subsistence resources would be similar to Alternative B, and this access would be maintained.

E.2.5.2 Evaluation of the Availability of Other Lands for the Purpose Sought to be Achieved

Evaluation of the availability of other lands would be similar to that described under Alternative B (see **Section E.2.2.2**, above).

E.2.5.3 Evaluation of Other Alternatives that would Reduce or Eliminate the Use, Occupancy, or Disposition of Public Lands Needed for Subsistence

Evaluation of other alternatives is identical to that described under Alternative B (see **Section E.2.2.3**, above).

E.2.5.4 Findings

Alternative D2 will not result in a significant restriction in subsistence uses. Potential impacts on subsistence resources and access from future oil and gas exploration, development, and production would be minimal, or they would be adequately mitigated by stipulations or ROPs under which lessees must operate. A positive determination pursuant to ANILCA Section 810 is not required.

E.2.6 Evaluation and Finding for the Cumulative Case

The goal of the cumulative case analysis presented in **Chapter 3** is to evaluate the incremental impact of the actions considered in the EIS, in conjunction with all past, present, and reasonably foreseeable future activities in or near the Coastal Plain, specifically, in the Kaktovik, Nuiqsut, Arctic Village, and Venetie subsistence use areas.

Actions included in the cumulative case analysis are listed in **Section F.2.2** in **Appendix F**. Past and present actions that have affected subsistence uses and resources are as follows:

- Oil and gas exploration, development, and production on the North Slope
- Transportation
- Subsistence activities
- Recreation and tourism
- Scientific research
- Community development
- Climate change

Reasonably foreseeable future actions include the following:

- Road and pipeline between Kaktovik and the Dalton Highway/Trans-Alaska Pipeline
- Oil and gas development in the Colville-Canning Area
- Oil and gas activity in the vicinity of Alpine

E.2.6.1 Evaluation of the Effect of Use, Occupancy, or Disposition on Subsistence Uses and Needs

Actions included in the cumulative case analysis are listed in **Section F.2.2** in **Appendix F**. These actions fall in to six broad categories: oil and gas exploration and development, transportation, subsistence activities, recreation and tourism, scientific research, and community development. Additionally, climate change is considered a variable that could contribute to potential cumulative effects of the proposed alternatives and reasonably foreseeable future actions. This section describes the potential impacts each of these categories could have to Kaktovik, Nuiqsut, Arctic Village, and Venetie subsistence uses.

Oil and Gas Exploration, Development, and Production

Oil and gas exploration, development, and production is ongoing and planned within the onshore North Slope, State and Federal waters in the Beaufort Sea, and in the Western Canadian Arctic. These activities include exploration work, infrastructure development, construction, and maintenance, gravel mining, and production associated with existing wells. These activities are expected to continue under all alternatives.

Section 3.4.3, Subsistence Uses and Resources, identifies cumulative infrastructure development on the North Slope as a major impact to subsistence activities. This is corroborated by other analyses and 810 evaluations. In the NPR-A Integrated Activity Plan/EIS, the BLM (2012) indicated that, irrespective of the alternative selected, cumulative activity on the North Slope had the potential to significantly restrict subsistence access for a number of communities. Increased infrastructure has contributed to a feeling of being "boxed in" by development in and around Nuiqsut. Impacts to Nuiqsut's ability to access subsistence resources, according to previous EISs, would be significant.

Similar to issues associated with development around Nuiqsut, ongoing and proposed oil and gas activities associated with Point Thomson and Liberty, would impact lands in the vicinity of Kaktovik, and would potentially restrict subsistence activities and access to subsistence resources within their subsistence use area. Past, present, and future development would not mirror the scenario observed for Alpine-associated development and Nuiqsut. Future development within the program area beyond the surface disturbance limit of 2,000 acres would require additional action by Congress, and is not included in the hypothetical development scenario (**Appendix B**). Future development associated with the Leasing EIS would not surround Kaktovik, but residents may still feel surrounded if there is development to the west, south, and east of their traditional hunting areas[2]. This could occur under Alternative B. Future development associated with oil and gas activities could occur along the coast, where multiple ports or seawater treatment plants could be constructed, and within the important subsistence use area bounded by the Hulahula and Jago Rivers. It could also occur under Alternatives C, D1, and D2, as future on-the-ground development could occur on corporation lands directly south of Kaktovik.

Numerous measures would be adopted to mitigate potential impacts to subsistence access. Under all alternatives, Lease Stipulation 1 would implement NSO along rivers that are important for subsistence use by residents of Kaktovik. Lease Stipulation 9 would require lessees to develop and implement an impact and conflict avoidance and monitoring plan to assess, minimize, and mitigate the effects of the infrastructure and its use on subsistence users. ROPs 18, 20, and 23 would require that roads and other infrastructure be designed to avoid or minimize impacts to subsistence access to tradition hunting and fishing areas. ROPs 36-40 would require that lessees participate in extensive consultation with subsistence communities. Lessees would be required to coordinate directly with Kaktovik and seek input from local advisory councils such as the North Slope and Eastern Interior Subsistence Regional Advisory Councils. They would be required to develop a plan to prevent unreasonable conflicts with subsistence activities, and to develop a subsistence access plan prior to beginning exploration or development. All future development plans would be subject to BLM review prior to approval.

Public testimony indicates that residents believe conflict avoidance and subsistence access plans mitigate potential impacts to subsistence. However, access patterns have changed in response to development on the North Slope, and residents still report feeling "boxed in" by existing development (SRB&A 2017). Potential impacts to subsistence access would likely be effectively mitigated under Alternatives B, C, D1, and D2. However, cumulative impacts associated with Point Thomson, Liberty, and other projects could result in more than no effect or slight inconvenience[3] on the ability of harvesters to reach and use active subsistence harvest sites. Therefore, cumulative impacts of oil and gas exploration, development, and construction could significantly impact Kaktovik's ability to access subsistence resources.

The BLM (2012) found that caribou availability for residents of Nuiqsut could be significantly impacted as a result of development in the vicinity of Alpine. Impacts to PCH caribou availability would not affect Nuiqsut, as their caribou subsistence use area does not overlap with the PCH range nor is there documented harvest of PCH caribou by Nuiqsut. Cumulative impacts to PCH caribou would not significantly impact residents of Nuiqsut under all alternatives.

Ongoing and future actions along the coast may contribute to some impacts to caribou availability. These impacts to caribou availability for Kaktovik are limited to aircraft and vehicle disturbance and are described below in *Transportation*.

[2]S. Braund, [Stephen R. Braund and Associates Senior Scientist], personal communication with E. Julianus [BLM Wildlife Biologist], EMPSi, [08 September 2018].
[3]Significance threshold defined on page 6-1 of BLM Instruction No. AK-2011-008.

Potential impacts from future oil and gas exploration, development, and production to PCH caribou abundance for residents of Kaktovik, Arctic Village, and Venetie under Alternatives B, C, D1, and D2, would be minor due to the speculative locations of future proposed infrastructure and more restrictive lease stipulations and ROPs. Ongoing or future development are not expected to impact caribou abundance. Therefore, the cumulative impact, in conjunction with Alternatives B, C, D1, and D2, would not significantly restrict subsistence uses of PCH caribou.

Transportation

Surface, air, and marine transportation within Kaktovik and Nuiqsut's subsistence use areas would continue under all alternatives. This includes roads and vehicular traffic, shipping and barging, and aircraft traffic. Increased activity associated with future oil and gas developments would result in higher levels of vessel, ground, and air traffic. This increased activity is likely under Alternatives B, C, D1, and D2. Under each alternative, NSOs, TLs, and standard terms and conditions would be sufficient to effectively mitigate potential impacts of transportation associated with future on-the-ground activities on subsistence resources. Potential impacts to caribou abundance, availability, or access to subsistence resources for Kaktovik would not be significant under all alternatives. Impacts to caribou availability due to development in the vicinity of Nuiqsut were found to be potentially significant for Nuiqsut. However, potential impacts to caribou from future oil and gas activities associated with all alternatives would not contribute to cumulative effects on Nuiqsut's resource availability.

Subsistence Activities

Subsistence activities on the North Slope would continue under all alternatives. Although subsistence practices are somewhat fluid and subject to annual variation, current and past hunting, gathering, fishing, and trapping activities would be similar in the types of activities and areas used by the communities in the program area in the foreseeable future. Subsistence activities would not vary by alternative and would not contribute to adverse effects on the abundance or availability of subsistence resources, nor would they impact subsistence users' ability to access subsistence resources.

Recreation and Tourism

Recreation and tourism would continue under all alternatives. Recreation and tourism activities would occur independent of development activities proposed under each of the proposed alternatives, and thus are not expected to vary by alternative. Although these activities occur across the North Slope, recreation and tourism are most concentrated in the Arctic Refuge and Kaktovik, where polar bear viewing is a popular activity. Recreation and tourism do have the potential to adversely affect the availability of subsistence resources if these resources are disturbed by aircraft conducting flightseeing tours. Such activities are carefully managed to avoid impacts to subsistence (USFWS 2015) and would not significantly affect the availability of subsistence resources. The abundance of subsistence resources would not be affected by recreation and tourism. Subsistence users' ability to access subsistence resources would not be affected.

Scientific Research

Scientific research is ongoing in the program area and within Kaktovik, Nuiqsut, Arctic Village, and Venetie's subsistence use areas. It is likely that scientific research would increase under Alternatives B, C, D1, and D2, particularly if mitigation measures are adopted that require companies to fund research documenting and monitoring impacts on specific resources, such has been done elsewhere (BLM 2012). Research activities typically involve vessel, air, and overland transport of researchers and equipment, and could contribute to cumulative effects. Research activities could affect the availability of subsistence resources under Alternatives B, C, D1, and D2. Caribou could be disturbed during aerial surveys, but impacts would be short-lived. The availability of subsistence resources would not be significantly impacted by research activities under the cumulative case if Alternatives B, C, D1, or D2 are adopted, nor would the abundance of or access to subsistence resources be significantly impacted.

Community Development

Community development projects would occur under all alternatives. The type and size of development projects could vary by alternative. Kaktovik would likely undertake community development projects if Alternatives B, C, D1, or D2 are selected. More projects may occur in or near Kaktovik if Alternatives C, D1, or D2 are selected. NSOs would be in place along the majority of the coast under these alternatives, creating a situation where seawater treatment plants or port and airport infrastructure may be more likely to be constructed or expanded in or near Kaktovik. Community development projects would not contribute to adverse impacts on the abundance or availability of subsistence resources, nor would they impact subsistence users' ability to access subsistence resources.

Climate Change

Climate change is an ongoing factor considered in cumulative effects analyses on the North Slope. Climate change could affect the habitat, behavior, distribution, and populations of fish and wildlife within the program area. It could also impact access to these resources. The trends in climate change that were described in BLM 2018a are expected to continue.

E.2.6.2 Evaluation of the Availability of Other Lands for the Purpose Sought to be Achieved

Evaluation of the availability of other lands is identical to that described under Alternative B (see **Section C.2.2.2**, above).

E.2.6.3 Evaluation of Other Alternatives that would Reduce or Eliminate the Use, Occupancy, or Disposition of Public Lands Needed for Subsistence

Evaluation of other alternatives is identical to that described under Alternative B (see **Section E.2.2.2**, above).

E.2.6.4 Findings

The cumulative case, when taken in conjunction with Alternatives B, C, D1, and D2, will not result in a significant restriction to subsistence uses for the communities of Nuiqsut, Arctic Village, and Venetie.

The cumulative case, when taken in conjunction with Alternatives B, C, D1, and D2, may result in a significant restriction to subsistence uses for the community of Kaktovik due to potential decrease in access to fish, marine mammals, and PCH caribou. A positive determination pursuant to ANILCA Section 810 is required.

E.3 NOTICE AND HEARINGS

ANILCA Section 810(a) provides that there shall 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). The BLM will provide notice in the *Federal Register* that it made positive findings pursuant to ANILCA Section 810 that the cumulative case presented in the EIS met the "may significantly restrict" threshold. As a result, public hearings will be held in the potentially affected community of Kaktovik. Notice of this hearing will be provided in the *Federal Register* and in local media, including the *Arctic Sounder* and KBRW, the Utqiagvik radio station with coverage to all villages on the North Slope. The meeting date and time will be posted on BLM's website at https://www.blm.gov/programs/planning-and-nepa/plans-in-development/alaska/coastal-plain-eis.

E.4 Subsistence Determinations under the ANILCA Section 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 USC 3120(a)(3)(A), (B), and (C)).

The BLM has found in this preliminary evaluation that the cumulative case considered in this EIS may significantly restrict subsistence uses. The BLM will undertake 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 community of Kaktovik.

The determination that the requirements of the ANILCA Section 810(a)(3)(A), (B), and (C) have been met will be analyzed in the Final ANILCA Section 810 Evaluation. The Final Evaluation will integrate input voiced during the hearing by the residents of Kaktovik.

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High Use Porcupine Caribou Herd Calving Area

Percent of years of caribou are present
>40%

Public Law 115-97 Coastal Plain

Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority

Data Source BLM GIS 2018. Yukon Environmental GIS 2018
Print Date 10/11/2018

Map E-1

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Table E-1
Lease Restrictions in High-Use Porcupine Caribou Herd Calving Area

Lease Stipulations	Alternative A	Alternative B	Alternative C	Alternative D1	Alternative D2
No surface occupancy/not offered for lease sale	728,300	135,500	631,200	714	714
Timing limitation	0	564,900	83,400	0	0
Controlled surface use	0	0	0	5,400	5,400
Standard terms and conditions	0	27,900	13,700	8,900	8,900

Source: BLM GIS 2018

Table E-2
Summary of Impacts on Abundance and Availability of Major Subsistence Resources for Kaktovik, Nuiqsut, Arctic Village, and Venetie

Resource	Impact	Context	Alternative A		Alternative B		Alternative C		Alternative D1		Alternative D2		Cumulative	
			Abundance	Availability	Abundance	Availability	Abundance	Availability	Abundance	Availability	Abundance	Availability	Abundance	Availability
Fish	Habitat loss or alteration	Site-specific	0	0	1	1	1	1	0	0	0	0	1	2
Fish	Disturbance or displacement	Regional	0	0	1	1	1	1	0	0	0	0	1	2
Fish	Injury or mortality	Site-specific	0	0	1	1	1	1	0	0	0	0	1	2
Marine mammals	Injury or mortality	Site-specific	0	0	1	0	1	0	1	0	1	0	2	0
Marine mammals	Disturbance or displacement	Regional	0	0	0	1	0	1	0	1	0	1	0	2
Caribou	Habitat loss or alteration	Site-specific	0	0	0	1	0	1	0	1	0	1	0	2
Caribou	Mortality or injury	Site-specific	0	0	1	0	1	0	1	0	1	0	1	0
Caribou	Altered movement	Local	0	0	0	2	0	1	0	2	0	2	2	2
Caribou	Altered behavior	Local	0	0	0	2	0	2	0	1	0	1	2	2
Caribou	Displacement of maternal caribou	Regional	0	0	2	0	2	0	1	0	1	0	2	2

Notes:
1. Table does not specify the degree to which each community is affected.
2. Gray (0) indicates no impact, yellow (1) indicates minor impact, orange (2) indicates moderate impact, and red (3) indicates major impact.

Table E-3
Summary of Impacts on Access to Major Subsistence Resources for Kaktovik, Nuiqsut, Arctic Village, and Venetie

Resource	Potential Effect	Context	Alternative A		Alternative B		Alternative C		Alternative D1		Alternative D2		Cumulative	
			Legal	Physical	Legal	Physical	Legal	Physical	Legal	Physical	Legal	Physical	Legal	Physical
Fish	Use of traditional fishing areas	Local	0	0	1	1	0	0	0	0	0	0	2	3
Marine mammals	Use of traditional marine mammal hunting areas	Local	0	0	1	1	0	0	0	0	0	0	2	3
Caribou	Use of traditional caribou hunting areas	Local	0	0	1	1	1	1	0	0	0	0	2	3

Notes:
1. Table does not specify the degree to which each community is affected.
2. Gray (0) indicates no impact, yellow (1) indicates minor impact, orange (2) indicates moderate impact, and red (3) indicates major impact.

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Appendix F

Approach to the Environmental Analysis

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Appendix F. Approach to the Environmental Analysis

F.1 Introduction

Issuance of oil and gas leases under the directives of Section 20001(c)(1) of Public Law (PL) 115-97 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, issuance of a lease represents an irretrievable commitment of oil and gas resources for potential future exploration and development activities, subject to further environmental review and authorization, that would result in impacts on the environment. The impacts of such future exploration and development activities that may occur because of the issuance of leases 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 Coastal Plain. Therefore, the analysis in Chapter 3 is of potential direct, indirect, and cumulative impacts from on-the-ground post-lease activities.

The methodology for the impact assessment conforms to the guidance found in the following sections of the Council on Environmental Quality (CEQ) regulations for implementing the National Environmental Policy Act (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. Since the action alternatives presented in this environmental impact statement (EIS) offer specific areas of the Coastal Plain as available for lease sale (subject to applicable laws, terms, conditions, and stipulations of the lease, as well as project specific environmental review and permits), rather than project-level exploration and development of oil and gas, the focus of the analysis is on the potential impacts of these future phases, which may follow leasing.

F.2 Direct and Indirect Impacts

Direct and indirect impacts are considered in **Chapter 3**, consistent with direction provided in 40 CFR 1502.16.

> **Direct Effects**—Effects that are caused by the proposed action and occur at the same time and place (40 CFR 1508.8). Examples of direct effects are filling of wetlands through the placement of gravel pads, and direct mortality of wildlife or vegetation.
>
> **Indirect Effects**—Effects that 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 GIS and other applications; in the absence of quantitative data, best professional judgment prevailed. 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 potential impact would 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 affect most or all of the program area, and regional impacts would extend beyond the program area boundaries.
>
> **Duration**—Describes the length of time 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.2.1 Social Costs of GHG Emissions

A protocol to estimate what is referenced as the "social cost of carbon" (SCC) associated with greenhouse gas (GHG) emissions was developed by a federal Interagency Working Group on Social Cost of Carbon (IWG), to assist agencies in addressing Executive Order (EO) 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, BLM has received requests to expand the use of SCC estimates to program and project-level National Environmental Policy Act (NEPA) analyses.

The decision was made not to expand the use of the SCC protocol for the oil and gas leasing actions discussed in this Leasing EIS for several reasons. Most notably, these leasing actions are not rulemaking for which the SCC protocol was originally developed. Second, on March 28, 2017, the President issued EO 13783 which, among other actions, directed that the IWG be disbanded and that the technical support documents upon 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 social cost of carbon and greenhouse gases 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 (OMB) 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 OMB 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 program decisions like this Leasing EIS.

Further, NEPA does not require a cost-benefit analysis (40 CFR Section 1502.23), although NEPA does require consideration of "effects" that include "economic" and "social" effects (40 CFR 1508.8(b)). The economic analysis in this EIS, as discussed in **Section 3.4.10**, Economy, is a regional economic impact analysis utilizing input-output modeling. Regional economic impact analyses describe effects that agency activities may have on economic conditions and local economic activity, generally expressed as projected changes in employment, labor income, and economic output (Watson et al. 2007). 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 that they desire to have occur whereas another person may view increased economic activity as negative or undesirable due to 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.

The fact that climate impacts associated with GHG emissions were not quantified in terms of monetary costs does not mean that climate impacts were ignored in this EIS. The EIS refers readers to Sections 3.1.1.1 and 3.1.1.2, respectively, of the Greater Mooses Tooth 2 (GMT2) Development Project Final Supplemental Environmental Impact Statement (SEIS) (BLM 2018) for descriptions of climate change trends in the Arctic and on the North Slope. Also, regarding the potential effects of climate change on the region, the reader is referred to Section 3.1.1.3 of the GMT2 SEIS (BLM 2018). In addition to the qualitative climate change discussions discussed above, the BLM quantified the direct and indirect GHG emissions associated with potential energy development that could result from post-leasing oil and gas activities discussed in this EIS (see **Tables 3-3** and **3-4**). Furthermore, **Table 3-2** provides an inventory of recent GHG emissions at various geographic scales, in units of million metric tons per year, for which development-related emissions can be compared against to provide an estimate of the relative contribution of such emissions at various geographic scales.

The BLM took the approach of referencing climate change trends and potential climate impacts at different scales and calculating direct and indirect GHG emissions 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 and 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 one metric ton increase in a single year—and includes, but is not limited to, 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, especially given that there are no current criteria or thresholds that determine a level of significance for social cost of carbon monetary values.

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; however, when they are 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 as follows:

> ...the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative 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 reasonably foreseeable future actions, could interact or accumulate over time and space, either through repetition or combined with other impacts, and 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**.
- Describe the potential direct and indirect effects of future oil and gas exploration, development, and production. As noted above, issuance of oil and gas leases under the directives of Section 20001(c)(1) of PL 115-97 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, issuance of a lease represents an irretrievable commitment of oil and gas resources for potential future exploration and development activities, subject to further environmental review and authorization, that would result in impacts on the environment. The impacts of such future exploration and development activities that may occur because of the issuance of leases 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 Coastal Plain. Therefore, the analysis in Chapter 3 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 timeframe may vary between resources depending on the historical data available and the relevance of past events to the current baseline.
- Identify past, present, and reasonably foreseeable future actions (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 in nature. 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 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 reasonably foreseeable future actions, 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 timeframe for cumulative impacts analysis spans from the 1970s through full realization of the hypothetical development scenario (**Appendix B**), which is anticipated to occur approximately 50 years after the Record of Decision for this EIS is signed, recognizing the timeframe for production could be more or less than 50 years given the speculative nature of the hypothetical development scenarios. The geographic scope generally encompasses the program area and the North Slope but extends beyond these areas for some resources (e.g., terrestrial wildlife), including into Canada. 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 Reasonably Foreseeable Future Actions

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 natural events. Past actions were identified using agency documentation, NEPA analyses, reports and resource studies, peer-reviewed literature, and best professional judgment.

The term reasonably foreseeable future action (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 50 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 timeframe of the EIS. Projects and activities considered in the cumulative effects analysis are summarized in **Table F-1** and are discussed in more detail below.

Table F-1
Past, Present, and Reasonably Foreseeable Future Actions Considered in the Cumulative Effects Analysis

Category	Area	Actions/Activities	Description
Oil and gas exploration, development, and production	• Onshore North Slope • State and federal waters (Beaufort Sea) • Western Canadian Arctic	• Geological and geophysical surveys • Infrastructure development • Gravel mining • Geotechnical borehole surveys • Construction and maintenance • Exploration activities • Production wells • Surface, air, and marine traffic • Scientific research for avian studies, bathymetry, cultural resources, and fisheries (directly related to oil and gas)	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/barging to Kaktovik • Aircraft traffic	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/Activities	Description
Subsistence Activities	• Kaktovik • Nuiqsut • Arctic Village • Venetie • Western Canadian Arctic	• Hunting • Trapping • Fishing • Whaling • Sealing • Traveling • Berry Picking	Anticipate a continuation of traditional past and present subsistence practices (See **Section 3.4.3**, Subsistence Uses and Resources) 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/Scenic viewing and photography • Sport/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**, Recreation). See below for an additional discussion.
Scientific Research	• Onshore North Slope • Nearshore waters • OCS waters • Arctic National Wildlife Refuge	• Arctic National Wildlife Refuge 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	• Kaktovik • Arctic Village • Venetie • Utqiaġvik • North Slope Borough	• 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 GMT2 SEIS (BLM 2018 Section 3.2.4) and are projected to continue and interact with other reasonably foreseeable future actions within 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

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 over the summer [May-August]), using 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 include 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. The discussion does not include small discoveries and undiscovered resources that are unlikely to be developed within the temporal scope of this EIS. The following reasonably foreseeable future onshore oil and gas projects are included in the cumulative effects analysis:

- **SAExploration 3-Dimensional (3D) Seismic Exploration Surveys**—Proposed 3D seismic exploration of the Coastal Plain of the Arctic Refuge would begin in winter 2018/2019. The project will include access to the program area from Deadhorse, storage of fuel, and up to two mobile camps, each capable of housing up to 160 people. It is expected that there would be a total of 360 miles of snow trails associated with moving up to two camps across the program area. There would be approximately 50 trailers including support trailers that make up a camp. Fuel would be delivered daily by ground vehicle to camps. Crew changes would occur twice weekly, either by aircraft or ground vehicle. Seismic operations would be conducted using 12 to15 rubber-tracked vibrators and 20,000 to 25,000 wireless autonomous recording devices for each of the two crews. Vibroseis vehicles would be positioned between 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**—The Liberty Prospect is located 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 construction of 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**—Point Thomson is a gas condensate field that is producing condensate that is shipped via a 22-mile oil pipeline 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**—The project is southeast of the East Channel of the Coleville 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 and a Central Processing Facility, Drill Site 2, Drill Site 3, an operations center pad, infield pipelines, the export/import Nanushuk pipeline, infield roads, an access road, a tie-in pad, and a potable water system. The project also includes temporary discharges to 5.8 acres of jurisdictional waters of the United States (US) for screeding at the Oliktok Dock.
- **Alpine CD-5**—This Alpine field satellite development drill site is on Alaska Native village corporation lands near Nuiqsut and is the first commercial oil production from the National Petroleum Reserve in Alaska (NPR-A). CD-5 went into production in late 2015. As a satellite to the Alpine Central Processing Facility (CPF), CD-5 has only minimal on-site processing facilities; however, it required 6 miles of gravel road, four bridges, and 32 miles of pipelines including completion of a gravel road and natural gas pipeline from Alpine CPF into Nuiqsut. ConocoPhillips Alaska, Inc. plans to continue drilling an additional 18 wells at CD-5 after the original 15 wells are completed for an eventual total of 33 wells.
- **Greater Mooses Tooth**—The Greater Mooses Tooth-1 (GMT1) project is the first commercial development on federal lands in the NPR-A; first oil production was achieved 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 existing CD-5 road and pipeline extension. The drilling pad can support up to 33 wells; initially it will only have nine wells. Production from GMT1 is expected to peak at 25,000 to 30,000 barrels of oil per day. The Greater Mooses Tooth-2 (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 CD-5 extension. Construction for GMT2 could begin in early 2019. GMT2 anticipated peak production will be higher than GMT1 at 35,000 to 40,000 barrels of oil per day.

- **Willow**—The Willow oil and gas prospect is located on Federal oil and gas leases ConocoPhillips holds within 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 a central processing facility, infrastructure pad, up to five drill pads with up to 50 wells on each pad, access and infield roads, an airstrip, pipelines, and a gravel mine on BLM-managed lands within the NPR-A. The Master Development Plan/EIS being prepared by the BLM will analyze the connected action of a temporary island to facilitate module delivery via sealift barges which would occur within waters managed by the State of Alaska. First production is currently anticipated around 2024-2025.
- **Greater Prudhoe Bay/Kuparuk**—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 LNG Project**—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.
- **Alaska Stand Alone Gas Pipeline**—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 5 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 West Dock would likely require improving the dock facilities and dredging to deepen the navigational channel to the dock head.

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 in the Arctic Refuge and 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.

Subsistence Activities

Subsistence activities occur throughout the program area and in the surrounding areas. Subsistence hunters primarily use off-highway vehicles, boats, and snowmachines for access. The types of subsistence uses and activities that were described in **Section 3.4.3**, Subsistence Uses and Resources, are expected to continue. Current and past hunting, gathering, fishing, and trapping subsistence activities 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

Until recently, recreation and tourism activities are generally pursued by non-resident visitors to the program area and surrounding areas. While a very small number of local residents have historically participated in recreational guiding and tourism, since 2010 residents have developed tourism around polar bear viewing, and in 2017 over 50 percent of the visitors to the program area are served by locally-owned tourism businesses. With the exception of adventure cruise ships that transit the Beaufort Sea coast in small numbers, there is a concentration of air sightseeing traffic in the Arctic Refuge. The types of recreation and tourism that were described in **Section 3.4.6**, Recreation, are expected to continue. Current and past sport hunting and fishing, or other recreation or tourism-related activities would be similar in the types of activities and areas used by the communities in the analysis area in the foreseeable future. Transport associated with recreation and tourism includes aircraft and powered and non-powered vessel traffic.

Scientific Research

There are scientific research programs that take place in the program area and the Arctic Refuge. These activities involve vessel, air, and overland transport of researchers and equipment, and 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 new airport in Kaktovik 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. Climate change could affect the habitat, behavior, distribution, and populations of fish and wildlife within 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 SEIS (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 which seem unlikely to occur within 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.

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 Corporations. Although there are no present plans to develop these non-federal lands for oil and gas, leasing in the Coastal Plain could result in exploration and development of recoverable hydrocarbons. Future NEPA analyses associated with Coastal Plain leasing will consider oil and gas activities on non-federal lands once project-specific details are available.

Arctic Strategic Transportation and Resources (ASTAR)

The ASTAR project is analyzing conceptual regional infrastructure corridors that could meet the needs of the North Slope and Northwest Arctic Borough The current vision of the proposed road network would help to link isolated communities and develop oil fields across the region; it does not currently connect to Arctic Village or Venetie. Effects of the project could include increased cultural connectivity, reduced costs to North Slope communities for dry goods, fuel, and consumables, decreased costs for rehabilitating legacy wells in the NPR-A, more efficient development of state and federal hydrocarbon resources, and increased economic activity providing job opportunities for the region. ASTAR is in its preliminary stages; definitive transportation corridor routing would be developed in coordination with the communities and the North Slope Borough.

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 have cascading or synergistic impacts on other resources. For example, water quality affects fish populations, which in turn influences subsistence harvests, which can have implications for other human outcomes such as health and sociocultural systems. As a result, there is some overlap among the resource sections in **Chapter 3** 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
Emissions of greenhouse gases from exploration, production, processing, and consumption of oil and gas.	Cumulative addition to global atmospheric concentrations of GHGs, potentially contributing to climate change.	Mass per year (tons per year or metric tons per year) of greenhouse gas (GHG) emissions from petroleum production.

Impact Analysis Area

- Direct/Indirect—Program area; development/production GHG emissions estimates.
- Cumulative—Coastal Plain GHG emissions compared with Alaska, the US, and global total GHG emissions.

Analysis Assumptions

- Coastal Plain oil production will not significantly increase the global market, that is, it would not significantly alter global demand and consumption of fossil fuels.

F.4.2 Air Quality

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
Leasing	Direct	• Exceedances of National Ambient Air Quality Standards (NAAQS) and Alaska Ambient Air Quality Standards (AAAQS) • Impacts on Air-quality Related Values (AQRVs)
Fuel combustion in construction equipment, aircraft, vehicles, and machinery such as drill rigs, generators, pumps, and compressor by phase	Indirect, short term (seismic surveys and exploratory drilling) Indirect, long term (buildout of develop units and production)	• Exceedances of NAAQS/AAAQS • Impacts on AQRVs
Construction of ice roads and airstrips to access and construct the central processing facilities (CPFs) and satellite well pads. Development of gravel pits, which are not included in the 2,000-acre surface disturbance cap, to provide materials for road and pad construction	Indirect, long term Localized, intermittent, and temporary	• Exceedances of NAAQS/AAAQS
Operation of gravel pits	Indirect, long-term Localized, temporary	• Exceedances of NAAQS/AAAQS

Action Affecting Resource	Type of Impact	Impact Indicators
Use of roads	Indirect, long-term Localized	• Exceedances of NAAQS/AAAQS
Regional sources of air emissions	Cumulative	• Exceedances of NAAQS/AAAQS • Impacts on AQRVs

Impact Analysis Area

- Direct/Indirect—Program area
- Cumulative—North Slope

Analysis Assumptions

- Because the location, timing, and level of future oil and gas development on the Coastal Plain is unknown at this time, the BLM has determined that a qualitative assessment is the appropriate form of analysis for this EIS.
- Future on-the-ground actions requiring BLM approval will require further NEPA analysis based on specific and detailed information about what kind of activity is proposed and where it will take place. Additional site-specific terms and conditions that may be required before any oil and gas activity is authorized will be determined as part of this future site-specific NEPA analysis.

F.4.3 Acoustic Environment

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
• Noise generated by drilling • Noise generated by aircraft used in fluid minerals activities • Noise generated in the construction and operation of roads, well pads, and other ancillary support activities	Noise disturbance to people and wildlife	• Sound intensity index—the relationship of background noise to an introduced sound level. • Distance to inaudibility • Number of flights per day • Acres closed to leasing and designated NSO

Impact Analysis Area

- Direct/Indirect—Program area
- Cumulative—Program area and community of Kaktovik

Analysis Assumptions

- Ambient noise levels are approximately 35 decibels (dB) on the Coastal Plain.
- Decibels typically attenuate at a rate of 6 dB per doubling of distance.
- Relationships of sound differences and audibility tables tabulated for the GMT2 SEIS analysis (BLM 2018) are generally representative of this EIS.

F.4.4 Physiography

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
• Temporary structures along coast • Gravel infrastructure • Gravel mines	Coastal erosion and deposition is both a direct and an indirect impact. Gravel infrastructure and mines are a direct impact on topography.	• Footprint of gravel fill, in acres • Size of gravel mines, in acres

Impact Analysis Area

- Direct/Indirect—Hypothetical development footprint for future gravel infrastructure and gravel mining within the program area
- Cumulative—Program area

Analysis Assumptions

- None

F.4.5 Geology and Minerals

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
• Gravel fill at locations of important bedrock exposures • Development could affect the risk of some geologic hazards • No impacts on mineral resources other than petroleum and aggregate resources, which are addressed in other sections	Direct impacts on important bedrock exposures	Discussion is qualitative

Impact Analysis Area

- Direct/Indirect—Hypothetical development footprint for future gravel infrastructure and gravel mining within the program area
- Cumulative—Program 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	n/a

Impact Analysis Area

- Direct/Indirect—Reduction in oil and gas resources available in the program area.
- Cumulative—Program area

Analysis Assumptions

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

F.4.7 Paleontological Resources

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
Ground disturbance caused by facilities development • Gravel fill at locations of bedrock exposures with high potential fossil yield classification (PFYC) rankings • Gravel extraction • Drilling	If gravel fill is placed over certain bedrock outcrops identified as having high paleontological yield potential, it would make them inaccessible for research. Infrastructure and increased human access would increase access to paleontological resources, which could result in potential looting and removal as well as adding to the identification and scientific body of knowledge of resources in the area.	• PFYC ranking of mapped units • Proximity to mapped units with assigned PFYC rankings

Impact Analysis Area

- Direct/Indirect—Program area
- Cumulative—Program area

Analysis Assumption

- PFYC rankings of 3, 4, 5, and U will require further field investigation for individual exploration projects.

F.4.8 Soil Resources

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
• Material resources extraction sites • Access roads, pads, staging areas, and airstrips (gravel fill or ice) • Off-tundra travel • Construction of structures, such as pipeline vertical support members, and building foundations • Reclamation of embankments and pads	• Direct surface disturbance to vegetation • Removal of surface-insulating organics to cause thaw of frozen soils and destruction of surface landforms • Sand and gravel mining in streams affecting stream structure • Placement of fill for construction of pads and roads • Installation of piling for vertical support members and infrastructure foundations	• Acres of disturbance to soil and permafrost • Changes to soil and permafrost from placing fills for embankments and pad • Changes to erosion of soil from placement of fills for embankments and pad • Extent of fugitive dust • Changes in drainage patterns due to permafrost thaw and redirection by embankments

Impact Analysis Area

- Direct/Indirect—Program area
- Cumulative—Program area

Analysis Assumptions

- Up to 2,000 acres of disturbance will occur on/across frozen soils under each action alternative.
- Pads and roads will be constructed to minimize potential thaw of frozen soils (use of thicker embankments or insulation).
- Water ponding will occur at base of embankments.
- Ice roads will be used to access material sites.
- Roads and pads will be reclaimed.

F.4.9 Sand and Gravel Resources

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
• Material resources extraction sites • Ice access roads • Reclamation	• Direct surface disturbance to vegetation; removal of surface-insulating organics to cause frozen soils to thaw and destruction of surface landforms • Sand and gravel mining in streams • Placement of fill for construction of pads and roads	• Acres/volume of material removed

Action Affecting Resource	Type of Impact	Impact Indicators
(see above)	• Changes in surface drainage and water impoundment • Changes in erosion where surface vegetation is removed.	(see above)

Impact Analysis Area

- Direct/Indirect—Program area
- Cumulative—Program 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 not included in 2,000-acre development limitation.

F.4.10 Water Resources

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
Sand and gravel mining	• Removal of subsurface material • Alteration of surface water flow patterns • Creation of thaw bulbs in permafrost • Placement of gravel fill, disrupting recharge • Increased sedimentation	• Change to surface water flow • Change to water levels • Change to surface water quality • Change to groundwater
Camps and facilities	• Lower water levels from potable water, fire suppression, and maintenance activities • Discharge of treated domestic wastewater	• Change to surface water quality • Change to water levels • Change to surface water flow
Construction and maintenance of gravel pads, roads and air access facilities	• Alteration of flow patterns • Oil spills	• Change to surface water flow • Change to surface water quality • Change to water levels • Change to groundwater levels • Change to marine water quality
Installation of culverts and bridges	• Alteration to stream hydraulics and drainage patterns • Inundation and starvation of areas	• Change to surface water flow • Change to surface water quality
Pipeline construction	• Increased sedimentation during construction • Water contamination due to oil spills	• Change to surface water flow • Change to surface water quality

Action Affecting Resource	Type of Impact	Impact Indicators
Snow roads	• Alteration of natural drainage patterns	• Change to surface water flow
Ice roads, bridges, pads, and airstrips	• Alteration of natural drainage patterns • Lower lake levels • Ice jamming during breakup	• Change to surface water flow • Change to surface water quality • Change to water levels
Barge docks and seawater treatment plant construction and operation	• Increased turbidity during construction • Oil spills • Coastal erosion from barge waves	• Change to marine water quality • Change to surface water flow • Change to surface water quality
Drilling and operation	• Disturbance of tundra soils • Oil spills • Lower water levels from hydrostatic testing	• Change to surface water flow • Change to surface water quality • Change to groundwater level • Change to marine water quality

Impact Analysis Area

- Direct/Indirect—Program area
- Cumulative—Program area

Analysis Assumptions

- The eastern and western program area boundaries follow the Staines River to the west and Aichilik River to the east.
- Impacts to water resources are similar to those describe in the GMT2 SEIS (BLM 2018) and other North Slope EISs. Discussions of impacts will be modified where data specific to the program area is available.
- The hypothetical development scenarios have similar impact but vary in scale and intensity, depending on what project is ultimately developed.
- No specific developments or infrastructure needs have been identified beyond the scenarios identified in **Appendix B**.

