



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

Willow Master Development Plan

Environmental Impact Statement

FINAL

Volume 2: Appendix A.1

Figures 1.4.1 - 3.13.6

August 2020

Prepared by:

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

In Cooperation with:

U.S. Army Corps of Engineers
U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service
Native Village of Nuiqsut
Iñupiat Community of the Arctic Slope
City of Nuiqsut
North Slope Borough
State of Alaska

**Estimated Total Costs Associated
with Developing and Producing this
EIS: \$6,668,400**



Mission

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

Cover Photo Illustration: Caribou in the Alpine Development on Alaska's North Slope.

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BLM/AK/PL-19/012+1610+F010

Willow Master Development Plan

Appendix A.1

Figures 1.4.1 - 3.13.6

August 2020

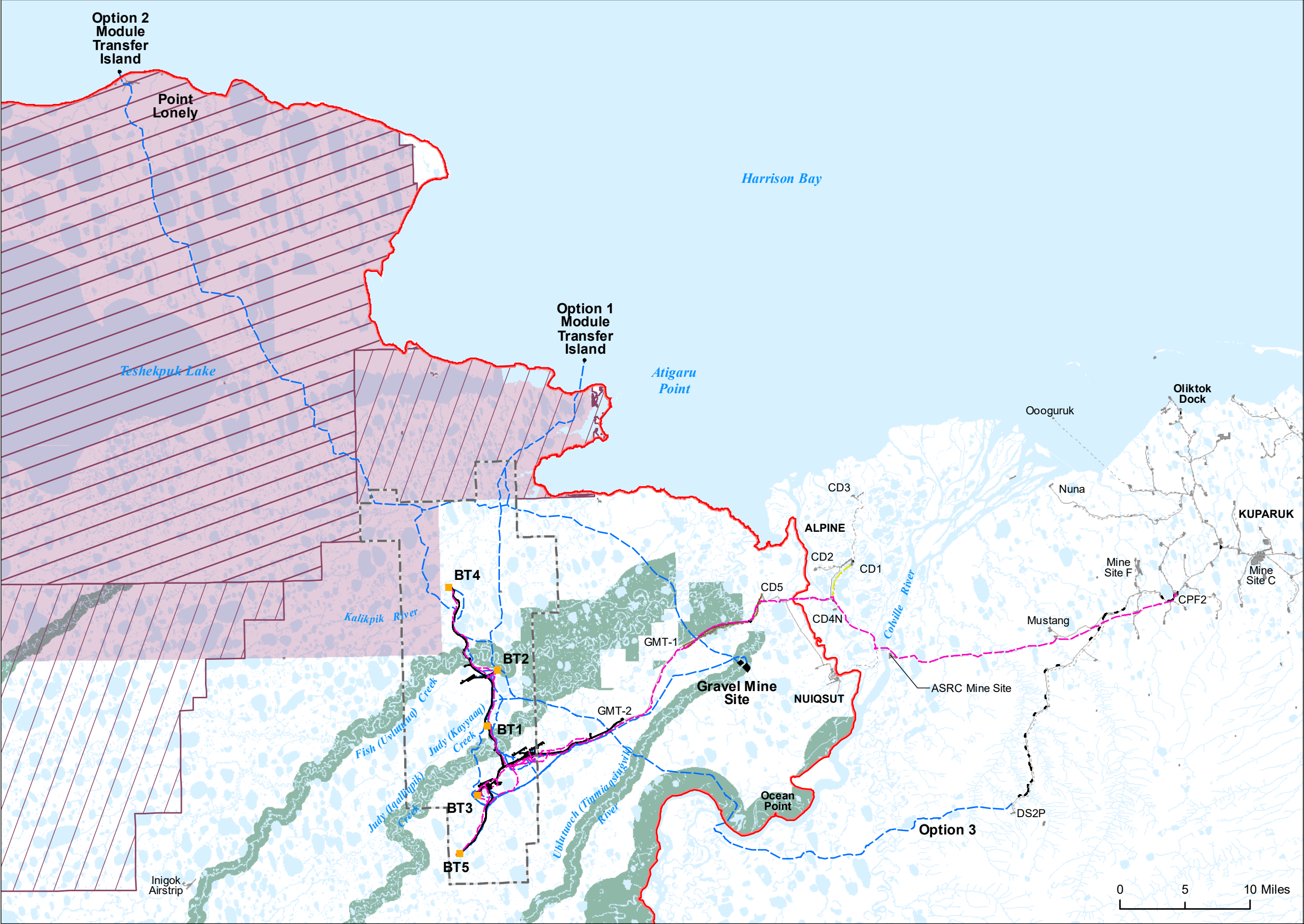
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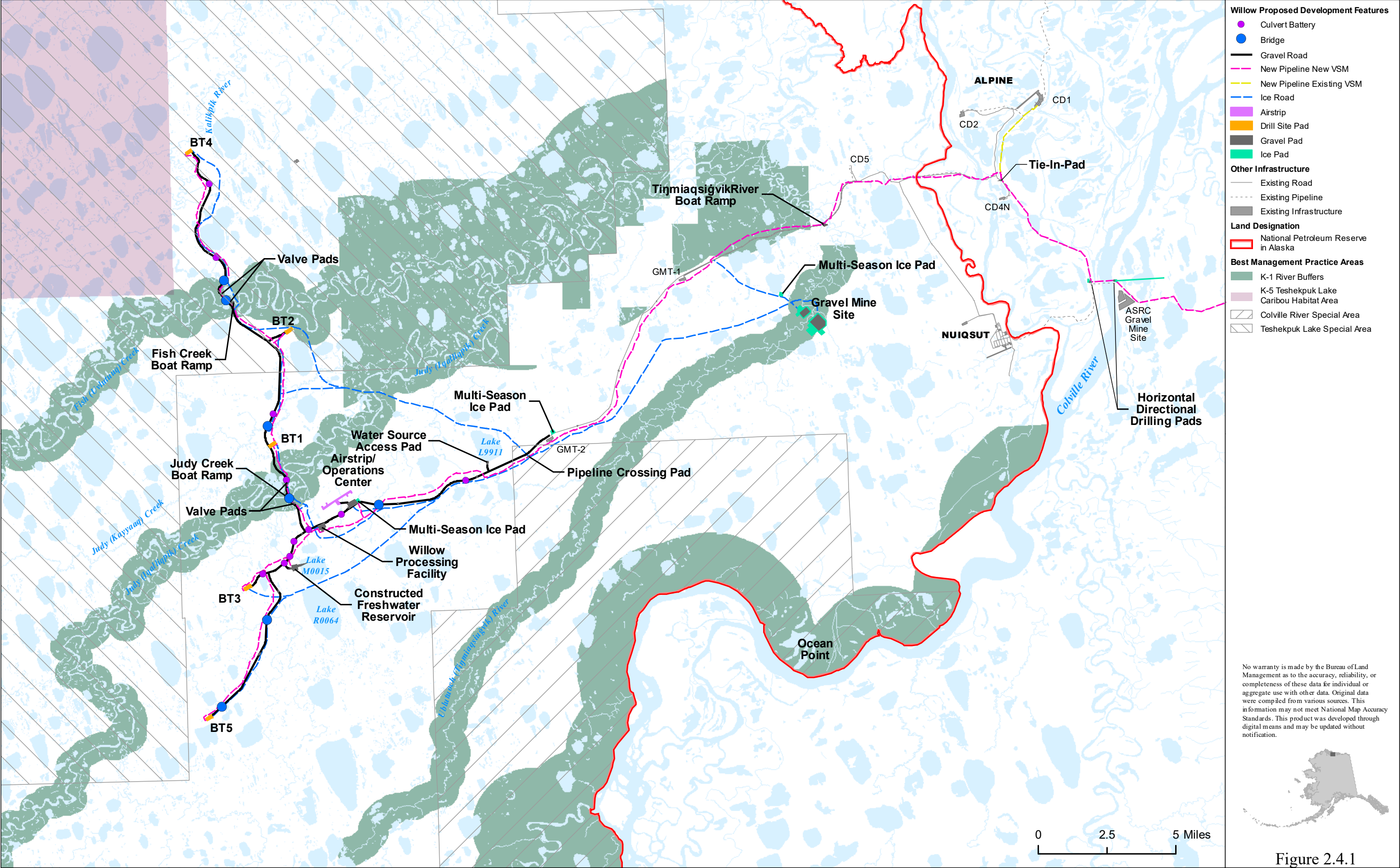