F.4.11 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/facility construction Introduction of contaminants including	• Introduction of contaminants including petroleum products and heavy metals caused by the development and operation of facilities • Temporary and permanent storage of solid waste generated from activities (storage area, landfill, or monofill)	• Solid waste cubic yards per day (based on annual average • Solid waste generated per day, calculations for air emissions of burning solid waste. • Sewage lagoon to be x acres to treat y volume per day (based on annual average). • Underground injection control wells depth of discharge and quantity

Action Affecting Resource	Type of Impact	Impact Indicators
petroleum products caused by: • Spills • Vehicle accidents/rollovers • Well blowouts • Pipeline leaks • Tank overfills Disposal of unregulated nonhazardous fluids • Injection of nonhazardous fluids through Class I UIC	• Air quality impacts from burning solid waste • Design and implementation of wastewater facilities • Creation of landfill, monofill, other • Management of spills • Underground injection well • Staging and storage areas • Underground injection control (Class I or II wells)	(see above)

Impact Analysis Area

- Direct/Indirect—Direct impacts evaluated for the geographic extent of hypothetical future development areas (up to 2,000 acres of development) within the program area. The indirect impacts area is 0.25 mile outside of the direct impact geographic area.
- Cumulative—Cumulative impacts are evaluated for the same geographic area as the indirect impacts area.

Analysis Assumptions

- Projects will require a stormwater pollution prevention plan (SWPPP), a SPCC, a solid waste general permit, and an ODPCP.
- Facilities will require a facility response plan to operate.
- Wastewater design will require approval from the DEC.
- Class I or II underground injection wells will require a permit/authorization from DEC.
- Storage of greater than 55 gallons (individual 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.
- Access to the landfill or sewage lagoon will be controlled.

F.4.12 Vegetation and Wetlands

Impacts and Indicators—Vegetation

Action Affecting Resource	Type of Impact	Impact Indicators
Seismic exploration: Development of rolligon or other all-terrain vehicle (ATV) trails	Vegetation and plant community alteration from rolligon or ATV traffic	Acreages of vegetation types in accessible areas for each alternative, stratified by oil potential and EIS-specific development stipulations; no indicator available to assess possible plant community changes.

Action Affecting Resource	Type of Impact	Impact Indicators
Exploration drilling: Ice placement for ice roads and pads	Vegetation and plant community alteration from ice placement and operation of ice roads	Acreages of vegetation types in accessible areas for each alternative, stratified by oil potential and EIS-specific development stipulations; no indicator available to assess possible plant community changes.
Exploration drilling: Water withdrawal from lakes to support ice-road and pad construction and other uses	Lacustrine (emergent) vegetation alteration from changing water levels	No quantitative indicator available
Project construction: Direct effects of gravel mining	Permanent loss of vegetation types	Acreages of vegetation types in accessible areas for each alternative, stratified by oil potential and specific development stipulations.
Project construction: Direct effects of gravel placement for roads and pads	Permanent loss of vegetation types	Acreages of vegetation types in accessible areas for each alternative, stratified by oil potential and EIS-specific development stipulations.
Project operations: Indirect effects of gravel roads and pads and pipeline corridors	Vegetation and plant community alteration from drifted snow and altered drainage patterns	Acreages of vegetation types in accessible areas for each alternative, stratified by oil potential and EIS-specific development stipulations; no indicator available to assess possible plant community changes.
Project operations: Traffic on gravel roads	Vegetation and plant community alteration from gravel spray and dust fallout	Acreages of vegetation types in accessible areas for each alternative, stratified by oil potential and EIS-specific development stipulations; no indicator available to assess possible plant community changes.
Project construction and operations: All disturbances with the capacity to introduce non-native/invasive species	Changes to plant community structure with the potential introduction of invasive or noxious non-native plants	No indicator available to assess possible plant community changes.
Project construction and operations: Oil and contaminant spills	Vegetation and plant community alteration from tundra spills	No indicator available to assess possible spill locations in relation to vegetation types.

Impacts and Indicators—Wetlands

Action Affecting Resource	Type of Impact	Impact Indicators
Seismic exploration Development of rolligon or other ATV trails	Alteration of wetland types from rolligon or ATV traffic	Acres of wetlands and water types in accessible areas for each alternative, stratified by oil potential and EIS-specific development stipulations

Action Affecting Resource	Type of Impact	Impact Indicators
Exploration drilling: Ice placement for ice roads and pads	Alteration of wetland types from ice placement and operation of ice roads	Acres of wetlands and water types in accessible areas for each alternative, stratified by oil potential and EIS-specific development stipulations
Exploration drilling: Water withdrawal from lakes to support ice road and pad construction and other uses	Lacustrine fringe and aquatic wetland alteration from changing water levels	Qualitative discussion
Project construction: Gravel mining	Permanent loss of wetlands and waters of the US	Acres of wetlands and water types in accessible areas for each alternative, stratified by oil potential and EIS-specific development stipulations
Project construction: Direct effects of gravel placement for roads and pads	Permanent loss of wetlands and Waters of the US	Acres of wetlands and water types in accessible areas for each alternative, stratified by oil potential and EIS-specific development stipulations
Project operations: Indirect effects of gravel roads and pads and pipeline corridors	Alteration of wetland types from drifted snow and altered drainage patterns	Acres of wetlands and water types in accessible areas for each alternative, stratified by oil potential and EIS-specific development stipulations
Project operations: Traffic on gravel roads	Alteration of wetland types from gravel spray and dust fallout	Acres of wetlands and water types in accessible areas for each alternative, stratified by oil potential and EIS-specific development stipulations
Project construction and operations: All disturbances with the capacity to introduce non-native/invasive species	Changes to plant community structure in wetlands with the potential introduction of invasive or noxious non-native plants	Qualitative discussion on possible plant community changes
Project construction and operations: Oil and contaminant spills	Wetland and plant community alteration from spills on tundra	Qualitative discussion on possible spill locations in relation to wetland types

Impact Analysis Area—Vegetation and Wetlands

- Direct/Indirect—Program area
- Cumulative—Program area

Analysis Assumptions—Vegetation and Wetlands

- The final footprint of the anchor development, consisting of 1 CPF, roads connecting to six satellite pads, a seawater treatment plant and access road, comprises approximately 750 acres for consideration of direct effects. The indirect area was calculated by buffering the 750-acre gravel footprint by 328 feet for an indirect effects area of 6,607 acres.

- The relative proportions for each area open for development under the alternatives and development stipulations will be affected in similar proportions under the anchor footprint. This is because spatially explicit information about where potential projects might be developed was absent for this programmatic EIS format.

F.4.13 Fish and Aquatic Species

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
Seismic Surveys: Use of rolligons or other ATVs Use of vibroseis to image the subsurface	Habitat Alteration—Flow alteration and fish passage: Compaction of ice over and surrounding waterbodies could cause short-term delays in melt. Disturbance, injury, or mortality—Increased sound pressure in unfrozen waterbodies, including springs, could disturb, injure, or kill fish.	Qualitative discussion based on best available information.
Water withdrawal from lakes or streams for ice roads, water supply, dust suppression, and other uses	Alteration or loss of winter and summer aquatic habitat due to water withdrawal activities may include the following: • Changes in water levels • Ice compaction • Changes in water chemistry – Declines in dissolved oxygen – Increases in solutes • Alteration of water flow during breakup (seasonal changes to water quantity and quality) • Changes in permafrost or groundwater sources • Loss of littoral habitat and wet meadow zones due to shallowing • Increased freezedown of substrate used by some aquatic invertebrates Injury or mortality of fish from entrainment or impingement at water intake.	Types and extent of effects by aquatic habitat (lakes, rivers, springs) Describe stream miles and acreage that could be affected

Action Affecting Resource	Type of Impact	Impact Indicators
Water withdrawal from marine or brackish water (Seawater Treatment Plant [STP])	Alteration or loss of aquatic habitat due to water withdrawal activities, may include changes in local salinity. Injury or mortality of fish from entrainment or impingement at water intake.	Type of habitat around STP intake offshore. Changes to water quality baseline because of water withdrawal described in **Section 3.2.10**, Water Resources
Onshore STP facility construction	• Alteration of marine or brackish water habitat (sedimentation) during construction. • Disturbance (temporary alteration of fish migratory route), injury, or mortality of fish due to ice trenching (winter construction) for intake pipe placement.	General footprint of ice trenching within 0.5-mile buffer zone (to be confirmed from water quality or water resource section) to account for: • noise effects • sedimentation
STP discharge to marine waters	Changes to salinity or other water quality from discharge of brine from saltwater treatment plant	• Changes to water quality baseline described in **Section 3.2.10**, Water Resources • Acres of expected mixing zone.
Gravel mining for road and pad construction	• Alteration or loss of aquatic habitat • Creation of deep aquatic habitat in gravel pits • Changes in water quality, including turbidity and mobilization of contaminants • Direct mortality, if mining occurs in water bodies	Acres of potential habitat affected by mining (acres of gravel sites, assuming all acres would be in rivers), and acres of gravel sites in the 50-year floodplain (indirect impacts on aquatic habitat).
New gravel roads, pads, culverts, and bridges	Direct aquatic habitat loss or blockage of fish passage Indirect aquatic habitat alteration from: • Gravel dust and spray • Temporary and periodic turbidity, sedimentation, and contaminant mobilization during gravel placement, compaction, and grading • Changes in natural drainage patterns, such as water impoundment and ice damming	Describe direct and indirect effects by aquatic habitat types and their context on the landscape.

Action Affecting Resource	Type of Impact	Impact Indicators
Vehicle traffic on ice or gravel infrastructure	Displacement of fish due to blocked fish 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	Describe ice infrastructure effects and their context on the landscape. Acres within 328 feet of gravel infrastructure that would be altered by dust or gravel spray. Changes resulting from erosion or thermokarst described in **Section 3.2.8**, Soils
Barging of materials	Disturbance and displacement of fishes during barging Invasive invertebrate and fish species introduced from released ballast water Accidental spills in marine waters	General description of noise associated with barging.
Barge landing or dock	Potential alteration of rearing or nearshore foraging habitat Disturbance and displacement of fishes	Acres of fill required, type of infrastructure required (such as overwater structure or sea wall) Number of barge trips required
Pipeline construction • Trenching for optic cable at stream and road-crossings (assumes trenching in, under, or next to pipe)	Loss or alteration of habitat	Describe direct and indirect effects of placing VSMs in the water column by aquatic habitat types and their context on the landscape.
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 assume all work in winter and thus no in-water work) Disturbance, injury, or mortality of fish due to noise or vibration during bridge construction	Describe fish-bearing streams that could require bridges, describe overwintering habitat at or near those waterbodies.
Ice roads and snow management	Displacement of fish or alteration of habitats due to changes in hydrology, melt, and runoff	Miles of ice road anticipated, if known General snow management practices

Action Affecting Resource	Type of Impact	Impact Indicators
Potential spills from: • storage, use, and transport of waste and hazardous materials (including crude oil, fuels, salt water, drilling fluids, and other chemicals). • wells, pipelines, or other infrastructure.	Habitat alteration or loss due to spills or leaks Injury or mortality of fish from spilled material if it enters water bodies	Described on broad level by habitat type (e.g., nearshore, mountain streams, and springs) and species affected
ATV activity on tundra (for operations, pipeline maintenance, and spill preparedness and planning)	Habitat alteration due to compression or damage to vegetation resulting in soil exposure, sediment runoff, and contaminant mobilization	Qualitatively describe by habitat type (e.g., mountain streams and springs) and species affected.

Impact Analysis Area

- Direct/Indirect—The program area plus the upstream extent of overwintering habitat for fishes. The nearshore area within the barge route, STP mixing zone, or other connected actions.
- Cumulative—Many of the species have life histories that include migrations from the program area west to Utqiagvik, east to the Mackenzie River, and upstream into freshwaters of the larger Arctic Coastal Plain

Analysis Assumptions

- The BLM leases are for onshore development; offshore activities could be considered connected actions, but the analysis does not include offshore infrastructure.
- A barge landing or dock will be part of the alternatives.
- There is more fish and aquatic invertebrate use of program area waters than have been confirmed to date (use over a broader area and by a higher number of species).
- There are contradictions in known ranges for certain species, such as Pink salmon, and slimy sculpin. These species are present and use the program area.
- Alternatives will include water withdrawal either from freshwater sources or, more likely, from marine waters via an onshore STP.

F.4.14 Birds

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
Seismic surveys by rolligon in winter	Compaction of snow and vegetation, delayed melt in rolligon footprints	Habitat affected (qualitative)
Gravel placement for roads and pads	Habitat loss	Acres of habitat affected
Gravel placement (roads and pads) and construction of pipeline corridors	Habitat alteration from drifted snow and altered drainage patterns	Acres of habitat affected (use dust fallout buffer)

Action Affecting Resource	Type of Impact	Impact Indicators
Road traffic on gravel roads	Habitat alteration from gravel spray and dust fallout	Acres of habitat affected (use dust fallout buffer)
Ice placement for ice roads and pads to support winter exploration and construction	Habitat alteration by ice roads and pads	Habitat affected (qualitative)
Water withdrawal from lakes to support ice road construction, water supply, dust suppression, and other uses	Habitat alteration by reduced/fluctuating water levels, loss of nesting sites on lakeshores, and reduced water quality and fish availability	Describe extent of effect in qualitative terms by aquatic habitat (lakes, rivers, springs)
Water withdrawal from and discharge to the marine environment (STP)	Alteration of aquatic habitat (salinity) for fish (consumed by birds) and potential injury to or mortality of fish at intake	Describe changes in water quality (refer to **Section 3.2.10**, Water Resources) and area of potential mixing zone
Gravel mining	Habitat loss: with rehabilitation after abandonment, potential creation of avian habitats previously absent on that site for some species	Habitat affected (qualitative)
Road traffic, air traffic, noise, and human activities	Disturbance and displacement of birds from affected areas	Acres of habitat affected (noise buffer)
Road traffic	Injury and mortality from accidental collisions	Describe potential for vehicle collisions
Potential spills from: • storage, use, and transport of waste and hazardous materials (including crude oil, fuels, salt water, drilling fluids, and other chemicals). • wells, pipelines, or other infrastructure.	Injury and mortality from accidental releases, discharges, or insecure containment Habitat alteration or loss due to spills or leaks	Describe potential for accidental exposure for individuals and habitats
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
Barging materials and modules	Disturbance and displacement of birds from nearshore habitats, potential alteration of aquatic habitats by open-water dredging	Describe potential displacement of birds
Human activities, including road and air traffic	Disturbance and displacement of large flocks of staging snow geese	Potential disturbance and displacement (no estimate of distance effect)

Impact Analysis Area

- Direct/Indirect—Program area and adjacent marine habitats;
- Cumulative—North Slope from NPR-A east to Arctic Refuge and Canada border

Analysis Assumptions

- For many actions, impacts can be described qualitatively either because resource and impact data are unavailable, or project details are uncertain or unknown at the time of this preliminary analysis. For most types of habitat impacts and for some types of behavioral disturbance, semi-quantitative estimates of areas affected are possible.
- Habitat Loss and Alteration (including disturbance and displacement): In the absence of spatially specific information, little can be said aside from total areas potentially affected. An upper limit of 2,000 acres is set by the Public Law 115-97.
  - Using a drawing of a standardized anchor field footprint (one CPF and six radiating access roads to six drill pads, one STP pad and 30-mile access road, totaling 750 acres), estimate the area within 328 feet (for impacts of dust fallout, gravel spray, thermokarsting, and impoundments) and within 656 feet (for impacts of disturbance and displacement).
  - Extrapolate to a footprint of 2,000 acres using the proportional increase in area that was calculated for each buffer area based on the 750-acre footprint.

F.4.15 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, other ungulates, carnivores (including denning grizzly bears), and small mammals	Area (acres or square miles [mi^2]) available for seismic activity under different alternatives
Ice placement for ice roads and pads to support winter exploration and construction	Habitat alteration by ice roads and pads	Area (acres or mi^2) available for ice road placement by habitat type and alternative, and by high, medium, low oil potential
Gravel placement for roads and pads	Direct habitat loss	Area (acres or mi^2) available for gravel road placement by habitat type and alternative, and by high, medium, low oil potential
Traffic on gravel roads	Habitat alteration from gravel spray and dust fallout	Area (acres or mi^2) of affected habitat, by habitat type
Gravel mining	Direct habitat loss With rehabilitation after abandonment Indirect habitat loss by disturbance during mining	Area (acres or mi^2) of affected habitat, by habitat type
Road traffic, air traffic, noise, and human activities	Disturbance and displacement of caribou and other species from affected areas	Proportion of years that areas are used by PCH per season.
Roads and pipelines	Potential obstructions to caribou movements to and from insect-relief habitat	Proportion of CAH caribou using the program area alternatives by season (based on percent of

Action Affecting Resource	Type of Impact	Impact Indicators
(see above)	Habitat loss due to spills or leaks	seasonal use density from kernel density) Proportion of years areas are used by PCH caribou by season
Road traffic	Injury and mortality from accidental collisions	Qualitative assessment
Potential spills from: • storage, use, and transport of waste and hazardous materials (including crude oil, fuels, salt water, drilling fluids, and other chemicals). • wells, pipelines, or other infrastructure.	Injury and mortality from accidental releases and discharges or insecure containment	Describe potential accidental exposure for individuals and habitats
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, non-local hunters, and other recreationists	Qualitative assessment

Impact Analysis Area

- Direct/Indirect—Program area (non-marine habitats)
- Cumulative—Annual ranges of the PCH and CAH caribou herds.

Analysis Assumptions

- Subsistence hunting will be allowed along gravel roads.
- Access approvals for recreation or non-subsistence uses within the program area will be dealt with at the APD phase when users apply for use permit.
- Oil development may be more likely in the high oil potential area, less likely in the low oil potential area.
- 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 3 weeks, based on research in North Slope oilfields.
- Roads and pipelines may deflect and delay caribou movements, but those effects can be mitigated by appropriate design features (pipeline height 7 feet or more, pipeline/road separation 500 feet or more) and management of human activities, as developed in the existing North Slope oilfields.

- Occupied grizzly bear dens will be avoided by at least 0.5 mile, as stipulated by the State of Alaska.

F.4.16 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/blasting, hauling, and placement	Direct habitat loss of polar bear critical habitat and potential maternal denning habitat from gravel mining and placement Alteration of habitat and temporary loss of use of polar bear critical habitat and potential maternal denning habitat from construction of ice roads and pads Behavioral disturbance of polar bears, especially denning females. Possible den abandonment and loss of cubs Temporary alteration of ringed seal habitat, including lair habitat Behavioral disturbance of ringed seals	Acreage of critical and maternal polar bear denning habitat affected by seismic exploration Apply distance buffer of 1 mile around maternal dens from literature-based assessment of disturbance from equipment operation and noise, and regulatory requirements under ITRs Acreage of nearshore, coastal habitat (less than 3m bathymetry limit) possibly used as lair sites for ringed seals that could be affected by seismic exploration Apply NMFS-approved distance buffer around known ringed seal lairs
Marine vessel traffic during open-water season	Behavioral disturbance of marine mammals by vessel passage and off-loading during open-water season Behavioral disturbance to polar bears onshore related to landings of marine vessels	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 from vehicle strikes	Apply distance buffer of 1 mile from literature-based assessment of disturbance from equipment operation and noise, and 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 or mortality of some polar bears Injury and mortality from accidental releases and discharges or insecure containment	Qualitative assessment, considering ROPs for waste handling and human/bear interaction plans

Impact Analysis Area

- Direct/Indirect—Program 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 only, except for those 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 the Biological Assessment and Biological Opinion, which are being prepared separately.
- Maternal den surveys for polar bears will be conducted before any activities occur in the program area, so that occupied dens can be avoided by at least 1 mile during exploration and development. It is unlikely that all dens will be identified during den surveys.
- An average of two barge landings per year is anticipated; the number of transports would vary based on ice conditions and the large equipment needed for upcoming development phases.
- Barge landings may require benthic 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).

F.4.17 Landownership and Use

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
• Areas open/closed to leasing and infrastructure development • Protective measures that influence the placement or design of uses	Restrictions on infrastructure development, including type, location, and design	• Acres made available for lease sale where new oil and gas related uses could be developed • Acres where protection measures would influence the design, location, and season or type of use
Landownership changes	Conveyance of lands out of federal ownership	Acres of landownership

Impact Analysis Area

- Direct/Indirect—Program area
- Cumulative—Program area

Analysis Assumptions

- 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 ownership as part of this EIS.

F.4.18 Cultural Resources

Impacts and Indicators

Note: Types of impact are not mutually exclusive and may occur across all actions impacting 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/loss of context • Vulnerability to erosion • Theft and vandalism	• Number of previously documented AHRS and TLUI sites in potentially affected area • Eligibility status of cultural resource sites • Traditional knowledge of culturally sensitive areas and traditional use areas and sites
Proposed operational infrastructure: • CPFs • Drill rigs and pads • Pipelines/VSMs • Roads • Material sites	• Change in character and setting • Change in use or access to traditional sites • Proximity of proposed Project components to culturally sensitive areas	• Same as above
Operations: • Traffic • Human presence • Maintenance and security activities • Proposed program policies	• Introduction of vibration, noise, or atmospheric elements, such as visual, dust, and olfactory • 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 • Impacts on beliefs and traditional religious practices • Neglect of a cultural resource that causes its deterioration • Lack of access to traditional use areas and impacts on broader cultural landscape	• Same as above

Impact Analysis Area

- Direct/Indirect—Program area
- Cumulative—North Slope

Analysis Assumptions

- All unsurveyed areas of the program area could contain cultural resources. Furthermore, past surveys have been cursory and likely did not adequately identify cultural resources.

- Cultural resource sites are treated as eligible for listing on the NRHP, until they are sufficiently evaluated as determined by the BLM.

F.4.19 Subsistence Uses and Resources

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
Noise, traffic, and human activity: • Construction noise • Gravel mining • Air traffic • Ground traffic • Seismic activity • Barge traffic • Drilling noise • 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 avoiding development and human activity Increased competition with outsider populations	• Results of **Section 3.3.4**, Terrestrial Mammals and **Section 3.3.5**, Marine Mammals regarding impacts of noise, traffic, and human activity on wildlife • Percent of harvests coming from program area (where data are available) • Percent of harvesters using the program area, by resource • Analysis of material and cultural importance of subsistence species • Analysis of Alaska Wildlife Harvest database—Requires data sharing agreement and estimate 1 month or more to develop agreement and analyze data. • Traditional knowledge regarding 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	• See above

Action Affecting Resource	Type of Impact	Impact Indicators
(see above)	Reduced user access due to harvester avoiding development infrastructure Increased user access due to use of project roads for subsistence activities Increased competition along new hunting corridors (roads)	(see above)
Contamination • Oil spills • Air pollution • Release, discharge, or insecure containment of hazardous materials or wastes	Reduced resource availability due to changes in resource abundance Reduced resource availability due to harvester avoiding contaminated resources Reduced user access due to harvester avoidance because of concerns about contamination	• Results of **Section 3.3.4**, Terrestrial Mammals and **Section 3.3.5**, Marine Mammals regarding impacts of oil spills on wildlife • Results of **Section 3.2.2**, Air Quality and **Section 3.4.11**, Public Health and Safety regarding impacts of air pollution on wildlife and human health • 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/personnel Reduced resource availability due to inability to hunt in or around certain infrastructure	• Percent of harvests coming from study area (where data are available) • Percent of harvesters using the study area, by resource • Traditional knowledge
Increased Employment/Revenue	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 **Section 3.4.10**, Economy • Traditional knowledge
General development	Impacts on cultural practices, values, and beliefs	• Traditional knowledge

Impact Analysis Area

- Direct/Indirect—All areas used by the 22 Alaskan caribou study communities and seven Canadian user groups subsistence study communities
- Cumulative—Same as direct/indirect analysis area

Analysis Assumption

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

F.4.20 Sociocultural Systems

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
Changes in income and employment levels	• No economic activity associated with regional or village corporation to many Arctic Village and Venetie residents • Influx of cash and impacts on social ties and political organizations • Hiring super household hunters • Lack of time for subsistence activities • Increased cash to support subsistence activities	• Results of **Section 3.4.10**, Economy regarding potential changes in employment and income • Results of **Section 3.4.3**, Subsistence Uses and Resources • Traditional knowledge
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 resulting from changes in subsistence providers • Loss of traditional use areas and knowledge associated with those places	• Results of **Section 3.4.3**, Subsistence Uses and Resources regarding impacts on subsistence • Traditional knowledge
Influx of non-resident temporary workers associated with project	• Conflicts between subsistence users and workers • Discomfort hunting in traditional use areas	• Results of economy chapter regarding outside workers • Results of **Section 3.4.3**, Subsistence Uses and Resources • 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 **Section 3.4.6**, Recreation • Results of **Section 3.4.11**, Public Health and Safety • Traditional knowledge

Action Affecting Resource	Type of Impact	Impact Indicators
Changes in available technologies	• Changes in equipment for subsistence • Changes in transportation routes • Changes in social ties, sharing, and interactions	• Results of **Section 3.4.10**, Economy regarding potential changes in employment and income • Traditional knowledge
General development	• Impacts on belief systems • Impacts on cultural identity	• Traditional knowledge

Impact Analysis Area

- Direct/Indirect—All of the subsistence study communities (Kaktovik, Nuiqsut, Arctic Village, and Venetie).
- Cumulative—Same as direct/indirect analysis area

Analysis Assumption

- There will eventually be oil and gas exploration, development, and production activities in the Coastal Plain similar to other developments on the North Slope

F.4.21 Environmental Justice

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
• Exploration phase activities • Development/constructio n 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 EO 12898

Impact Analysis Area

- Direct/Indirect—All of the subsistence study communities (Kaktovik, Nuiqsut, Arctic Village, and Venetie).
- 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, and/or Alaska Native tribal entities. This could include such effects identified in any specific resource analysis, but primarily with subsistence, sociocultural, economics, and public health and safety.
- Minority populations and low-income populations are be defined by CEQ guidance on the implementation of EO 12898. The general reference population for this analysis is the State of Alaska.

- Communities specifically included in the local and regional analyses of direct and indirect Environmental justice effects are Kaktovik, Nuiqsut, Arctic Village, and Venetie. These communities have been identified based on the results of the subsistence, sociocultural, economic, and/or public health and safety analyses in conjunction with community demographic information establishing minority and/or low-income population status.

F.4.22 Recreation

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
Disturbance in priority recreation areas (direct)	• 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, including specially permitted commercial activities • Change in the social setting due to a concentration of users in a smaller area	• Acres of areas made available for lease sales that overlap popular recreation areas and are not subject to NSO stipulations • Acres of surface disturbance that overlap popular recreation areas
Noise, lights, and human activity (direct and indirect)	• Change in the quality of the recreation setting and/or user experiences • Displacement of recreation opportunities (from surface disturbance)	• Acres where protective measures that minimize impacts on recreation would apply
Change in resource values (e.g., wildlife) that contribute to the quality of the recreation setting (indirect)	Change in the quality of the recreation setting and/or user experiences	• Acres where protective measures that minimize impacts on the resource and that contribute to recreation settings and experiences would apply

Impact Analysis Area

- Direct/Indirect—Program area
- Cumulative—Program area

Analysis Assumptions

- Current recreation in the planning area will continue.
- The potential for user interactions between all types of users will increase with increasing use.

F.4.23 Special Designations

Impacts and Indicators

Action Impacting Resource	Type of Impact	Impact Indicators
Marine Protected Areas Lease Stipulation 4 – Nearshore marine, lagoon and barrier island habitats of the Southern Beaufort Sea within the boundary of the Arctic National Wildlife Refuge Lease Stipulation 9 – Coastal Area Wild and Scenic Rivers Lease Stipulation 1 – Rivers and Streams Wilderness Lease Stipulation 10 – Wilderness Boundary	TL stipulation on major coastal waterbodies and coastal islands between May 15 and until the later of November 1 or sea ice is within 10 miles of the coast of each season, whichever is later. NSO stipulation on coastal waters, lagoons or barrier islands within the boundaries of the Arctic Refuge Coastal Plain area or 2 miles inland of the coast. NSO stipulation for WSRs in the program area within the setback distances outlined in Chapter 2, Alternatives. NSO stipulation within 3 miles of the southern and eastern boundaries of the Coastal Plain adjacent to the Mollie Beattie Wilderness Area.	• Natural Heritage, the primary conservation focus • ORVs, tentative classification, and free-flowing nature of the river segment or corridor • Changes to the untrammeled and naturalness of the program area, opportunities for solitude or primitive and unconfined recreation, and unique or supplemental values

Impact Analysis Area

- Direct/Indirect
  - MPAs—All marine waters and lagoons located within and off the northern coast of the program area.
  - WSRs—Up to 4 miles of either side of the ordinary high water mark of the eligible or suitable rivers in the program area.
  - Wilderness Characteristics, Quality, and Values—Program area.
- Cumulative
  - MPAs—All marine waters and lagoons located within the Arctic Refuge and off the northern coast of the program area.
  - WSRs—Up to 4 miles of either side of the ordinary high water mark of the eligible or suitable rivers in the Arctic Refuge.
  - Wilderness Characteristics, Quality, and Values—All lands in the Arctic Refuge, with an emphasis on the Mollie Beattie Wilderness Area.

Analysis Assumptions

- The MPA in the program area will continue to be managed in accordance with EO 13158, Marine Protected Areas, May 26, 2000, and guidance from the National Oceanic and Atmospheric Administration on their website: https://marineprotectedareas.noaa.gov/dataanalysis/mpainventory/mpaviewer/

- Any eligible or suitable rivers in the program area will be managed under interim protective measures required by the WSR Act and BLM Manual 6400 until Congress makes a decision regarding WSR designation into the NWSRS.
- The BLM will not permit any actions that would adversely affect the free-flowing nature, ORVs, or tentative classification of any portion of the eligible or suitable rivers or actions that will reduce water quality to the extent that rivers would no longer support the ORVs.

F.4.24 Visual Resources

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
Surface disturbances, gravel mining, and construction of structures, including pipelines	New structures and disturbances that do not resemble other elements in an undeveloped landscape	Changes to the form, line, color, and texture of landform, vegetation, and water, as well as changes to dark skies and wildlife

Impact Analysis Area

- Direct/Indirect—Program area
- Cumulative—Program area

Analysis Assumptions

- Visual resources in the program area will become more sensitive to visual change; in other words, they will increase in value over time.
- Visual resources will become increasingly important to residents of and visitors to the area.
- Residents of, and visitors to the program area are sensitive to changes in visual quality and to the overall scenic quality of the area that contributes to living conditions and the visitor experience.
- Activities that cause the most contrast and are the most noticeable to the viewer will have the greatest impact on scenic quality.
- As the number of acres of disturbance increase, the amount of impacts on 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 pipelines; 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 of the surrounding viewsheds.
- Best management practices and project design, avoidance, or mitigation can reduce but not entirely prevent impacts on visual resources.
- Due to the slow rate of recovery of vegetation and surface conditions, all impacts on visual resources from surface disturbances will be long-term.
- The BLM visual resource management system/visual resource contrast rating process (BLM Handbook H-8431-1) will be used for site-specific actions.

F.4.25 Transportation

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
• Areas available or unavailable for new transportation infrastructure • Seasonal or other timing-related restrictions on access	• Change in the location or type of new transportation infrastructure allowed	• Acres made available for leasing that are not subject to NSO stipulations where transportation infrastructure could be placed • Acres subject to CSU or TLs that could influence the type, location, or design of transportation infrastructure
New infrastructure limiting public or subsistence access	Change in the level (increase or decrease) of access for public or subsistence use	Acres made available for leasing that are not subject to NSO stipulations where transportation infrastructure could increase or decrease the level of access for the public or subsistence user

Impact Analysis Area

- Direct/Indirect—Program area
- Cumulative—Program area

Analysis Assumptions

- Roads developed for oil and gas development will not be available for public use but could be seasonally available for subsistence users.
- Commercial and visits from non-residents will continue to increase, thereby increasing the demand for public access
- 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 snowmachine (winter).

F.4.26 Economy

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
• Exploration phase activities • Development/constructio n phase activities • Operations phase activities • Production of oil and gas resources	• Direct and Indirect Effects • Employment effects • Income effects • Fiscal effects • Effects on public infrastructure and services • Effects on relevant/selected economic sectors	• Average part-time and full-time jobs (number of jobs) • Income (wages in dollars) • Government revenues and expenditures (dollars) • Increase or decrease in economic activity by sector (most likely qualitative)

Impact Analysis Area

- Direct/Indirect—Local (Kaktovik), Regional (NSB), State
- Cumulative—Same as direct/indirect

Analysis Assumptions

- Description of potential oil and gas activities and time frames under each alternative—This will include scenarios or assumptions regarding exploration, development, and production activities, such as road/ice road construction, on-shore pipelines, processing facilities, and camps. This will be the basis for quantifying the magnitude and scale of economic impacts. Information will be developed by the Project team based on geological prospects, examples of scenarios from previous EISs and environmental assessments in the North Slope, and subject matter experts.
- Production volumes by year—This data will be used to calculate potential royalty payments and other State and the Federal government tax payments.
- Oil price forecasts—This information will be used to quantify potential royalty payments and other fiscal effects of the proposed project. Oil price projections can be obtained from the Alaska Department of Revenue (ADOR Revenue Sources) and from the Energy Information Administration (EIA) Annual Outlook. Alternatively, a constant price scenario could be adopted by the Project team.
- Construction costs (CAPEX) and construction schedule—This information will be 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. This data can also be used to estimate direct employment requirements associated with the construction. The MAG-PLAN model and data from previous oil and gas development studies in the North Slope can be used to develop rough-order of magnitude cost estimates.
- Annual operations and maintenance costs of the facilities—This information will be used to calculate indirect (or multiplier) effects of operations and maintenance spending as well as potential government revenues, including state corporate income taxes. This data can also be used to estimate direct employment requirements associated with the operations phase (if direct jobs data are not available). The MAG-PLAN model and data from previous oil and gas development studies in the North Slope can be used to develop rough-order of magnitude cost estimates.
- Tariffs and transportation costs—This information will be used to calculate the basis for calculating royalty payments. Data on existing tariffs and transportation costs are published by the ADOR Revenue Sources Book.
- Landownership—If available, this information will be used to determine potential royalty and right-of-way payments that will accrue to the landowners.

F.4.27 Public Health

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 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 Kaktovik public health system	• Change in unintentional accidents and injuries • Change in oil and gas revenue for the North Slope Borough and Kaktovik
Oil and gas development	Economic impacts on health	Change in oil and gas revenue for Kaktovik residents, the North Slope Borough, and Kaktovik
Oil and gas development	Accidents and safety	Changes in Kaktovik resident travel patterns for subsistence harvest

Impact Analysis Area

- Direct/Indirect—Program area, including Kaktovik
- Cumulative—Program area, including Kaktovik

Analysis Assumptions

- A health impact assessment will be required for specific oil and gas developments once the lease sale is complete.

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Appendix G

Potential Fossil Yield Classification System

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Appendix G. Potential Fossil Yield Classification System

G.1 Introduction

The Potential Classification Yield Classification (PFYC) system allows Bureau of Land Management (BLM) employees to make initial assessments of paleontological resources; to analyze potential effects of a proposed action under the National Environmental Policy Act (NEPA); and to conduct other BLM resource-related activities. The PFYC system can also highlight the areas for paleontological research efforts or predict illegal collecting. The system provides a consistent and streamlined approach to determine if a potential action may affect paleontological resources.

The PFYC system provides baseline guidance for assessing paleontological resources. The classification should be considered early in an analysis and should be used to assist in determining the need for further assessment or actions. When considering proposed actions, the PFYC system should be used in conjunction with a map of known fossil localities.

Occurrences of paleontological resources are known to be correlated with mapped geologic units (i.e., formations). The PFYC is created from available geologic maps and assigns a class value to each geological unit, representing the potential abundance and significance of paleontological resources that occur in that geological unit. PFYC assignments should be considered as only a first approximation of the potential presence of paleontological resources, subject to change, based on ground verification.

In the PFYC system, geologic units are assigned a class based on the relative abundance of significant paleontological resources and their sensitivity to adverse impacts. This classification is applied to the geologic formation, member, or other mapped unit. The classification is not intended to be applied to specific paleontological localities or small areas in units. Although significant localities of paleontological resources may occasionally occur in a geologic unit that has been assigned a lower PFYC classification, widely scattered important fossils or localities do not necessarily indicate a higher class assignment. Instead, the overall abundance of scientifically important localities is intended to be the major determinant for the assigned classification.

The descriptions for the class assignments below serve as guidelines rather than as strict definitions. Knowledge of the geology and the paleontological potential for individual geological units are considered when developing PFYC assignments. These assignments must be developed using scientific expertise with input from a BLM paleontologist; however, they may include collaboration and peer review from outside researchers who are knowledgeable about both the geology and the nature of paleontological resources that may be found in each geological unit. Each state has unique geologic maps and unique PFYC assignments. It is possible, and occasionally desirable, to have different assignments for a similar geologic unit across separate states.

G.1.1 Class 1—Very Low

These are geologic units that are not likely to contain recognizable paleontological resources. Units assigned to Class 1 typically have one or more of the following characteristics:

- Geologic units are igneous or metamorphic, excluding air-fall and reworked volcanic ash units.
- Geologic units are Precambrian in age.

Management concerns for paleontological resources in Class 1 units are usually negligible or not applicable. Paleontological mitigation is unlikely to be necessary, except in very rare or isolated circumstances that result in the unanticipated presence of paleontological resources, such as unmapped geology contained in a mapped geologic unit. For example, young fissure-fill deposits often contain fossils but are too limited in extent to be represented on a geological map; a lava flow that preserves evidence of past life, or caves that contain important paleontological resources. (Such exceptions are the reason that no geologic unit is assigned a Class 0.)

Overall, the probability of affecting significant paleontological resources is very low, and further assessment of paleontological resources is usually unnecessary. An assignment of Class 1 normally does not trigger a further analysis, unless paleontological resources are known or found to exist; however, standard stipulations should be put in place before any land use action is authorized, in order to accommodate an unanticipated discovery.

G.1.2 Class 2—Low

This is assigned to geologic units that are not likely to contain paleontological resources. Such units typically have one or more of the following characteristics:

- Field surveys have verified that significant paleontological resources are not present or are very rare.
- Units are generally younger than 10,000 years before present.
- There are recent aeolian (wind-driven) deposits.
- Sediments exhibit significant physical and chemical changes (i.e., diagenetic alteration) that make fossil preservation unlikely.

Except where paleontological resources are known or found to exist, management concerns for paleontological resources are generally low and further assessment is usually unnecessary, except in occasional or isolated circumstances. Paleontological mitigation is necessary only where paleontological resources are known or found to exist.

The probability of affecting significant paleontological resources is low. Localities containing important paleontological resources may exist, but they are occasional and should be managed on a case-by-case basis. An assignment of Class 2 may not trigger further analysis unless paleontological resources are known or found to exist; however, standard stipulations should be put in place before any land use action is authorized to accommodate unanticipated discoveries.

G.1.3 Class 3—Moderate

This is assigned to sedimentary geologic units where fossil content varies in significance, abundance, and predictable occurrence. Units assigned to Class 3 have some of the following characteristics:

- Fossils are marine in origin, with sporadic known occurrences of paleontological resources.
- Paleontological resources may occur intermittently, but abundance is known to be low.

- Units may contain significant paleontological resources, but these occurrences are widely scattered.
- The potential for an authorized land use to affect a significant paleontological resource is known to be low-to-moderate.

Management concerns for paleontological resources are moderate because the existence of significant paleontological resources is known to be low. Common invertebrate or plant fossils may be found in the area, and opportunities may exist for casual collecting.

Paleontological mitigation strategies will be proposed, based on the nature of the proposed activity.

This classification includes units of moderate or infrequent occurrence of paleontological resources. Management considerations cover a broad range of options that may include record searches, pre-disturbance surveys, monitoring, mitigation, or avoidance. Surface-disturbing activities may require assessment by a qualified paleontologist to determine whether significant paleontological resources occur in the area of a proposed action and whether the action could affect the paleontological resources.

G.1.4 Class 4—High

This is assigned to geologic units that are known to contain a high occurrence of paleontological resources. Units assigned to Class 4 typically have the following characteristics:

- Significant paleontological resources have been documented but may vary in occurrence and predictability.
- Surface-disturbing activities may adversely affect paleontological resources.
- Rare or uncommon fossils, including nonvertebrate (such as soft body preservation) or unusual plant fossils, may be present.
- Illegal collecting may affect some areas.

Management concerns for paleontological resources in Class 4 are moderate to high, depending on the proposed action.

Paleontological mitigation strategies will depend on the nature of the proposed activity, but field assessment by a qualified paleontologist is normally needed to assess local conditions.

The probability for affecting significant paleontological resources is moderate to high and depends on the proposed action. Mitigation planners must consider the nature of the proposed disturbance, such as removal or penetration of protective surface alluvium or soils, potential for future accelerated erosion, or increased ease of access that could result in looting. Detailed field assessment is normally required and on-site monitoring or spot-checking may be necessary during land-disturbing activities. In some cases, avoiding known paleontological resources may be necessary.

G.1.5 Class 5—Very High

These are highly fossiliferous geologic units that consistently and predictably produce significant paleontological resources. Units assigned to Class 5 have some or all the following characteristics:

- Significant paleontological resources have been documented and occur consistently.
- Paleontological resources are highly susceptible to adverse impacts from surface-disturbing activities.
- The unit is frequently the focus of illegal collecting.

Management concerns for paleontological resources in Class 5 areas are high to very high.

A field survey by a qualified paleontologist is almost always needed. Paleontological mitigation may be necessary before or during surface-disturbing activities.

The probability for affecting significant paleontological resources is high. The area should be assessed before land tenure adjustments. Pre-work surveys are usually needed, and on-site monitoring may be necessary during land use activities. Avoidance or resource preservation through controlled access, designation of areas of avoidance, or special management designations should be considered.

G.1.6 Class U—Unknown Potential

These are such geologic units that cannot receive an informed PFYC assignment. Characteristics of Class U may include the following:

- Geological units may exhibit features or preservation conditions that suggest significant paleontological resources could be present, but little information about the actual paleontological resources of the unit or area is known.
- Geological units represented on a map are based on lithologic character or basis of origin but have not been studied in detail.
- Scientific literature does not exist or does not reveal the nature of paleontological resources.
- Reports of paleontological resources are anecdotal or have not been verified.
- The area or geologic unit is poorly or under studied.
- BLM staff has not yet been able to assess the nature of the geologic unit.

Until a provisional assignment is made, geologic units that have an unknown potential have medium to high management concerns.

Lacking other information, field surveys are normally necessary, especially before a ground-disturbing activity is authorized. An assignment of Class U may indicate the unit or area is poorly studied, and field surveys are needed to verify the presence or absence of paleontological resources. Literature searches or consultation with professional colleagues may allow an unknown unit to be provisionally assigned to another PFYC, but the geological unit should be formally assigned to a class after adequate survey and research is performed to make an informed determination.

G.1.7 Class W—Water

This class is assigned to any surface area that is mapped as water. Most bodies of water do not normally contain paleontological resources; however, shorelines should be carefully considered for uncovered or transported paleontological resources. Reservoirs are a special concern because important paleontological resources are often exposed during low water intervals. In karst areas, sinkholes and cenotes[1] may trap animals and contain paleontological resources. Dredging river systems may disturb sediments that contain paleontological resources.

G.1.8 Class I—Ice

Includes any area that is mapped as ice or snow. Receding glaciers, including exposed lateral and terminal moraines, should be considered for their potential to reveal recently exposed paleontological resources. Other considerations are melting snow fields that may contain paleontological resources, with possible soft-tissue preservation.

G.1.9 Special Notes

When developing PFYC assignments, the following should be considered:

- Standard stipulations should always be in place before any land use action is authorized, in order to accommodate an unanticipated discovery.
- Class 1 and 2 and Class 4 and 5 units may be combined for broad applications, such as large-scale planning or programmatic assessments, or when geologic mapping at an appropriate scale is not available. Resource assessment, mitigation, and other management considerations will need to be addressed when actual land-disturbing activities are proposed.
- Where large projects affect multiple geologic units with different PFYCs, field surveys and monitoring should be applied appropriately. For example, the BLM Authorized Officer may determine that on-the-ground (pedestrian) surveys are necessary for the Class 4 and 5 formations but not for Class 2 formations.
- Based on information gained by surveys, the BLM may adjust PFYC assignments appropriately. Actual survey and monitoring intensities, as well as the extent of discoveries, should be included in any assessment, mitigation, or permit report so the BLM may reevaluate PFYC assignments.
- A geologic unit may receive a higher or lower classification in specific areas where the occurrence of fossils is known to be higher or lower than in other areas where the unit is exposed.
- Some areas are difficult to evaluate, such as talus, colluvium, tailings, fill, borrow, and other mapped features. A PFYC assignment should be made for each area using available information, or the area should be assigned to Class U.
- The BLM-wide PFYC assignments are maintained and periodically updated by the BLM paleontology team and may be obtained by contacting the BLM state or regional paleontologist assigned to an area.

G.2 Coastal Plain Geologic Units' PFYC Descriptions

The PFYC model for Alaska is in development as of November 2018; the excerpts below are preliminary PFYC rankings and descriptions for selected units in the program area.[2] Final rankings, descriptions, and associated citations will be incorporated when the PFYC model is complete.

[1]Deep sinkholes formed by the collapse of limestone cavities and having a pool at the bottom fed by groundwater.
[2]B. Breithaupt, BLM Regional Paleontologist, email to Anna Kohl, HDR environmental scientist, on July 30, 2018, regarding preliminary PFYC rankings and unit descriptions for the program area.

G.2.1 Unconsolidated and poorly consolidated surficial deposits

PFYC: 2-3

Most Quaternary, Pleistocene, and uppermost Tertiary deposits have not been given formation names and are frequently mapped based on lithologic character and estimated age. Care should be taken with these deposits with regard to fossil resources, as it is very hard to predict which deposits might be fossiliferous. Many of these types of deposits contain significant flora and fauna, although the distribution of fossils is often spotty. These deposits should not be underestimated for their fossil potential. Recent Holocene and disturbed deposits are ranked very low potential.

G.2.2 Sagavanirktok Formation (Tertiary)

PFYC: 3-4

This formation contains floral fossils (Gryc et al. 1951). Fossil flora were collected from the Sagwon Member of this formation (*Metasequuoia occidentalis*, *Trapa microphylla*, and *Cinnamononum ficoides*; Spicer et al. 1994). There were no fossils from the Franklin Bluffs Member and it is not likely to produce any; the Nuwok Member contains mollusc fossils and prolific microfauna (foraminifers and ostracodes; Detterman et al. 1975). Mull et al. (2003) added the White Hills Member in addition to the Sagwon, Franklin Bluffs, and Nuwok Members. Mollusc fossils were found in what used to unofficially be called the Nuwok Formation (MacNeil 1957).

G.2.3 Jago River Formation (Upper Cretaceous)

PFYC: 3

This formation contains palynomorphs and plant fossils (Buckingham 1987; Molenaar et al. 1987). The Bathtub Graywacke is included in this formation, which does not contain any invertebrate fossils but has some plant fossils; however, the only identifiable material was an equisetum and a few fragments of the marine algae *Tyttodiscus* (Detterman et al. 1975).

G.2.4 Canning Formation (Cretaceous-Tertiary)

PFYC: 2-3

Palynomorphs were used to decide age (Bird and Molenaar 1987).

G.2.5 Seabee Formation (Upper Cretaceous)

PFYC: 4

Marine fossils found are *Scaphites delicatulus*, Borissjakoceras (ammonites), and Inoceramus (Gryc et al. 1951). Pelecypod and ammonite megafauna and microfauna were found in the lower part of the formation, Foraminifera and palynomorphs in upper part (Mull et al. 2003). Pelecypods, ammonites, fish scales, and vertebrae (Lindsey 1986) were also found. The Arctos database listed a therapod or small bird trace fossil (footprint).

G.2.6 Hue Shale (Lower Cretaceous)

PFYC: 3

This includes a bed that is rich in Inoceramus bivalve prisms and fish remains; more Inoceramus prisms are found higher in the formation, along with palynomorphs (Molenaar et al. 1987).

G.2.7 Kemik Sandstone (Lower Cretaceous)

PFYC: 2-3

The was previously a member of the Kongakut Formation. Molenaar (1988) mentions some marine mollusc fossils that were collected below this formation but not that they are from this formation particularly. Trace fossils were Skolithos, Dioplocraterion, Arenicolites, and Ophiomorpha (Reifenstuhl 1995). Arctos database lists: belemnite guards.

G.2.8 Wahoo Limestone (Lisburne Group) (Carboniferous)

PFYC: 3

Lower part of the unit has a brachiopod-bryozoan assemblage and corals; the upper part contains brachiopods (Brosgé et al. 1962). It contains some rugose and tabulate corals, but they are not very abundant (Armstrong and Mamet 1977). Colonial corals *Corwenia jagoensis* and *Lithostrotionella wahooensis* were found (Armstrong 1972).

G.2.9 Alapah Limestone (Lisburne Group) (Carboniferous)

PFYC: 3

Lithostrotionoid corals, broken shells, and fish teeth were found (Bowsher and Dutro 1957), along with molluscs, brachiopods, corals, and gastropods (Dutro 1987) and ammonites, plants, Nautiloids (Lindsey 1986).

G.2.10 Ivishak Formation (Sadlerochit Group) (Triassic)

PFYC: 3

This formation contains ammonoids (Keller et al. 1961). It includes the Kavik Member, Ledge Sandstone Member, Fire Creek Siltstone Member (Detterman et al. 1975). The Kavik Member contains ammonites, pelecypods, and a few microfossils; the Ledge Sandstone Member has sparse brachiopods and ammonites, most of which are fragmentary; and the Fire Creek Siltstone Member contains sparse Euflemingites ammonites and Lingula brachiopods (Detterman et al. 1975).

G.2.11 Echooka Formation (Sadlerochit Group) (Permian)

PFYC: 3

Keller et al. (1961) say this formation is fossiliferous, but they do not say what kinds of fossils. They were raised to the formation level and divided into two members by Detterman et al. (1975). The upper part of the Joe Creek Member is abundantly fossiliferous with brachiopods, and the lower part has more sparse fossils; the upper part of the Joe Creek Member also contains abundant bryozoans and corals and some trilobites and pelecypods (Detterman et al. 1975).

G.2.12 Kongakut Formation (Lower Cretaceous)

PFYC: 2-3

There are buchia shells, some poorly preserved pelecypods, and some microfossils that indicate a similarity to Barremian rocks of the Richardson Mountains in the Yukon Territory (Detterman et al. 1975).

G.2.13 Kingak Shale (Jurassic)

PFYC: 3

Crinoids, bivalves, cephalopods, and ammonites are found in this shale (Leffingwell 1919).

Also included are marine molluscs (bivalves, ammonites, cephalopods, and ammonites) and crinoids (Payne et al. 1951). Early Jurassic fossils in northeast Alaska are sparse but include pelecypods; crinoids are also present in the formation, as well as ammonites and microfossils associated with pelecypods and ammonites (Detterman et al. 1975). There are ammonites from the early Jurassic, but they are not abundant or well preserved (Lindsey 1986). Arctos database: guards from Belemnoidea.

Appendix H
Water Resources

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Appendix H. Water Resources

Table H-1
Average Monthly Air Temperatures at Barter Island, Toolik Lake, and Kuparuk

Barter Island Station: Avg. Monthly Temp. (°F)		Toolik Lake Station: Avg. Monthly Temp. (°F)	
Month	**2015**	**2017**	**2018**
Jan	no data	no data	no data
Feb	no data	no data	9.2
Mar	no data	no data	8.1
Apr	no data	no data	9.7
May	no data	no data	29.1
Jun	no data	no data	41.6
Jul	no data	no data	no data
Aug	no data	no data	no data
Sep	no data	32.7	no data
Oct	5.2	17	no data
Nov	no data	8.9	no data
Dec	no data	10.3	no data

Adapted from *Global Summary of the Month Station Details* by the National Centers for Environmental Information: https://www.ncdc.noaa.gov/cdo-web/datatools/findstation

Table H-1 *(continued)*
Average Monthly Air Temperatures at Barter Island, Kuparuk, and Toolik Lake

Kuparuk Station: Avg. Monthly Air Temp. (°F)																		
Month	Years																	
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Jan	-14.4	-11.8	-20.6	-12	-14	-11	-16	-18	-21	-18	-19	-14	23.8	22.5	7.4	0.9	8.6	10.7
Feb	-16.7	-5.7	-22.6	-17	-29	-17	-6.6	-14	-19	-17	-13	-9.5	1	2.3	-10	-16	-8.2	3.9
Mar	-15.5	-19.7	-4.8	-14	-20	-9.3	-19	-21	-21	-22	-13	-8.9	-18	-10	-13	-4.5	-6	-9.3
Apr	-1.8	0.8	3.3	7.1	-1	1.1	-4.5	7.6	9.2	3.6	11	-2.5	-18	-14	-6.3	-5.4	-12	0.8
May	15.3	12.4	27.9	23.8	23.8	23.3	26.2	18.5	27.1	26.7	21.7	23.1	-25	-8.2	-9.8	-7.4	-9.3	-2.2
Jun	43.9	39.2	39.3	37.7	44.7	37.5	46.6	39.6	44.6	39	38.3	-26	-11	4.2	7.6	10.5	4.5	3.6
Jul	46	47.1	45.2	48.5	49.4	40.4	47.6	46.8	49.7	47.5	49.2	-14	-2.9	29.2	31	30.1	25.8	21.2
Aug	41.8	41.5	43.4	40.6	48.1	44.8	40.2	45.8	41.3	45.3	47.4	-29	20.6	38.5	48.1	43.6	38.8	34.5
Sep	32.8	35.1	38.9	33.1	33.8	34.9	39.7	38	34	34.8	37.5	2.2	44.1	45.3	44.4	49.2	52.2	no data
Oct	14.5	8.6	20.2	23.9	18.8	19.2	24.9	19.2	16.9	25	22.2	22	49.3	42.4	41.1	45.4	45.1	no data
Nov	-2.3	-2.4	7.1	-0.3	-1.4	-13	-1	10.7	0.9	-3.2	12.1	41.8	45.8	34.2	30.3	35.3	36.8	no data
Dec	-7.2	-11.8	-3.8	-9.8	-12	-5.9	-4.3	-4.5	-3.1	-3.4	-17	51.4	31.9	22.1	20.3	24.9	21.3	no data

Adapted from *Global Summary of the Month Station Details* by the National Centers for Environmental Information: https://www.ncdc.noaa.gov/cdo-web/datatools/findstation

Table H-2
Average Annual Monthly Precipitation at Toolik Lake and Kuparuk

Toolik Lake Station: Avg. Monthly Precipitation (inches)		
Month	Years	
	2017	2018
Jan	no data	0.12
Feb	no data	0.44
Mar	no data	0.2
Apr	no data	0.06
May	no data	0.9
Jun	no data	1.45
Jul	no data	no data
Aug	no data	no data
Sep	0.69	no data
Oct	0.81	no data
Nov	0.62	no data
Dec	0.12	no data

Adapted from *Normals Annual/Seasonal Station Details* by the National Centers for Environmental Information: https://www.ncdc.noaa.gov/cdo-web/datatools/findstation

Table H-2 *(continued)*
Average Annual Monthly Precipitation at Toolik Lake and Kuparuk

Kuparuk Station: Avg. Annual Monthly Precipitation (inches)																		
Month	Years																	
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Jan	0.09	0.01	0.21	0.09	0.01	0.2	0.19	0.45	0.04	0	0.21	0.22	1.02	0.29	0.5	0.27	0.81	0.83
Feb	0.12	0	0.15	0.13	0.3	0.09	0.11	0.02	0.19	0.17	0.11	0.26	0.36	0.41	0.76	0.05	0.13	0.74
Mar	0.06	0	0.12	0.02	0.3	0.03	0.01	0.06	0.08	0	0.21	0.03	0.15	0.04	0.16	0.21	0.39	0.23
Apr	0.07	0.01	0.14	0.18	0.04	0.05	0.31	0.14	0.09	0.2	0.12	0.07	0.02	0.12	0.3	0.08	0.52	0.37
May	0	0.03	0	0.19	0	0.14	0.04	0.29	0.56	0.04	0.08	0.51	0.02	0.01	0.15	0.2	0.09	0.11
Jun	0.16	0.35	1.05	0.01	0.4	0.01	0.78	0.22	0.43	0	0.05	0.17	0.2	0.09	0.31	0.1	0.11	0.12
Jul	1.12	0.26	1.1	2.22	1.02	1.06	1.67	0.22	1.07	0.45	1.22	0.07	0.91	0.76	0.09	0.11	0.18	0.25
Aug	0.38	1.35	1.93	0.67	0.61	0.5	1.07	0.11	0.62	2.13	0.4	0.1	0.43	0.49	0.14	1.1	0.01	0.3
Sep	0.14	0.25	1.67	0.4	0.97	0.62	0.12	0.01	0.2	0.67	0	0.12	0.31	1.09	0.28	0.81	0.67	no data
Oct	0.13	0.28	0.46	0.87	0.5	0.21	0.35	0.15	0.52	0.33	0.34	0.09	1.77	0.44	2.58	1.63	2.16	no data
Nov	0.03	0.17	0.04	0.11	0.16	0.5	0.23	0.4	0.29	0.11	0.56	0.03	0.89	0.5	0.33	1.63	1.02	no data
Dec	0.05	0.08	0.44	0.14	0.28	0.25	0.27	0.09	0.19	0.15	0.17	0.1	1.02	1.42	0.22	0.28	0.87	no data

Adapted from *Normals Annual/Seasonal Station Details* by the National Centers for Environmental Information: https://www.ncdc.noaa.gov/cdo-web/datatools/findstation

Table H-3
Average Annual Monthly Snowfall at Kuparuk

Kuparuk Station: Avg Annual Monthly Snowfall (inches)																		
Month	**Years**																	
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Jan	4.1	0.6	4	2.4	0.2	3.5	4.3	5.3	1	0.4	7.4	0.6	7.1	5.2	5.1	4.5	17.2	11.2
Feb	5.5	1	1.4	4.8	2.7	2	2.6	0.5	3.4	5.4	3	1.9	3.5	5.2	11.7	1.7	2.5	5.2
Mar	3.3	0.9	1	2.1	5.1	1	0.8	1.2	2.6	0	4.8	0.8	1.7	1	4.1	3.9	1.8	5.2
Apr	4	1.2	1.8	4	1.5	1.3	5.5	3.9	7.2	2.7	2.6	1.9	0.9	2	3.3	1.1	6.3	6.3
May	2	7.4	0	6.5	0	3.7	0.8	10.3	0.8	1.6	0.3	1.3	1	1.5	3.4	5	3.3	1.5
Jun	0	0	1.8	0	0	0.2	0.3	0	0	0	0.3	2.2	4	4.1	10.2	1.3	2.9	0.9
Jul	0	0	0	0	0	0	0	0	0	0	0	1.4	8.9	4.4	0.2	0	0.8	4.3
Aug	1.7	0.1	0	0	0	0	0	0	0	0	0	1.3	4.7	1.4	1	2.5	0	0
Sep	1.5	1.9	3.4	2.8	4.4	0.3	0	0	0.5	3.5	0	3		0	0	0	0	no data
Oct	5.5	7.5	15.3	7.9	8	4.7	6.5	5.1	17.3	6.9	9.3	1.6	0	0	0	0	0	no data
Nov	0.7	7.1	2.7	3.3	2	10.2	4.8	15.1	7.5	4.4	13.5	0	0	0.6	3.1	0.2	0	no data
Dec	1.1	4.2	9.3	5.4	2.7	5.3	5.5	3.7	4.3	4.2	4.4	0	6	7	2.8	1.1	3	no data

Adapted from *Normals Annual/Seasonal Station Details* by the National Centers for Environmental Information: https://www.ncdc.noaa.gov/cdo-web/datatools/findstation

Table H-4
Summary of Drainage Basins and Streams in the Coastal Plain

Drainage Basin	Waterbodies (notable streams)	Headwater Origin	Receiving Water	Drainage Area (square miles)	Length (miles)
Aichilik River	None	Romanzof Mountains	Beaufort Lagoon	-	75
Akutoktak (Akootoaktuk) River	None	Romanzof Mountains	Okpilak River	97	11.8
Angun River	None	Tundra Drainage	Angun Lagoon, Beufort Sea	745	30
Canning River	Marsh Fork	Franlin Mountains	Camden Bay	1930	125
Hulahula River	None	Romanzof Mountains	Camden Bay	685	90
Itkilyariak Creek, West Fork	Itkilyariak Creek, Salderochit River	Sadlerochit Mountains	Camden Bay	27	14.8
Jago River	None	McCall Glacier on Mt. Isto, Romanzof Mountains	Jago Lagoon, Beaufort Sea	798	90
Marsh Fork-Canning River	Canning River	Philip Smith Mountains	Canning River	-	50
Niguanak River	None	Tundra drainage	Oruktalik Lagoon	136	14.1
Okpilak	Akutoktak River	Okpilak Glacier, Brooks Range	Camden Bay	-	70
Sadlerochit River	Peters River	Franklin Mountains, Brooks Range	Camden Bay	520	0.2
Sadlerochit Spring Creek	Itkilyariak Creek, Salderochit River	Eastern Sadlerochit Mountains	Camden Bay	0.5	-
Sikrelurak River	None	Tundra drainage	West Fork Sikrelurak River	75	18.5
Tamayariak River	Upper Main Stem, Lower West Fork, Middle Fork, and Upper West Fork of Tamayariak River, Canning River	Sadlerochit Mountains	Beaufort Sea	350	19.3

Adapted from *Water Resource Inventory and Assessment* by the US Dept. of the Interior (1987-1992, Table 2), https://www.fws.gov/alaska/water/arctic.htm, and https://alaska.guide/Rivers
Recreated from *National Hydrography Dataset: flowlines GIS data*. by the US Geological Survey and https://alaska.guide/Rivers

Table H-5
Surface Water Discharge

Akutoktak River																	
Recording Period	Average Daily Value (cubic ft/sec)									Period Measurement Summary							
	Jun			Jul			Aug			(cubic ft/sec)				(ac-ft)	(CFSM)	(in)
	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Seven-Day Low Flow	Instantaneous Peak Flow (IPF)	IPF Date	Total Runoff	Average Runoff	Total Runoff
May 19-Sep 26 1988	280	1000	20	10	20	5.9	33	111	5.5	89	6.03	119 e	8/23/1988	23046	0.91	4.45
Jul 6- Aug 20 1989	295	1020	10	129	719	2.4	-	608	66	233	3.57	1703	8/20/1989	29096	2.4	5.62
May 18-Sep 19 1990	27	134	6.9	3	8	1.0	3	11	0.80	38	0.93	215	6/20/1990	9454	0.39	1.83
May 17-Sep 24 1991	255	1230	31	45	314	3.1	36	100	11	111	3.77	768	6/14/1991	28717	1.14	5.55
May 28 – Sep 21 1992	180	630	11	10	29	4.3	105	943	7.5	104	5.57	1818	8/27/1992	24202	1.07	4.67

Adapted from *Water Resource Inventory and Assessment Arctic National Wildlife Refuge (1987-1992): Appendix A* by the US Fish and Wildlife Service

Table H-5 *(continued)*
Surface Water Discharge

Itkilyariak Creek, West Fork																
Recording Period	Average Daily Value (cubic ft/sec)									Period Measurement Summary						
	Jun			Jul			Aug			(cubic ft/sec)				(ac-ft)	(CFSM)	(in)
	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Seven-Day Low Flow	Instantaneous Peak Flow (IPF)	IPF Date	Total Runoff	Average Runoff	Total Runoff
1988	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
May 27 – Sep 22 1989	42	90	4.9	49	320	0.0	101	554	25.0	59	1.88	1419	8/20/1989	13909	2.19	9.69
May 13 – Sep 19 1990	30	89	4.9	7.6	49	0.0	5.0	21	1.2	54	0.53	160	6/19/1990	13921	2.01	9.70
May 18 – Sep 24 1991	202	1120	37	11	37	6.0	25	173	4.1	85	2.89	276	6/14/1991	19624	3.14	13.68
May 29 – Sep 21 1992	78	710	7.7	-	24	15	80	679	3.7	91	-	1255	8/27/1992	14740	3.37	10.27

Note: e = estimate

Adapted from *Water Resource Inventory and Assessment Arctic National Wildlife Refuge (1987-1992): Appendix A* by the US Fish and Wildlife Service

Table H-5 *(continued)*
Surface Water Discharge

Niguanak River (in cubic ft/sec unless noted otherwise)																
Recording Period	Average Daily Value (cubic ft/sec)									Period Measurement Summary						
	Jun			Jul			Aug			(cubic ft/sec)				(ac-ft)	(CFSM)	(in)
	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Seven-Day Low Flow	Instantaneous Peak Flow (IPF)	IPF Date	Total Runoff	Average Runoff	Total Runoff
1988	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jun 9 – Sep 22 1989	518	1360	53	76	311	18	193	1148	50	259	39.50	2071	8/21/1989	60670	1.90	8.35
May 11 – Sep 19 1990	65	138	26	-	21	0.7	-	1	0.0	111	0.00	-	-	29170	0.82	4.02
May 17 – Sep 24 1991	716	2000	215	123	515	41	22	52	9.3	282	4.11	1319	6/14/1991	73199	2.07	10.08
May 28- Jul 7 1992	321	1109	90	-	203	92	-	-	-	-	-	-	-	-	-	-

Adapted from *Water Resource Inventory and Assessment Arctic National Wildlife Refuge (1987-1992): Appendix A* by the US Fish and Wildlife Service

Table H-5 *(continued)*
Surface Water Discharge

Sadlerochit River																
Recording Period	Average Daily Value (cubic ft/sec)									Period Summary Report						
	Jun			Jul			Aug			(cubic ft/sec)				(ac-ft)	(CFSM)	(in)
	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Seven-Day Low Flow	Instantaneous Peak Flow (IPF)	IPF Date	Total Runoff	Average Runoff	Total Runoff
Jul 21 – Sep 27 1988	-	-	-	-	846	342	-	1937	695	-	92.91	2194	8/22/1988	-	-	-
Jun 19 – Sep 23 1989	-	3315	923	1672	4124	649	159	4385	572	1414	313.63	5733	8/4/1989	271966	2.72	9.80
Jun 11 – Sep 3 1990	1333	2678	177	943	1429	633	432	662	271	833	333.05	4857	6/18/1990	140419	1.60	5.06
Jun 4 – Sep 24 1991	1793	3715	365	1317	9190	399	692	1732	380	1035	122.67	21000	7/21/1991	203142	1.99	7.32
Jun 2 to Sep 21 1992	1563	2614	123	1670	5656	625	1034	4216	362	1240	88.97	9506	7/26/1992	280395	2.38	10.11

Adapted from *Water Resource Inventory and Assessment Arctic National Wildlife Refuge (1987-1992): Appendix A* by the US Fish and Wildlife Service

Table H-5 *(continued)*
Surface Water Discharge

Sadlerochit Spring Creek																
Recording Period	Average Daily Value (cubic ft/sec)									Period Summary Report						
	Jun			Jul			Aug			(cubic ft/sec)				(ac-ft)	(CFSM)	(in)
	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Seven-Day Low Flow	Instantaneous Peak Flow (IPF)	IPF Date	Total Runoff	Average Runoff	Total Runoff
Jul 22 – Sep 30 1988	38	40	33	39	40	37	41	44	37	36	28	55	8/16/1988 8/19/1988	25795	-	967
Oct 1 1988 – Sep 30 1989	37	42	32	43	52	38	58	81	46	41	28	108	8/20/1989	29334	-	1100
Oct 1 1989 – Sep 30 1990	39	40	36	37	40	36	36	36	35	37	28	41	8/18/1990 8/19/1990	26825	-	1006
Oct 1 1990 – Sep 30 1991	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oct 1 1991 – Sep 30 1992	38	40	36	42	45	40	45	51	45	36	28	61	8/27/1992	26075	-	978

Adapted from *Water Resource Inventory and Assessment Arctic National Wildlife Refuge (1987-1992): Appendix A* by the US Fish and Wildlife Service

Table H-5 *(continued)*
Surface Water Discharge

Sikrelurak River																	
Recording Period	Average Daily Values (cubic ft/sec)									Period Summary Report							
	Jun			Jul			Aug			(cubic ft/sec)				(ac-ft)	(CFSM)	(in)
	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Seven-Day Low Flow	Instantaneous Peak Flow (IPF)	IPF Date	Total Runoff	Average Runoff	Total Runoff
Jun 8 – Sep 22 1988	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jun 8 – Sep 22 1989	336	1220	16	19	72	1.7	62	235	13	126	4.38	282	8/20/1989	28518	1.69	7.16
May 18 – Sep 19 1990	22	47	11	2.2	9.2	1.7	0.3	1.5	0.0	42	0.00	117	9/7/1990	10386	0.56	2.61
May 17 – Sep 24 1991	310	1480	44	33	118	13	11	28	4.6	108	3.14	1787	6/4/1991	28004	1.44	7.03
May 28 – Sep 14 1992	767	930	15	6	26	1.3	1.4	2.0	1.3	99	1.35	1057	6/10/1992	19654	1.33	4.93

Adapted from *Water Resource Inventory and Assessment Arctic National Wildlife Refuge (1987-1992): Appendix A* by the US Fish and Wildlife Service

Table H-5 *(continued)*
Surface Water Discharge

Tamayariak River																
Recording Period	Average Daily Values(cubic ft/sec)									Period Summary Table						
	Jun			Jul			Aug			(cubic ft/sec)				(ac-ft)	(CFSM)	(in)
	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Seven-Day Low Flow	Instantaneous Peak Flow (IPF)	IPF Date	Total Runoff	Average Runoff	Total Runoff
May 26 – Sep 26 1988	563	1400	160	70	140	18	312	1039	120	279	21.07	1996	8/12/1988	68526	2.05	9.44
Jun 1 – Sep 22 1989	696	2140	114	242	823	53	338	778	138	383	93.54	997	7/17/1989	86571	2.81	11.93
May 11 to Sep 19 1990	197	794	88	56	146	30	116	1100	21	247	23.57	4099	9/6/1990	64748	1.82	8.92
May 17 – Sep 24 1991	681	2000	139	288	1400	66	279	2442	72	381	62.13	3244	8/22/1991	98928	2.80	13.63
May 27 – Aug 26 1992	385	1032	109	65	154	32	1777	68	25	217	27.69	2856	8/27/1992	39564	1.59	5.45
Jun 1 – Sep 20 2008	173	347	60	87	457	27	238	1340	27	a	-	-	-	-	-	-
Oct 1 2008-Sep 30 2009	595	1550	117	68	239	20	172	533	32	94	0.00	2250	6/5/2009	67840	0.63	8.54
Oct 1 2009-Sep 30 2010	330	704	116	119	310	48	220	1000	39	70	0.00	1570	8/7/2010	50360	0.47	6.34
Oct 1 2010 – Sep 30 2011	311	615	76	71	203	40	57	180	30	88	0.00	3230	5/26/2011	63280	0.587	7.96
Oct 1 2011 – Sep 30 2012	286	775	76	82	249	38	181	465	74	72	0.00	1190	5/31/2012	52070	0.48	6.55

Note: a denotes statistics not provided by USGS due to partial water year.