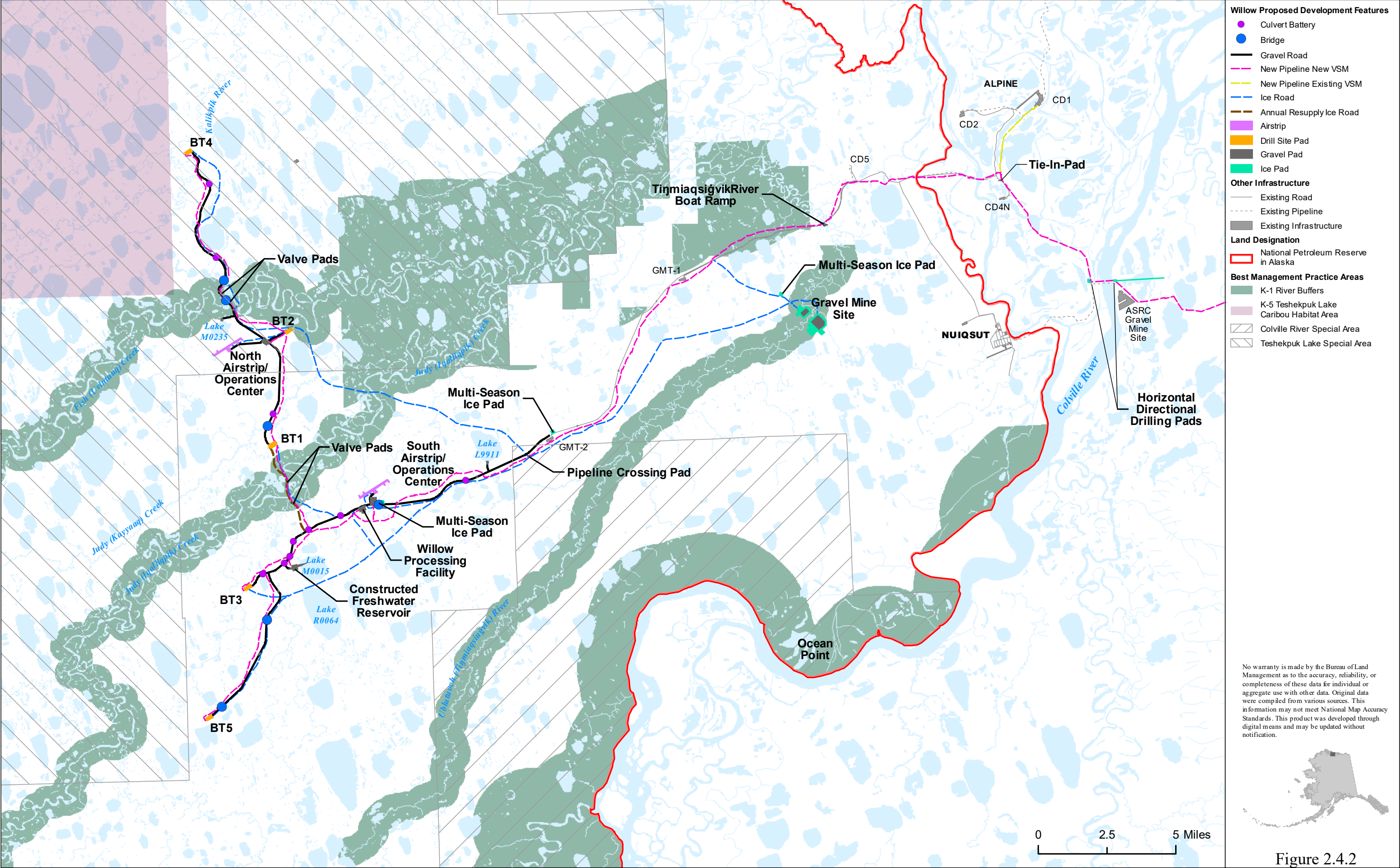
- Willow Proposed Development Features**
- Drill Site (Not to Scale)
 - Ice Road
 - New Pipeline Existing VSM
 - New Pipeline New VSM
 - Gravel Footprint
- Other Infrastructure**
- Existing Road
 - Existing Pipeline
 - Existing Infrastructure
- Best Management Practice Areas**
- K-1 River Buffers
 - K-5 Teshekpuk Lake Caribou Habitat Area
- Land Designation**
- National Petroleum Reserve in Alaska
- Oil & Gas Legend**
- Unavailable to Leasing
 - Unavailable to Leasing and no new non-subsistence infrastructure
- Oil and Gas Lease Unit**
- Bear Tooth

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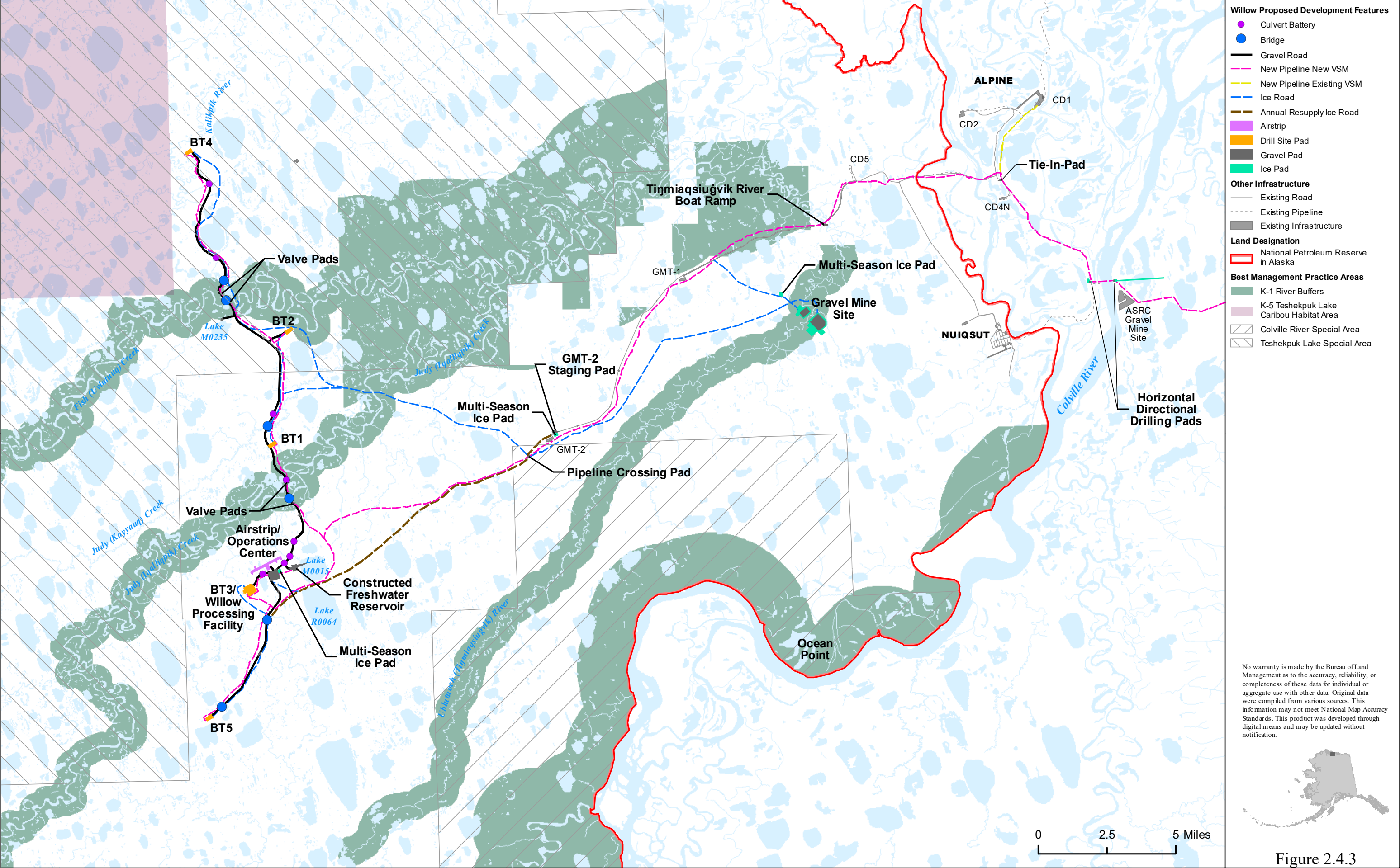