Adapted from *Water Resource Inventory and Assessment Arctic National Wildlife Refuge (1987-1992): Appendix A* by the US Fish and Wildlife Service and *USGS Water Data Reports 2008-2012 Station 15960000 Tamayariak R near Kaktovik AK.*

Table H-5 *(continued)*
Surface Water Discharge

Tamayariak River, Lower West Fork																
Recording Period	Average Daily Values (cubic ft/sec)									Period Summary Report						
	Jun			Jul			Aug			(cubic ft/sec)				(ac-ft)	(CFSM)	(in)
	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Seven-Day Low Flow	Instantaneous Peak Flow (IPF)	IPF Date	Total Runoff	Average Runoff	Total Runoff
May 28 – Sep 26 1988	403	1380	50	20	40	11	114	392	9.4	155	10.17	496	9/5/1988	38123	1.58	7.28
Jun 1 – Sep 20 1989	525	1880	10	115	345	43	153	477	44	221	25.14	647	8/21/1989	49204	2.26	9.40
May 18 – Sep 19 1990	43	110	20	11	20	6.1	3.8	6.1	2.2	133	2.41	2455	9/6/1990	32981	1.36	6.30
May 17 – Sep 24 1991	493	2050	135	129	960	24	50	241	19	206	21.50	1750	7/23/1991	53649	2.10	10.25
Oct 1991 – Sep 1992	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Adapted from *Water Resource Inventory and Assessment Arctic National Wildlife Refuge (1987-1992): Appendix A* by the US Fish and Wildlife Service

Table H-5 *(continued)*
Surface Water Discharge

Tamayariak River, Middle Fork																
	Average Daily Values (cubic ft/sec)									Period Summary Report						
	Jun			Jul			Aug			(cubic ft/sec)				(ac-ft)	(CFSM)	(in)
Recording Period	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Seven-Day Low Flow	Instantaneous Peak Flow (IPF)	IPF Date	Total Runoff	Average Runoff	Total Runoff
May 26 – Sep 26 1988	384	1300	50	8.6	40	2.2	100	351	1.4	139	2.02	618	9/5/1988	34185	2.27	10.46
Jun 5 – Sep 20 1989	454	1780	26	70	255	14	127	282	43	193	18.87	303	8/21/1989	42889	3.15	13.12
May 11 – Sep 19 1990	39	151	12	3.5	11	0.82	0.78	4.7	0.41	69	0.46	637	9/6/1990	18165	1.13	5.56
May 17 – Sep 24 1991	373	1580	38	90	800	14	34	225	6.9	144	6.11	1867	6/4/1991	37507	2.35	11.47
May 28 – Sep 15 1992	90	470	12	3.7	17	0.80	65	1026	0.60	73	0.71	1455	8/27/1992	16024	1.19	4.90

Adapted from *Water Resource Inventory and Assessment Arctic National Wildlife Refuge (1987-1992): Appendix A* by the US Fish and Wildlife Service

Table H-5 *(continued)*
Surface Water Discharge

Tamayariak River, Upper West Fork																	
Recording Period	Average Daily Values (cubic ft/sec)									Period Summary Report							
	Jun			Jul			Aug			(cubic ft/sec)				(ac-ft)	(CFSM)	(in)
	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Seven-Day Low Flow	Instantaneous Peak Flow (IPF)	IPF Date	Total Runoff	Average Runoff	Total Runoff
May 26 – Sep 26	439	1490	60	9.4	50	0.8	85	271	1.1	144	0.92	404	8/13/1988	35536	2.94	13.54
Jun 1 – Sep 20 1989	418	2050	24	55	220	3.4	126	530	37	175	10.89	1478	8/20/1989	38785	3.55	14.78
May 18 – Sep 19 1990	26	130	6.0	1.9	6.2	0.00	17	323	0.00	79	0.00	1328	9/6/1990	19597	1.61	7.47
May 17 – Sep 24 1991	350	1820	82	99	681	9.1	38	202	6.3	145	2.70	1219	8/22/1991	37794	2.96	14.40
May 28 – Aug 25 1992	154	890	6.6	11	40	4.0	0.73	4.0	0.00	89	0.00	996	6/10/1992	16042	1.81	6.11

Adapted from *Water Resource Inventory and Assessment Arctic National Wildlife Refuge (1987-1992): Appendix A* by the US Fish and Wildlife Service

Table H-5 *(continued)*
Surface Water Discharge

Canning River																
Recording Period	Average Daily Values (cubic ft/sec)									Period Summary Report						
	Jun			Jul			Aug			(cubic ft/sec)				(ac-ft)	(CFSM)	(in)
	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Seven-Day Low Flow	Instantaneous Peak Flow (IPF)	IPF Date	Total Runoff	Average Runoff	Total Runoff
Jun 23 – Sep 30 2008	-	-	-	4779	13200	1990	4317	12800	1180	a	-	-	-	-	-	-
Oct 1 2008 – Sep 31 2009	11260	28900	4550	4435	11200	2240	2505	5040	1370	1961	0.00	32700	6/10/2009	1420000	1.02	13.79
Oct 1 2009 – Sep 31 2010	4555	9000	1760	4906	15300	2190	6315	16900	2520	1629	20	19200	7/31/2010	1180000	0.84	11.46
Oct 1 2010 – Sep 31 2011	3749	10300	1300	3811	11900	1970	2588	6610	1310	1502	20	a	a	1088000	0.78	10.57
Oct 1 2011 – Sep 31 2012	5161	10200	2410	4713	10900	2400	4094	9390	1830	1541	2	13000	7/26/2012	1118000	0.80	10.87

Note: a denotes statistics not calculated by USGS.

Adopted from USGS Water Report 2008 – 2012 15955000 Conning River Above Stoines River Neor Deodhorse AK

Table H-5 *(continued)*
Surface Water Discharge

Hulahula River																
Recording Period	Average Daily Values (cubic ft/sec)									Period Summary Report						
	Jun			Jul			Aug			(cubic ft/sec)				(ac-ft)	(CFSM)	(in)
	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Seven-Day Low Flow	Instantaneous Peak Flow (IPF)	IPF Date	Total Runoff	Average Runoff	Total Runoff
Oct 1 2010 – Sep 31 2011	1157	4960	257	1869	5720	765	945	3690	362	489	0.00	12800	5/24/2011	354200	0.71	9.70
Oct 1 2011 – Sep 31 2012	1783	3930	523	2329	4940	1420	1234	2650	545	535	0.00	6640	7/25/2012	388300	0.78	10.63
Oct 1 2012 – Sep 31 2013	3198	9500	429	2766	6780	1290	1933	4840	576	745	0.00	12700	6/17/2013	539300	1.09	14.77
Oct 1 2013 – Sep 31 2014	2366	4090	1390	2399	4630	847	1176	2760	784	563	0.00	6240	7/04/2014	a	0.82	11.2
Oct 1 2014 – Sep 31 2015	1259	2510	324	1571	3310	690	1466	3170	732	492	0.00	4830 b	5/26/2015	a	0.72	9.76
Oct 1 2015 – Sep 31 2016	2580	8750	293	2299	8890	666	1584	2800	731	653	0.00	13500	7/08/2016	a	0.95	13.0
Oct 1 2016 – Sep 31 2017	1392	2440	722	2089	4950	1440	2150	3140	1380	579	0.00	6870	7/24/2017	a	0.85	11.5

Note: a denotes statistics not calculated by USGS. b denotes discharge due to snowmelt, ice-jam, or debris breakup

Adapted from *USGS Water Report 2011 – 2017 15980000 Hulahula River Near Kaktovik, AK*

Table H-6
Summary of Data for Lakes in Regions of the Program Area

Ice Depth		0 ft Ice		4 ft Ice (Jan 4)		7 ft Ice (Apr 16)	
Region	**No. Lakes**	**Volume (acre-ft)**	**Percent of Total (%)**	**Volume (acre-ft)**	**Percent of Total (%)**	**Volume (acre-ft)**	**Percent of Total (%)**
Canning	43	35,541	64.2	12,378	69.7	2,669	79.3
Katakturuk	2	339	0.6	93	0.5	6	0.2
Sadlerochit	34	9,959	18.0	2,504	14.1	186	5.5
Jago	40	9,543	17.2	2,783	15.7	505	15.0
Totals	**119**	**55,382**	**100.0**	**17,758**	**100.0**	**3,366**	**100.0**

Recreated from *Distribution and quantification of water within the lakes of the 1002 Area, Arctic National Wildlife Refuge, Alaska: Table 1.* (USFWS 2015)

H.1 References

USFWS (US Fish and Wildlife Service). 2015. Arctic National Wildlife Refuge Revised Comprehensive Conservation Plan. US Fish and Wildlife Service, Final Environmental Impact Statement, Vol. 1. Internet website: https://www.fws.gov/home/arctic-ccp/.

Appendix I

Solid and Hazardous Waste

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Appendix I. Solid and Hazardous Waste

Table I-1
Facilities Registered with the EPA and ADEC in the Vicinity of the Coastal Plain

EPA or ADEC Registry ID	Facility Name	Description	Location
110067059523	Bill Sands Camp	Mobile camp; various sites	Beaufort Lagoon
110064792112	USFWS Arctic Refuge: Griffin Point DEW Line Staging Site		Griffin Point
110003039104	Kaktovik Department of Municipal Services	Conditional exempt small quantity generator	Kaktovik
110030898544	Kaktovik Wastewater Treatment Facility	Wastewater treatment facility	Kaktovik
110006878129	US Air Force LRRS - Barter Island	Various facilities DEW Line and LRRS	Kaktovik
110006877610	USFWS Nuvagapak DEW Line Site		Nuvagapak Point
AKG573038	Kaktovik Sewage Lagoon	File not available	Kaktovik
POA-2001-1081-M11	Beaufort Sea Exxon Point Thomson Project	Placement of fill in wetlands and streams	Kaktovik
AKG572024	Kaktovik Wastewater Treatment Facility	Authorization to discharge effluent into a mixing zone in Kaktovik Lagoon	Kaktovik
2016DB0001-0023	Point Thomson Central Pad	Injection of nonhazardous wastes in a Class I Underground Injection Control Well	Kaktovik
POA-2001-1082-M1	Beaufort Sea Exxon Point Thomson Project	File not available	Kaktovik
POA-2011-1092	Beaufort Sea NSB Material Site	Placement of fill in 105.04 acres of wetland	Kaktovik
POA-2011-957	Beaufort Sea NSB Airport	Placement of fill in 31.36 acres of wetland	Kaktovik
POA-2004-8	Kaktovik Lagoon Kaktovik Subdivision	Placement of fill in 7.6 acres of wetland	Kaktovik

Sources: EPA 2018; ADEC GIS 2018

Table I-2
Solid Waste Facilities in the Vicinity of the Coastal Plain

Facility Name	Classification	Location	Status
Kaktovik Landfill	Class III landfill[1]	Kaktovik	Closed
Kaktovik Community Tank Farm	Tank farm	Kaktovik	Active
Kaktovik Barter Island LRRS Hanger	Military	Kaktovik	Active
Kaktovik Barter Island LRRS Refueling Area	Polluted soil	Kaktovik	Active
Kaktovik 1.9 SE Landfill	Class III landfill	Kaktovik	Active
Barter Island LRRS-C&D GP	Inert monofill	Kaktovik	Retired
Barter Island LRRS Biosolids Land Application	Land application site	Kaktovik	Retired
Barter Island (Kaktovik) LRRS (BAR-Main DEWline)	Class III camp landfill	Kaktovik	Retired

Source: ADEC 2018a

Table I-3
ADEC Identified Contaminated Sites in the Vicinity of the Coastal Plain

ADEC Hazard ID	Site Name	Status
737	Brownlow Point/DERP	Cleanup complete
739	South Barter Island barrel dump	Cleanup complete
752	Barter Island DEW—POL catchment	Cleanup complete
753	Barter Island DEW—old dump site (LF019)	Cleanup complete
754	Barter Island Dew—heated storage (SS013)	Cleanup complete, institutional controls
755	Barter Island Dew—garage (SS014)	Cleanup complete, institutional controls
756	Barter Island DEW—weather station	Cleanup complete
757	Barter Island DEW—POL tanks	Cleanup complete, institutional controls
759	Barter Island DEW—JP-4 spill (SS021)	Cleanup complete
760	Barter Island DEW—old landfill (LF001)	Cleanup complete
761	Barter Island DEW—runway Dump	Cleanup complete
801	Barter Island DEW—contamination ditch (SD008)	Cleanup complete
802	Barter Island DEW—White Alice (SS016)	Cleanup complete
1431	Waldo arms fuel	Cleanup complete
1679	Collinson Point DEW Line—Sitewide	Informational
1681	Griffin Point/DERP	Cleanup complete
1921	Kaktovik Kaveolook School	Cleanup complete
2306	NSB Kaktovik power plant tank farm	Active
2307	NSB Kaktovik tank farm terminal	Active
2327	NSB Kaktovik KIC pad	Active
3085	Barter Island—staging area	Cleanup complete
3825	Jago River drum site	Cleanup complete
4036	Barter Island DEW—air terminal (SS011)	Cleanup complete, institutional controls

[1]Rural landfills often not connected by road to a larger landfill or are more than 50 miles by road from a larger landfill. The landfill serves fewer than 1,500 people.

ADEC Hazard ID	Site Name	Status
4037	Barter Island DEW—fuel tanks (ST018)	Cleanup complete, institutional controls
4038	Barter Island DEW—dump area NW (LF009)	Cleanup complete
4222	Barter Island LRRS refueling area (CG002)	Cleanup complete
4229	Barter Island LRRS hangar (SS022)	Active
25328	Collinson Point DEW Line POL pipeline corridor	Active
25329	Collinson Point DEW Line AST pad and AST pond	Active
25330	Collinson Point DEW Line Quonset hut #3	Active
25331	Collinson Point DEW Line shop building area	Active
25332	Collinson Point DEW Line composite building area	Active
25333	Nuvagapak Point DEW Line AST pad area	Active
25335	Nuvagapak Point DEW Line dump site D	Active
25336	Nuvagapak Point DEW Line debris pile A (Grid Area)	Active
25337	Nuvagapak Point DEW Line Kogotpak River dump site E	Active
26827	NSB Kaktovik transformer	Active

Source: ADEC 2018b, 2018c

Table I-4
ADEC 1995–2018 Database Spill Records for Areas near Kaktovik, Alaska

Year	Number of Spill Records	Annual Cumulative Spill Volume (Gallons)	Substance Spilled
1996	1	150	Diesel
1999	3	545	Diesel and engine lube oil
2004	4	621	Used oil and diesel
2005	2	*56 pounds*	Other
2006	1	100	Diesel
2008	5	2,120	Gasoline and diesel
2009	1	75	Ethylene glycol (antifreeze)
2010	2	2,456	Diesel
2011	1	25	Engine lube oil
2014	3	355	Glycol and propylene glycol
2015	1	5,250	Diesel
2016	4	201	Ethylene glycol, process water, diesel, and other
2017	6	4,415	Diesel, ethylene glycol, and unknown

Source: ADEC 2018c

I.1 References

ADEC (Alaska Department of Environmental Conservation). 2018a. Solid Waste Information Management System. Internet website: http://dec.alaska.gov/Applications/EH/SWIMS/Search.aspx.

______. 2018b. Division of Spill Prevention and Response Contaminated Sites. Internet website: http://dec.alaska.gov/spar/csp.aspx. Last updated November 2017.

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ADEC GIS. 2018. Contaminated sites, Alaska Department of Conservation. Internet website: https://dec.alaska.gov/spar/csp.aspx.

EPA (US Environmental Protection Agency). 2018d. EnviroMapper. Internet website: https://geopub.epa.gov/myem/efmap/index.html?ve=10&pText=.

Appendix J

Vegetation and Wetlands, Birds, and Terrestrial Mammals

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Appendix J. Vegetation and Wetlands, Birds, and Terrestrial Mammals

J.1 Vegetation and Wetlands

The vegetation mapping chosen to quantify the coverage of each vegetation type in the program area (**Map 3-10**, Vegetation, in **Appendix A**) was prepared by the Alaska Center for Conservation Science (ACCS) (ACCS 2016; Boggs et al. 2016). This mapping was developed for the entire North Slope by applying a common hierarchical classification to various data sources (Boggs et al. 2016). The primary data source used for the program area was a moderate resolution (30-meter pixel) raster vegetation mosaic map compiled by multiple contributors including the North Slope Science Initiative, United States (US) Fish and Wildlife Service (USFWS), Bureau of Land Management (BLM), National Park Service (NPS) Alaska Center for Conservation Science (ACCS), Ducks Unlimited, Inc., Spatial Solutions Inc., and Michigan Tech Research Institute (Ducks Unlimited 2013). The intent of the 2013 mapping effort was to update existing vegetation maps to more recent Landsat Thematic Mapper imagery where available. There are a variety of other land cover maps available that cover the program area and provide information at various scales. These maps typically are based on a range of Landsat imagery products, but the ACCS map provides the best combination of land cover mapping review and a vegetation classification suitable for use in this Environmental Impact Statement (EIS). The advantage of using the ACCS (2016) map is that (1) the vegetation classes are easily recognizable and relate well to the classes described in the commonly used Alaska Vegetation Classification (Viereck et al. 1992), and (2) the mosaic source data were vetted by a committee and represent the best available vegetation data layers for the program area (Boggs et al. 2016).

Common species found within the vegetation or land cover types listed in **Table J-1** are listed below.

Table J-1
Vegetation and Land Cover Types in the Program Area[1]

Vegetation or Land Cover Type	Area (acres)	% of Coastal Plain
Bareground	10,244	1
Dwarf Shrub	7,818	1
Dwarf Shrub-Lichen	2	<1
Fire Scar[2]	14	<1
Freshwater or Saltwater	134,892	9
Herbaceous (Marsh)	5,965	<1
Herbaceous (Mesic)	477,603	31
Herbaceous (Wet)	252,053	16
Herbaceous (Wet-Marsh) (Tidal)	2,764	<1
Low Shrub	242,312	15
Sparse Vegetation	29,328	2
Tall Shrub (Open-Closed)	14	<1
Tussock Tundra (Low shrub or Herbaceous)	400,327	26
Total area	1,563,336*	100.0

[1]From broad-scale land cover mapping for northern, western, and interior Alaska prepared by Boggs et al. (2016)
[2]The areas for the pixels mapped as fire scars were reviewed on satellite imagery and appear to be incorrectly classified
Source: Boggs et al. (2016)
*Acres summed to +/- 200 acres

Dwarf Shrub

The individual shrub species characterizing both dry and moist sites are similar, dominated primarily by *Dryas* spp., *Arctostaphylos rubra, Salix reticulata, S. rotundifolia,* and *Cassiope tetragona.* Dry sites support herbaceous species, including *Saxifraga hirculus, Polygonum bistorta, Petasites frigida, Polemonium boreale, Equisetum arvense, Carex* spp., *Festuca* spp., *Hierochloe* spp., *Epilobium latifolium*, and *Geum glaciale*. Lichens, such as *Cetraria* spp., are also common on dry sites. Moist sites are also dominated by *Dryas* spp. but also support wetland sedges (*Carex bigelowii, C. aquatilis*, and *Eriophorum vaginatum*), horsetails (*Equisetum arvense*), and mosses (e.g., *Tomenthypnum nitens*) (USFWS 2015).

Low and Tall Shrub

The low and tall shrubs are primarily deciduous, dominated by willows (*Salix* spp.). Common species are *S. alaxensis* (typically the dominant overtopping tall shrub species), and an assortment of low willows such as *S. lanata, S. richardsonii, S. glauca, S. brachycarpa*, and *S. hastata*. The understory often includes a variety of dwarf shrub and herbaceous vascular plants, including *Arctostaphylos rubra, Salix reticulata, Shepherdia canadensis, Dryas integrifolia, D. dummondii, Equisetum arvense, E. variegatum, E. scirpoides, Carex* spp., *Juncus castaneus, Petasites frigida*, and *Hedysarum* spp. (USFWS 2015).

Low shrub communities usually have an open canopy of mixed deciduous species, such as *Salix pulchra, Betula nana,* and *Vaccinium uliginosum*. These communities occupy low-lying basins or toeslopes and are often associated with moist sedge tussock tundra. Common associate species in low shrub stands are *Eriophorum vaginatum, Ledum decumbens, Vaccinium vitis-idaea, Cassiope tetragona,* and *Empetrum nigrum* (USFWS 2015).

Moist Herbaceous Meadow

These moist herbaceous communities are dominated by wetland sedges, such s *Eriophorum angustifolium* and *Carex aquatilis*. Often co-dominant with the sedges are dwarf shrubs, such as *Salix pulchra, S. reticulata,* and *Dryas integrifolia*. The tussock tundra type ranges from herb dominated to low-shrub dominated. In the program area, herb-dominated tussock tundra is more common on the broad, low-lying Coastal Plain, and the low-shrub dominated type is more common inland in the Brooks Range foothills. Tussock tundra is dominated by the tussock forming sedge *Eriophorum vaginatum*. The co-dominant shrubs include the typical assemblage of deciduous and evergreen, ericaceous species (*Salix reticulata, S. pulchra, Betula nana, Dryas integrifolia, Vaccinium uliginosum, V. vitis-idaea,* and *Ledum decumbens*) (USFWS 2015).

Wet Herbaceous Meadow

The most common freshwater species is the grass *Arctophila fulva* in deeper water, with *Carex aquatilis* and *Eriophorum angustifolium* occupying shallower lake fringe zones. Salt tolerant marsh species in the tidal areas include *Puccinellia phryganodes, Carex subspathacea,* and *Dupontia fisheri* (USFWS 2015). Trace amounts of forbs and dwarf shrubs may be present, such as *Pedicularis* spp., *Valeriana capitata, Polygonum* spp., and *Salix fuscescens* (USFWS 2015).

Table J-2
Rare Vascular Plant Taxa with Documented Occurrences in the Program Area

Taxa	State Rank	Global Rank	Federal Listings
Cardamine microphylla	S2	G3G4	BLM Watch
Carex atherodes	S3S4	G5	-
Chrysosplenium rosendahlii	S1S2	G4G5Q	-
Draba subcapitata	S1S2	G4	BLM Watch
Festuca viviparoidea ssp. *viviparoidea*	SU	G4G5	-
Papaver gorodkovii	S2S3	G3	BLM Sensitive
Puccinellia andersonii	S1S2	G3G5	-
Puccinellia vahliana	S3	G4	BLM Watch
Saxifraga rivularis ssp. *arctolitoralis*	S2	G5T2T3	-
Smelowskia media	S2S3	GNR	BLM Watch
Symphyotrichum pygmaeum	S2	G2G4	BLM Sensitive
Erigeron murii	S2S3	G2G3	BLM Sensitive
Erigeron porsildii	S3S4	G3G4	BLM Watch
Trisetum sibiricum ssp. *litorale*	S3	G5T4Q	BLM Sensitive

Source: Alaska Center for Conservation Science Rare Plant Data Portal (ACCS 2018)

Table J-3
Acreages of Coarse Scale Vegetation Types within Alternative B Stratified by Land-use Category and Hydrocarbon Potential

Vegetation Type within Land-use Categories	High Hydrocarbon Potential	% High HCP within Land-use Category	Medium Hydrocarbon Potential	% Medium HCP within Land-use Category	Low Hydrocarbon Potential	% Low HCP within Land-use Category
No surface occupancy	**142,210.7**	**100.0**	**120,858.4**	**100.0**	**96,318.7**	**100.0**
Bareground	767.1	0.5	4,260.5	3.5	3,206.3	3.3
Dwarf Shrub	1,905.0	1.3	600.2	0.5	301.1	0.3
Dwarf Shrub-Lichen	1.2	<0.1	-	-	-	-
Fire Scar[1]	3.6	<0.1	-	-	1.8	<0.1
Freshwater or Saltwater	52,534.5	36.9	40,583.9	33.6	9,089.4	9.4
Herbaceous (Marsh)	2,904.6	2.0	10.9	<0.1	4.7	<0.1
Herbaceous (Mesic)	23,274.1	16.4	32,648.0	27.0	25,360.5	26.3
Herbaceous (Wet)	31,796.9	22.4	17,303.8	14.3	14,730.9	15.3
Herbaceous (Wet-Marsh) (Tidal)	730.8	0.5	92.7	<0.1	224.2	0.2
Low Shrub	3,435.9	2.4	11,031.9	9.1	21,341.5	22.2
Sparse Vegetation	21,699.6	15.3	1,838.8	1.5	202.8	0.2
Tall Shrub (Open-Closed)	2.9	<0.1	-	-	-	-
Tussock Tundra	3,154.5	2.2	12,487.7	10.3	21,855.5	22.7
Standard terms and conditions only	**285,663.3**	**100.0**	**287,338.8**	**100.0**	**45,561.3**	**100.0**
Bareground	74.8	<0.1	346.7	0.1	29.1	0.0
Dwarf Shrub	2,540.6	0.9	745.5	0.3	192.6	0.4
Dwarf Shrub-Lichen	0.3	<0.1	-	-	-	-
Fire Scar[1]	7.3	<0.1	1.1	<0.1	-	-
Freshwater or Saltwater	8,483.7	3.0	7,651.6	2.7	128.7	0.3
Herbaceous (Marsh)	2,985.9	1.0	56.5	0.0	-	-
Herbaceous (Mesic)	114,090.7	39.9	93,459.1	32.5	11,087.1	24.3
Herbaceous (Wet)	38,531.3	13.5	34,569.9	12.0	1,992.0	4.4
Herbaceous (Wet-Marsh) (Tidal)	696.7	0.2	418.0	0.1	-	-

Vegetation Type within Land-use Categories	High Hydrocarbon Potential	% High HCP within Land-use Category	Medium Hydrocarbon Potential	% Medium HCP within Land-use Category	Low Hydrocarbon Potential	% Low HCP within Land-use Category
Low Shrub	16,351.5	5.7	44,533.7	15.5	8,746.9	19.2
Sparse Vegetation	5,104.2	1.8	364.9	0.1	75.1	0.2
Tall Shrub (Open-Closed)	-	-	0.2	<0.1	-	-
Tussock Tundra	96,796.3	33.9	105,191.6	36.6	23,309.8	51.2
Timing Limitations	-	-	**250,141.0**	**100.0**	**335,287.9**	**100.0**
Bareground	-	-	497.3	0.2	1,062.1	0.3
Dwarf Shrub	-	-	332.1	0.1	1,201.3	0.4
Dwarf Shrub-Lichen	-	-	-	-	-	-
Fire Scar[1]	-	-	-	-	-	-
Freshwater or Saltwater	-	-	11,429.3	4.6	4,991.3	1.5
Herbaceous (Marsh)	-	-	0.4	<0.1	1.6	<0.1
Herbaceous (Mesic)	-	-	106,242.4	42.5	71,441.4	21.3
Herbaceous (Wet)	-	-	64,468.7	25.8	48,659.5	14.5
Herbaceous (Wet-Marsh) (Tidal)	-	-	442.1	0.2	159.3	0.0
Low Shrub	-	-	29,337.1	11.7	107,533.6	32.1
Sparse Vegetation	-	-	-	-	42.2	0.0
Tall Shrub (Open-Closed)	-	-	-	-	10.4	<0.1
Tussock Tundra	-	-	37,391.6	14.9	100,185.2	29.9
Grand Total	**427,874.0**	-	**658,338.2**	-	**477,167.9**	-

Note: Tables were generated by intersecting multiple GIS datasets using acreages calculated in GIS and rounded to the nearest 0.1 of an acre; totals may not match the rounded Alternative summary acreage tables.

[1]The areas for the pixels mapped as fire scars were reviewed on satellite imagery and appear to be incorrectly classified.

Source: BLM GIS 2018

Table J-4
Acreages of Coarse Scale Wetland Types within Alternative B Stratified by Land-use Category and Hydrocarbon Potential

Wetland Types within Land-use Categories	High Hydrocarbon Potential	% High HCP within Land-use Categories	Medium Hydrocarbon Potential	% Medium HCP within Land-use Categories	Low Hydrocarbon Potential	% Low HCP within Land-use Categories
No surface occupancy	**140,898.0**	**100.0**	**113,438.0**	**100.0**	**90,784.6**	**100.0**
Estuarine and Marine Deepwater	33,657.4	23.9	30,470.0	26.9	4,369.9	4.8
Estuarine and Marine Wetland	5,447.7	3.9	2,495.0	2.2	96.0	0.1
Freshwater Emergent Wetland	59,785.9	42.4	54,993.8	48.5	71,438.0	78.7
Freshwater Forested/Shrub Wetland	11,808.1	8.4	14,421.6	12.7	8,520.8	9.4
Freshwater Pond	1,584.2	1.1	344.7	0.3	90.5	0.1
Lake	2,496.9	1.8	471.2	0.4	159.1	0.2
Riverine	26,117.8	18.5	10,241.7	9.0	6,110.3	6.7
Standard terms and conditions only	**284,623.8**	**100.0**	**283,320.2**	**100.0**	**44,789.9**	**100.0**
Estuarine and Marine Deepwater	2,191.7	0.8	451.3	0.2	79.5	0.2
Estuarine and Marine Wetland	640.8	0.2	461.5	0.2	47.8	0.1
Freshwater Emergent Wetland	243,898.8	85.7	258,122.4	91.1	41,686.8	93.1
Freshwater Forested/Shrub Wetland	27,681.3	9.7	19,507.3	6.9	2,568.7	5.7
Freshwater Pond	1,113.9	0.4	1,082.7	0.4	3.2	<0.1
Lake	4,749.3	1.7	2,122.7	0.7	-	-
Riverine	4,348.0	1.5	1,572.3	0.6	403.9	0.9
Timing limitations	-	-	**228,832.8**	**100.0**	**322,155.6**	**100.0**
Estuarine and Marine Deepwater	-	-	34.5	0.0	49.7	0.0
Estuarine and Marine Wetland	-	-	205.8	0.1	269.4	0.1
Freshwater Emergent Wetland	-	-	218,098.1	95.3	310,311.9	96.3
Freshwater Forested/Shrub Wetland	-	-	5,341.9	2.3	8,149.3	2.5
Freshwater Pond	-	-	1,160.4	0.5	353.0	0.1
Lake	-	-	1,933.6	0.8	391.4	0.1
Riverine	-	-	2,058.5	0.9	2,630.9	0.8
Grand Total	**425,521.8**	-	**625,591.0**	-	**457,730.1**	-

Note: Tables were generated by intersecting multiple GIS datasets using acreages calculated in GIS and rounded to the nearest 0.1 of an acre; totals may not match the rounded Alternative summary acreage tables.
Source: BLM GIS 2018

Table J-5
Acreages of Coarse Scale Vegetation Types within Alternative C Stratified by Land-use Category and Hydrocarbon Potential

Vegetation Types within Land-use Categories	High Hydrocarbon Potential	% High HCP within Land-use Categories	Medium Hydrocarbon Potential	% Medium HCP within Land-use Categories	Low Hydrocarbon Potential	% Low HCP within Land-use Categories
No surface occupancy	**194,039.0**	**100.0**	**328,157.4**	**100.0**	**410,176.1**	**100.0**
Bareground	819.7	0.4	4,739.5	1.4	4,015.6	1.0
Dwarf Shrub	2,835.4	1.5	892.5	0.3	804.3	0.2
Dwarf Shrub-Lichen	1.5	<0.1	-	-	-	-
Fire Scar[1]	6.0	<0.1	-	-	1.8	<0.1
Freshwater or Saltwater	57,102.5	29.4	51,493.7	15.7	14,059.4	3.4
Herbaceous (Marsh)	4,399.4	2.3	14.9	<0.1	6.2	<0.1
Herbaceous (Mesic)	40,522.0	20.9	117,961.9	35.9	89,521.7	21.8
Herbaceous (Wet)	47,693.6	24.6	72,791.2	22.2	60,500.1	14.7
Herbaceous (Wet-Marsh) (Tidal)	1,296.2	0.7	945.4	0.3	383.5	0.1
Low Shrub	6,997.8	3.6	34,153.6	10.4	124,900.7	30.5
Sparse Vegetation	23,321.9	12.0	1,838.8	0.6	205.9	0.1
Tall Shrub (Open-Closed)	2.9	<0.1	-	-	-	-
Tussock Tundra	9,040.1	4.7	43,325.9	13.2	115,776.9	28.2
Standard terms and conditions only	**184,455.8**	**100.0**	**129,410.3**	**100.0**	**73.9**	**100.0**
Bareground	22.2	0.0	212.3	0.2	-	-
Dwarf Shrub	1,293.9	0.7	379.0	0.3	-	-
Fire Scar[1]	4.9	0.0	1.1	<0.1	-	-
Freshwater or Saltwater	3,892.5	2.1	5,389.4	4.2	73.9	100.0
Herbaceous (Marsh)	1,468.5	0.8	43.6	0.0	-	-
Herbaceous (Mesic)	69,030.7	37.4	48,304.2	37.3	-	-
Herbaceous (Wet)	20,239.0	11.0	24,778.3	19.1	-	-
Herbaceous (Wet-Marsh) (Tidal)	131.4	0.1	7.4	<0.1	-	-
Low Shrub	9,280.2	5.0	12,639.5	9.8	-	-

Vegetation Types within Land-use Categories	High Hydrocarbon Potential	% High HCP within Land-use Categories	Medium Hydrocarbon Potential	% Medium HCP within Land-use Categories	Low Hydrocarbon Potential	% Low HCP within Land-use Categories
Sparse Vegetation	3,350.6	1.8	233.4	0.2	-	-
Tall Shrub (Open-Closed)	-	-	0.2	<0.1	-	-
Tussock Tundra	75,741.9	41.1	37,421.9	28.9	-	-
Timing limitations	**49,379.3**	**100.0**	**200,770.7**	**100.0**	**66,918.0**	**100.0**
Bareground	-	-	152.7	0.1	282.0	0.4
Dwarf Shrub	316.2	0.6	406.3	0.2	890.8	1.3
Fire Scar[1]	-	-	-	-	-	-
Freshwater or Saltwater	23.1	0.0	2,781.7	1.4	76.0	0.1
Herbaceous (Marsh)	22.7	0.0	9.3	0.0	-	-
Herbaceous (Mesic)	27,812.2	56.3	66,083.4	32.9	18,367.4	27.4
Herbaceous (Wet)	2,395.6	4.9	18,773.0	9.4	4,882.4	7.3
Herbaceous (Wet-Marsh) (Tidal)	-	-	0.0	0.0	-	-
Low Shrub	3,509.3	7.1	38,109.6	19.0	12,721.4	19.0
Sparse Vegetation	131.3	0.3	131.5	0.1	114.1	0.2
Tall Shrub (Open-Closed)	-	-	-	-	10.4	0.0
Tussock Tundra (Low shrub or Herbaceous)	15,168.8	30.7	74,323.2	37.0	29,573.6	44.2
Grand Total	**427,874.1**	-	**658,338.4**	-	**477,168.0**	-

Note: Tables were generated by intersecting multiple GIS datasets using acreages calculated in GIS and rounded to the nearest 0.1 of an acre; totals may not match the rounded Alternative summary acreage tables.

[1]The areas for the pixels mapped as fire scars were reviewed on satellite imagery and appear to be incorrectly classified.

Source: BLM GIS 2018

Table J-6
Acreages of Coarse Scale Wetland Types within Alternative C Stratified by Land-use Category and Hydrocarbon Potential

Wetland Types within Land-use Categories	High Hydrocarbon Potential	% High HCP within Land-use Categories	Medium Hydrocarbon Potential	% Medium HCP within Land-use Categories	Low Hydrocarbon Potential	% Low HCP within Land-use Categories
No surface occupancy	**192,624.7**	**100.0**	**316,645.2**	**100.0**	**394,890.5**	**100.0**
Estuarine and Marine Deepwater	35,135.7	18.2	30,936.7	9.8	4,455.6	1.1
Estuarine and Marine Wetland	6,072.5	3.2	3,138.6	1.0	382.7	0.1
Freshwater Emergent Wetland	97,005.8	50.4	250,725.2	79.2	365,820.1	92.6
Freshwater Forested/Shrub Wetland	20,416.9	10.6	16,273.7	5.1	14,980.6	3.8
Freshwater Pond	2,138.7	1.1	1,235.7	0.4	435.3	0.1
Lake	4,472.6	2.3	2,356.8	0.7	550.5	0.1
Riverine	27,382.5	14.2	11,978.5	3.8	8,265.7	2.1
Standard terms and conditions only	**183,802.4**	**100.0**	**128,801.6**	**100.0**	**73.9**	**100.0**
Estuarine and Marine Deepwater	713.4	0.4	19.1	0.0	43.5	58.9
Estuarine and Marine Wetland	16.0	0.0	23.6	0.0	30.4	41.1
Freshwater Emergent Wetland	158,748.1	86.4	119,545.2	92.8	-	-
Freshwater Forested/Shrub Wetland	18,103.1	9.8	5,629.3	4.4	-	-
Freshwater Pond	552.4	0.3	972.4	0.8	-	-
Lake	2,773.6	1.5	1,768.7	1.4	-	-
Riverine	2,895.8	1.6	843.3	0.7	-	-
Timing limitations	**49,094.8**	**100.0**	**180,144.2**	**100.0**	**62,765.7**	**100.0**
Freshwater Emergent Wetland	47,930.8	97.6	160,944.0	89.3	57,616.7	91.8
Freshwater Forested/Shrub Wetland	2969.5	6.0	17,367.9	9.6	4,258.2	6.8
Freshwater Pond	7.0	0.0	379.7	0.2	11.4	0.0
Lake	-	-	401.9	0.2	-	-
Riverine	187.5	0.4	1,050.7	0.6	879.4	1.4
Grand Total	**425,521.9**	**-**	**625,591.0**	**-**	**457,730.1**	**-**

Note: Tables were generated by intersecting multiple GIS datasets using acreages calculated in GIS and rounded to the nearest 0.1 of an acre; totals may not match the rounded Alternative summary acreage tables
Source: BLM GIS 2018

Table J-7
Acreages of Coarse Scale Vegetation Types within Alternatives D1 and D2 Stratified by Land-use Category and Hydrocarbon Potential

Wetland Types within Land-use Categories	High Hydrocarbon Potential	% High HCP within Land-use Categories	Medium Hydrocarbon Potential	% Medium HCP within Land-use Categories	Low Hydrocarbon Potential	% Low HCP within Land-use Categories
Controlled surface use	**32,403.9**	**100.0**	**80,469.3**	**100.0**	**10,993.2**	**100.0**
Dwarf Shrub	239.9	0.7	281.2	0.3	28.9	0.3
Freshwater or Saltwater	14.2	<0.1	157.5	0.2	-	-
Herbaceous (Marsh)	5.7	<0.1	0.7	0.0	-	-
Herbaceous (Mesic)	19,623.7	60.6	22,920.0	28.5	1,678.8	15.3
Herbaceous (Wet)	848.2	2.6	2,010.6	2.5	289.5	2.6
Low Shrub	1,292.6	4.0	16,465.7	20.5	2,516.5	22.9
Sparse Vegetation	113.3	0.3	126.8	0.2	-	-
Tussock Tundra	10,266.4	31.7	38,506.8	47.9	6,479.5	58.9
No surface occupancy	**256,255.1**	**100.0**	**384,431.4**	**100.0**	**67,866.0**	**100.0**
Bareground	825.8	0.3	3,848.8	1.0	639.9	0.9
Dwarf Shrub	3,423.2	1.3	1,028.4	0.3	908.1	1.3
Dwarf Shrub-Lichen	1.5	0.0	-	-	-	-
Fire Scar[1]	9.6	0.0	0.2	0.0	1.8	0.0
Freshwater or Saltwater	60,637.6	23.7	48,544.0	12.6	4,973.3	7.3
Herbaceous (Marsh)	5,282.8	2.1	53.0	0.0	0.1	0.0
Herbaceous (Mesic)	63,077.8	24.6	129,642.0	33.7	19,199.7	28.3
Herbaceous (Wet)	57,709.5	22.5	69,869.7	18.2	6,021.2	8.9
Herbaceous (Wet-Marsh) (Tidal)	1,427.6	0.6	945.4	0.2	27.5	0.0
Low Shrub	12,459.1	4.9	46,355.2	12.1	11,220.7	16.5
Sparse Vegetation	24,962.4	9.7	1,961.7	0.5	314.5	0.5
Tall Shrub (Open-Closed)	2.9	0.0	-	-	7.1	0.0
Tussock Tundra (Low shrub or Herbaceous)	26,435.3	10.3	82,183.1	21.4	24,552.2	36.2

Wetland Types within Land-use Categories	High Hydrocarbon Potential	% High HCP within Land-use Categories	Medium Hydrocarbon Potential	% Medium HCP within Land-use Categories	Low Hydrocarbon Potential	% Low HCP within Land-use Categories
Standard terms and conditions only (for D1) or timing limitations (for D2)	**131,885.2**	**100.0**	**72,783.9**	**100.0**	**0.4**	**100.0**
Bareground	9.3	0.0	2.8	0.0	<0.1	<0.1
Dwarf Shrub	669.7	0.5	168.6	0.2	<0.1	<0.1
Fire Scar[1]	1.3	0.0	0.9	0.0	-	-
Freshwater or Saltwater	223.6	0.2	3,868.0	5.3	0.1	25.0
Herbaceous (Marsh)	339.7	0.3	14.2	0.0	-	-
Herbaceous (Mesic)	50,845.2	38.6	30,217.6	41.5	<0.1	<0.1
Herbaceous (Wet)	10,172.4	7.7	15,741.8	21.6	<0.1	<0.1
Herbaceous (Wet-Marsh) (Tidal)	-	-	7.3	0.0	-	-
Low Shrub	5,771.8	4.4	6,498.1	8.9	0.1	25.0
Sparse Vegetation	974.0	0.7	115.1	0.2	-	-
Tall Shrub (Open-Closed)	-	-	0.2	0.0	-	-
Tussock Tundra	62,878.3	47.7	16,149.2	22.2	0.2	50.0
Grand Total	**420,544.2**	-	**537.684.6**	-	**78,859.6**	-

Note: Tables were generated by intersecting multiple GIS datasets using acreages calculated in GIS and rounded to the nearest 0.1 of an acre; totals may not match the rounded Alternative summary acreage tables.