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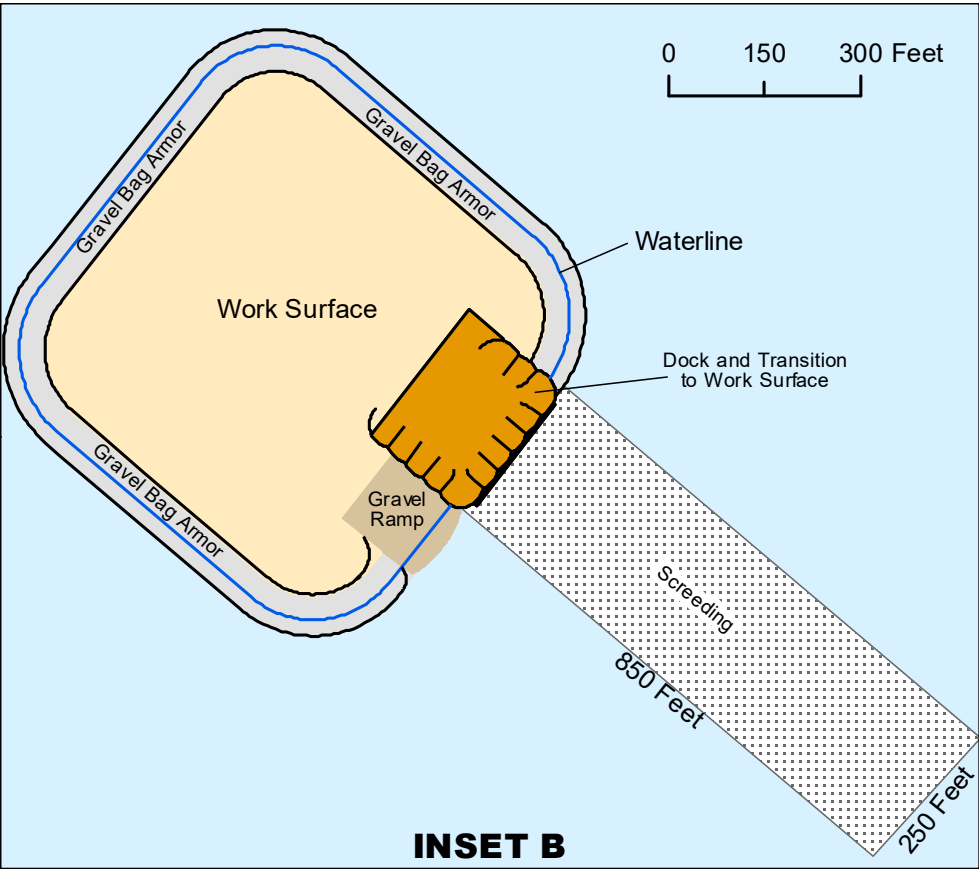
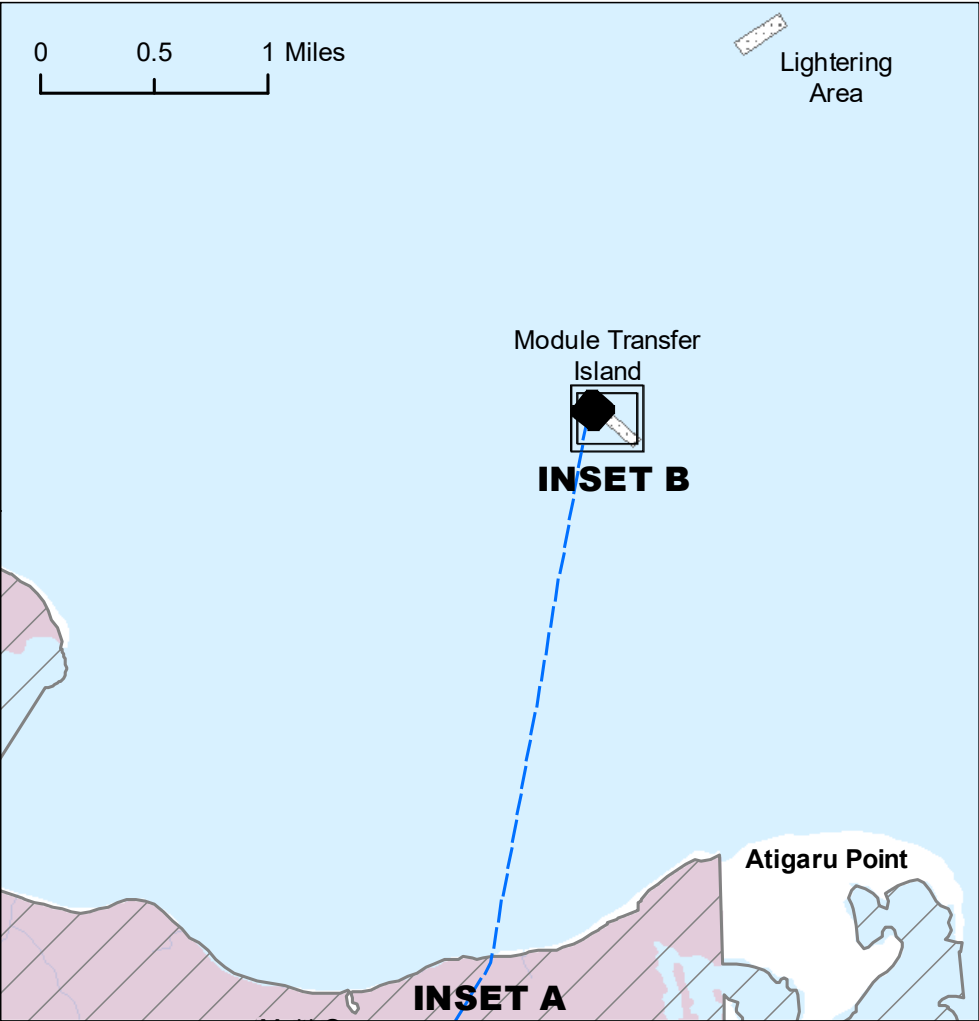
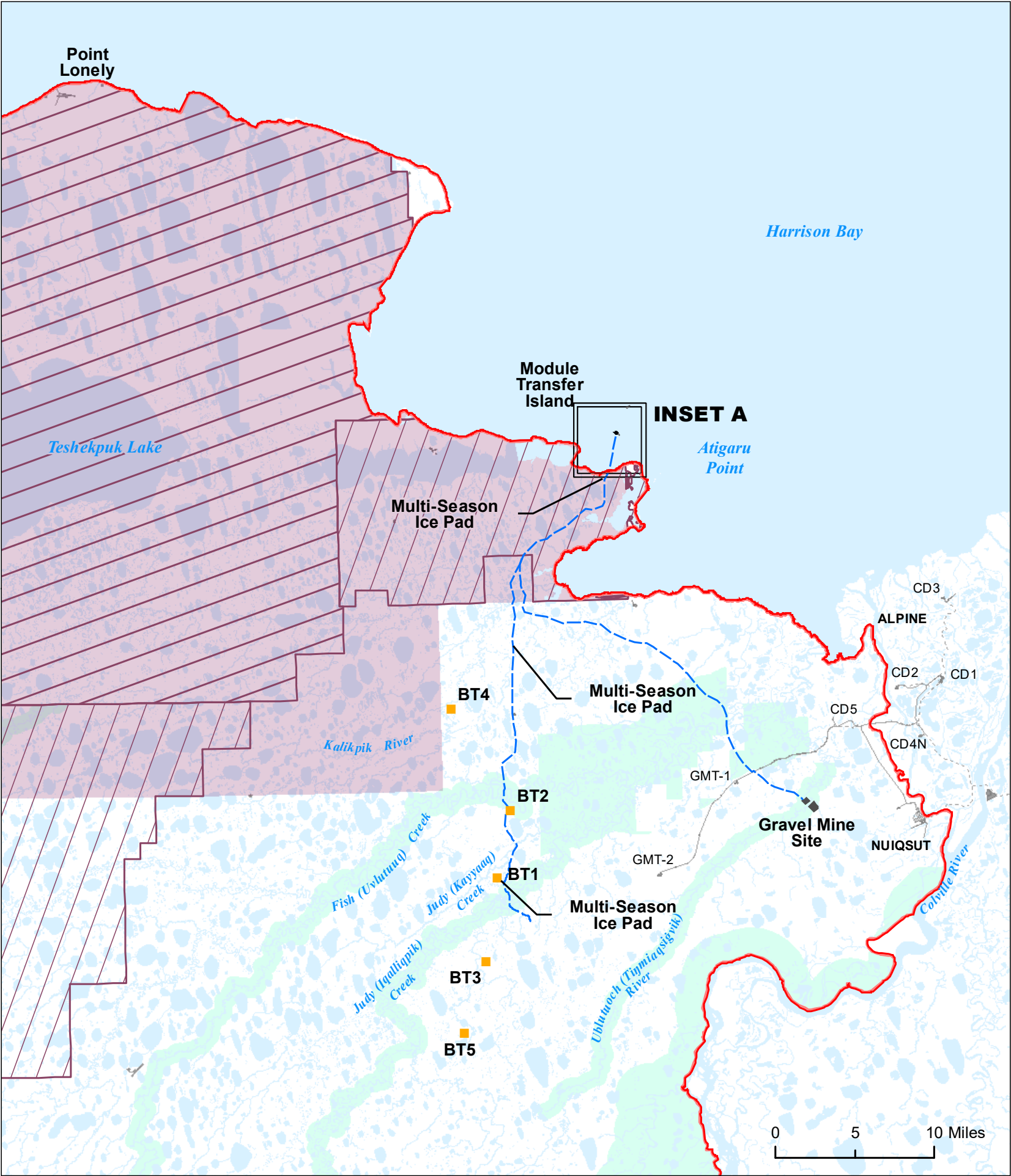
Figure 2.4.2



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Figure 2.4.3



Willow Proposed Development Features

- Drill Site (Not to Scale)
- Ice Road
- Module Transfer Island
- Gravel Mine Site
- Screeding
- Ice Pad

Other Infrastructure

- Existing Road
- Existing Pipeline
- Existing Infrastructure

Land Designation

- National Petroleum Reserve in Alaska

Best Management Practice Areas

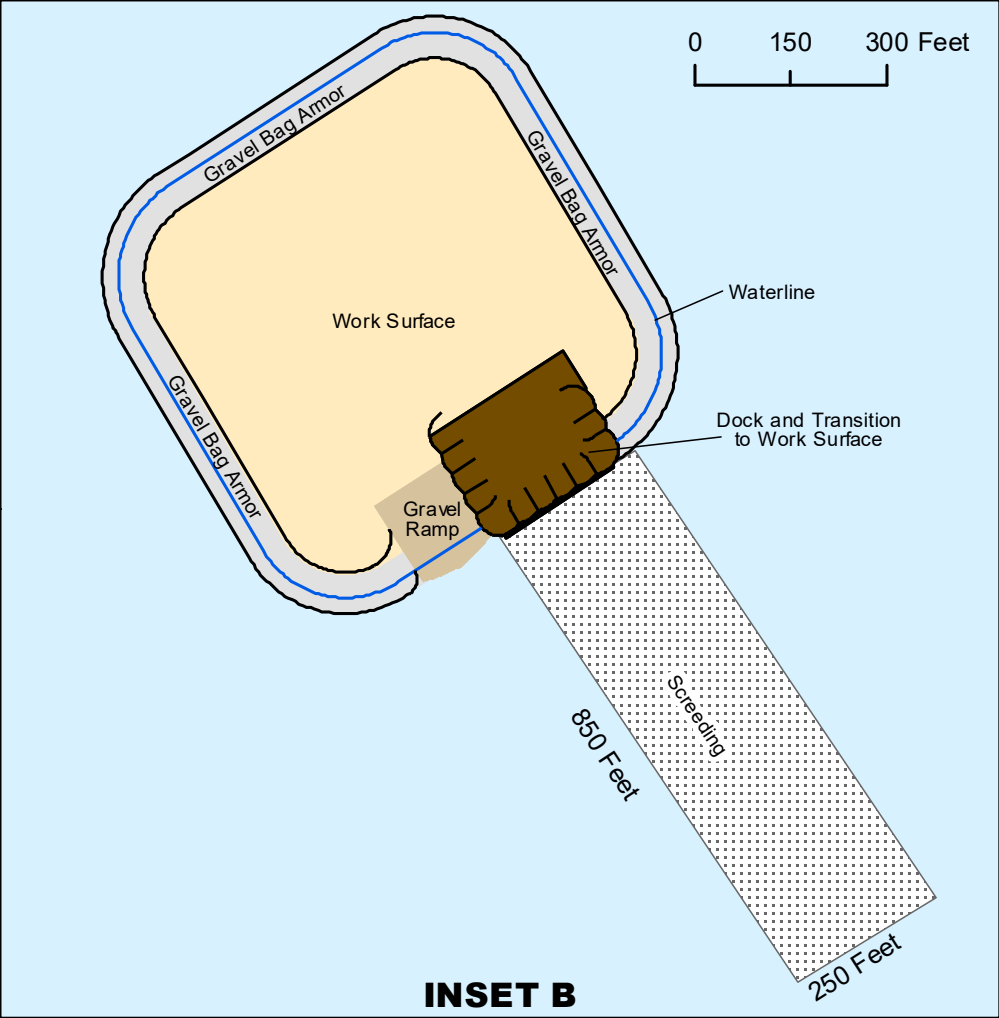
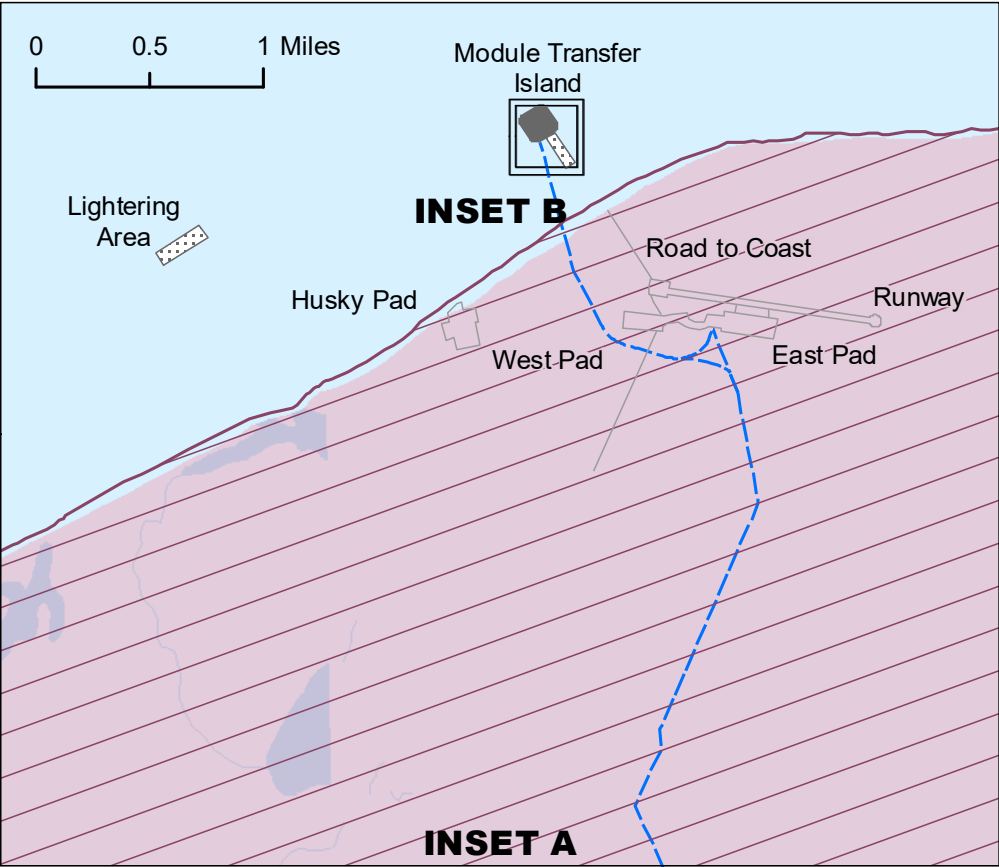
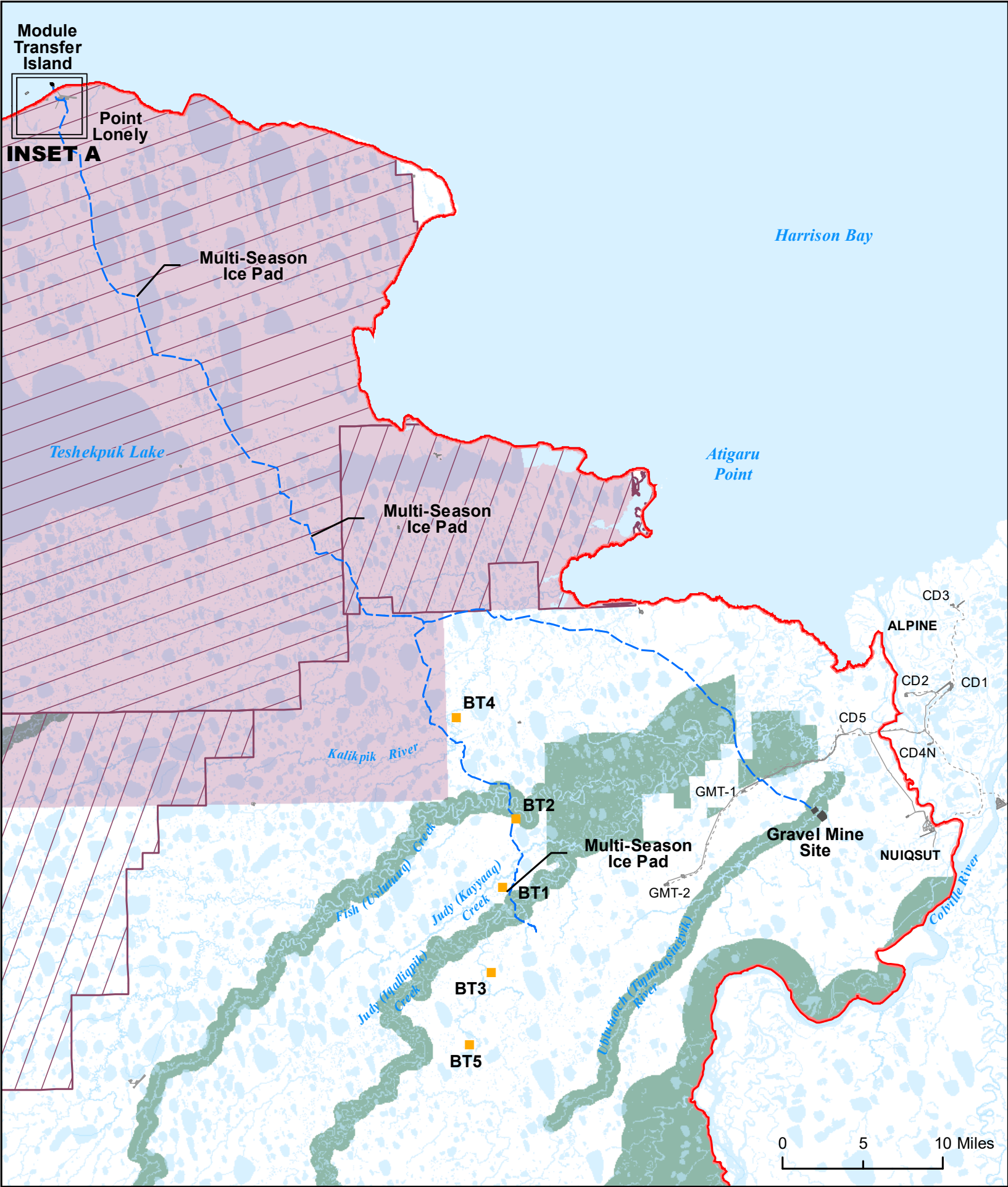
- K-1 River Buffers
- K-5 Teshekpuk Lake
- Caribou Habitat Area