[1]The areas for the pixels mapped as fire scars were reviewed on satellite imagery and appear to be incorrectly classified.

Source: BLM GIS 2018

Table J-8
Acreages of Coarse Scale Wetland Types within Alternatives D1 and D2 Stratified by Land-use Category and Hydrocarbon Potential

Wetland Types within Land-use Categories	High Hydrocarbon Potential	% High HCP within Land-use Categories	Medium Hydrocarbon Potential	% Medium HCP within Land-use Categories	Low Hydrocarbon Potential	% Low HCP within Land-use Categories
Controlled surface use	**32,403.9**	**100.0**	**79,240.6**	**100.0**	**10,952.0**	**100.0**
Freshwater Emergent Wetland	31,743.8	98.0	70,979.1	89.6	10,616.4	96.9
Freshwater Forested/Shrub Wetland	548.6	1.7	7,943.7	10.0	264.3	2.4
Freshwater Pond	4.6	<0.1	30.3	<0.1	2.5	<0.1
Lake	-	-	65.8	0.1	-	-
Riverine	106.9	0.3	221.6	0.3	68.9	0.6
No surface occupancy	**254,537.4**	**100.0**	**353,908.6**	**100.0**	**62,250.2**	**100.0**
Estuarine and Marine Deepwater	35,831.3	14.1	30,955.3	8.8	4,234.1	6.8
Estuarine and Marine Wetland	6,080.8	2.4	3,160.4	0.9	118.2	0.2
Freshwater Emergent Wetland	148,099.1	58.2	281,822.7	79.6	51,841.1	83.3
Freshwater Forested/Shrub Wetland	26,242.5	10.3	25,191.8	7.1	4,733.6	7.6
Freshwater Pond	2,556.2	1.0	1,270.6	0.4	40.1	0.1
Lake	7,150.8	2.8	1,986.4	0.6	-	-
Riverine	28,576.7	11.2	9,521.2	2.7	1,283.2	2.1
Standard terms and conditions only (for D1) or timing limitations (for D2)	**131,259.5**	**100.0**	**72,548.3**	**100.0**	**0.4**	**100.0**
Estuarine and Marine Deepwater	17.8	<0.1	0.4	<0.1	-	-
Estuarine and Marine Wetland	7.7	<0.1	1.8	<0.1	-	-
Freshwater Emergent Wetland	118,031.7	89.9	68,570.3	94.5	0.3	75.0
Freshwater Forested/Shrub Wetland	11,836.5	9.0	1,770.5	2.4	<0.1	<0.1
Freshwater Pond	122.5	0.1	770.9	1.1	-	-
Lake	95.3	0.1	1,206.8	1.8	-	-
Riverine	1,148.0	0.9	227.6	0.3	0.1	25.0
Grand Total	**418,200.8**	**-**	**505,697.5**	**-**	**73,202.6**	**-**

Note: Tables were generated by intersecting multiple GIS datasets using acreages calculated in GIS and rounded to the nearest 0.1 of an acre; totals may not match the rounded Alternative summary acreage tables.
Source: BLM GIS 2018

J.2 Birds

Table J-9
Status, Abundance, and Conservation Listings of Bird Species Occurring on the Arctic Refuge Coastal Plain

Species Group/ Common Name	Scientific Name	Status and Abundance[a]	Conservation Listings							
			ESA[b]	USFWS BCC[c]	BLM[d]	ADFG[e]	US SCPP[f]	PIF[g]	AUD[h]	IUCN[i]
Waterbirds										
Greater White-fronted Goose	*Anser albifrons*	Breeder: uncommon Migrant: common (spring, fall)								
Snow Goose	*Anser caerulescens*	Visitor: rare (summer) Migrant: common (spring), abundant (fall)								
Ross's Goose	*Anser rossii*	Migrant: casual (spring), possible (fall)								
Brant	*Branta bernicla*	Breeder: uncommon Migrant: common (coast)							Y	
Cackling Goose	*Branta hutchinsii*	Breeder: common Migrant: common (spring, fall)								
Trumpeter Swan	*Cygnus buccinator*	Breeder and Visitor: casual			S					
Tundra Swan	*Cygnus columbianus*	Breeder: common								
Northern Shoveler	*Spatula clypeata*	Possible Breeder: uncommon Visitor: uncommon								
Gadwall	*Mareca strepera*	Visitor: casual								
Eurasian Wigeon	*Mareca penelope*	Visitor: casual								
American Wigeon	*Mareca americana*	Migrant: uncommon								
Mallard	*Anas platyrhynchos*	Breeder: rare (inland), uncommon (rest of coastal plain)								
Northern Pintail	*Anas acuta*	Breeder and Migrant: common								
Green-winged Teal	*Anas crecca*	Breeder: uncommon (inland), rare (coast) Migrant: rare (coast)							Y	
Canvasback	*Aythya valisineria*	Visitor: casual								
Greater Scaup	*Aythya marila*	Breeder: rare (inland) Visitor: uncommon (coast) Migrant: uncommon (coast)							R	

Table J-9
Status, Abundance, and Conservation Listings of Bird Species Occurring on the Arctic Refuge Coastal Plain

Species Group/ Common Name	Scientific Name	Status and Abundance[a]	Conservation Listings: ESA[b]	USFWS BCC[c]	BLM[d]	ADFG[e]	US SCPP[f]	PIF[g]	AUD[h]	IUCN[i]
Lesser Scaup	*Aythya affinis*	Breeder: rare (inland) Visitor: rare (inland)								
Steller's Eider	*Polysticta stelleri*	Visitor: rare (coast)	T			A			R	VU
Spectacled Eider	*Somateria fischeri*	Breeder: rare (coast) Visitor: uncommon (coast)	T			A			R	
King Eider	*Somateria spectabilis*	Breeder: fairly common (coast) Migrant: uncommon (coast)							Y	
Common Eider	*Somateria mollissima*	Breeder: common (barrier islands) Migrant: common (coast)								NT
Harlequin Duck	*Histrionicus histrionicus*	Breeder: rare (inland)								
Surf Scoter	*Melanitta perspicillata*	Possible Breeder: uncommon (inland) Migrant: uncommon (coast)								
White-winged Scoter	*Melanitta fusca*	Possible Breeder: rare (inland) Migrant: common (coast)								
Black Scoter	*Melanitta americana*	Migrant: uncommon (coast)				A			R	NT
Long-tailed Duck	*Clangula hyemalis*	Breeder: common Migrant: abundant (coast) in fall								VU
Common Goldeneye	*Bucephala clangula*	Visitor: rare								
Smew	*Mergellus albellus*	Visitor: accidental								
Common Merganser	*Mergus merganser*	Visitor: casual (inland)								
Red-breasted Merganser	*Mergus serrator*	Breeder: fairly common (inland), rare (coast) Migrant: fairly common (coast)								
Horned Grebe	*Podiceps auritus*	Possible Breeder: uncommon (inland) Visitor: casual								VU
Red-necked Grebe	*Podiceps grisegena*	Visitor: casual							R	
Sandhill Crane	*Antigone canadensis*	Breeder: rare Summer Resident: uncommon								

Table J-9
Status, Abundance, and Conservation Listings of Bird Species Occurring on the Arctic Refuge Coastal Plain

Species Group/ Common Name	Scientific Name	Status and Abundance[a]	Conservation Listings							
			ESA[b]	USFWS BCC[c]	BLM[d]	ADFG[e]	US SCPP[f]	PIF[g]	AUD[h]	IUCN[i]
Red-throated Loon	*Gavia stellata*	Breeder: fairly common (coast) Migrant: fairly common (coast)		C	S	A				
Pacific Loon	*Gavia pacifica*	Breeder: common Migrant: common (coast)								
Common Loon	*Gavia immer*	Visitor: rare (coast)								
Yellow-billed Loon	*Gavia adamsii*	Migrant: uncommon (coast), rare (inland)		C	S	A			R	NT
Shorebirds										
Black-bellied Plover	*Pluvialis squatarola*	Breeder: rare Migrant: rare (coast) to fairly common (coast in fall)					MC			
American Golden-Plover	*Pluvialis dominica*	Breeder: common			W	A	HC		R	
Semipalmated Plover	*Charadrius semipalmatus*	Breeder: uncommon (barrier islands) and fairly common (inland) Visitor: rare								
Killdeer	*Charadrius vociferus*	Visitor: casual					MC			
Eurasian Dotterel	*Charadrius morinellus*	Visitor: casual								
Upland Sandpiper	*Bartramia longicauda*	Breeder: fairly common (inland)				A				
Whimbrel	*Numenius phaeopus*	Breeder: rare (inland) Visitor: uncommon (coast)		C	S	A	HC		Y	
Black-tailed Godwit	*Limosa limosa*	Visitor: accidental								
Hudsonian Godwit	*Limosa haemastica*	Visitor: casual		C[j]	S	A	HC		Y	
Bar-tailed Godwit	*Limosa lapponica*	Possible Breeder: uncommon		C	S	A	GC		R	NT
Ruddy Turnstone	*Arenaria interpres*	Breeder: fairly common (coast), uncommon (inland)					MC			
Red Knot	*Calidris canutus*	Migrant: rare		C	S	A	GC		R	NT
Ruff	*Calidris pugnaC*	Visitor: casual								
Sharp-tailed Sandpiper	*Calidris acuminata*	Migrant: casual (coast)							R	
Stilt Sandpiper	*Calidris himantopus*	Breeder: uncommon Migrant: uncommon (fall)								

Table J-9
Status, Abundance, and Conservation Listings of Bird Species Occurring on the Arctic Refuge Coastal Plain

Species Group/ Common Name	Scientific Name	Status and Abundance[a]	Conservation Listings							
			ESA[b]	USFWS BCC[c]	BLM[d]	ADFG[e]	US SCPP[f]	PIF[g]	AUD[h]	IUCN[i]
Red-necked Stint	*Calidris ruficollis*	Visitor: casual (coast)								NT
Sanderling	*Calidris alba*	Breeder: rare Migrant: rare (coast in spring), uncommon (coast in fall)				A	MC			
Dunlin	*Calidris alpina*	Breeder: uncommon (coast) Migrant: uncommon (coast in fall)		C	S	A	HC[k]		R	
Baird's Sandpiper	*Calidris bairdii*	Breeder: uncommon								
Least Sandpiper	*Calidris minutilla*	Visitor: rare								
White-rumped Sandpiper	*Calidris fuscicollis*	Breeder: rare Migrant: rare (spring), uncommon (fall)								
Buff-breasted Sandpiper	*Calidris subruficollis*	Breeder: uncommon Migrant: uncommon		C	S	A	HC		R	NT
Pectoral Sandpiper	*Calidris melanotos*	Breeder: abundant Migrant: abundant (coast in fall)				A	HC		R	
Semipalmated Sandpiper	*Calidris pusilla*	Breeder: abundant (coast), common (inland) Migrant: common (coast in fall)				A	HC			NT
Western Sandpiper	*Calidris mauri*	Possible Breeder: rare, Migrant: uncommon on coast				A	MC		Y	
Long-billed Dowitcher	*Limnodromus scolopaceus*	Breeder: uncommon, Visitor: fairly common (summer), Migrant: common on coast					MC			
Wilson's Snipe	*Gallinago delicata*	Possible Breeder and Visitor: rare								
Spotted Sandpiper	*Actitis macularius*	Breeder: uncommon (inland)								
Wandering Tattler	*Tringa incana*	Breeder: uncommon (inland)							Y	
Lesser Yellowlegs	*Tringa flavipes*	Visitor: casual		C[l]		A	HC		R	
Wilson's Phalarope	*Phalaropus tricolor*	Visitor: accidental								
Red-necked Phalarope	*Phalaropus lobatus*	Breeder: common Migrant: common to abundant (coast)					MC			

Table J-9
Status, Abundance, and Conservation Listings of Bird Species Occurring on the Arctic Refuge Coastal Plain

Species Group/ Common Name	Scientific Name	Status and Abundance[a]	Conservation Listings							
			ESA[b]	USFWS BCC[c]	BLM[d]	ADFG[e]	US SCPP[f]	PIF[g]	AUD[h]	IUCN[i]
Red Phalarope	*Phalaropus fulicarius*	Breeder: fairly common (coast east to Jago delta), uncommon (rest of coastal plain) Migrant: uncommon (coast in fall)			W		MC			
Larids										
Pomarine Jaeger	*Stercorarius pomarinus*	Breeder: occasionally common (coast) Visitor: common (summer) Migrant: common (spring)								
Parasitic Jaeger	*Stercorarius parasiticus*	Breeder: uncommon Summer Resident: common								
Long-tailed Jaeger	*Stercorarius longicaudus*	Breeder: fairly common (inland), rare (coast) Summer Resident: common								
Black-legged Kittiwake	*Rissa tridactyla*	Visitor: rare (coast mostly offshore)							R	VU
Ivory Gull	*Pagophila eburnea*	Migrant: rare							R	NT
Sabine's Gull	*Xema sabini*	Breeder: uncommon (coast) Migrant: uncommon (coast)								
Bonaparte's Gull	*Chroicocephalus philadelphia*	Visitor: casual								
Ross's Gull	*Rhodostethia rosea*	Migrant: rare (coast)								
Mew Gull	*Larus canus*	Breeder and Visitor: rare								
Herring Gull	*Larus argentatus*	Visitor and Migrant: rare								
Thayer's Gull	*Larus thayeri*	Visitor: rare								
Slaty-backed Gull	*Larus schistisagus*	Visitor: casual (coast)								
Glaucous-winged Gull	*Larus glaucescens*	Visitor: casual (coast)								
Glaucous Gull	*Larus hyperboreus*	Breeder: common (coast), uncommon (inland) Summer Resident: adundant (coast)								
Caspian Tern	*Hydroprogne caspia*	Visitor: accidental								
Arctic Tern	*Sterna paradisaea*	Breeder: uncommon (coast), rare (inland) Summer Resident: common		C						

Table J-9
Status, Abundance, and Conservation Listings of Bird Species Occurring on the Arctic Refuge Coastal Plain

Species Group/ Common Name	Scientific Name	Status and Abundance[a]	Conservation Listings							
			ESA[b]	USFWS BCC[c]	BLM[d]	ADFG[e]	US SCPP[f]	PIF[g]	AUD[h]	IUCN[i]
Raptors and Owls										
Osprey	*Pandion haliaetus*	Visitor: accidental								
Bald Eagle	*Haliaeetus leucocephalus*	Visitor: casual								
Northern Harrier	*Circus hudsonius*	Possible Breeder: uncommon (inland) Summer Resident: uncommon				A				
Sharp-shinned Hawk	*Accipiter striatus*	Visitor: casual								
Northern Goshawk	*Accipiter gentilis*	Visitor: casual (inland)								
Rough-legged Hawk	*Buteo lagopus*	Breeder: uncommon (inland) Visitor: rare (coast)								
Golden Eagle	*Aquila chrysaetos*	Breeder: rare (inland) Visitor: fairly common			W	A				
Snowy Owl	*Bubo scandiacus*	Breeder: common (in high microtine rodent years) to rare				A		C		VU
Short-eared Owl	*Asio flammeus*	Breeder: common (in high microtine rodent years) to uncommon			W	A				
American Kestrel	*Fao sparverius*	Visitor: casual				A				
Merlin	*Fao columbarius*	Possible Breeder and Visitor: rare								
Gyrfaon	*Fao rusticolus*	Permanent Resident and Breeder: uncommon (inland) Visitor: rare on coast				A				
Peregrine Faon	*Fao peregrinus*	Breeder: rare Visitor: uncommon								
Landbirds										
Willow Ptarmigan	*Lagopus lagopus*	Permanent Resident and Breeder: uncommon (coast), common to abundant (inland)								
Rock Ptarmigan	*Lagopus muta*	Permanent Resident and Breeder: common								
Common Nighthawk	*Chordeiles minor*	Visitor: casual								
Rufous Hummingbird	*Selasphorus rufus*	Visitor: accidental				A		C	R	

Table J-9
Status, Abundance, and Conservation Listings of Bird Species Occurring on the Arctic Refuge Coastal Plain

Species Group/ Common Name	Scientific Name	Status and Abundance[a]	Conservation Listings							
			ESA[b]	USFWS BCC[c]	BLM[d]	ADFG[e]	US SCPP[f]	PIF[g]	AUD[h]	IUCN[i]
Belted Kingfisher	*Megaceryle ayon*	Visitor: casual				A				
Hammond's Flycatcher	*Empidonax hammondii*	Visitor: accidental								
Eastern Phoebe	*Sayornis phoebe*	Visitor: accidental								
Say's Phoebe	*Sayornis saya*	Visitor: rare								
Eastern Kingbird	*Tyrannus tyrannus*	Visitor: accidental								
Northern Shrike	*Lanius borealis*	Possible Breeder and Visitor: rare (inland)								
Gray Jay	*Perisoreus canadensis*	Visitor: casual								
Common Raven	*Corvus corax*	Permanent Resident: uncommon Possible Breeder: rare								
Horned Lark	*Eremophila alpestris*	Breeder: rare (inland) Visitor: rare (rest of coastal plain)				A				
Tree Swallow	*Tachycineta bicolor*	Visitor: casual				A				
Violet-green Swallow	*Tachycineta thalassina*	Visitor: casual							R	
Bank Swallow	*Riparia riparia*	Visitor: casual				A			R	
Cliff Swallow	*Petrochelidon pyrrhonota*	Possible Breeder and Visitor: rare								
Barn Swallow	*Hirundo rustica*	Visitor: casual				A				
American Dipper	*Cinclus mexicanus*	Permanent Resident and Breeder: uncommon (inland)								
Bluethroat	*Luscinia svecica*	Breeder: rare (inland)								
Northern Wheatear	*Oenanthe oenanthe*	Visitor: rare								
Gray-cheeked Thrush	*Catharus minimus*	Visitor: rare			W					
Hermit Thrush	*Catharus guttatus*	Visitor: accidental								
American Robin	*Turdus migratorius*	Breeder: uncommon (inland) Visitor: rare (coast)								
Varied Thrush	*Ixoreus naevius*	Visitor: casual				A				
Cedar Waxwing	*Bombycilla cedrorum*	Visitor: accidental								
Eastern Yellow Wagtail	*Motacilla tschutschensis*	Breeder: fairly common								
American Pipit	*Anthus rubescens*	Breeder: rare Migrant: uncommon (fall)				A				

Table J-9
Status, Abundance, and Conservation Listings of Bird Species Occurring on the Arctic Refuge Coastal Plain

Species Group/ Common Name	Scientific Name	Status and Abundance[a]	Conservation Listings							
			ESA[b]	USFWS BCC[c]	BLM[d]	ADFG[e]	US SCPP[f]	PIF[g]	AUD[h]	IUCN[i]
Common Redpoll	*Acanthis flammea*	Breeder: common				A				
Hoary Redpoll	*Acanthis hornemanni*	Breeder: common								
Pine Siskin	*Spinus pinus*	Visitor: casual				A				
Lapland Longspur	*Caarius lapponicus*	Breeder: abundant								
Smith's Longspur	*Caarius pictus*	Visitor: rare		C	S	A				
Snow Bunting	*Plectrophenax nivalis*	Breeder: common (coast)				A				
Northern Waterthrush	*Parkesia noveboracensis*	Visitor: casual								
Orange-crowned Warbler	*Oreothlypis celata*	Visitor: casual				A			R	
Yellow Warbler	*Setophaga petechia*	Breeder: rare (inland) Visitor: rare (coast)				A				
Yellow-rumped Warbler	*Setophaga coronata*	Visitor: casual								
Wilson's Warbler	*Cardellina pusilla*	Visitor: rare				A				
American Tree Sparrow	*Spizelloides arborea*	Breeder: common (inland): Visitor: rare (coast)								
Chipping Sparrow	*Spizella passerina*	Visitor: casual				A				
Clay-colored Sparrow	*Spizella pallida*	Visitor: accidental								
Savannah Sparrow	*Passerculus sandwichensis*	Breeder: common				A				
Fox Sparrow	*Passerella iliaca*	Breeder: rare (inland) Visitor: rare (coast)				A				
White-throated Sparrow	*Zonotrichia albicollis*	Visitor: casual								
White-crowned Sparrow	*Zonotrichia leucophrys*	Breeder: uncommon (inland) Visitor: rare (coast)				A				
Dark-eyed Junco	*Junco hyemalis*	Visitor: rare								
Red-winged Blackbird	*Agelaius phoeniceus*	Visitor: casual				A				
Rusty Blackbird	*Euphagus carolinus*	Visitor: casual				A				VU
Brown-headed Cowbird	*Molothrus ater*	Visitor: casual								

Table J-9
Status, Abundance, and Conservation Listings of Bird Species Occurring on the Arctic Refuge Coastal Plain

			Conservation Listings							
Species Group/ Common Name	**Scientific Name**	**Status and Abundance[a]**	**ESA[b]**	**USFWS BCC[c]**	**BLM[d]**	**ADFG[e]**	**US SCPP[f]**	**PIF[g]**	**AUD[h]**	**IUCN[i]**
Seabirds										
Thick-billed Murre	*Uria lomvia*	Migrant: rare (coast)								
Black Guillemot	*Cepphus grylle*	Breeder: rare (coast) Summer Resident: uncommon (coast)								
Least Auklet	*Aethia pusilla*	Visitor: casual (coast)								
Horned Puffin	*Fratercula corniculata*	Visitor: rare (coast)							R	
Tufted Puffin	*Fratercula cirrhata*	Visitor: casual (coast)							R	
Northern Fulmar	*Fulmarus glacialis*	Visitor: rare (offshore)								
Short-tailed Shearwater	*Ardenna tenuirostris*	Visitor: rare (coast mostly offshore)								

[a]Status and abundance from the bird occurrence information for the Arctic Refuge Coastal Plain presented in USFWS (2015b).
[b]Endangered Species Act listings for Alaska (USFWS and NMFS 2014).
[c]C = Bird of Conservation Concern from USFWS (USFWS 2008).
[d]S = Sensitive Species; W = Watchlist Species; from BLM (BLM 2018 [in prep.]).
[e]A = At-risk Species from ADFG (2015).
[f]GC = Greatest concern; HC = High concern; MC = Moderate concern from Senner et al. (2016).
[g]C = Birds of Continental Concern from Rosenberg et al. (2016).
[h]R = Red-list species; Y = Yellow-list species from Warnock (2017a and 2017b).
[i]EN = Endangered; VU = Vulnerable; NT = Near Threatened from IUCN (2018).
[j]Listed as a species of conservation concern for Bird Conservation Regions 2 and 5 only.
[k]Listed at the regional not national level.
[l]Listed as a species of conservation concern for Bird Conservation Regions 4 and 5 only.

Table J-10
Conservation Listings of Additional Bird Species Occurring along Vessel Transit Route between Dutch Harbor and the Program Area

Species Group/ Common Name	Scientific Name	Conservation Listings					
		ESA[a]	USFWS BCC[b]	BLM[c]	ADFG[d]	AUD[e]	IUCN[f]
Waterbirds							
Emperor Goose	*Anser canagicus*			S	A	Y	NT
Snow Goose	*Anser caerulescens*						
Brant	*Branta bernicla*					Y	
Cackling Goose (Aleutian, Taverner's, Minima)	*Branta hutchinsii*					Y	
Steller's Eider	*Polysticta stelleri*	T			A	R	VU
Spectacled Eider	*Somateria fischeri*	T			A	R	
King Eider	*Somateria spectabilis*					Y	
Common Eider	*Somateria mollissima*						NT
Harlequin Duck	*Histrionicus histrionicus*						
Surf Scoter	*Melanitta perspicillata*						
White-winged Scoter	*Melanitta fusca*						
Black Scoter	*Melanitta americana*					R	NT
Long-tailed Duck	*Clangula hyemalis*						VU
Common Goldeneye	*Bucephala clangula*						
Barrow's Goldeneye	*Bucephala islandica*						
Common Merganser	*Mergus merganser*						
Red-breasted Merganser	*Mergus serrator*						
Red-throated Loon	*Gavia stellata*		C	S	A		
Arctic Loon	*Gavia arctica*						
Pacific Loon	*Gavia pacifica*						
Common Loon	*Gavia immer*						
Yellow-billed Loon	*Gavia adamsii*		C	S	A	R	NT
Shorebirds							
Red-necked Phalarope	*Phalaropus lobatus*			W			
Red Phalarope	*Phalaropus fulicarius*						

Table J-10
Conservation Listings of Additional Bird Species Occurring along Vessel Transit Route between Dutch Harbor and the Program Area

Species Group/ Common Name	Scientific Name	Conservation Listings ESA[a]	USFWS BCC[b]	BLM[c]	ADFG[d]	AUD[e]	IUCN[f]
Larids							
Pomarine Jaeger	*Stercorarius pomarinus*						
Parasitic Jaeger	*Stercorarius parasiticus*						
Long-tailed Jaeger	*Stercorarius longicaudus*						
Black-legged Kittiwake	*Rissa tridactyla*					R	VU
Red-legged Kittiwake	*Rissa brevirostris*		C		A	R	VU
Sabine's Gull	*Xema sabini*						
Bonaparte's Gull	*Chroicocephalus philadelphia*						
Mew Gull	*Larus canus*						
Ring-billed Gull	*Larus delawarensis*						
Herring Gull	*Larus argentatus*				A		
Iceland Gull	*Larus glaucoides*						
Slaty-backed Gull	*Larus schistisagus*						
Glaucous-winged Gull	*Larus glaucescens*						
Glaucous Gull	*Larus hyperboreus*						
Aleutian Tern	*Onychoprion aleuticus*		C		A	R	VU
Caspian Tern	*Hydroprogne caspia*		C				
Arctic Tern	*Sterna paradisaea*		C				
Seabirds							
Dovekie	*Alle alle*						
Common Murre	*Uria aalge*						
Thick-billed Murre	*Uria lomvia*						
Black Guillemot	*Cepphus grylle*						
Pigeon Guillemot	*Cepphus columba*						
Marbled Murrelet	*Brachyramphus marmoratus*		C	S	A	R	EN
Kittlitz's Murrelet	*Brachyramphus brevirostris*		C	S	A	R	NT
Ancient Murrelet	*Synthliboramphus antiquus*				A		
Cassin's Auklet	*Ptychoramphus aleuticus*				A		NT
Parakeet Auklet	*Aethia psittacula*						

Table J-10
Conservation Listings of Additional Bird Species Occurring along Vessel Transit Route between Dutch Harbor and the Program Area

Species Group/ Common Name	Scientific Name	Conservation Listings					
		ESA[a]	USFWS BCC[b]	BLM[c]	ADFG[d]	AUD[e]	IUCN[f]
Least Auklet	*Aethia pusilla*						
Whiskered Auklet	*Aethia pygmaea*		C			Y	
Crested Auklet	*Aethia cristatella*						
Rhinoceros Auklet	*Cerorhinca monocerata*						
Horned Puffin	*Fratercula corniculata*					R	
Tufted Puffin	*Fratercula cirrhata*					R	
Laysan Albatross	*Phoebastria immutabilis*		C		A		NT
Black-footed Albatross	*Phoebastria nigripes*		C		A		NT
Short-tailed Albatross	*Phoebastria albatrus*	E			A	R	VU
Northern Fulmar	*Fulmarus glacialis*						
Short-tailed Shearwater	*Ardenna tenuirostris*						
Sooty Shearwater	*Ardenna grisea*						NT
Fork-tailed Storm-Petrel	*Oceanodroma furcata*						
Leach's Storm-Petrel	*Oceanodroma leucorhoa*						VU
Double-crested Cormorant	*Phalacrocorax auritus*					Y	
Red-faced Cormorant	*Phalacrocorax urile*		C		A	R	
Pelagic Cormorant	*Phalacrocorax pelagicus*		C		A		

[a]Endangered Species Act listings for Alaska (USFWS and NMFS 2014).
[b]C = Bird of Conservation Concern from USFWS (2008).
[c]S = Sensitive species; W = Watchlist Species; from BLM (2018 [in prep.]).
[d]A = At-risk species from ADFG (2015).
[e]R = Red-list species; Y = Yellow-list species from Warnock (2017a and 2017b).
[f]EN = Endangered; VU = Vulnerable; NT = Near Threatened from IUCN (2018).

J.3 Terrestrial Mammals

Table J-11
Terrestrial Mammal Species Known or Suspected to Occur in the Arctic National Wildlife Refuge (adapted from Appendix F in USFWS 2015)

English Name[a]	Scientific Name[a]	Present in Program Area
Cinereus shrew	*Sorex cinereus*	No
Pygmy shrew	*Sorex hoyi*	No
Dusky shrew	*Sorex monticolus*	No
Tundra shrew	*Sorex tundrensis*	Yes
Barren ground shrew	*Sorex ugyunak*	Yes
Holarctic least shrew	*Sorex minutissimus*	Yes
Collared lemming	*Dicrostonyx groenlandicus*	Yes
Brown lemming	*Lemmus trimucronatus*	Yes
Long-tailed vole	*Microtus longicaudus*	No
Singing vole	*Microtus miurus*	Yes
Root (tundra) vole	*Microtus oeconomus*	Yes
Meadow vole	*Microtus pennsylvanicus*	No
Taiga vole	*Microtus xanthognathus*	No
Northern red-backed vole	*Myodes rutilus*	No
Common muskrat	*Ondatra zibethicus*	No
Northern bog lemming	*Synaptomys borealis*	No
Alaska marmot	*Marmota broweri*	No
Arctic ground squirrel	*Urocitellus parryii*	Yes
Red squirrel	*Tamiasciurus hudsonicus*	No
North American porcupine	*Erethizon dorsatum*	No
American beaver	*Castor canadensis*	No; range is expanding northward
Snowshoe hare	*Lepus americanus*	Rare; range is expanding northward
Wolverine	*Gulo gulo*	Yes
North American river otter	*Lontra canadensis*	Rare
American marten	*Martes americana*	No
Ermine	*Mustela erminea*	Yes
Least weasel	*Mustela nivalis*	Yes
American mink	*Neovison vison*	No
Canada lynx	*Lynx canadensis*	Rare
Wolf	*Canis lupus*	Yes
Coyote	*Canis latrans*	Rare
Arctic fox	*Vulpes lagopus*	Yes
Red Fox	*Vulpes vulpes*	Yes
American black bear	*Ursus americanus*	No
Brown (grizzly) bear	*Ursus arctos*	Yes
Moose	*Alces americanus*	Yes
Caribou	*Rangifer tarandus*	Yes
Dall's sheep	*Ovis dalli*	No; nearby in mountains to south
Muskox	*Ovibos moschatus*	Yes

[a]Sources: MacDonald and Cook (2009), with taxonomic and nomenclatural updates from Bradley et al. (2014).