Oil & Gas

- Unavailable to Leasing
- Unavailable to Leasing and no new non-subsistence infrastructure

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Figure 2.4.4



Willow Proposed Development Features

- Drill Site (Not to Scale)
- Ice Road
- Module Transfer Island
- Gravel Mine Site
- Screeding
- Ice Pad

Other Infrastructure

- Existing Road
- Existing Pipeline
- Existing Infrastructure

Land Designation

- National Petroleum Reserve in Alaska

Best Management Practice Areas

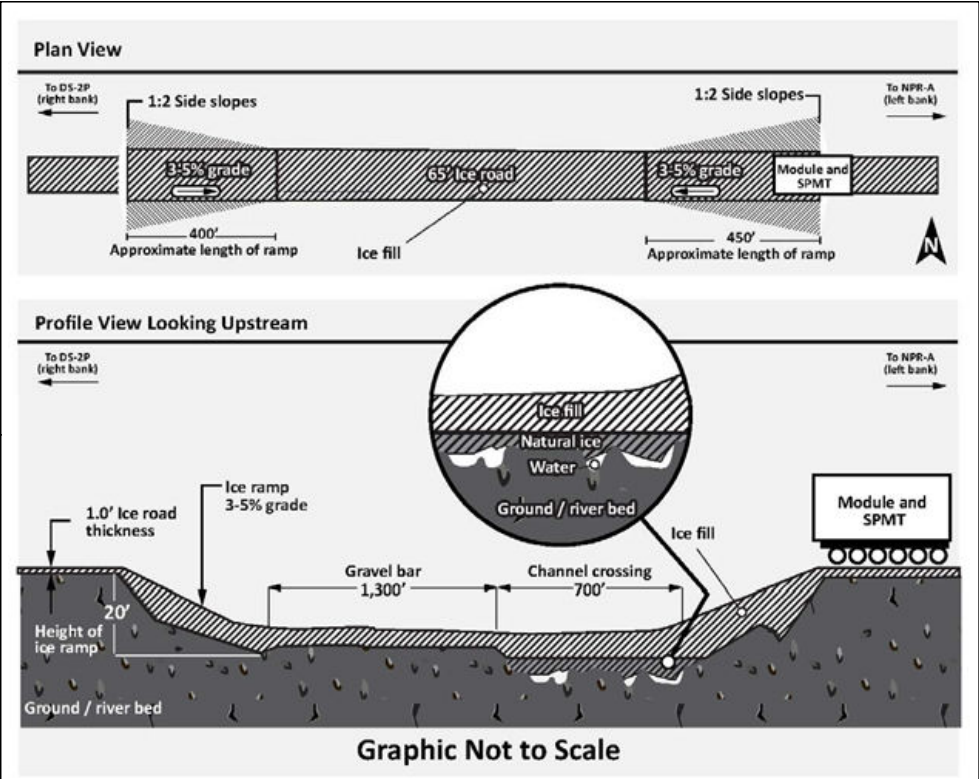
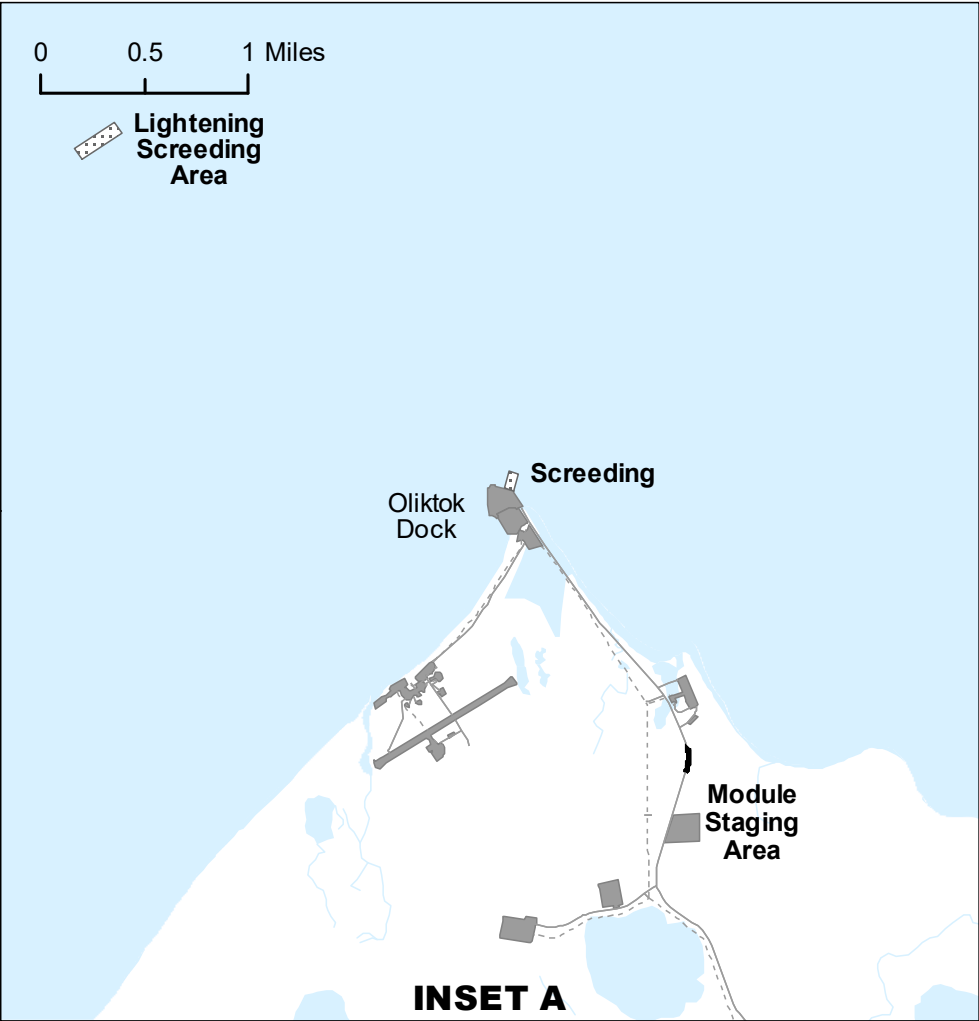
- K-1 River Buffers
- K-5 Teshekpuk Lake Caribou Habitat Area

Oil & Gas

- Unavailable to Leasing
- Unavailable to Leasing and no new non-subsistence infrastructure

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Figure 2.4.5



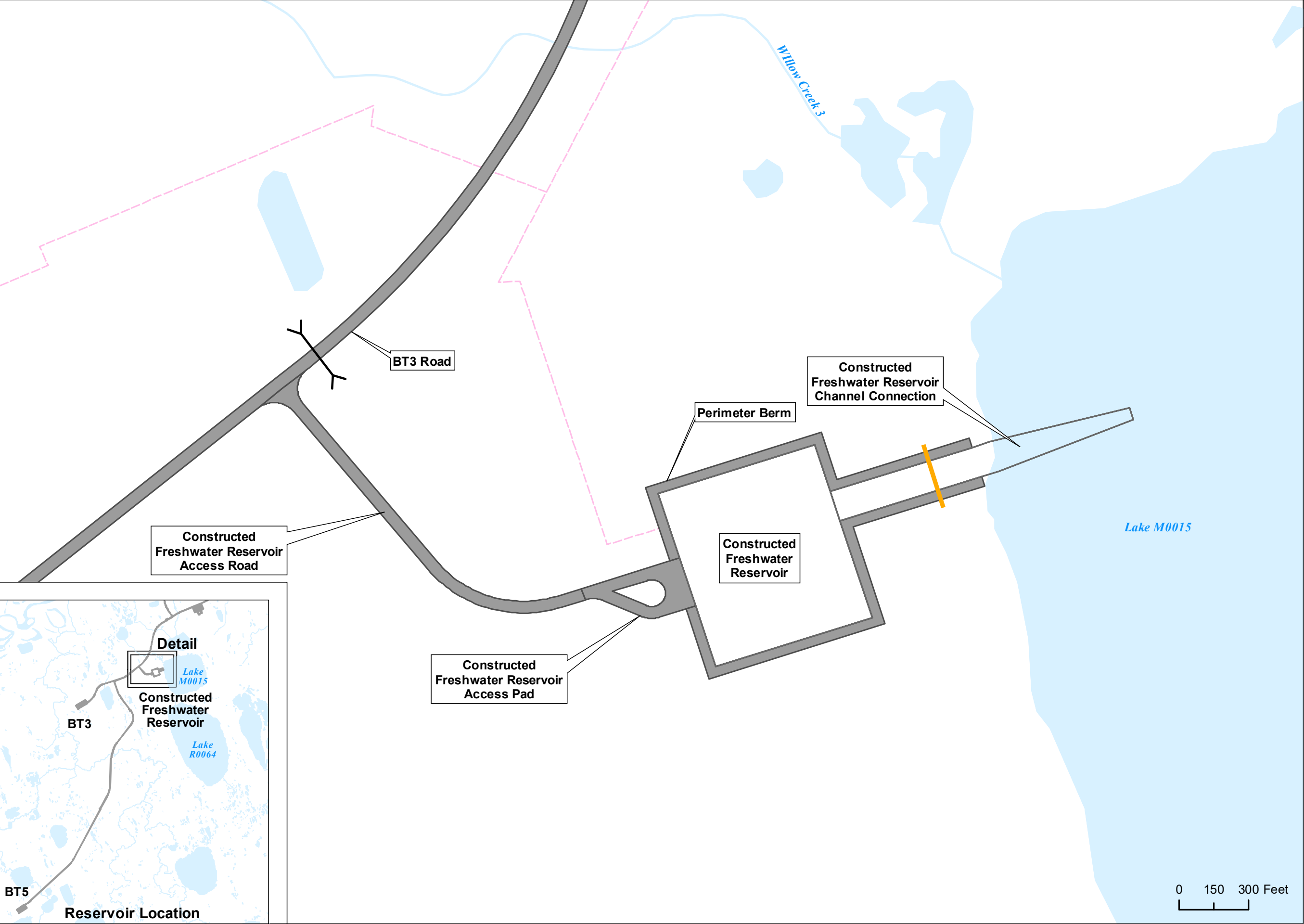
DETAIL A - Colville River Ice Bridge

- Willow Proposed Development Features**
- Drill Site (Not to Scale)
 - Option 3 Existing Road
 - Gravel Footprint
 - Screeding
- Other Infrastructure**
- Existing Road
 - Existing Pipeline
 - Existing Infrastructure
- Land Designation**
- National Petroleum Reserve in Alaska
- Best Management Practice Areas**
- K-1 River Buffers
 - K-5 Teshekpuk Lake Caribou Habitat Area
- Oil & Gas**
- Unavailable to Leasing
 - Unavailable no Leasing and no new non-subsistence infrastructure

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Figure 2.4.6



Willow Proposed Development Features

- Culvert Battery
- Weir
- New Pipeline New VSM
- Gravel Footprint

Note:
Alternative B is shown as a reference.
The freshwater reservoir would be the same for all action alternatives.

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Figure 2.5.1

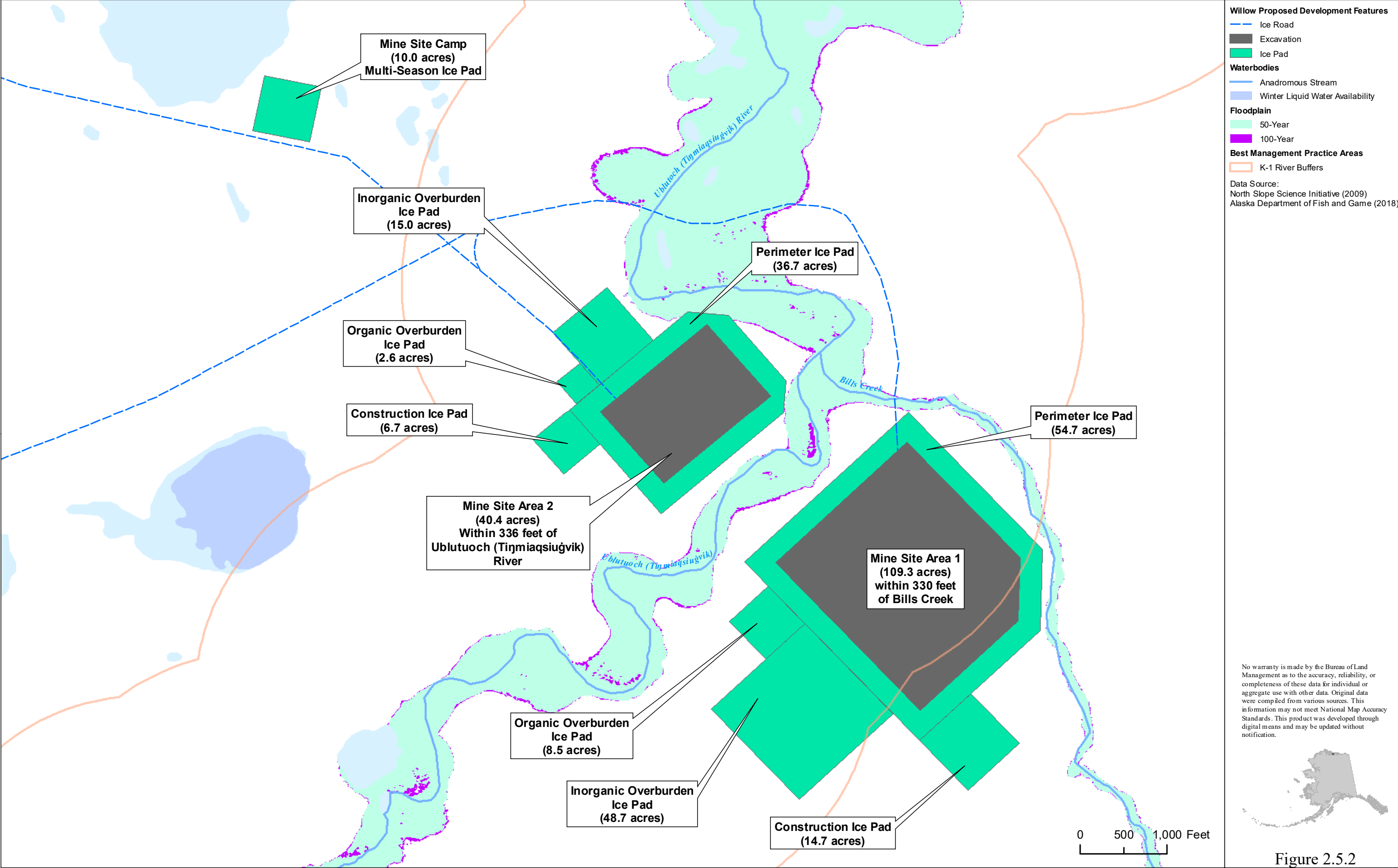
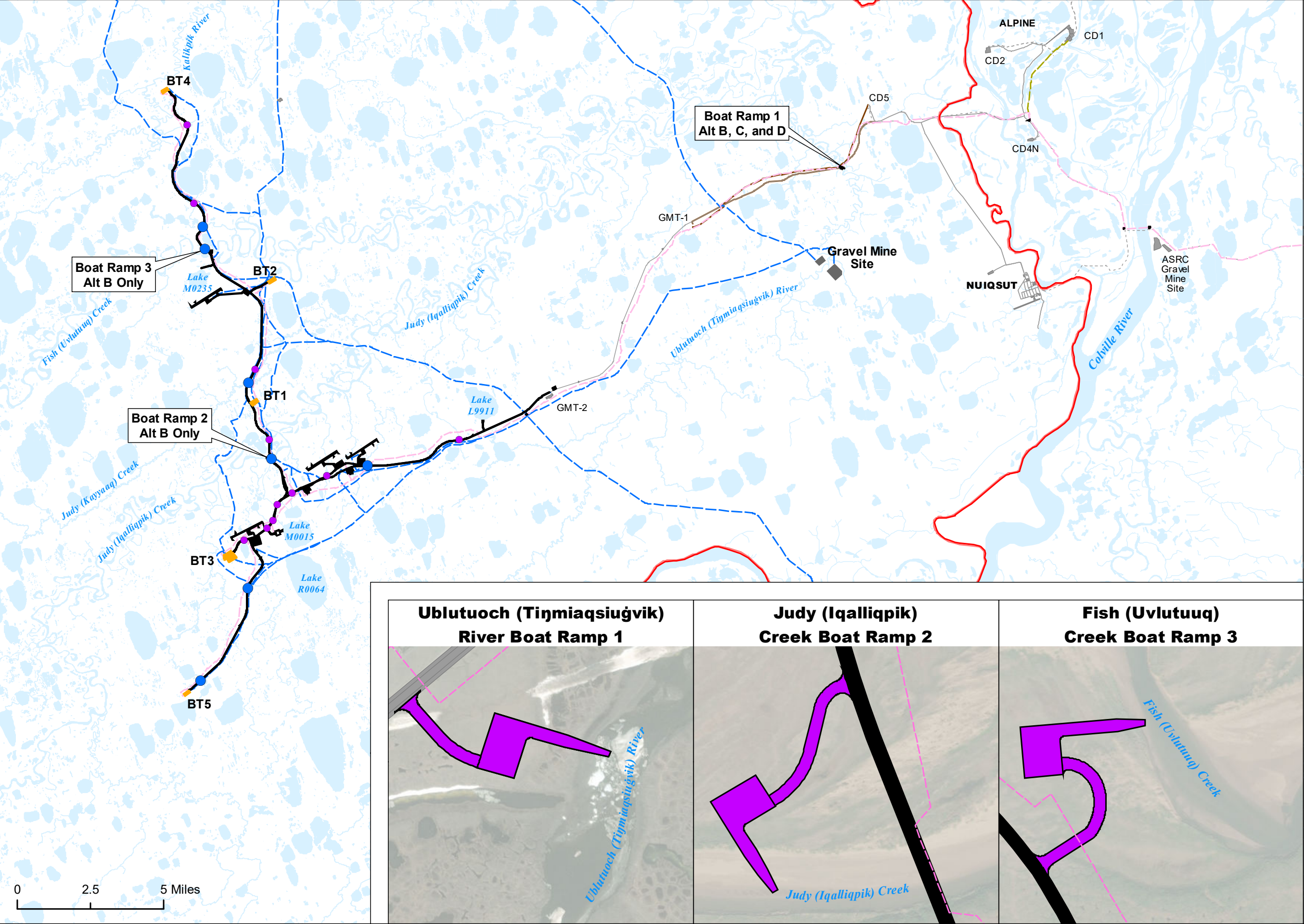