Table J-12
Acres within Different Levels of Use (percent of years caribou present) by Parturient Porcupine Caribou during Calving, by Different Lease Restriction Categories, Alternatives, and Areas of Expected Oil Potential

PCH Calving Table						
Alternative	Lease Type	Percent of Years Present	Oil Potential High	Medium	Low	Total
B	No Sale/No Surface Occupancy	< 20%	105,300	14,900	900	121,100
		20 - 30%	3,700	14,600	3,100	21,400
		30 - 40%	0	11,100	500	11,600
		> 40%	0	51,700	83,800	135,500
	Timing Limitations	< 20%	0	100	0	100
		20 - 30%	0	300	500	800
		30 - 40%	0	8,400	8,900	17,300
		> 40%	0	241,200	323,700	564,900
	Standard Terms and Conditions Only	< 20%	263,800	69,000	1,900	334,700
		20 - 30%	19,300	76,400	31,000	126,700
		30 - 40%	0	114,900	10,400	125,300
		> 40%	0	26,100	1,800	27,900
C	No Sale/No Surface Occupancy	< 20%	148,200	15,100	900	164,200
		20 - 30%	10,800	21,500	3,600	35,900
		30 - 40%	0	25,500	1,200	26,700
		> 40%	0	236,700	394,500	631,200
	Timing Limitations	< 20%	43,000	34,000	1,900	78,900
		20 - 30%	6,400	50,600	31,000	88,000
		30 - 40%	0	47,500	18,600	66,100
		> 40%	0	68,600	14,800	83,400
	Standard Terms and Conditions Only	< 20%	177,900	34,800	0	212,700
		20 - 30%	5,800	19,100	0	24,900
		30 - 40%	0	61,400	0	61,400
		> 40%	0	13,700	0	13,700
D1	No Sale/No Surface Occupancy	< 20%	205,200	44,200	2,800	252,200
		20 - 30%	22,600	57,100	27,600	107,300
		30 - 40%	0	68,400	16,800	85,200
		> 40%	0	305,600	408,400	714,000
	Controlled Surface Use	< 20%	32,400	26,500	0	58,900
		20 - 30%	0	21,600	7,100	28,700
		30 - 40%	0	27,900	3,000	30,900
		> 40%	0	4,500	900	5,400
	Standard Terms and Conditions Only	< 20%	131,500	13,400	0	144,900
		20 - 30%	400	12,500	0	12,900
		30 - 40%	0	38,000	0	38,000
		> 40%	0	8,900	0	8,900
D2	No Sale/No Surface Occupancy	< 20%	205,200	44,200	2,800	252,200
		20 - 30%	22,600	57,100	27,600	107,300
		30 - 40%	0	68,400	16,800	85,200
		> 40%	0	305,600	408,400	714,000
	Controlled Surface Use	< 20%	32,400	26,500	0	58,900
		20 - 30%	0	21,600	7,100	28,700
		30 - 40%	0	27,900	3,000	30,900
		> 40%	0	4,500	900	5,400

PCH Calving Table						
Alternative	**Lease Type**	**Percent of Years Present**	**Oil Potential**			
			High	**Medium**	**Low**	**Total**
D2 *(continued)*	Timing Limitations	< 20%	131,500	13,400	0	144,900
		20 - 30%	400	12,500	0	12,900
		30 - 40%	0	38,000	0	38,000
		> 40%	0	8,900	0	8,900

Source: BLM GIS 2018

Table J-13
Acres within Different Levels of Use (percent of years caribou present) by Porcupine Caribou during Post-calving, by Different Lease Restriction Categories, Alternatives, and Areas of Expected Oil Potential

PCH Post-calving Table						
Acres (x1000)		**Percent of Years Present**	**Oil Potential**			
Alternative	**Lease Type**		**High**	**Medium**	**Low**	**Total**
B	No Sale/No Surface Occupancy	< 20%	83,400	4,900	700	89,000
		20 - 30%	11,700	19,000	400	31,100
		30 - 40%	11,700	38,500	5,700	55,900
		> 40%	2,200	30,000	81,500	113,700
	Timing Limitations	< 20%	111,900	53,800	0	165,700
		20 - 30%	77,300	84,700	1,800	163,800
		30 - 40%	69,800	106,300	35,400	211,500
		> 40%	24,100	41,600	7,900	73,600
	Standard Terms and Conditions Only	< 20%	0	29,000	4,800	33,800
		20 - 30%	0	61,100	14,100	75,200
		30 - 40%	0	86,800	16,100	102,900
		> 40%	0	73,200	298,100	371,300
C	No Sale/No Surface Occupancy	< 20%	103,500	35,800	5,500	144,800
		20 - 30%	26,400	56,200	14,500	97,100
		30 - 40%	27,000	122,700	16,100	165,800
		> 40%	2,200	84,100	364,100	450,400
	Timing Limitations	< 20%	91,900	43,400	0	135,300
		20 - 30%	62,700	72,100	0	134,800
		30 - 40%	29,200	13,400	0	42,600
		> 40%	0	100	0	100
	Standard Terms and Conditions Only	< 20%	0	8,400	0	8,400
		20 - 30%	0	36,400	1,800	38,200
		30 - 40%	25,300	95,400	41,100	161,800
		> 40%	24,100	60,500	23,400	108,000
D1	No Sale/No Surface Occupancy	< 20%	124,500	69,400	5,500	199,400
		20 - 30%	46,300	114,000	16,400	176,700
		30 - 40%	52,300	179,900	48,900	281,100
		> 40%	4,800	112,000	384,700	501,500
	Controlled Surface Use	< 20%	70,900	18,200	0	89,100
		20 - 30%	42,800	48,000	0	90,800
		30 - 40%	18,200	6,600	0	24,800
		> 40%	0	0	0	0

PCH Post-calving Table						
Acres (x1000)		Percent of Years Present	Oil Potential			
Alternative	Lease Type		High	Medium	Low	Total
D1 *(continued)*	Standard Terms and Conditions Only	< 20%	0	0	0	0
		20 - 30%	0	2,700	0	2,700
		30 - 40%	10,900	45,100	8,300	64,300
		> 40%	21,500	32,600	2,700	56,800
D2	No Sale/No Surface Occupancy	< 20%	124,500	69,400	5,500	199,400
		20 - 30%	46,300	114,000	16,400	176,700
		30 - 40%	52,300	179,900	48,900	281,100
		> 40%	4,800	112,000	384,700	501,500
	Controlled Surface Use	< 20%	0	0	0	0
		20 - 30%	0	2,700	0	2,700
		30 - 40%	10,900	45,100	8,300	64,300
		> 40%	21,500	32,600	2,700	56,800
	Timing Limitations	< 20%	70,900	18,200	0	89,100
		20 - 30%	42,800	48,000	0	90,800
		30 - 40%	18,200	6,600	0	24,800
		> 40%	0	0	0	0

Source: BLM GIS 2018

Table J-14
Estimated Percentage of Central Arctic Caribou Herd Seasonal Range (based on a utilization distribution from a kernel density estimate) by Different Lease Restriction Categories, Alternatives, and Areas of Expected Oil Potential

CAH Percentage Kernel Density Table						
Percent of CAH		Season	Oil Potential			
Alternative	Lease Type		High	Medium	Low	Total
B	No Sale/No Surface Occupancy	Postcalving	0.220	0.045	0.005	0.270
		Mosquito	1.396	0.198	0.058	1.652
		Oestrid Fly	0.323	0.197	0.154	0.675
		Late Summer	0.115	0.066	0.092	0.273
	Timing Limitations	Postcalving	0.000	0.037	0.009	0.046
		Mosquito	0.000	0.267	0.203	0.470
		Oestrid Fly	0.000	0.321	0.463	0.784
		Late Summer	0.000	0.083	0.268	0.351
	Standard Terms and Conditions Only	Postcalving	0.891	0.158	0.029	1.078
		Mosquito	3.547	0.818	0.090	4.454
		Oestrid Fly	0.836	0.576	0.094	1.506
		Late Summer	0.426	0.263	0.071	0.761
C	No Sale/No Surface Occupancy	Postcalving	0.334	0.071	0.009	0.414
		Mosquito	1.892	0.413	0.233	2.538
		Oestrid Fly	0.487	0.442	0.557	1.486
		Late Summer	0.170	0.127	0.329	0.626
	Timing Limitations	Postcalving	0.054	0.121	0.034	0.209
		Mosquito	0.617	0.627	0.118	1.363
		Oestrid Fly	0.190	0.505	0.154	0.850
		Late Summer	0.054	0.210	0.103	0.368
	Standard Terms and Conditions Only	Postcalving	0.722	0.048	0.000	0.771
		Mosquito	2.434	0.242	0.000	2.676
		Oestrid Fly	0.482	0.147	0.000	0.629
		Late Summer	0.316	0.075	0.000	0.391
D1	No Sale/No Surface Occupancy	Postcalving	0.469	0.135	0.033	0.637
		Mosquito	2.668	0.844	0.328	3.840
		Oestrid Fly	0.708	0.794	0.684	2.185
		Late Summer	0.258	0.270	0.414	0.942
	Controlled Surface Use	Postcalving	0.043	0.077	0.010	0.130
		Mosquito	0.469	0.322	0.023	0.814
		Oestrid Fly	0.123	0.220	0.027	0.370
		Late Summer	0.037	0.114	0.018	0.169
	Standard Terms and Conditions Only	Postcalving	0.599	0.029	0.000	0.628
		Mosquito	1.807	0.117	0.000	1.923
		Oestrid Fly	0.329	0.080	0.000	0.409
		Late Summer	0.246	0.028	0.000	0.274
D2	No Sale/No Surface Occupancy	Postcalving	0.469	0.135	0.033	0.637
		Mosquito	2.668	0.844	0.328	3.840
		Oestrid Fly	0.708	0.794	0.684	2.185
		Late Summer	0.258	0.270	0.414	0.942
	Controlled Surface Use	Postcalving	0.043	0.077	0.010	0.130
		Mosquito	0.469	0.322	0.023	0.814
		Oestrid Fly	0.123	0.220	0.027	0.370
		Late Summer	0.037	0.114	0.018	0.169

CAH Percentage Kernel Density Table						
Percent of CAH		Season	Oil Potential			
Alternative	Lease Type		High	Medium	Low	Total
D2	Timing Limitations	Postcalving	0.599	0.029	0.000	0.628
(continued)		Mosquito	1.807	0.117	0.000	1.923
		Oestrid Fly	0.329	0.080	0.000	0.409
		Late Summer	0.246	0.028	0.000	0.274

Source: BLM GIS 2018

Table J-15
Porcupine Caribou Calving and Post-Calving in the Program Area

Percent of Years that Calving Caribou are Present	Area (acres)	% of Coastal Plain
< 20 %	455,900	30.7
20-30 %	148,900	10.0
30-40 %	154,100	10.4
> 40 %	728,200	49.0
Percent of Years that Post-Calving Caribou are Present	**Area (acres)**	**% of Coastal Plain**
< 20 %	288,400	19.4
20-30 %	270,000	18.2
30-40 %	370,300	24.9
> 40 %	558,500	37.6

Source: BLM GIS 2018

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Appendix K
Fish and Aquatic Species

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Appendix K. Fish and Aquatic Species

K.1 Freshwater Fish

Many of the resident freshwater fish discussed below have at least some ability to tolerate brief periods of saline waters (USFWS 2015). Additional freshwater species not listed here, such as slimy sculpin, lake trout, and arctic char, have been reported in other parts of the Arctic National Wildlife Refuge (Arctic Refuge), and may be present (but not yet confirmed) in waters of the program area (BLM 2012). **Table K-1** summarizes habitat use and life history information for common species in the program area.

Round whitefish is a relatively small, benthic invertebrate feeding whitefish found in clearwater rivers and lakes in northern latitudes of North America and northeast Asia. The vast majority of round whitefish are resident freshwater fish, but some may tolerate brief periods in brackish waters. In the program area, these fish are found only in the Canning River. They are relatively less migratory in behavior than other whitefish. They are a minor component of subsistence catch due to low density.

Arctic grayling live in lakes and streams throughout northern North America and Asia and are found abundantly throughout the Arctic Refuge Coastal Plain. They exhibit very limited salinity tolerance. Adults feed on aquatic and terrestrial invertebrates and are capable of extensive annual movements between overwintering sites and summer feeding habitats. Though they constitute a minor subsistence component, recreational fishing for arctic grayling is likely common for residents of Kaktovik.

Burbot is large freshwater cod that inhabits deep areas of rivers and lakes throughout the circumpolar north (Evenson 1990; USFWS 2015). In the program area, burbot are found in waters along the Canning River (Smith and Glesne 1983; USFWS 2015). Burbot feed on insect larvae and other invertebrates as juveniles but move to a fish diet around age 4.

Ninespine stickleback are found throughout northern waters of North America. In the Arctic Refuge it is found in lakes, rivers and streams and is tolerant of saline waters up to 20 parts per thousand (ppt). This small, relatively short-lived species is present in large numbers throughout its range. Ninespine stickleback feed on small crustaceans and insects. They themselves are a major prey item for many larger species of fish as well as birds. Ninespine stickleback overwinter in freshwater habitats in the program area.

K.2 Anadromous Fish

There are at least nine species of anadromous fish in the program area. Most use this area and adjacent coastal waters seasonally for foraging or migration to other habitats. Pacific salmon are at the northern portion of their range in the project area, though their numbers appear to be increasing with warming trends in the region. Whitefish are common in the program area and are extremely important to subsistence communities. Dolly Varden are the only sport/subsistence fish that overwinters in the program area and its numbers are therefore limited by available in spawning and overwintering habitat. For brevity, some of the following species are discussed within the context of family groups with similar life histories.

Pacific salmon (*Onchorhynchus* spp.) are represented by three primary species that have been reported in coastal waters adjacent to the program area; pink salmon, chum salmon, and Chinook salmon. Chinook salmon have not been reported in streams in the area, but several reports of chum salmon have been noted in the Canning River (Smith and Glesne 1983; USFWS 2015). Pink salmon are found in the Staines and Canning River complex. Pink salmon feed on plankton, larval fishes, fish eggs, and aquatic invertebrates. Juveniles of chum and Chinook salmon consume copepods and amphipods before switching to a diet of fish as sub-adults and adults whereupon they reach large sizes (Bradford et al. 2009; Horne-Brine et al. 2009; Salo 1991). All spawn in freshwater streams where the young emerge from gravel and disperse to the sea; almost immediately for chum and pink salmon and after a period of a year or more for Chinook salmon (Salo 1991; USFWS 2015). Depending on the species, each salmon spends between 1 and 5 years at sea before returning to freshwater to spawn and die.

Whitefish (***Coregonus* spp.**) are important subsistence fishes and, in addition to the mostly freshwater round whitefish, are represented by four anadromous species found either in Arctic Refuge Coastal Plain streams or in the adjacent coastal waters: humpback whitefish, least cisco, broad whitefish, and arctic cisco. Each species displays a different degree of freshwater and saline water reliance during their life. All are relatively long-lived (up to 20 years and older). Because waters of the program area do not support overwintering or spawning habitat sufficient for these species, they are found only in the adjacent coastal waters as they migrate or forage. Humpback whitefish are medium sized, benthic invertebrate-feeding fish that are found in rivers lakes and estuaries in Asia and North America. In the Arctic Refuge Coastal Plain, they are only rarely documented in adjacent nearshore waters as they forage during summer months. Though they are rarely targeted for subsistence, they are a common bycatch species. Least cisco are a relatively small, nearshore and pelagic-feeding whitefish that is found in Arctic and sub-Arctic environments of Asia and North America. They are common in estuaries, rivers and lakes in northern Alaska, but are only found in coastal waters in or adjacent to the Arctic Refuge Coastal Plain during summer months as they forage before returning to deeper overwintering and spawning waters to the west or east (Seigle 2003; USFWS 2015). Least cisco may undertake extensive spawning, overwintering, and foraging migrations annually. As with humpback whitefish, they are caught mostly incidentally during subsistence activities and are commonly a source of dog food. Broad whitefish are a relatively large, primarily benthic-feeding fish that is very important in subsistence activities in northern Alaska, including in coastal waters adjacent to the program area. The species may exhibit freshwater resident or anadromous behavior, but those found near the program area during summer are overwintering and spawning elsewhere. Arctic cisco are a relatively small, pelagic-feeding species found in nearly all arctic waters. In Alaska, the evidence suggests that arctic cisco originate and later spawn in waters of the Mackenzie River drainage (Zimmerman et al. 2013; USFWS 2015). Arctic cisco are found foraging in Beaufort Sea coastal waters and overwintering in brackish waters of large rivers such as the Colville River to the west and Mackenzie River to the east. This is a fully anadromous species not known to reside in freshwaters. They are a prized subsistence species known for high fat content and good taste (Moulton et al. 2010).

Rainbow Smelt is a small schooling fish that spawns in freshwater but can be found extensively in nearshore brackish and marine waters throughout the Arctic Coastal Plain (ACP). They feed on a varied diet of crustacea, plankton, and various other aquatic invertebrates, as well as fish eggs and small fish. They are relatively short-lived (6 years) but can be highly migratory. It is unknown how common these fish are in the program area but they are known to have spawning populations in the Colville, Sag, Kuk, and Mackenzie Rivers (Craig 1984).

Dolly Varden is a coldwater species found in the higher latitude waters of North America, as well as Russia, Japan, and Korea. They are found widely within the northern portion of the Arctic Refuge and in several rivers of the Arctic Refuge Coastal Plain and adjacent coastal waters and can display resident and anadromous forms. In the Program Area, spawning populations are documented in the Canning, Hulahula (Brown et al. 2014; USFWS 2015), and Aichilik (USFWS 2015). Isolated resident populations are found in springs and lakes in the Canning (McCart and Craig 1973; USFWS 2015), Sadlerochit (USFWS 2015), and Jago (USFWS 2015) River drainages. Resident species are typically smaller and live shorter lives while anadromous forms are larger and longer-lived (Underwood et al. 1996; USFWS 2015). Anadromous forms typically migrate to brackish, nearshore waters of the Arctic Refuge Coastal Plain at ages 2–5 from their overwintering habitats in deep pools and spring-fed areas of the Arctic Refuge Coastal Plain rivers (Underwood et al. 1996; Fechhelm et al. 1997; USFWS 2015). They are a highly migratory species who feed on mysid shrimp and amphipods, exhibiting little piscivory. They are the primary species targeted in subsistence fisheries by Kaktovik residents on the Hulahula River and in coastal areas during summer.

K.3 Coastal Marine Fish

Although adult and juvenile stages of several species of marine fishes may use coastal and lagoon waters adjacent to the Program Area, this section focuses on the four most commonly observed species. Additional species likely to occur in marine waters are described in the National Petroleum Reserve-Alaska Integrated Activity Plan/Environmental Impact Statement (BLM 2012).

Arctic cod are distributed throughout the entirety of the northern polar basin and may be the most abundant and widely distributed fish in the Beaufort Sea. They are common and often abundant in nearshore coastal waters adjacent to the Arctic Refuge Coastal Plain. They inhabit cold, saline waters, but are tolerant of fluxes in temperature, salinity, and are found nearshore, offshore and even lower reaches of large rivers. They are typically a small to medium sized species. They are common in nearshore coastal waters in summer and fall before moving into full-scale marine waters during winter. Arctic cod prey on amphidpods, copepods, and mysid shrimp and are themselves common prey for marine mammals, birds and fish (Craig et al. 1984; Frost and Lowry 1984; USFWS 2015). They are incidentally harvested during subsistence activities along the Beaufort Sea coast, including near Kaktovik.

Saffron cod are found throughout the North Pacific and in the Arctic Ocean. They are common and widely distributed in the Beaufort Sea and along the Arctic Refuge Coastal Plain. They are found from coastal lagoons to offshore marine waters and some lower reaches of large rivers. They range from medium to large in size and feed on mysid shrimp, amphipods, and decapods, with some piscivory upon reaching larger sizes (Ellis 1962; USFWS 2015).

Fourhorn sculpin are found throughout the circumpolar north including the Beaufort Sea coastline, and waters adjacent to the Arctic Refuge Coastal Plain where they are typically very abundant. They feed on mysids, amphipods, isopods, and small fish.

Arctic flounder are found in coastal marine waters of much of the Artic and sub-Arctic of North America and Siberia. They are commonly found in nearshore waters of the Beaufort Sea, including the waters adjacent to the Arctic Refuge Coastal Plain. They are a relatively medium sized species, which remain near to shorelines and lagoons but are sometimes found in lower river reaches (Bendock 1979; USFWS 2015). They feed on amphipods, mollusks, crustaceans, and small fish.

Table K-1
Life History Attributes for Fish Species that May Use the Program Area

Species	Lifespan (years)	Age at Maturity (years)	Spawning Behavior	Spawning in Program Area?	Habitat Use in Program Area	Feeding Behavior in Program Area	Subsistence Use in Arctic Coastal Plain
Arctic Cisco	~20	7–8	Semi-annual; Fall	No	Summer months migration and foraging in freshwater and coastal marine waters	Pelagic invertebrates	Extensive
Arctic Cod	6–7	2–3	Annual to semi-annual; Fall	Likely	Common in coastal marine waters for spawning and rearing	Amphipods, copepods, mysid shrimp	Limited
Arctic Flounder	9–12	4–5	Annual to semi-annual	Likely	Common during summer months in marine waters; lower river deltas	Amphipods, mollusks, crustacea, and small fish	Limited
Arctic Grayling	up to 18	4–8	Annual to semi-annual; Spring	Unknown	Summer months in some freshwater streams; limited use of marine waters	Aquatic and terrestrial invertebrates	Limited
Broad Whitefish	>20	5–8	Annual to semi-annual: Fall	No	Summer months migration and foraging in freshwater and coastal marine waters	Benthic invertebrates	Extensive
Burbot	>20	6–7	Semi-annual; Winter	No	Summer months in Canning River	Insect larve and other invertebrates as juveniles; fish diet as adults	Extensive
Chinook Salmon	~4–5	1–5	Once; Summer/Fall	No	Rare in coastal marine waters for migration and foraging	Copepods/amphipods (early) fish (later)	Limited
Chum Salmon	~4–5	2–6	Once; Summer/Fall	No	Migration and foraging in Canning and Staines rivers; coastal marine waters	Copepods/amphipods (early) fish (later)	Limited
Dolly Varden	Resident = 7 Anadromous = 10	Resident = 2–4 Anadromous = 4–8	Semi-annual; Fall	Yes	Common during summer and winter months in freshwater streams and springs; coastal marine waters; spawning and overwintering in freshwater springs	Resident = Dipteran larvae and macroinvertebrates Anadromous = Mysids,amphipods, and fish	Extensive

Species	Lifespan (years)	Age at Maturity (years)	Spawning Behavior	Spawning in Program Area?	Habitat Use in Program Area	Feeding Behavior in Program Area	Subsistence Use in Arctic Coastal Plain
Fourhorn Sculpin	up to 14	3–9	Annual to semi-annual	Likely	Common in summer and fall in coastal marine waters; lower river deltas	Mysid shrimp, amphipods, isopods, fish	Limited
Humpback Whitefish	>20	5–11	Annual to semi-annual: Fall	No	Summer months migration and foraging in freshwater and coastal marine waters	Benthic invertebrates	Extensive
Least Cisco	>25	3–7	Annual to semi-annual; Fall	Likely	Summer months migration and foraging in freshwater and coastal marine waters	Pelagic invertebrates and small fish	Limited
Ninespine Stickleback	up to 5	1–2	Annual; Summer	Yes	Common during summer and winter months in marine waters; freshwater. Spawning, rearing, overwintering	aquatic and terrestrial insects, and crustacea	None
Pink Salmon	2	2	Once: Summer/Fall	No	Migration and foraging in Canning and Staines rivers; coastal marine waters	Plankton, larval fishes, fish eggs, aquatic invertebrates	Limited
Round Whitefish	>20	3–8	Annual to semi-annual	No	Summer months migration and foraging in Canning River and some marine waters	Benthic invertebrates	Limited
Rainbow Smelt	~6	2–6	Once; Summer/Fall	Unknown	Found in coastal marine waters; lower river deltas in summmer/fall	Copepods, fish eggs, algae as juveniles; decapods, mysid shrimp, copepod, ampipod, small fish and other invertebrates as adults	Limited
Saffron Cod	10–12	2–3	Annual to semi-annual: Fall	Likely	Common in coastal marine waters for spawning and rearing	Amphipods, copepods, decapods, mysid shrimp, some fish	Limited

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Appendix L
Cultural Resources

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Appendix L. Cultural Resources

Table L-1
Documented AHRS Sites in Program Area

AHRS #	Site Name	Period	Resource Description
BRL-00005	Uqsruqtalik	Historic	Camp, hunting, sod houses, cabins, ice cellars
BRL-00007	Naalagiagvik	Prehistoric, Historic, Protohistoric	Settlement, sod houses, burials
BRL-00009	-	Historic	Burials
BRL-00012	-	Historic	Residential, cabin, log, sod house
BRL-00017	Uqsruqtalik	Historic	Burials
BRL-00018	Kapiluuraq	Historic	Camp, fishing, sod house
BRL-00020	-	Historic	Residential, sod house
BRL-00022	Puukak	Historic	Camp, sod houses, cemetery
BRL-00023	(Doe) BAR-M (AHRS) Barter Island	Historic	Defense, DEW Line
BRL-00044	Gravel structures, Barter Island Airfield	Historic	Defense, DEW Line, transportation
BRL-00051	Barter Island seawall	Historic	Military, seawall, defense, DEW Line
BRL-00052	Browers Camp	Historic, Modern	Camp, tent floors, drying racks, windbreaks
XDP-00001	Angun	Historic	Sod house ruins, foundations
XDP-00021	-	Historic	-
XDP-00022	-	Historic	-
XDP-00024	Atchalik	Historic	Sod house ruins, sod quarry, cache pots
XDP-00026	-	Historic	Burials
XDP-00027	-	Historic	Sod house ruins, sod quarry
XDP-00028	-	Historic	Burials, box coffins
XDP-00029	-	Historic	-
XDP-00030	-	Historic	-
XDP-00031	-	Prehistoric	Lithic scatter
XDP-00032	-	Prehistoric	-
XDP-00033	-	Historic	-
XDP-00034	-	Historic	-
XDP-00035	-	Prehistoric	-
XDP-00045	Beaufort Lagoon (AHRS) Demarcation Point	Historic	Defense, DEW Line
XDP-00046	Nuvagapak Jacobson and Wentworth's TLUI Site 32	-	-
XDP-00048	Nuvagapak reburial	Historic	Reburied human remains
XFI-00003	Anderson Point	Prehistoric	Settlement, bone and wood artifacts
XFI-00009	Brownlow Point, Agliguagruk	Historic	House ruins, burials
XFI-00011	Sanniqsaaluk	Historic	Cabin, ice cellar, camp
XFI-00013	-	Historic	Ice cellar
XFI-00014	-	Historic	Lookout tower
XFI-00015	-	Historic	Single dwelling, sod house
XFI-00016	-	Historic	Settlement, sod houses, sod quarry
XFI-00017	Kanigniivik	Historic	Burials

AHRS #	Site Name	Period	Resource Description
XFI-00018	-	Historic	Single dwelling, sod house, artifacts
XFI-00019	-	Historic	Single dwelling, sod house
XFI-00020	-	Historic	Single dwelling, sod house
XFI-00030	Flaxman Island-Brownlow Point Historic District	-	-
XFI-00033	Brownlow cemetery	Historic	Cemetery
XFI-00034	Brownlow southern grave	Historic	Isolated grave
XFI-00035	-	Prehistoric	Artifact scatter
XMM-00001	Camden Bay	Prehistoric	House pit, midden, organic artifacts
XMM-00004	-	Historic	Sod houses, cellar
XMM-00005	-	Historic	Sod house ruin
XMM-00006	-	Historic	Sod house ruin, ice cellar, tent frame remains
XMM-00007	-	Prehistoric	Tent ring
XMM-00008	-	Prehistoric	-
XMM-00009	-	Prehistoric	Tent ring, scattered stones of other features
XMM-00010	-	Prehistoric	-
XMM-00011	-	Prehistoric	-
XMM-00012	-	Prehistoric	Tent ring, hearth(?)
XMM-00013	-	Prehistoric	-
XMM-00014	-	Prehistoric	-
XMM-00015	-	Prehistoric	-
XMM-00016	-	Prehistoric	-
XMM-00017	-	Prehistoric	-
XMM-00018	-	Historic	Sod house ruins, log cabin, historic debris
XMM-00019	-	Historic	Sod house, quarry
XMM-00020	-	Prehistoric	-
XMM-00021	-	Historic	-
XMM-00022	-	Prehistoric	-
XMM-00023	-	Prehistoric	-
XMM-00024	-	Prehistoric	-
XMM-00025	-	Prehistoric	-
XMM-00026	-	Prehistoric	-
XMM-00027	-	Prehistoric	-
XMM-00028	-	Prehistoric	Tent ring, scattered stones of other features
XMM-00029	-	Historic	-
XMM-00030	-	Prehistoric	-
XMM-00031	-	Historic	-
XMM-00032	-	Historic	-
XMM-00033	-	Historic	-
XMM-00034	-	Prehistoric	-
XMM-00035	-	Prehistoric, Historic	-
XMM-00037	-	Prehistoric	-
XMM-00038	-	Prehistoric	Tent rings
XMM-00039	-	Historic	-
XMM-00040	-	Historic	-
XMM-00041	-	Historic	Fish camp, tent rings(?)
XMM-00042	-	Historic	Settlement, winter, reindeer herding
XMM-00043	-	Historic	Settlement, winter, reindeer herding
XMM-00044	-	Historic	-

AHRS #	Site Name	Period	Resource Description
XMM-00045	-	Historic	Cemetery
XMM-00046	-	Historic	-
XMM-00114	(Doe) Camden Bay (AHRS) POW-D	Historic	Building, structure, defense, DEW Line
XMM-00117	Sivugag	-	-

Source: ADNR OHA 2018

Notes: - = no information provided in AHRS database. Information provided in this table is verbatim from the AHRS database.

Table L-2
Documented TLUI Sites in Program Area

TLUI #	Site Name	Resource Description
TLUIXMM032	Nuvugaq	House and ice cellar ruins
TLUIXMM005	Iqalugliuraq	House ruins and fishing area
TLUIXMM036	Aanalaaq	House ruins and graves
TLUIXMM033	Sallibutchich	Reindeer herding area
TLUIXMM027	Sivugaq	Landmark and resting place along trail
TLUIXMM028	1st Fish Hole	Fishing area
TLUIXMM039	Katakturuk	Viewing area
TLUIXMM032	Nuvugaq	Ruins and trapping and duck hunting area
TLUIXFI027	Aglibuabruk Cemetery	Cemetery
TLUIBRL012	Uqsruqtalik	House ruins and graves
TLUIBRL(44)	Kapijbuurak	House and ice cellar ruins
TLUIBRL011	Puukak	House ruins
TLUIXDP010	Iglubruatchiat	House ruin
TLUIXDP009	Imaibeauraq	House ruins, ice cellar ruins, and graves
TLUIXDP008	Anfun	House ruin and oil seep
TLUIXDP007	Atchalik	House ruins and fishing area
TLUIXFI009	Tigutaam Inaa	House ruins, fishing area, and place of important events
TLUIXFI010	Kayutak	House ruins
TLUIXFI011	Kafifiivik	House ruins and graves
TLUIXFI012	Aanalaaq	House ruins and graves
TLUIXFI013	Sanniqsaaluk	House ruins and graves
TLUIXFI015	Sallibutchit	House ruins, fishing area, and hunting and camping area
TLUIXFI017	Kunagrak	House ruin
None Given	Grave 2015	Grave
None Given	2 graves	Grave
None Given	Disturbed grave associated with Iglugruatchiaq	Grave
None Given	Kapijbuurak (2)	House ruin
None Given	Atchalik	House ruin
None Given	Atchalik	House ruin
None Given	Grave	Grave
None Given	Uqsruqtalik Graves	Grave
None Given	Nuvugapak	House ruins
None Given	Aanaalaaq	None given
None Given	Aanalaaq	House ruins and graves

Source: IHLC 2018

L.1 References

ADNR OHA (Alaska Department of Natural Resources Office of History and Archaeology). 2018. Alaska Heritage Resources Survey. Anchorage, Alaska.

IHLC (Iñupiat History, Language, and Cultural Division). 2018. Traditional Land Use Inventory Sites. Utqiaġvik, Alaska.

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Appendix M
Subsistence Uses and Resources

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Appendix M. Subsistence Uses and Resources

M.1 Kaktovik

M.1.1 Harvest Data

Table M-1
Kaktovik Subsistence Harvest Estimates by Resource Category, All Resources Study Years

Study Year	Resource	Percent of Households					Estimated Harvest				Percent of Total Harvest
		Use	Try to Harvest	Harvest	Give	Receive	Number[1]	Total Pounds[2]	Average HH Pounds	Per Capita Pounds	
1985	All Resources	100	93	91	83	100	-	61,663	1,163	328	100.0
	Salmon	2	0	0	0	2	0	0	0	0	0.0
	Non-Salmon Fish	100	86	81	45	93	6,866	11,403	215	61	18.5
	Large Land Mammals	100	79	71	71	100	288	35,331	667	188	57.3
	Small Land Mammals	60	52	52	31	24	427	160	3	1	0.3
	Marine Mammals	88	69	57	41	86	174	10,762	203	57	17.5
	Migratory Birds	83	76	71	48	57	964	3,388	64	18	5.5
	Upland Game Birds	86	74	69	45	43	867	607	11	3	1.0
	Vegetation	24	17	2	5	21	-	13	<1	<1	<0.1
1986	All Resources	100	89	87	83	100	-	84,060	1,501	433	100.0
	Non-Salmon Fish	96	75	72	66	87	4,416	6,951	124	36	8.3
	Large Land Mammals	98	68	62	57	98	198	24,908	445	128	29.6
	Small Land Mammals	47	45	40	19	30	183	39	1	<1	<0.1
	Marine Mammals	96	64	60	64	96	-	49,723	888	256	59.2
	Migratory Birds	-	-	-	-	-	273	1,673	30	9	2.0
	Upland Game Birds	87	62	62	47	55	1,012	708	13	4	0.8
	Eggs	2	2	2	0	2	4	1	<1	<1	<0.1
	Vegetation	49	21	21	11	40	-	58	1	<1	0.1
1992a	All Resources	96	89	89	83	92	-	170,939	2,713	886	100.0
	Salmon	26	9	9	11	19	50	105	2	1	0.1
	Non-Salmon Fish	94	83	81	70	68	18,415	22,847	363	118	13.4
	Large Land Mammals	96	70	57	62	83	212	28,705	456	149	16.8
	Small Land Mammals	47	43	38	21	19	213	162	3	1	0.1
	Marine Mammals	89	64	40	70	87	-	115,645	1,836	599	67.7
	Migratory Birds	83	62	51	47	70	970	2,702	43	14	1.6
	Upland Game Birds	85	60	57	47	49	769	539	9	3	0.3
	Eggs	23	15	13	15	15	56	8	<1	<1	<0.1
	Vegetation	77	72	70	23	40	-	227	4	1	0.1

Study Year	Resource	Percent of Households					Estimated Harvest				Percent of Total Harvest
		Use	Try to Harvest	Harvest	Give	Receive	Number[1]	Total Pounds[2]	Average HH Pounds	Per Capita Pounds	
1992b[3]	All Resources	-	-	-	-	-	-	180,970	-	-	100.0
	Salmon	-	-	-	-	-	20	123	-	-	0.1
	Non-Salmon Fish	-	66	-	-	-	19,641	32,941	-	-	18.2
	Large Land Mammals	-	-	-	-	-	195	24,763	-	-	13.7
	Small Land Mammals	-	-	-	-	-	51	13	-	-	<0.1
	Marine Mammals	-	-	-	-	-	77	120,287	-	-	66.5
	Migratory Birds	-	64	-	-	-	773	2,362	-	-	1.3
	Upland Game Birds	-	-	-	-	-	400	257	-	-	0.1
	Eggs	-	-	-	-	-	32	5	-	-	<0.1
	Vegetation	-	50	-	-	-	56	219	-	-	0.1
1994-95	All Resources	-	-	-	-	-	-	126,893	-	-	100.0
	Salmon	-	-	-	-	-	1	6	-	-	<0.1
	Non-Salmon Fish	-	-	-	-	-	4,425	7,934	-	-	6.3
	Large Land Mammals	-	-	-	-	-	119	17,007	-	-	13.4
	Small Land Mammals	-	-	-	-	-	59	18	-	-	<0.1
	Marine Mammals	-	-	-	-	-	46	100,725	-	-	79.4
	Migratory Birds	-	-	-	-	-	411	1,102	-	-	0.9
	Upland Game Birds	-	-	-	-	-	119	119	-	-	0.1
2002-03	All Resources	-	-	-	-	-	-	104,777	-	-	100.0
	Non-Salmon Fish	-	-	-	-	-	2,363	4,784	-	-	4.6
	Large Land Mammals	-	-	-	-	-	130	17,104	-	-	16.3
	Small Land Mammals	-	-	-	-	-	56	20	-	-	<0.1
	Marine Mammals	-	-	-	-	-	30	80,877	-	-	77.2
	Migratory Birds	-	-	-	-	-	536	1,585	-	-	1.5
	Upland Game Birds	-	-	-	-	-	370	370	-	-	0.4
	Eggs	-	-	-	-	-	30	5	-	-	<0.1
	Marine Invertebrates	-	-	-	-	-	3	6	-	-	<0.1
	Vegetation	-	-	-	-	-	9	27	-	-	<0.1
2007	All Resources	-	-	-	-	-	6,277	78,243	954	-	100.0
	Salmon	-	-	-	-	-	5	14	<1	-	<0.1
	Non- Salmon Fish	-	-	-	-	-	5,086	7,592	93	-	9.7
	Large Land Mammals	-	-	-	-	-	181	21,168	258	-	27.1
	Small Land Mammals	-	-	-	-	-	31	14	<1	-	<0.1
	Marine Mammals	-	-	-	-	-	17	47,316	577	-	60.5
	Migratory Birds	-	-	-	-	-	537	1,814	22	-	2.3
	Upland Game Birds	-	-	-	-	-	199	139	2	-	0.2
	Bird Eggs	-	-	-	-	-	43	13	<1	-	<0.1
	Marine Invertebrates	-	-	-	-	-	-	-	-	-	-
	Vegetation	-	-	-	-	-	179	173	2	-	0.2

Study Year	Resource	Percent of Households					Estimated Harvest				Percent of Total Harvest
		Use	Try to Harvest	Harvest	Give	Receive	Number[1]	Total Pounds[2]	Average HH Pounds	Per Capita Pounds	
2008	All Resources	-	-	-	-	-	6,735	101,398	1,237	-	100.0
	Salmon	-	-	-	-	-	11	34	<1	-	<0.1
	Non- Salmon Fish	-	-	-	-	-	5,364	12,000	146	-	11.8
	Large Land Mammals	-	-	-	-	-	230	26,123	319	-	25.8
	Small Land Mammals	-	-	-	-	-	47	2	<1	-	<0.1
	Marine Mammals	-	-	-	-	-	23	60,731	741	-	59.9
	Migratory Birds	-	-	-	-	-	698	2,274	28	-	2.2
	Upland Game Birds	-	-	-	-	-	155	155	2	-	0.2
	Bird Eggs	-	-	-	-	-	170	44	1	-	<0.1
	Marine Invertebrates	-	-	-	-	-	-	-	-	-	-
	Vegetation	-	-	-	-	-	36	36	<1	-	<0.1
2009	All Resources	-	-	-	-	-	4,796	126,628	1,472	-	100.0
	Salmon	-	-	-	-	-	4	14	<1	-	<0.1
	Non- Salmon Fish	-	-	-	-	-	3,737	7,919	92	-	6.3
	Large Land Mammals	-	-	-	-	-	202	23,050	268	-	18.2
	Small Land Mammals	-	-	-	-	-	54	8	<1	-	0.0
	Marine Mammals	-	-	-	-	-	22	93,638	1,089	-	73.9
	Migratory Birds	-	-	-	-	-	397	1,632	19	-	1.3
	Upland Game Birds	-	-	-	-	-	287	287	3	-	0.2
	Bird Eggs	-	-	-	-	-	0	0	0	-	0.0
	Marine Invertebrates	-	-	-	-	-	-	-	-	-	-
	Vegetation	-	-	-	-	-	93	82	1	-	0.1
2010	All Resources	-	-	-	-	-	1,870	79,231	990	-	100.0
	Salmon	-	-	-	-	-	4	16	<1	-	<0.1
	Non- Salmon Fish	-	-	-	-	-	1,195	762	10	-	1.0
	Large Land Mammals	-	-	-	-	-	143	16,105	201	-	20.3
	Small Land Mammals	-	-	-	-	-	19	3	<1	-	<0.1
	Marine Mammals	-	-	-	-	-	12	61,474	768	-	77.6
	Migratory Birds	-	-	-	-	-	151	596	7	-	0.8
	Upland Game Birds	-	-	-	-	-	266	266	3	-	0.3
	Bird Eggs	-	-	-	-	-	0	0	0	-	0.0
	Marine Invertebrates	-	-	-	-	-	-	-	-	-	-
	Vegetation	-	-	-	-	-	81	9	<1	-	<0.1
2010-11	All Resources	100	96	94	84	100	13,138	202,958	2,388	707	100.0
	Salmon	19	7	6	9	14	59	288	3	1	0.1
	Non- Salmon Fish	96	83	76	69	84	10,799	27,198	320	95	13.4
	Large Land Mammals	94	56	47	51	93	511	68,458	805	239	33.7
	Small Land Mammals	29	23	17	13	16	150	302	4	1	0.1
	Marine Mammals	99	91	89	69	97	59	103,108	1,213	359	50.8
	Migratory Birds	73	51	40	40	67	788	2,547	30	9	1.3
	Upland Game Birds	60	43	37	29	40	710	710	8	3	0.4
	Bird Eggs	1	1	1	1	0	7	5	0	0	0.0
	Marine Invertebrates	1	0	0	0	1	0	0	0	0	0.0
	Vegetation	46	29	19	21	41	55	342	4	1	0.2

Study Year	Resource	Percent of Households					Estimated Harvest				Percent of Total Harvest
		Use	Try to Harvest	Harvest	Give	Receive	Number[1]	Total Pounds[2]	Average HH Pounds	Per Capita Pounds	
2011[4]	All Resources	-	-	-	-	-	8,216	98,841	1,236	-	100.0
	Salmon	-	-	-	-	-	1	6	<1	-	<0.1
	Non- Salmon Fish	-	-	-	-	-	7,390	16,837	210	-	17.0
	Large Land Mammals	-	-	-	-	-	191	21,920	274	-	22.2
	Small Land Mammals	-	-	-	-	-	6	3	<1	-	<0.1
	Marine Mammals	-	-	-	-	-	14	58,944	737	-	59.6
	Migratory Birds	-	-	-	-	-	239	884	11	-	0.9
	Upland Game Birds	-	-	-	-	-	127	127	2	-	0.1
	Bird Eggs	-	-	-	-	-	65	18	<1	-	<0.1
	Marine Invertebrates	-	-	-	-	-	-	-	-	-	-
	Vegetation	-	-	-	-	-	183	102	1	-	0.1
2012	All Resources	-	-	-	-	-	5,806	133,258	1,666	-	100.0
	Salmon	-	-	-	-	-	7	32	<1	-	<0.1
	Non- Salmon Fish	-	-	-	-	-	4,948	9,556	119	-	7.2
	Large Land Mammals	-	-	-	-	-	169	20,099	251	-	15.1
	Small Land Mammals	-	-	-	-	-	39	2	<1	-	<0.1
	Marine Mammals	-	-	-	-	-	9	102,278	1,278	-	76.8
	Migratory Birds	-	-	-	-	-	434	1,089	14	-	0.8
	Upland Game Birds	-	-	-	-	-	0	0	0	-	0.0
	Bird Eggs	-	-	-	-	-	0	0	0	-	0.0
	Marine Invertebrates	-	-	-	-	-	-	-	-	-	-
	Vegetation	-	-	-	-	-	202	202	3	-	0.2

Sources: 1985, 1986 (ADFG 2018); 1992a (Pedersen 1995a); 1992b (Fuller and George 1999); 1994-95 (Brower, Olemaun, and Hepa 2000); 2002-03 (Bacon, Hepa, Brower, Pederson, Olemaun, George, and Corrigan 2009); 2007-2012 (Harcharek, Kayotuk, George, and Pederson 2018); 2010-11 (Kofinas, BurnSilver, Magdanz, Stotts, and Okada 2016).