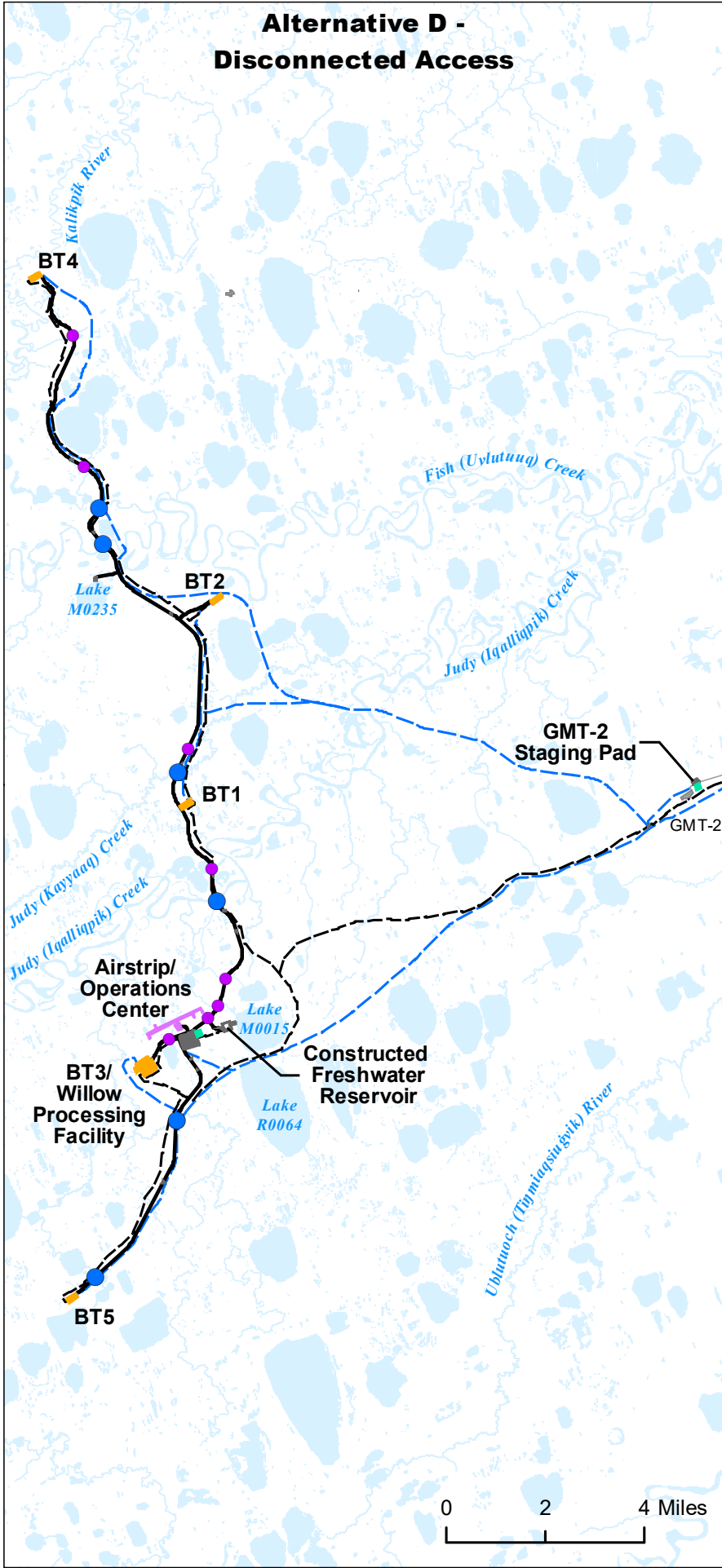
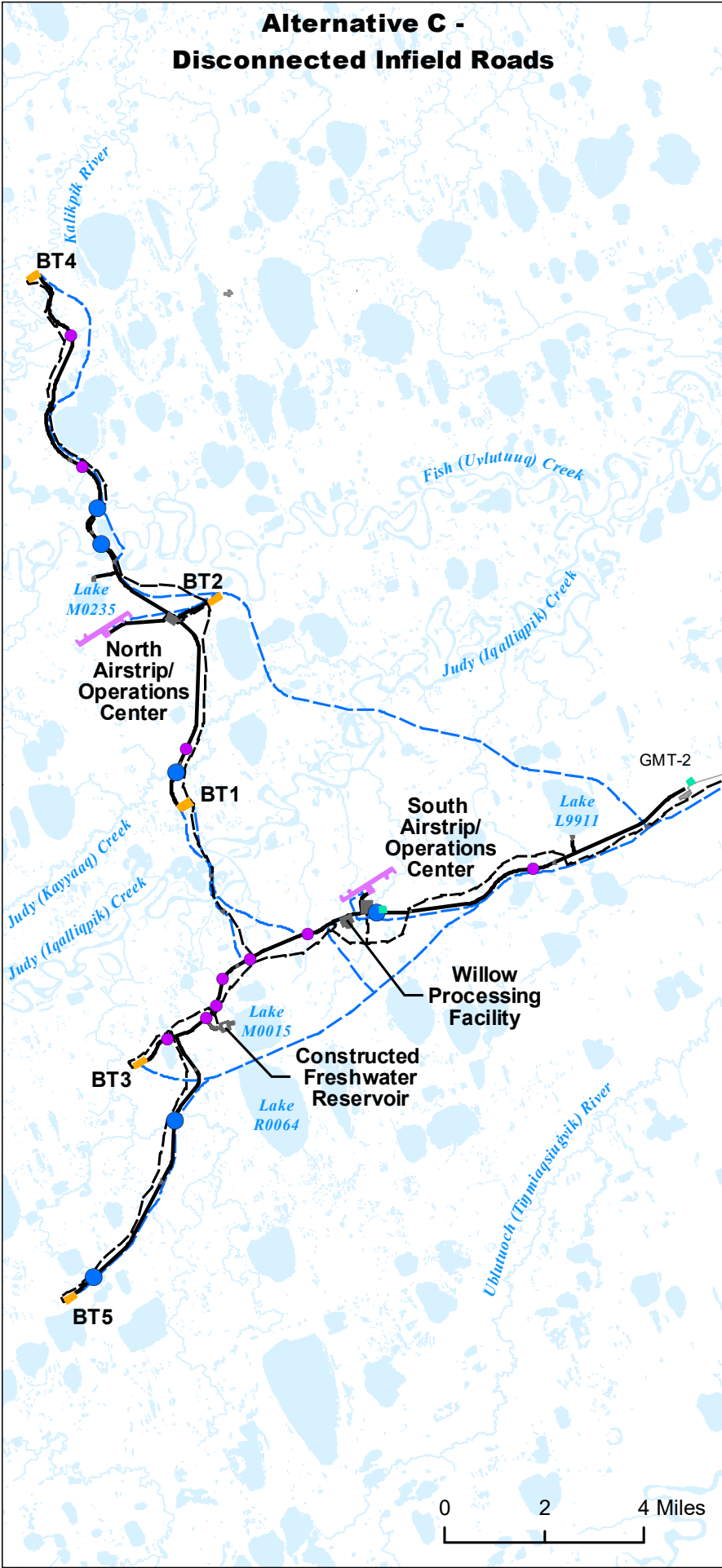
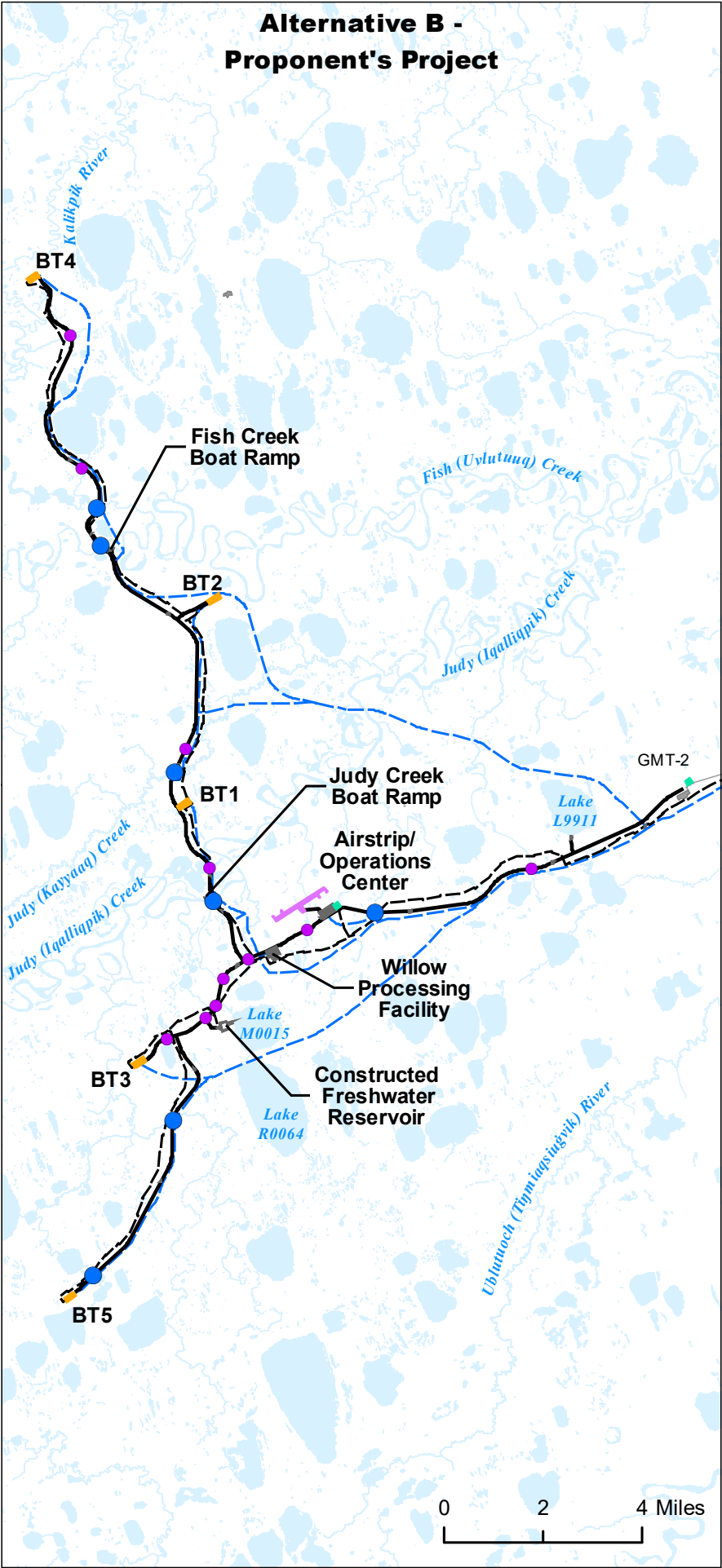
Figure 2.5.2