Notes: Sources: 2000-01, 2001-02 Pedersen and Linn 2005

[1]Estimated numbers represent individuals in all cases except vegetation, where they represent gallons.
[2]Estimated pounds include only edible pounds and therefore do not include estimates for resources, such as furbearers, that are not typically eaten by community residents.
[3]Due to a low response rate during the NSB 1992b survey, these data should be viewed with caution. Household participation for the 1992b study year is based on Table A5 in Fuller and George (1999); participation in migratory bird harvests includes waterfowl and eggs; participation in vegetation harvests includes only berries; participation in non-salmon fish harvests is for fish in general.
[4]The survey in 2011 consisted of only an 8-month survey, covering May through December 2011; therefore, estimates from 2011 may not be directly comparable with other years that covered an entire year. The estimated harvest numbers for the 1994-95 and 2002-03 data were derived by summing individual species in each resource category. Also, for those study years, total pounds were derived from conversion rates found at ADFG (2018) and total usable pounds for bowhead whales were calculated based on the method presented in (SRB&A and ISER 1993). These estimates do not account for whale girth and should be considered approximate; more exact methods for estimating total whale weights are available in George, Philo, Suydam, Carroll, and Albert, n.d.

(Stephen R. Braund & Associates, 2018)

Table M-2
Kaktovik Subsistence Harvest Estimates by Resource Category, Non-Comprehensive Study Years

Study Year	Resource	Percent of Households					Estimated Harvest			
		Use	Try to Harvest	Harvest	Give	Receive	Number	Total Pounds	Average HH Pounds	Per Capita Pounds
2000-01	Non-Salmon Fish	61	43	38	36	52	3,137	5,970	35	11
2001-02	Non-Salmon Fish	76	55	47	33	47	5,036	9,748	55	19

(*Stephen R. Braund & Associates 2018*)

Table M-3
Kaktovik Subsistence Harvest Estimates by Selected Species, All Study Years

Study Year	Resource[1]	Percent of Households					Estimated Harvest				Percent of Total Harvest
		Use	Try to Harvest	Harvest	Give	Receive	Number[2]	Total Pounds[3]	Average HH Pounds	Per Capita Pounds	
1981-82	Caribou	-	-	-	-	-	43	-	-	-	-
1982-83	Caribou	-	-	-	-	-	160	-	-	-	-
1983-84	Caribou	-	-	-	-	-	107	-	-	-	-
1985-86	Caribou	-	-	-	-	-	235	-	-	-	-
1985	Caribou	95	76	69	67	86	235	27,941	527	149	45.3
	Arctic Char	100	86	81	41	69	3,075	8,611	162	46	14.0
	Ringed Seal	69	50	45	26	45	151	6,360	120	34	10.3
	Dall Sheep	79	29	21	21	74	47	4,622	87	25	7.5
	Bearded Seal	62	43	33	29	57	21	3,776	71	20	6.1
	Geese	71	62	57	38	43	647	2,913	55	15	4.7
	Cisco	79	60	55	29	62	3,546	2,482	47	13	4.0
	Moose	45	7	7	5	38	4	1,893	36	10	3.1
	Muskox	43	5	2	2	43	1	748	14	4	1.2
	Polar Bear	24	5	2	2	21	1	626	12	3	1.0
	Ptarmigan	86	74	69	45	43	867	607	11	3	1.0
1986	Bowhead Whale	96	62	43	51	94	-	43,704	780	225	52.0
	Caribou	98	66	60	53	94	178	21,188	378	109	25.2
	Arctic Char	94	70	70	62	77	1,768	4,951	88	25	5.9
	Bearded Seal	75	34	26	23	64	17	2,936	52	15	3.5
	Ringed Seal	72	40	38	28	60	44	1,851	33	10	2.2
	Dall Sheep	75	15	9	9	68	17	1,710	31	9	2.0
	Cisco	85	53	53	45	79	2,402	1,682	30	9	2.0
	Muskox	68	4	4	4	66	2	1,413	25	7	1.7
	Geese	83	55	51	36	70	371	1,410	25	7	1.7
	Polar Bear	15	6	4	4	13	2	1,182	21	6	1.4
1986-87	Caribou	-	-	-	-	-	201	-	-	-	-
1987-88	Caribou	-	-	55	-	-	185	22,229	383	104	-

Study Year	Resource[1]	Percent of Households: Use	Try to Harvest	Harvest	Give	Receive	Estimated Harvest: Number[2]	Total Pounds[3]	Average HH Pounds	Per Capita Pounds	Percent of Total Harvest
1990[4]	Caribou	-	-	48	-	-	113	13,453	224	67	-
1991	Caribou	-	-	50	-	-	181	22,113	369	94	-
1992a	Bowhead Whale	87	53	6	62	85	-	108,160	1,717	560	63.3
	Caribou	96	70	55	53	75	158	19,136	304	99	11.2
	Arctic Char	92	81	79	66	45	5,523	15,463	245	80	9.0
	Bering Cisco[8]	77	62	62	57	45	8,103	5,672	90	29	3.3
	Dall Sheep	70	36	28	32	64	44	4,379	70	23	2.6
	Bearded Seal	75	47	28	32	60	24	4,246	67	22	2.5
	Muskox	53	21	9	17	51	5	3,179	50	16	1.9
	Geese	79	60	47	40	62	601	2,135	34	11	1.2
	Moose	36	11	6	9	32	4	2,011	32	10	1.2
	Ringed Seal	47	30	26	28	36	42	1,689	27	9	1.0
1992b[5]	Bowhead Whale	-	59	-	-	-	3	108,463	-	-	59.9
	Arctic Char	-	-	-	-	-	7,937	22,224	-	-	12.3
	Caribou	-	66	-	-	-	136	15,926	-	-	8.8
	Arctic Cisco	-	-	-	-	-	-	7,143	-	-	3.9
	Dall Sheep	-	-	-	-	-	53	5,249	-	-	2.9
	Walrus	-	23	-	-	-	5	3,737	-	-	2.1
	Musk Ox	-	-	-	-	-	6	3,588	-	-	2.0
	Bearded Seal	-	62	-	-	-	17	2,998	-	-	1.7
	Beluga	-	-	-	-	-	2	2,761	-	-	1.5
	Grayling	-	-	-	-	-	3,299	2,639	-	-	1.5
	Geese	-	-	-	-	-	563	2,034	-	-	1.1
1994-95	Bowhead Whale	-	-	-	-	-	3	88,688	-	-	69.9
	Caribou	-	-	-	-	-	78	10,608	-	-	8.4
	Bearded Seal	-	-	-	-	-	21	8,820	-	-	7.0
	Dolly Varden	-	-	-	-	-	1,875	6,188	-	-	4.9
	Dall Sheep	-	-	-	-	-	30	3,120	-	-	2.5
	Muskox	-	-	-	-	-	9	2,655	-	-	2.1
	Arctic Cisco	-	-	-	-	-	2,358	1,651	-	-	1.3
2000-01	Dolly Varden	-	-	35	-	-	1,739	4,869	27	9	-
	Arctic Cisco	-	-	91	-	-	1,361	953	32	9	-
	Lake Trout	-	-	4	-	-	37	148	2	1	-
2001-02	Dolly Varden	-	-	44	-	-	2,649	7,418	41	14	-
	Arctic Cisco	-	-	38	-	-	2,187	1,531	19	7	-
	Lake Trout	-	-	6	-	-	200	800	10	3	-
2002-03	Bowhead Whale	-	-	-	-	-	3	75,515	-	-	72.1
	Caribou	-	-	-	-	-	112	15,232	-	-	14.5
	Arctic Char	-	-	-	-	-	1,162	3,834	-	-	3.7
	Bearded Seal	-	-	-	-	-	8	3,360	-	-	3.2
	Dall Sheep	-	-	-	-	-	18	1,872	-	-	1.8
	Ringed Seal	-	-	-	-	-	17	1,258	-	-	1.2

Study Year	Resource[1]	Percent of Households: Use	Try to Harvest	Harvest	Give	Receive	Estimated Harvest: Number[2]	Total Pounds[3]	Average HH Pounds	Per Capita Pounds	Percent of Total Harvest
2007	Bowhead Whale	-	-	-	-	-	3	40,833	498	-	52.2
	Caribou	-	-	-	-	-	181	21,168	258	-	27.1
	Beluga Whale	-	-	-	-	-	6	5,934	72	-	7.6
	Dolly Varden	-	-	-	-	-	1,658	4,643	57	-	5.9
	Arctic Cisco	-	-	-	-	-	3,198	2,239	27	-	2.9
2008	Bowhead Whale	-	-	-	-	-	3	57,482	701	-	56.7
	Caribou	-	-	-	-	-	185	21,586	263	-	21.3
	Dolly Varden	-	-	-	-	-	3,921	10,980	134	-	10.8
	Dall Sheep	-	-	-	-	-	45	4,425	54	-	4.4
	Polar Bear	-	-	-	-	-	3	1,662	20	-	1.6
	Bearded Seal	-	-	-	-	-	6	1,117	14	-	1.1
2009	Bowhead Whale	-	-	-	-	-	3	88,488	1029	-	69.9
	Caribou	-	-	-	-	-	170	19,872	231	-	15.7
	Dolly Varden	-	-	-	-	-	2,449	6,857	80	-	5.4
	Bearded Seal	-	-	-	-	-	15	2,915	34	-	2.3
	Dall Sheep	-	-	-	-	-	29	2,886	34	-	2.3
	Beluga Whale	-	-	-	-	-	2	1,450	17	-	1.1
	White-Fronted Geese	-	-	-	-	-	274	1,234	14	-	1.0
2010	Bowhead Whale	-	-	-	-	-	3	53,167	665	-	67.1
	Caribou	-	-	-	-	-	115	13,458	168	-	17.0
	Beluga Whale	-	-	-	-	-	8	8,075	101	-	10.2
	Dall Sheep	-	-	-	-	-	16	1,612	20	-	2.0
	Black Bear[6]	-	-	-	-	-	12	1,035	13	-	1.3
2010-11	Bowhead	97	90	89	60	94	3	78,662	925	274	38.8
	Caribou	94	53	46	51	93	429	58,305	686	203	28.7
	Dolly Varden	94	79	76	64	77	6,333	20,898	246	73	10.3
	Beluga	76	30	26	30	74	15	10,318	121	36	5.1
	Bearded Seal	57	28	17	24	54	24	10,165	120	35	5.0
	Dall Sheep	76	14	14	0	73	78	8,089	95	28	4.0
	Broad Whitefish	43	26	20	20	29	1,148	3,729	44	13	1.8
	Geese	70	49	40	37	60	701	2,272	27	8	1.1
	Moose	16	9	4	4	13	4	1,960	23	7	1.0
2011[7]	Bowhead Whale	-	-	-	-	-	3	57,661	721	-	58.3
	Caribou	-	-	-	-	-	170	19,909	249	-	20.1
	Dolly Varden	-	-	-	-	-	5,440	15,232	190	-	15.4
	Dall Sheep	-	-	-	-	-	20	2,011	25	-	2.0
	Bering Cisco[8]	-	-	-	-	-	1,093	1,093	14	-	1.1
	Bearded Seal	-	-	-	-	-	5	1,016	13	-	1.0
2012	Bowhead Whale	-	-	-	-	-	3	100,968	1,262	-	75.8
	Caribou	-	-	-	-	-	155	18,145	227	-	13.6
	Dolly Varden	-	-	-	-	-	2,861	8,010	100	-	6.0
2015	Caribou	-	52	-	-	-	303	35,451	-	-	-

Sources: 1981-82, 1982-83 (Pedersen and Coffing 1984); 1983-84 (Coffing and Pedersen 1985); 1985-86, 1986-87, 1987-88 (Pedersen 1990); 1985, 1986, 1990, 1991, (ADFG 2018); 1992a (Pedersen 1995a); 1992b (Fuller and George 1999); 1994-95 (Brower et al. 2000); and 2000-01, 2001-02 (Pedersen and Linn 2005); 2002-03 (Bacon et al. 2009); 2007-2012 (Harcharek et al. 2018); 2010-11 (Kofinas et al. 2016); 2015 (SRB&A 2017a).

Notes:
[1]Except in the case of ducks and geese, which are lumped into more general species categories, this table shows individual species, unless they are not available for a given study year.
[2]Estimated numbers represent individuals in all cases except vegetation, where they represent gallons.
[3]Estimated pounds include only edible pounds and therefore do not include estimates for resources, such as furbearers, that are not typically eaten by community residents.
[4]Per capita pounds may be underestimated.
[5]Data should be viewed with caution due to a low response rate. Household participation for the 1992b study year was based on Table A5 in Fuller and George (1999). Bearded seal participation rates include all species of seal.
[6]Probably misreported and should be brown bear (Akłaq).
[7]The survey in 2011 consisted of only an 8-month survey, covering May through December 2011; therefore, estimates from 2011 may not be directly comparable with other years that covered an entire year. For All Resources study years (1985, 1986, 1992a, 1992b, 1994-95, 2002-03), species are listed in descending order by percent of total harvest and are limited to species accounting for at least 1.0 percent of the total harvest; for single-resource study years, species are listed in descending order by total estimated pounds (or total number harvested, in the case of salmon study years) and limited to the five top species. Years lacking "% of total harvest" data were not comprehensive (i.e., all resources) study years).
[8]Reports of Bering cisco harvests in 1992 and 2011 may be incorrect, as Bering cisco are rare in the Kaktovik area. The data are likely referencing Arctic cisco. The estimated harvest numbers for the 1994-95 and 2002-03 data were derived by summing individual species in each resource category. Also, for those study years, total pounds were derived from conversion rates found at (ADFG 2018) and total (usable) pounds for bowhead whales were calculated based on the method presented in SRB&A and ISER (1993). These estimates do not account for whale girth and should be considered approximate; more exact methods for estimating total whale weights are available in George et al., n.d.

(Stephen R. Braund & Associates 2018)

M.1.2 Seasonal Round

Table M-4
Kaktovik Annual Cycle of Subsistence Activities

Resources	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Freshwater Non-Salmon	■	■	■	■	■	■	■	■	■	■	■	■
Marine Non-Salmon	■	■	■	■	■	■	■	■	■		■	■
Salmon							■	■	■			
Caribou	■	■	■	■	■	■	■	■	■	■	■	■
Moose	■	■	■	■			■	■	■	■	■	■
Bear					■		■	■	■	■	■	
Sheep	■		■	■				■	■	■	■	■
Muskox	■	■	■					■		■	■	■
Furbearers	■	■	■	■	■			■		■	■	■
Small Land Mammals			■	■	■	■		■	■		■	
Marine Mammals	■	■	■	■	■	■	■	■	■	■	■	■
Upland Birds			■	■	■	■	■	■		■	■	
Waterfowl				■	■	■	■	■	■	■		
Eggs				■	■	■	■	■	■	■		
Marine Invertebrates								■				
Plants and Berries							■	■	■			
Total Number of Resources Categories by Month	**8**	**7**	**10**	**11**	**10**	**8**	**11**	**16**	**12**	**11**	**11**	**8**

Sources: 2002-03 (Bacon et al. 2009); 1994-95 (Brower et al. 2000); 2004 (EDAW Inc., Consulting, Research, Callaway, Associates, and Economics 2008); 1992 (Fuller and George 1999); (Kofinas et al. 2016); pre-1989 (Pedersen, Haynes, and Wolfe 1991); 2000-01 (Pedersen and Linn 2005); 1996-2006 (SRB&A 2010); 2007-2012 (Harcharek et al. 2018)

■ Subsistence activity

M.1.3 Travel Method

Table M-5
Kaktovik Travel Method to Subsistence Use Areas

Resources	Boat	Snowmachine	Foot	Car/Truck	ATV
Arctic Cisco	5	1	3	2	4
Burbot	5	4	4	0	0
Arctic Char/Dolly Varden and Broad Whitefish	5	4	2	1	3
Broad Whitefish	5	3	2	2	4
Caribou	5	4	3	0	2
Moose	5	0	0	0	0
Wolf and Wolverine	4	5	0	0	0
Bowhead Whale	5	0	0	0	0
Seals	5	4	0	0	0
Walrus	5	0	0	0	0
Geese	4	5	3	0	3
Eider	4	5	3	0	2
Total Number of Resources Targeted	**12**	**9**	**7**	**3**	**6**

Sources: 1996-2006 (SRB&A 2010)

Note: For each resource, darker shades indicate greater use of that travel method and lighter shades indicate lesser use of a travel method. The shades have been given a value of 0 – 5, 0 being the lightest and 5 the darkest.

M.1.4 Resource Importance

Table M-6
Material and Cultural Importance of Subsistence Resources, Kaktovik

Resource Level	Resource[1]	Cultural Importance: Percent of Households Try to Harvest	Cultural Importance: Percent of Households Receive	Material Importance: Percent of Total Harvest
Major Resources[2]	Bearded Seal	38	59	2.6
	Bering Cisco[3]	62	45	2.2
	Bowhead Whale[6]	62	89	56.6
	Caribou	66	93	21.6
	Dall Sheep	24	70	2.9
	Dolly Varden and Arctic Char	79	67	7.4
	Ptarmigan	60	47	0.4
	Wood	64	21	-
Moderate Resources[4]	Arctic Cisco	17	16	1.2
	Arctic Fox	14	1	-
	Arctic Grayling	11	13	0.2
	Belukha/Beluga	12	38	2.6
	Blueberry	20	22	<.1
	Broad Whitefish	8	25	0.3
	Canada Geese	48	46	0.3

Resource Level	Resource[1]	Cultural Importance		Material Importance
		Percent of Households		Percent of Total Harvest
		Try to Harvest	Receive	
Moderate Resources[4] *(continued)*	Common Eider	19	15	0.1
	Cranberry	21	33	0.1
	King Eider	13	10	<.1
	Lake Trout	13	24	0.3
	Least Cisco	9	13	0.1
	Long-Tailed Duck (Oldsquaw)	22	17	<.1
	Moose	8	37	1.3
	Muskox	8	40	1.5
	Polar Bear	4	12	0.8
	Ringed Seal	38	36	1.5
	Saffron Cod	16	1	<.1
	Salmonberry/Cloudberry	21	33	0.1
	Snow Geese	17	9	<.1
	Squirrel	28	16	0.1
	Walrus	8	31	0.6
	Whitefronted Geese	30	26	0.5
	Wolf	11	2	-
	Wolverine	13	2	-
Minor Resources[5]	Bird Eggs	6	6	<.1
	Brown Bear	3	6	0.2
	Halibut	1	9	0.2
	Humpback Whitefish	-	5	<.1
	Red Fox	9	1	-
	Spotted Seal	9	5	0.2

Sources: 1981-82, 1982-83 (Pedersen and Coffing 1984); 1983-84 (Coffing and Pedersen 1985); 1985-86, 1986-87, 1987-88 (Pedersen 1990); 1985, 1986, 1990, 1991, (ADFG 2018); 1992a (Pedersen 1995a); 1992b (Fuller and George 1999); 1994-95 (Brower et al. 2000); and 2000-01, 2001-02 (Pedersen and Linn 2005); 2002-03 (Bacon et al. 2009); 2007-2012 (Harcharek et al. 2018); 2010-11 (Kofinas et al. 2016); 2015 (SRB&A 2017a)

Notes:
[1]Resources that contributed an average of less than 1 percent of harvest, less than 5 percent attempting harvests, and less than 5 percent receiving harvests are categorized as minor and are not shown.
[2]Major resources contribute > 9 percent total harvest, have ≥ 50 percent of households attempting harvest, or have ≥ 50 percent of households receiving a resource.
[3]Reports of Bering cisco harvests in 1992 and 2011 may be incorrect, as Bering cisco are rare in the Kaktovik area. The data are likely referencing Arctic cisco.
[4]Moderate resources contribute 2 to 9 percent of total harvest, have 11 to 49 percent of households attempting harvest, or have 11 to 49 percent of households receiving a resource.
[5]Minor resources contribute < 2 percent of total harvest, have ≤ 10 percent of households attempting harvest, or have ≤ 10 percent of households receiving a resource.
[6]Averages include unsuccessful bowhead whale harvest years.

M.2 NUIQSUT

M.2.1 Harvest Data

Table M-7
Nuiqsut Subsistence Harvest Estimates by Resource Category, All Resources Study Years

Study Year	Resource	Percent of Households					Estimated Harvest				Percent of Total Harvest
		Use	Try to Harvest	Harvest	Give	Receive	Number*	Total Pounds**	Average HH Pounds	Per Capita Pounds	
1985	All Resources	100	98	98	95	100	-	160,035	2,106	399	100.0
	Salmon	60	43	40	23	23	441	1,366	18	3	0.9
	Non-Salmon Fish	100	93	93	83	75	67,712	69,243	911	173	43.3
	Large Land Mammals	98	90	90	80	70	536	67,621	890	169	42.3
	Small Land Mammals	65	63	58	23	13	688	245	3	1	0.2
	Marine Mammals	100	48	23	30	100	59	13,355	176	33	8.3
	Migratory Birds	90	90	85	60	55	1,733	6,626	87	17	4.1
	Upland Game Birds	88	88	88	58	13	1,957	1,370	18	3	0.9
	Bird Eggs	25	25	23	8	10	262	40	1	<1	<0.1
	Vegetation	38	50	18	10	20	-	169	2	<1	0.1
1992***	All Resources	-	-	-	-	-	-	150,195	-	-	100.0
	Salmon	-	-	-	-	-	6	65	-	-	0.0
	Non-Salmon Fish	-	74	-	-	-	36,701	51,890	-	-	34.5
	Large Land Mammals	-	-	-	-	-	299	41,386	-	-	27.6
	Small Land Mammals	-	-	-	-	-	46	1	-	-	0.0
	Marine Mammals	-	-	-	-	-	49	52,865	-	-	35.2
	Migratory Birds	-	-	-	-	-	1,105	3,655	-	-	2.4
	Upland Game Birds	-	-	-	-	-	378	265	-	-	0.2
	Eggs	-	-	-	-	-	25	4	-	-	<0.1
	Vegetation	-	32	-	-	-	-	66	-	-	<0.1
1993	All Resources	100	94	90	92	98	-	267,818	2,943	742	100.0
	Salmon	71	45	36	39	47	272	1,009	11	3	0.4
	Non-Salmon Fish	97	79	79	87	90	71,626	89,481	983	248	33.4
	Large Land Mammals	98	76	74	82	92	691	87,306	959	242	32.6
	Small Land Mammals	53	45	42	27	18	599	84	1	<1	<0.1
	Marine Mammals	97	58	37	79	97	113	85,216	936	236	31.8
	Migratory Birds	87	74	73	63	65	2,238	3,540	39	10	1.3
	Upland Game Birds	60	45	45	42	26	973	681	7	2	0.3
	Eggs	40	21	19	15	23	346	104	1	<1	<0.1
	Vegetation	79	71	71	27	40	-	396	4	1	0.1

Study Year	Resource	Percent of Households: Use	Try to Harvest	Harvest	Give	Receive	Estimated Harvest: Number*	Total Pounds**	Average HH Pounds	Per Capita Pounds	Percent of Total Harvest
1994-95****	All Resources	-	-	-	-	-	-	83,228	-	-	100.0
	Salmon	-	-	-	-	-	10	31	-	-	<0.1
	Non-Salmon Fish	-	-	-	-	-	15,190	46,569	-	-	56.0
	Large Land Mammals	-	-	-	-	-	263	32,686	-	-	39.3
	Small Land Mammals	-	-	-	-	-	42	0	-	-	0.0
	Marine Mammals	-	-	-	-	-	25	1,504	-	-	1.8
	Migratory Birds	-	-	-	-	-	569	2,289	-	-	2.8
	Upland Game Birds	-	-	-	-	-	58	58	-	-	0.1
	Vegetation	-	-	-	-	-	14	91	-	-	0.1
1995-96	All Resources	-	-	-	-	-	-	183,576	-	-	100.0
	Salmon	-	-	-	-	-	42	131	-	-	0.1
	Non-Salmon Fish	-	-	-	-	-	10,612	16,822	-	-	9.2
	Large Land Mammals	-	-	-	-	-	364	43,554	-	-	23.7
	Small Land Mammals	-	-	-	-	-	27	0	-	-	0.0
	Marine Mammals	-	-	-	-	-	178	120,811	-	-	65.8
	Migratory Birds	-	-	-	-	-	683	2,166	-	-	1.2
	Upland Birds	-	-	-	-	-	19	13	-	-	<0.1
	Vegetation	-	-	-	-	-	12	78	-	-	<0.1
2000-01	All Resources	-	-	-	-	-	-	183,246	-	-	100.0
	Salmon	-	-	-	-	-	10	75	-	-	<0.1
	Non-Salmon Fish	-	-	-	-	-	26,545	27,933	-	-	15.2
	Large Land Mammals	-	-	-	-	-	504	62,171	-	-	33.9
	Small Land Mammals	-	-	-	-	-	108	2	-	-	<0.1
	Marine Mammals	-	-	-	-	-	31	87,929	-	-	48.0
	Migratory Birds	-	-	-	-	-	1,192	5,108	-	-	2.8
	Upland Birds	-	-	-	-	-	23	16	-	-	<0.1
	Vegetation	-	-	-	-	-	2	13	-	-	<0.1
2014	All Resources	100	95	90	91	97	-	371,992	3,444	896	100.0
	Salmon	64	41	40	31	35	-	3,889	36	9	1.0
	Non-Salmon Fish	93	78	71	72	71	-	85,106	788	205	22.9
	Large Land Mammals	91	66	64	67	72	-	108,359	1,003	261	29.1
	Small Land Mammals	17	16	10	2	7	-	0	0	0	0.0
	Marine Mammals	95	55	40	71	95	-	169,367	1,568	408	45.5
	Migratory Birds	79	71	66	52	38	-	4,742	44	11	1.3
	Upland Birds	16	12	12	9	5	-	78	1	<1	<0.1
	Vegetation	67	55	53	21	38	-	414	4	1	0.1

Sources: 1985 (ADFG 2018); 1992 (Fuller and George 1999); 1993 (Pedersen 1995b); 1994-95 (Brower and Hepa 1998); 1995-96, 2000-01 (Bacon et al. 2009); 2014 (Brown, Braem, Mikow, Trainor, Slayton, Runfola, Ikuta, Kostick, McDevitt, Park, and Simon 2016).

Notes:
*Estimated numbers represent individuals in all cases except vegetation, where they represent gallons.
**Estimated pounds include only edible pounds and therefore do not include estimates for resources, such as furbearers, that are not typically eaten by community residents.
***The estimated pounds of moose harvested in 1992 is likely too high (Fuller and George 1999).

****The 1994-95 study year underrepresents the harvest of Arctic cisco and humpback whitefish (Brower and Hepa 1998). Nuiqsut did not successfully harvest a bowhead whale in 1994-95.

The estimated harvest numbers for the 1994-95, 1995-96 and 2000-01 data were derived by summing individual species in each resource category. Also for those study years, total pounds were derived from conversion rates found at ADFG (2018), and total usable pounds for bowhead whales were calculated based on the method presented in SRB&A and ISER (1993). These estimates do not account for whale girth and should be considered approximate; more exact methods for estimating total whale weights are available in George et al., n.d.

(*Stephen R. Braund & Associates 2018*)

Table M-8
Nuiqsut Subsistence Harvest Estimates by Selected Species, All Study Years

Study Year	Resource*	Percent of Households					Estimated Harvest				Percent of Total Harvest
		Use	Try to Harvest	Harvest	Give	Receive	Number**	Total Pounds***	Average HH Pounds	Per Capita Pounds	
1985	Caribou	98	90	90	80	60	513	60,021	790	150	37.5
	Cisco	98	75	73	65	60	46,478	29,354	386	73	18.3
	Broad Whitefish	95	80	78	70	40	7,900	26,861	353	67	16.8
	Bowhead Whale	100	23	5	8	100	0	7,458	98	19	4.7
	Moose	40	40	18	20	25	13	6,650	88	17	4.2
	White-Fronted Geese	90	90	85	55	48	1,340	6,028	79	15	3.8
	Arctic Grayling	78	65	63	48	35	4,055	3,650	48	9	2.3
	Humpback Whitefish	48	45	38	33	13	4,345	3,476	46	9	2.2
	Arctic Char	75	63	60	33	35	1,060	2,969	39	7	1.9
	Burbot	75	60	60	43	33	669	2,675	35	7	1.7
	Bearded Seal	48	25	15	15	35	15	2,675	35	7	1.7
	Ringed Seal	53	25	18	23	40	40	1,676	22	4	1.0
1992	Bowhead Whale	-	-	-	-	-	2	48,715	-	-	32.4
	Caribou	-	81	-	-	-	278	32,551	-	-	21.7
	Arctic Cisco	-	-	-	-	-	22,391	22,391	-	-	14.9
	Broad Whitefish	-	-	-	-	-	6,248	15,621	-	-	10.4
	Moose****	-	-	-	-	-	18	8,835	-	-	5.9
	Humpback Whitefish	-	-	-	-	-	1,802	4,504	-	-	3.0
	Arctic Char	-	-	-	-	-	1,544	4,324	-	-	2.9
	Bearded Seal	-	-	-	-	-	16	2,760	-	-	1.8
	Arctic Grayling	-	-	-	-	-	3,114	2,491	-	-	1.7
	Canada Geese	-	-	-	-	-	319	1,437	-	-	1.0
1993	Caribou	98	74	74	79	79	672	82,169	903	228	30.7
	Bowhead Whale	97	37	5	76	97	3	76,906	845	213	28.7
	Broad Whitefish	90	66	66	65	66	12,193	41,455	456	115	15.5
	Arctic Cisco	89	69	68	81	60	45,237	31,666	348	88	11.8
	Ringed Seal	65	42	31	40	55	98	7,277	80	20	2.7
	Burbot	79	63	57	53	55	1,416	5,949	65	16	2.2
	Moose	69	47	10	29	63	9	4,403	48	12	1.6
	Arctic Grayling	79	69	65	44	27	4,515	4,063	45	11	1.5
	Least Cisco	63	52	47	36	27	6,553	3,277	36	9	1.2

Study Year	Resource*	Percent of Households					Estimated Harvest				Percent of Total Harvest
		Use	Try to Harvest	Harvest	Give	Receive	Number**	Total Pounds***	Average HH Pounds	Per Capita Pounds	
1994-95*****	Broad Whitefish	-	-	-	-	-	3,237	37,417	-	-	45.0
	Caribou	-	-	-	-	-	258	30,186	-	-	36.3
	Arctic Cisco	-	-	-	-	-	9,842	6,889	-	-	8.3
	Moose	-	-	-	-	-	5	2,500	-	-	3.0
	Geese Unidentified	-	-	-	-	-	474	2,133	-	-	2.6
	Ringed Seal	-	-	-	-	-	24	1,008	-	-	1.2
1995-96	Bowhead Whale	-	-	-	-	-	4	110,715	-	-	60.3
	Caribou	-	-	-	-	-	362	42,354	-	-	23.1
	Broad Whitefish	-	-	-	-	-	2,863	9,735	-	-	5.3
	Ringed Seal	-	-	-	-	-	155	6,527	-	-	3.6
	Arctic Cisco	-	-	-	-	-	5,030	3,521	-	-	1.9
	Bearded Seal	-	-	-	-	-	17	2,974	-	-	1.6
	Least Cisco	-	-	-	-	-	1,804	1,804	-	-	1.0
1999-00	Caribou	-	-	-	-	-	413	-	-	112	-
2000-01	Bowhead Whale	-	-	-	-	-	4	86220	-	-	47.1
	Caribou	-	-	-	-	-	496	57,985	-	-	31.6
	Arctic Cisco	-	-	-	-	-	18,222	12,755	-	-	7.0
	Broad Whitefish	-	-	-	-	-	2,968	10,092	-	-	5.5
	White-fronted Geese	-	-	-	-	-	787	3,543	-	-	1.9
	Moose	-	-	-	-	-	6	3,000	-	-	1.6
2002-03	Caribou	95	47	45	49	80	397	-	-	118	-
2003-04	Caribou	97	74	70	81	81	564	-	-	157	-
2004-05	Caribou	99	62	61	81	96	546	-	-	147	-
2005-06	Caribou	100	60	59	97	96	363	-	-	102	-
2006-07	Caribou	97	77	74	66	69	475	-	-	143	-
2010	Caribou	94	86	76	-	-	562	65,754	707	-	-
2011	Caribou	92	70	56	49	58	437	51,129	544	134	-
2012	Caribou	99	68	62	65	79	501	58,617	598	147	-
2013	Caribou	95	79	63	62	75	586	68,534	692	166	-
2014	Bowhead	93	29	21	57	91	5	148,087	1,371	357	39.8
	Caribou	90	66	64	67	59	774	105,193	974	253	28.3
	Broad Whitefish	72	60	59	52	40	11,439	36,605	339	88	9.8
	Arctic Cisco	83	52	48	59	53	46,277	32,394	300	78	8.7
	Bearded Seal	67	38	22	40	62	13,846	13,846	128	33	3.7
	Least Cisco	33	28	28	19	7	13,332	9,333	86	22	2.5
	Ringed Seal	52	40	35	38	33	108	6,156	57	15	1.7
2015	Caribou	96	84	78	74	72	628	73,527	728	180	-

Sources: 1985 (ADFG 2018); 1992 (Fuller and George 1999); 1993 (Pedersen 1995b); 1994-95 (Brower and Hepa 1998); 1995-96, 2000-01 (Bacon et al. 2009); 1999-00, 2002-2007 (Braem et al. 2011); 2010, 2011, 2012, 2013 (SRB&A 2012, 2013, 2014, 2015); 2014 (Brown et al. 2016); 2015 (SRB&A 2017b)

Notes:
*This table shows individual species unless they are not available for a given study year.
**Estimated numbers represent individuals in all cases except vegetation, where they represent gallons.
***Estimated pounds include only edible pounds and therefore do not include estimates for resources, such as furbearers, that are not typically eaten by community residents.
****The estimated pounds of moose harvested in 1992 is likely too high (Fuller and George 1999).

*****The 1994-95 study year underrepresents the harvest of Arctic cisco and humpback whitefish (Brower and Hepa 1998); Nuiqsut did not successfully harvest a bowhead whale in 1994-95.

For All Resources study years (1985, 1992, 1993, 1994-95, 1995-96, 2000-01), species are listed in descending order by percent of total harvest and are limited to species accounting for at least 1.0 percent of the total harvest; for single-resource study years, species are listed in descending order by total estimated pounds (or total number harvested, in the case of salmon study years) and are limited to the five top species. Years lacking percent of total harvest data were not comprehensive study years for all resources.
The estimated harvest numbers for the 1992, 1994-95, 1995-96 and 2000-01 data were derived by summing individual species in each resource category. Also, for those study years, total pounds were derived from conversion rates found at ADFG (2018). Total usable pounds for bowhead whales were calculated based on the method presented in SRB&A and ISER (1993). These estimates do not account for whale girth and should be considered approximate; more exact methods for estimating total whale weights are available in George et al., n.d. For the 2002-03, 2003-04, 2004-05, 2005-06, 2006-07, and 2010-11 study years, total pounds were derived from conversion rates from Braem, Kaleak, Koster, Leavitt, Neakok, Patkotak, Pedersen, and Simon 2011.

(*Stephen R. Braund & Associates 2018*)

M.2.2 Seasonal Round

Table M-9
Nuiqsut Annual Cycle of Subsistence Activities

Resources	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Freshwater Non-Salmon												
Marine Non-Salmon												
Salmon												
Caribou												
Moose												
Bear												
Muskox												
Furbearers												
Small Land Mammals												
Marine Mammals												
Upland Birds												
Waterfowl												
Eggs												
Plants and Berries												
Total Number of Resource Categories by Month	**6**	**5**	**6**	**7**	**9**	**10**	**10**	**12**	**11**	**10**	**8**	**8**

Sources: 1995-96, 2000-01 (Bacon et al. 2009); 2002-2007 (Braem et al. 2011); 1994-95 (Brower and Hepa 1998); Pre-1979 (Brown 1979); 2014 (Brown et al. 2016); 2004 (EDAW Inc. et al. 2008); 1992 (Fuller and George 1999); 2001-2012 (Galginaitis 2014); 1988 (Hoffman, Libbey, and Spearman 1988); 1979 (Libbey, Spearman, and Hoffman 1979); 1995-2006 (SRB&A 2010); 2008-2015 (SRB&A 2017b)

Limited activity and/or harvests Moderate activity and/or harvests High activity and/or harvests

M.2.3 Travel Method

Table M-10
Nuiqsut Travel Method to Subsistence Use Areas

Resources	Boat	Snowmachine	Foot	Car/Truck	ATV	Plane
Arctic Cisco and Burbot	3	5	2	4	0	0
Arctic Char and Dolly Varden and Broad Whitefish	5	4	3	0	0	0
Caribou	5	4	0	2	4	0
Moose	5	0	4	0	0	0
Wolf and Wolverine	4	5	0	0	0	4
Bowhead Whale	5	0	0	0	0	0
Seals	5	4	0	0	0	0
Geese	4	5	3	1	2	0
Eider	5	4	0	0	0	0
Total Number of Resources Targeted	**9**	**7**	**4**	**3**	**2**	**1**

Sources: 1995-2006 (SRB&A 2010), 2008-2015 (SRB&A 2017b).

Notes: For each resource, darker shades indicate greater use of that travel method; lighter shades indicate lesser use of a travel method. The shades have been given a value of 0 – 5, 0 being the lightest and 5 the darkest. Caribou based on SRB&A 2017; all others based on SRB&A 2010a.

M.2.4 Resource Importance

Table M-11
Material and Cultural Importance of Subsistence Resources, Nuiqsut

Resource Level	Resource	Cultural Importance: Percent of Households Trying to Harvest	Cultural Importance: Percent of Households Receiving	Material Importance: Percent of Total Harvest
Major Resources[2]	Arctic Cisco	61	57	8.8
	Arctic Grayling	50	24	1.0
	Bearded Seal	32	50	1.6
	Bowhead Whale[5]	30	96	30.4
	Broad Whitefish	69	49	15.5
	Burbot	51	35	1.0
	Caribou	73	75	29.9
	Cloudberry	55	29	0.0
	White Fronted Geese	62	36	1.4
	Wood	50	3.2	0.0
Moderate Resources[3]	Arctic Char	38	22	0.9
	Arctic Fox	14	1	0.0
	Beluga	2	24	0.0
	Bird Eggs	16	12	0.0
	Blueberries	29	16	0.0
	Brant	17	9	0.1
	Brown Bear	14	18	0.2
	Canada Geese	42	24	0.4
	Chum Salmon	23	11	0.6

Resource Level	Resource	Cultural Importance		Material Importance
		Percent of Households		Percent of Total Harvest
		Trying to Harvest	Receiving	
Moderate Resources[3] *(continued)*	Ground Squirrel	45	8	0.1
	Humpback Whitefish	26	9	1.0
	King Eider	24	19	0.0
	Least Cisco	40	17	1.1
	Long-Tailed Duck	8	13	0.0
	Moose	40	41	2.5
	Pink Salmon	28	17	0.4
	Polar Bear	7	29	0.2
	Ptarmigan	48	15	0.2
	Rainbow Smelt	13	22	0.1
	Red Fox	22	2	0.0
	Ringed Seal	36	43	1.6
	Snow Geese	19	7	0.0
	Spotted Seal	13	5	0.1
	Walrus	7	43	0.2
	Wolf	18	6	0.0
	Wolverine	22	5	0.0
Minor Resources[4]	Arctic Cod	7	7	0.0
	Chinook Salmon	2	9	0.0
	Coho Salmon	3	5	0.0
	Common Eider Duck	7	3	0.1
	Cranberries	9	5	0.0
	Crowberries	7	2	0.0
	Dall Sheep	-	9	0.0
	Dolly Varden	10	3	0.4
	Lake Trout	3	8	0.0
	Muskox	-	8	0.3
	Northern Pike	7	7	0.0
	Northern Pintail	5	1.6	0.0
	Round Whitefish	5	1	0.1
	Saffron Cod	7	-	0.0
	Sheefish	-	6	0.0
	Sockeye Salmon	3	6	0.0
	Sourdock	5	7	0.0
	Weasel	5	-	0.0

Sources: 1985 (ADFG 2018); 1992 (Fuller and George 1999); 1993 (Pedersen 1995b); 1994-95 (Brower and Hepa 1998); 1995-96, 2000-01 (Bacon et al. 2009); 1999-00, 2002-2007 (Braem et al. 2011); 2010, 2011, 2012, 2013 (SRB&A 2012, 2013, 2014, 2015); 2014 (Brown et al. 2016); 2015 (SRB&A 2017)

Notes:
[1]Resources that contributed an average of less than 1 percent of harvest, less than 5 percent attempting harvests, and less than 5 percent receiving harvests are categorized as minor and are not be shown.
[2]Major resources contribute > 9 percent total harvest, have ≥ 50 percent of households attempting harvest, or have ≥ 50 percent of households receiving resource.
[3]Moderate resources contribute 2 to 9 percent of total harvest, have 11 to 49 percent of households attempting harvest, or have 11 to 49 percent of households receiving resource.
[4]Minor resources contribute < 2 percent of total harvest, have ≤ 10 percent of households attempting harvest, or have ≤ 10 percent of households receiving resource.
[5]Averages include unsuccessful bowhead whale harvest years.

M.3 Arctic Village

M.3.1 Harvest Data

Table M-12
Arctic Village Subsistence Harvest Estimates by Resource Category, Non-Comprehensive Study Years

Study Year	Resource	Percent of Households: Use	Try to Harvest	Harvest	Give	Receive	Estimated Harvest: Number	Total Pounds	Average HH Pounds	Per Capita Pounds
2000	Migratory Birds	87	46	52	37	39	437	820	16	6
2001	Non-Salmon Fish	63	-	63	24	28	4,754	9,923	102	34
2002	Non-Salmon Fish	80	-	42	21	42	7,676	18,416	181	67

Sources: 2000 (Andersen and Jennings 2001); 2001-02, 2002-03 (Adams, Tanner, and Nelson 2005)

(Stephen R. Braund & Associates, 2018)

Table M-13
Arctic Village Subsistence Harvest Estimates by Selected Species, All Study Years

Study Year	Resource*	Percent of Households: Use	Try to Harvest	Harvest	Give	Receive	Estimated Harvest: Number**	Total Pounds***	Average HH Pounds	Per Capita Pounds	Percent of Total Harvest
2000	Scoter	-	-	-	-	-	187	370	7	3	-
	Scaup	-	-	-	-	-	71	118	2	1	-
	Long-tailed Duck (Oldsquaw)	-	-	-	-	-	67	100	2	1	-
	Mallard	-	-	-	-	-	49	95	2	1	-
	White-fronted Geese	-	-	-	-	-	10	43	1	<1	-
2001	Broad Whitefish	12	-	12	8	5	990	3,958	39	14	-
	Humpback Whitefish	17	-	17	10	7	1,685	3,538	38	12	-
	Grayling	47	-	47	13	20	1,257	1,257	13	4	-
	Northern Pike	18	-	18	7	5	187	562	6	2	-
	Lake Trout	9	-	9	2	0	212	212	4	1	-
2002	Humpback Whitefish	28		10	4	20	3,987	8,373	84	30	-
	Broad Whitefish	40		16	10	26	1,673	6,691	65	24	-
	Northern Pike	20		18	11	2	598	1,793	18	7	-
	Grayling	32		29	8	5	857	857	9	3	-
	Unknown Whitefish	2		1	0	1	188	328	3	1	-

Sources: 2000 (Andersen and Jennings 2001); 2001-02, 2002-03 (Adams et al. 2005)
Notes: For single-resource study years, species are listed in descending order by total estimated pounds and limited to the five top species. Years lacking percent of total harvest data were not comprehensive study years for all resources.

Notes:
*This table shows individual species unless they are not available for a given study year.
**Estimated numbers represent individuals in all cases except vegetation, where they represent gallons.
***Estimated pounds include only edible pounds and therefore do not include estimates for resources, such as furbearers, that are not typically eaten by community residents.

(*Stephen R. Braund & Associates, 2018*)

M.3.2 Seasonal Round

Table M-14
Arctic Village Annual Cycle of Subsistence Activities

Resources	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Fish												
Caribou												
Moose												
Sheep												
Furbearers												
Small Land Mammals												
Waterfowl												
Vegetation (Wood)												
Total Number of Resource Categories by Month	**5**	**5**	**6**	**3**	**4**	**3**	**3**	**6**	**6**	**5**	**7**	**6**

Sources: 1970-82 (Caulfield 1983); 2000 (Andersen and Jennings 2001)

Low to medium levels of activity; High levels of activity

M.3.3 Resource Importance

Data to calculate resources of importance for Arctic Village are not available. This is because there have been no comprehensive household harvest surveys conducted for that community; however, based on existing literature and statements from community members during scoping and elsewhere, the assumption is that caribou is a resource of primary subsistence, economic, cultural, and spiritual importance for the community of Arctic Village.

M.4 Venetie

M.4.1 Harvest Data

Table M-15
Venetie Subsistence Harvest Estimates by Resource Category, All Resources Study Years

Study Year	Resource	Percent of Households					Estimated Harvest				Percent of Total Harvest
		Use	Try to Harvest	Harvest	Give	Receive	Number*	Total Pounds**	Average HH Pounds	Per Capita Pounds	
2009	All Resources	99	86	81	-	-	13,344	74,602	794	274	100.0
	Salmon	76	37	26	-	-	2,742	20,775	221	76	27.8
	Non-Salmon Fish	81	67	63	-	-	6,348	6,745	72	25	9.0
	Large Land Mammals	94	63	33	-	-	159	36,977	393	136	49.6
	Small Land Mammals	56	44	43	-	-	1,632	3,126	33	12	4.2
	Marine Mammals	18	0	0	-	-	0	0	0	0	0.0
	Migratory Birds	79	57	55	-	-	2,134	5,501	59	20	7.4
	Upland Game Birds	20	31	16	-	-	119	119	1	0	0.2
	Vegetation	67	46	43	-	-	210	1,360	15	5	1.8

Source: 2009 (Kofinas et al. 2016)

(Stephen R. Braund & Associates, 2018)

Table M-16
Venetie Subsistence Harvest Estimates by Resource Category, Non-Comprehensive Study Years

Study Year	Resource	Percent of Households					Estimated Harvest			
		Use	Try to Harvest	Harvest	Give	Receive	Number	Total Pounds	Average HH Pounds	Per Capita Pounds
2000	Migratory Birds	-	-	68	-	-	2,077	3,306	94	25

Source: 2000 (Andersen and Jennings 2001)

(Stephen R. Braund & Associates, 2018)

Table M-17
Venetie Subsistence Harvest Estimates by Selected Species, All Study Years

Study Year	Resource*	Percent of Households: Use	Try to Harvest	Harvest	Give	Receive	Estimated Harvest: Number**	Total Pounds***	Average HH Pounds	Per Capita Pounds	Percent of Total Harvest
2000	Unknown Scoter	-	-	-	-	-	1,354	1,354	39	10	-
	White-fronted Geese	-	-	-	-	-	150	638	18	5	-
	Canada Geese	-	-	-	-	-	153	609	17	5	-
	Long-tailed Duck (Oldsquaw)	-	-	-	-	-	217	326	9	2	-
	Mallard	-	-	-	-	-	65	122	3	1	-
2008-09	Moose	95	51	32	68	92	22	12,060	-	80	-
	Caribou	98	18	18	65	92	16	2,135	-	14	-
	Black Bear	14	11	6	3	6	5	532	-	4	-
	Brown Bear	5	8	2	0	2	1	150	-	1	-
	Lynx	3	3	3	2	0	1	-	-	-	-
2009	Moose	93	61	30	60	87	40	21,476	229	79	28.8
	Caribou	86	23	14	49	85	105	14,230	151	52	19.1
	Chum Salmon	42	27	20	12	30	2,066	12,395	132	46	16.6
	Chinook Salmon	69	27	16	26	62	675	8,374	89	31	11.2
	Arctic Grayling	80	66	62	44	49	5,492	4,943	53	18	6.6
	Geese	68	45	37	36	56	969	3,142	33	12	4.2
	Whitefishes	41	13	8	12	40	853	1,791	19	7	2.4
	Beaver	26	15	14	14	15	65	1,298	14	5	1.7
	Snowshoe Hare	43	36	35	21	16	574	1,148	12	4	1.5
	Black Bear	19	17	8	6	12	10	886	9	3	1.2
2009-10	Moose	53	41	13	36	50	24	16,548	-	86	-
	Caribou	39	13	5	25	39	6	556	-	3	-
	Black Bear	8	5	5	2	5	4	417	-	2	-
	Brown Bear	3	2	2	2	2	1	196	-	1	-
	Lynx	3	3	3	2	2	86	-	-	-	-
2010-11	Moose	-	35	9	11	14	5	2,916	-	16	-
	Caribou	-	30	15	16	10	44	6,615	-	37	-
	Lynx	-	0	0	0	9	0	-	-	-	-
	Marten	-	0	0	0	4	0	-	-	-	-

Sources: 2000 (ADFG 2018); 2008-09, 2009-10 (Van Lanen, Stevens, Brown, Maracle, and Koster 2012); 2009 (Kofinas et al. 2016); 2010-11 (Stevens and Maracle n.d.)

Notes:
*This table shows individual species unless they are not available for a given study year.
**Estimated numbers represent individuals in all cases except vegetation, where they represent gallons.
***Estimated pounds include only edible pounds and therefore do not include estimates for resources, such as furbearers, that are not typically eaten by community residents.

For all resources study years (2009), species are listed in descending order by percent of total harvest and are limited to species accounting for at least 1.0 percent of the total harvest; for single resource study years, species are listed in descending order by total estimated pounds and are limited to the five top species. Years lacking percent of total harvest data were not comprehensive study years for all resources.

(*Stephen R. Braund & Associates, 2018*)

M.4.2 Seasonal Round

Table M-18
Venetie Annual Cycle of Subsistence Activities

Resources	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Fish												
Caribou												
Moose												
Bear												
Furbearers												
Small Land Mammals												
Waterfowl												
Berries												
Wood												
Total Number of Resource Categories by Month	**4**	**4**	**5**	**6**	**5**	**5**	**5**	**7**	**7**	**2**	**4**	**4**

Sources: 2000 (Andersen and Jennings 2001); 1970-82 (Caulfield 1983); Kofinas et al. 2016; 2008-09, 2009-10 (Van Lanen et al. 2012); 2010-11 (Stevens and Maracle, n.d.)

Low to medium levels of activity; High levels of activity

M.4.3 Resource Importance

Table M-19
Material and Cultural Importance of Subsistence Resources, Venetie

Resource Level	Resource	Cultural Importance: Percent of Households: Trying to Harvest	Cultural Importance: Percent of Households: Receive	Material Importance: Percent of Total Harvest
Major Resources	Arctic Grayling	66	49	6.6
	Caribou	21	56	19.1
	Chinook Salmon	27	62	11.2
	Chum Salmon	27	30	16.6
	Moose	47	61	28.8
Moderate Resources	Bearded Seal	0	15	-
	Beaver	15	15	1.7
	Black Bear	11	8	1.2
	Blueberry	41	49	0.9
	Bowhead	0	15	-
	Low Bush Cranberry	35	30	0.8
	Muskrat	11	10	0.5
	Other Birds	31	8	0.2
	Parka Squirrel (Ground)	10	12	0.2
	Ptarmigan	27	8	0.1
	Snowshoe Hare	18	8	1.5
	Whitefishes	13	40	2.4
Minor Resources	Beluga	0	6	-
	Brown Bear	6	1	0.5
	Grouse	7	2	-

Sources: 2000 (ADFG 2018); 2008-09, 2009-10 (Van Lanen et al. 2012); 2009 (Kofinas et al. 2016); 2010-11 (Stevens and Maracle n.d.)

Notes:
[1]Resources that contributed an average of less than 1 percent of harvest, less than 5 percent attempting harvests, and less than 5 percent receiving harvests are categorized as minor and are not be shown.
[2]Major resources contribute > 9 percent total harvest, have ≥ 50 percent of households attempting harvest, or have ≥ 50 percent of households receiving resource.
[3]Moderate resources contribute 2 to 9 percent of total harvest, have 11 to 49 percent of households attempting harvest, or have 11 to 49 percent of households receiving resource.
[4]Minor resources contribute < 2 percent of total harvest, have ≤ 10 percent of households attempting harvest, or have ≤ 10 percent of households receiving resource.

M.5 Caribou Study Communities

Table M-20
Caribou Harvest Data for All Available Study Years, Caribou Study Communities

Community	Study Year	Percent of Households (HH)					Estimated Harvest				Percent of Total Harvest
		Using	Trying to Harvest	Harvesting	Giving	Receiving	Total Number	Total Pounds	Average HH Lbs	Per Capita Lbs	
Alatna	1997-98	73	46	36	36	46	21	2,730	248	109	-
	1998-99	100	90	60	50	60	11	1,430	143	53	-
	1999-00	100	57	0	0	100	0	-	0	0	-
	2001-02	27	0	0	0	27	0	-	0	0	-
	2002-03	100	67	67	50	83	34	4,420	368	123	-
	2011	100	83	67	67	100	28	3,705	412	118	39.3
	Average	***83***	***57***	***38***	***34***	***69***	***16***	***2,048***	***195***	***67***	***39.3***
Allakaket	1997-98	42	15	6	10	39	11	1,375	25	8	-
	1998-99	100	55	26	20	86	43	5,623	92	29	-
	1999-00	93	34	12	15	86	13	1,719	29	10	-
	2001-02	21	7	7	3	15	9	1,170	19	7	-
	2002-03	96	68	44	32	68	106	13,728	312	53	-
	2011	76	48	33	48	62	95	12,350	217	84	-
	Average	***72***	***38***	***21***	***21***	***59***	***46***	***5,994***	***116***	***32***	**-**
Arctic Village	***No Comparable Caribou Harvest Data***										
Anaktuvuk Pass	1990-91	-	-	55	-	-	592	69,964	985	223	-
	1991-92	-	-	51	-	-	545	66,712	940	245	-
	1992	-	74	-	-	-	600	70,222	889	260	82.6
	1993-94	-	-	43	-	-	574	67,713	846	219	-
	1994-95	-	-	-	-	-	322	43,792	-	-	83.2
	1996-97	-	-	-	-	-	210	28,587	-	-	90.0
	1998-99	-	-	-	-	-	500	68,000	-	-	89.5
	1999-00	-	-	-	-	-	329	44,744	-	-	75.2
	2006-07	92	61	53	47	63	696	81,490	1,000	299	-
	2011	95	63	53	52	73	616	77,706	914	251	79.2
	2002-03	-	-	-	-	-	436	59,310	-	-	91.5
	2001-02	-	-	-	-	-	271	36,910	-	-	75.6
	2000-01	-	-	-	-	-	732	99,579	-	-	89.1
	Average	***94***	***66***	***51***	***50***	***68***	***494***	***62,671***	***929***	***250***	***84.0***

Community	Study Year	Percent of Households (HH)					Estimated Harvest				Percent of Total Harvest
		Using	Trying to Harvest	Harvesting	Giving	Receiving	Total Number	Total Pounds	Average HH Lbs	Per Capita Lbs	
Atqasuk	1996-97	-	-	-	-	-	398	-	-	-	-
	2003	93	66	61	66	66	-	-	-	-	-
	2004	100	79	79	69	74	-	-	-	-	-
	2005	96	70	59	74	63	-	-	-	-	-
	2006	95	67	60	76	57	-	-	-	-	-
	Average	***96***	***70***	***65***	***71***	***65***	***398***	-	-	-	-
Beaver	1985	-	3	0	0	0	0	-	0	0	0.0
	2010-11	-	-	-	-	-	5	650	-	-	-
	2011	0	0	0	0	0	0	-	0	0	0
	Average	***0***	***0***	***0***	***0***	***0***	***0***	-	***0***	***0***	***0***
Bettles	1981-82	-	-	15	-	5	14	1,788	72	28	10.6
	1983	-	-	10	-	-	5	644	25	8	4.4
	1984	-	-	6	-	-	3	451	12	5	4.4
	1997-98	14	29	0	14	14	0	-	0	0	-
	1998-99	60	40	40	60	20	25	3,276	364	107	-
	1999-00	67	44	44	33	33	21	2,773	173	52	-
	2002-03	58	8	0	12	58	0	-	0	0	-
	2011	63	25	25	25	50	6	780	98	65	37.1
	Average	***52***	***29***	***18***	***29***	***30***	***9***	***1,214***	***93***	***33***	***14.1***
Birch Creek	2008-09	25	0	0	25	25	0	-	0	0	-
	2009-10	40	7	0	33	40	0	-	0	0	-
	2010-11	-	0	0	0	8	0	-	0	0	-
	Average	***33***	***2***	***0***	***19***	***24***	***0***	-	***0***	***0***	***0.0***
Chalkyitsik	2008-09	0	0	0	0	0	0	-	0	0	0
	2009-10	0	0	0	0	0	0	-	0	0	0
	2010-11	0	0	0	0	0	0	-	0	0	0
	Average	***0***	***0***	***0***	***0***	***0***	***0***	-	***0***	***0***	***0***
Circle	2008-09	85	23	3	5	83	1	130	-	1.3	-
	2009-10	7	7	7	0	7	4	400	-	5.9	-
	2010-11	-	0	0	0	0	0	-	-	0	-
	Average	***46***	***10***	***3***	***2***	***30***	***2***	***177***	-	***2.4***	-
Coldfoot	***2011***	***75***	***50***	***25***	***50***	***50***	***2***	***325***	***65***	***33***	***85.3***
Eagle	***2004***	***61***	***61***	***14***	***15***	***52***	***19***	***1,957***	***28.8***	***15.2***	***15.7***

Community	Study Year	Percent of Households (HH)					Estimated Harvest				Percent of Total Harvest
		Using	Trying to Harvest	Harvesting	Giving	Receiving	Total Number	Total Pounds	Average HH Lbs	Per Capita Lbs	
Evansville	1981-82	-	-	15	-	5	14	1,788	72	28	10.6
	1983	-	-	10	-	-	5	644	25	8	4.4
	1984	-	-	6	-	-	3	451	12	5	4.4
	1997	50	14	7	21	50	3	334	19	8	-
	1998	67	25	17	8	58	4	455	33	16	-
	1999	67	25	17	17	50	2	282	22	10	-
	2002-03	58	8	0	12	58	0	-	0	0	-
	2011	77			25	77	-	-	-	-	0.0
	Average	***64***	***18***	***10***	***17***	***50***	***4***	***565***	***26***	***11***	***4.9***
Fort Yukon	1986-87	73	13	9	10	64	156	15,587	74	25	2.5
	2008-09	12	2	1	13	3	3	355	-	1	-
	2009-10	20	10	9	8	18	35	3,518	-	8	-
	Average	***35***	***8***	***6***	***10***	***28***	***65***	***6,487***	***74***	***11***	***2.5***
Kaktovik	1981-82	-	-	-	-	-	43	-	-	-	-
	1982-83	-	-	-	-	-	160	-	-	-	-
	1983-84	-	-	-	-	-	107	-	-	-	-
	1985-86	-	-	-	-	-	235	-	-	-	-
	1985	95	76	69	67	86	235	27,941	527	149	45.3
	1986	98	66	60	53	94	178	21,188	378	109	25.2
	1986-87	-	-	-	-	-	201	-	-	-	-
	1987-88	-	-	55	-	-	185	22,229	383	104	-
	1990	-	-	48	-	-	113	13,453	224	67	-
	1991	-	-	50	-	-	181	22,113	369	94	-
	1992a	96	70	55	53	75	158	19,136	304	99	11.2
	1992b	-	66	-	-	-	136	15,926	-	-	8.8
	1994-95	-	-	-	-	-	78	10,608	-	-	8.4
	2002-03	-	-	-	-	-	112	15,232	-	-	14.5
	2010-11	94	53	46	51	93	429	58,305	686	203	28.7
	Average	***96***	***66***	***55***	***56***	***87***	***170***	***22,613***	***410***	***118***	***20.3***

Community	Study Year	Percent of Households (HH)					Estimated Harvest				Percent of Total Harvest
		Using	Trying to Harvest	Harvesting	Giving	Receiving	Total Number	Total Pounds	Average HH Lbs	Per Capita Lbs	
Nuiqsut	1985	98	90	90	80	60	513	60,021	790	150	37.5
	1992	-	81	-	-	-	278	32,551	-	-	21.7
	1993	98	74	74	79	79	672	82,169	903	228	30.7
	1994-95	-	-	-	-	-	258	30,186	-	-	36.3
	1995-96	-	-	-	-	-	362	42,354	-	-	23.1
	1999-00	-	-	-	-	-	413	-	-	112	-
	2000-01	-	-	-	-	-	496	57,985	-	-	31.6
	2002-03	95	79	63	62	75	586	68,534	692	166	-
	2003-04	99	68	62	65	79	501	58,617	598	147	-
	2004-05	92	70	56	49	58	437	51,129	544	134	-
	2005-06	94	86	76	-	-	562	65,754	707	-	-
	2006-07	97	77	74	66	69	475	-	-	143	-
	2010	100	60	59	97	96	363	-	-	102	-
	2011	99	62	61	81	96	546	-	-	147	-
	2012	97	74	70	81	81	564	-	-	157	-
	2013	95	47	45	49	80	397	-	-	118	-
	2014	90	66	64	67	59	774	105,193	974	253	28.3
	2015	96	84	78	74	72	628	73,527	728	180	-
	Average	***96***	***73***	***67***	***71***	***75***	***490***	***60,668***	***742***	***157***	***29.9***
Point Lay	1987	94	72	72	63	73	157	18,418	428	153	17.2
	2012	93	64	60	71	76	356	48,380	705	186	31.3
	Average	***94***	***68***	***66***	***67***	***75***	***256***	***33,399***	***567***	***169***	***24.2***
Stevens Village	2009-10	5	0	0	5	5	0	-	-	0	-
	2008-09	-	0	0	0	10	0	-	-	0	-
	Average	***5***	***0***	***0***	***3***	***8***	***0***	***-***	***-***	***0***	***-***

Community	Study Year	Percent of Households (HH)					Estimated Harvest				Percent of Total Harvest
		Using	Trying to Harvest	Harvesting	Giving	Receiving	Total Number	Total Pounds	Average HH Lbs	Per Capita Lbs	
Utqiaġvik	1987	-	-	26	-	-	1,595	186,669	199	62	30.1
	1988	-	-	27	-	-	1,533	179,314	191	59	29.2
	1989	-	-	39	-	-	1,656	193,744	207	64	22.2
	1992	-	46	-	-	-	1,993	233,206	-	-	17.1
	1995-96	-	-	-	-	-	2,155	293,094	-	-	24.5
	1996-97	-	-	-	-	-	1,158	157,420	-	-	13.3
	2000	-	-	-	-	-	3,359	456,851	-	-	29.3
	2001	-	-	-	-	-	1,820	247,520	-	-	22.9
	2002-03	92	61	55	80	78	5,641	659,997	-	123	-
	2003	-	-	-	-	-	2,092	284,444	-	-	22.8
	2003-04	87	52	45	73	69	3,548	415,116	-	82	-
	2004-05	85	51	48	62	64	4,338	507,546	-	94	-
	2005-06	90	50	47	81	78	4,535	530,595	-	103	-
	2006-07	92	65	59	65	70	5,380	629,460	-	111	-
	2014	70	38	33	38	52	4,323	587,897	371	111	30.6
	Average	***86***	***52***	***42***	***67***	***68***	***3008***	***370,858***	***242***	***90***	***24.2***
Venetie	2008-09	98	18	18	65	92	16	2,135	-	14	-
	2009	86	23	14	49	85	105	14,230	151	52	19.1
	2009-10	39	13	5	25	39	6	556	-	3	-
	2010-11	-	30	15	16	10	44	6,615	-	37	-
	Average	***74***	***21***	***13***	***39***	***56***	***43***	***5,884***	***151***	***26***	***19.1***
Wainwright	1988	-	-	57	-	-	505	59,085	476.49	117	23.0
	1989	-	-	66	-	-	711	83,187	699.05	177.75	23.7
	2009	97	64	61	62	84	1,231	167,356	1,073	284	41.7
	Average	***97***	***64***	***61***	***62***	***84***	***816***	***103,209***	***749***	***193***	***29.5***
Wiseman	1991	-	-	-	-	-	10	1,260	-	-	28.2
	2011	80	80	60	60	20	4	520	104	40	13.6
	Average	***80***	***80***	***60***	***60***	***20***	***7***	***890***	***104***	***40***	***20.9***

Source: ADFG 2018

Table M-21
Total Annual Harvest Summary of Porcupine Caribou as Reported at Annual Harvest Meetings of the Porcupine Caribou Management Board, 2010/11 through 2015/16

Canadian User Group	PCH Harvest						
	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	6 Year Total
Inuvialuit (NWT)[1]	121	294	176	368	123	345	1,427
NWT Gwich'in[2]	1,197	939	615	1,936	451	2,558	7,696
Vuntut Gwichin[3]	265	511	403	473	114	148	1,914
Tr'ondek Hwech'in[4]	1	3	1	2	0	12	19
Nacho Nayak Dun[5]	0	0	0	3	0	5	8
Yukon licensed[6]	38	13	8	81	3	232	375
NWT licensed[7]	98	90	80	57	58	67	450
Total (all user groups)	1,720	1,850	1,283	2,920	749	3,367	11,889

Sources: Porcupine Caribou Management Board 2018

Notes: The data provided above is a summary of data collected by each user group and submitted to the Porcupine Caribou Management Board annually. The methods of data collection and reporting vary by user group and reflect a combination of reported and estimated harvests.

[1]Including Inuvialuit in and around Aklavik, Inuvik, and Tuktoyaktuk. Estimated harvest.
[2]Including Gwich'in in and around Aklavik, Inuvik, Fort McPherson, and Tsiigehtchic. Minimum count harvest.
[3]Including First Nation Members in and around Old Crow. Minimum count harvest.
[4]Including First Nation Members in and around Dawson City. Minimum count harvest.
[5]Including First Nation Members in and around Mayo. Minimum count harvest.
[6]Including licensed hunters in the Yukon Territory. Mandatory kill reporting, total count.
[7]Including licensed hunters in the Northwest Territory. Maximum number of caribou harvested based on license sales.

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Appendix N
Environmental Justice

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Appendix N. Environmental Justice

Table N-1
Low-Income Populations of Kaktovik, Nuiqsut, Arctic Village, and Venetie, Compared with the North Slope Borough (NSB) and the State of Alaska: 2016

Demographic/Income Characteristic	Kaktovik	Nuiqsut	Arctic Village	Venetie	NSB	State of Alaska
Total population*	262	446	192	181	9,606	747,894
Persons employed	62	130	37	39	5,393	353,954
Unemployment rate (percent)	18.4	19.8	35.1	29.1	10.0	7.8
Per capita income	$21,925	$24,312	$15,253	$12,695	$49,982	$34,191
Median household income	$53,750	$84,464	$25,000	$27,813	$72,027	$74,444
Median family income	$66,250	$74,750	$28,750	$24,583	$77,330	$87,365
Percent low-income**	3.8	6.4	46.7	53.2	11.2	10.1

Source: US Census Bureau. 2016. "ACS 2012-2016 5-Year, DP03" unless otherwise noted.
https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_14_5YR_DP03&prodType=table

*Total population figures shown for the individual communities are 2017 Alaska Department of Commerce, Community, and Economic Development Certified Population figures (https://www.commerce.alaska.gov/dcra/dcraexternal/community/); NSB and Alaska population census estimates for 2016.
** Defined as those persons living below the poverty threshold.

Table N-2
Minority Populations of Kaktovik, Nuiqsut, Arctic Village, and Venetie, Compared with the NSB and the State of Alaska: 2010

Demographic Characteristic		Kaktovik		Nuiqsut		Arctic Village		Venetie		NSB		State of Alaska	
		Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Race	White	24	10.0	40	10.0	7	4.6	3	1.8	3,059	32.4	455,320	64.1
	Black	0	0.0	1	0.2	0	0.0	0	0.0	91	1.0	21,949	3.1
	American Indian/Alaska Native	212	88.7	350	87.1	135	88.8	152	91.6	5,046	53.5	102,556	14.4
	Asian	0	0.0	0	0.0	0	0.0	1	0.6	414	4.4	37,459	5.3
	Pacific Islander	0	0.0	0	0.0	0	0.0	0	0.0	103	1.1	7,219	1.0
	Other	0	0.0	0	0.0	0	0.0	0	0.0	7	0.1	1,111	0.2
	Two or more races	3	1.3	11	2.7	10	6.6	10	6.0	461	4.9	45,368	6.4
Ethnicity	Hispanic or Latino	0	0.0	0	0.0	0	0.0	3	1.8	249	2.6	39,249	5.5
	Non-Hispanic or Latino	239	100.0	402	100.0	152	100.0	163	98.2	9,181	97.4	670,982	94.5
Minority status	Total minority population	215	90.0	362	90.0	145	95.4	163	98.2	6,371	67.6	254,911	35.9
	Total non-minority population	24	10.0	40	10.0	7	4.6	3	1.8	3,059	32.4	455,320	64.1
Total Population		**239**	**100.0**	**402**	**100.0**	**152**	**100.0**	**166**	**100.0**	**9,430**	**100.0**	**710,231**	**100.0**

Source: United States Census Bureau 2010

American Fact Finder.https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=DEC_10_PL_P2&prodType=table; 2010 Census Redistricting Data (Public Law 94-171) Summary File: Hispanic or Latino, and Not Hispanic or Latino by Race.

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Appendix O

Economy

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Appendix O. Economy

Table O-1
Populations of the Potentially Affected Communities and Areas, 2010 to 2017

Area	2010	2011	2012	2013	2014	2015	2016	2017	Percent Change
Communities									
Anaktuvuk Pass	324	323	343	358	325	357	355	355	10
Atqasuk	233	243	234	248	230	243	221	224	-4
Utqiaġvik	4,212	4,314	4,434	4,504	4,481	4,548	4,468	4,474	6
Kaktovik	239	247	244	262	251	243	244	234	-2
Nuiqsut	402	426	427	452	446	450	470	482	20
Point Hope	674	668	667	683	654	680	672	677	0
Point Lay	189	183	196	215	190	211	213	232	23
Wainwright	556	570	564	541	554	554	557	570	3
Venetie	166	186	180	197	187	189	192	181	9
Arctic Village	152	167	177	175	194	180	180	192	26
North Slope Borough	9,430	9,575	9,710	9,864	9,732	9,887	9,801	9,849	4
Alaska	710,231	722,388	731,042	735,776	736,906	737,467	739,709	737,080	4

Source: (Alaska Department of Labor and Workforce Development [ADOWLD] 2018a

Table O-2
Employment and Total Wages in Potentially Affected Communities

Area	Residents Employed		Employment Sector			Total Wages
	#	%	Private	Local	State	
Kaktovik	125	71	41	84	0	$4,958,179
Anaktuvuk Pass	150	68	35	115	0	$4,075,079
Atqasuk	112	76	19	93	0	$3,535,983
Nuiqsut	193	75	73	120	0	$5,919,157
Point Hope	301	67	117	183	1	$8,023,956
Point Lay	106	77	15	91	0	$3,479,948
Wainwright	219	63	72	147	0	$6,659,365
Utqiagvik	2,044	71	875	1,155	14	$111,007,143
Arctic Village	87	78	14	70	3	$1,302,019
Venetie	103	57	23	80	0	$1,643,639

Source: ADOLWD 2018b

Table O-3
Kaktovik Resident Employment by Industry and Worker Characteristics, 2016

Industry	Number of Workers	Percent of Total Employed	Female	Male	Age 45 and Over	Age 50 and Over
Natural Resources and Mining	1	0.8	0	1	0	0
Construction	15	12.0	0	15	5	4
Trade, Transportation and Utilities	3	2.4	0	3	1	1
Financial Activities	13	10.4	5	8	7	5
Professional and Business Services	3	2.4	1	2	3	1
Leisure and Hospitality	4	3.2	4	0	2	2
Local Government	84	67.2	47	37	34	26
Other	2	1.6	0	2	0	0

Source: ADOLWD 2018c

Table O-4
City of Kaktovik Fiscal Year 2018 Budget

Source of Revenues	Amount
Locally Generated Revenues	**$1,117,380**
Tax Revenues	$48,000
Service Charges	$22,210
Enterprise Revenues	$840,759
Rentals	$45,000
Leases	$126,411
Sales	$27,000
Other Local Revenues	$8,000
State of Alaska Revenues	**$69,066**
Other Outside Revenues	**$277,457**
Total Operating Revenues	**$1,463,904**

Uses of Funds (Expenditures)	Amount
Administration and Finance	$302,777
Council	$13,111
Pull Tabs	$644,517
Bingo	$162,028
Recreation	$34,014
ASRC Summer Youth Program	$10,000
Others	$297,457
Total Operating Expenditures	**$1,463,903**

Source: Alaska Department of Commerce, Community, and Economic Development [ADCCED] 2018

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