- Willow Proposed Development Features**
- Culvert Battery
 - Bridge
 - New Pipeline Existing VSM
 - New Pipeline New VSM
 - Ice Road
 - Drill Site Pad
 - Gravel Footprint
 - Boat Ramp
- Other Infrastructure**
- Existing Road
 - Existing Pipeline
 - Existing Infrastructure
- Land Designation**
- National Petroleum Reserve in Alaska

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Figure 2.5.3



Willow Proposed Development Features

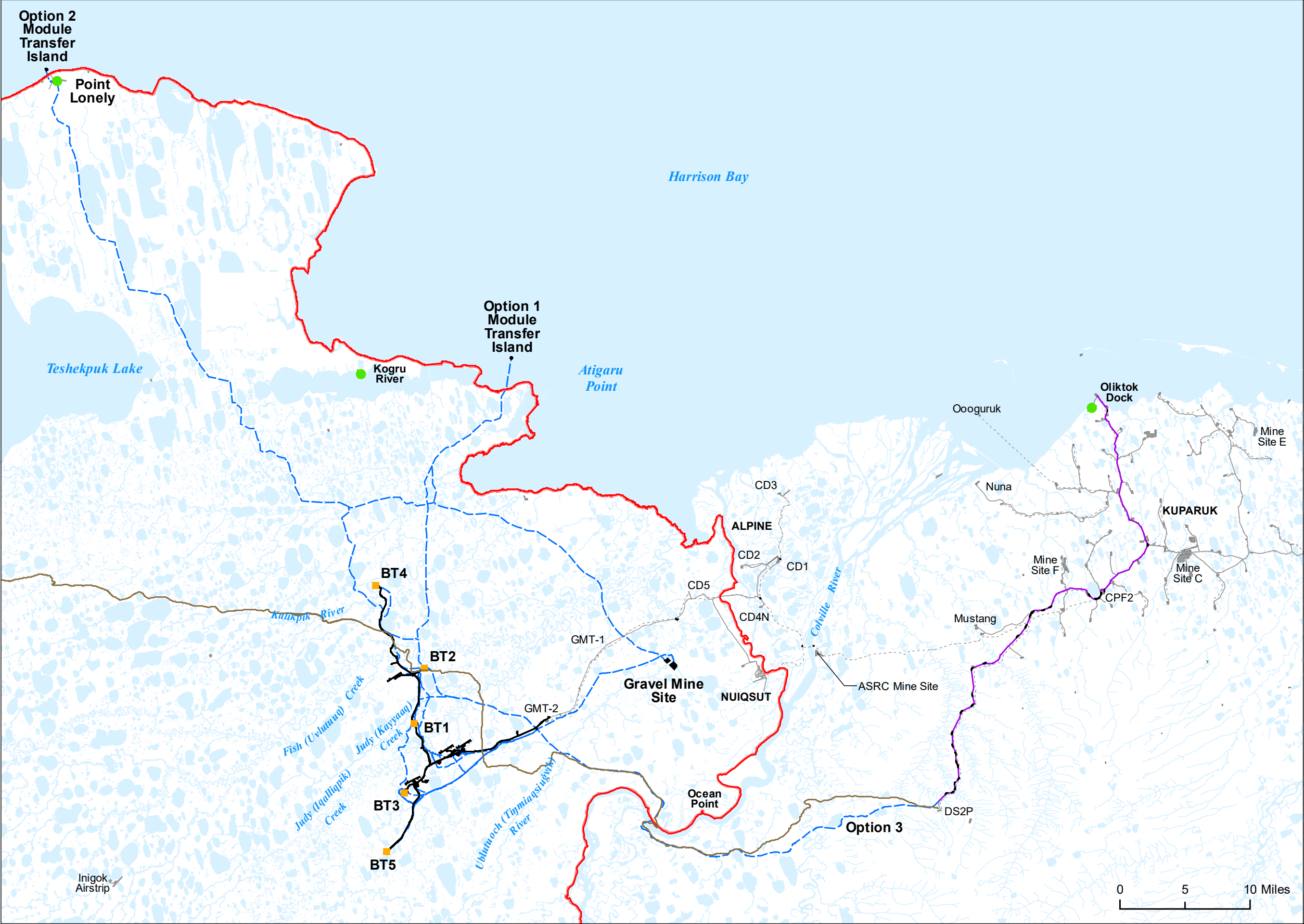
- Culvert Battery
- Bridge
- Gravel Road
- Pipeline
- Ice Road
- Airstrip
- Dill Site Pad
- Gravel Pad
- Ice Pad

Other Infrastructure

- Existing Road
- Existing Pipeline
- Existing Infrastructure

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Figure 2.7.1



- Past and Present Actions**
- Former Department of Defense Site
 - Community Winter Access Trail Project
- Willow Proposed Development Features**
- Drill Site (Not to Scale)
 - Ice Road
 - Option 3 Existing Road
 - Gravel Footprint
- Other Infrastructure**
- Existing Road
 - Existing Pipeline
 - Existing Infrastructure
- Land Designation**
- National Petroleum Reserve in Alaska

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Figure 3.1.1

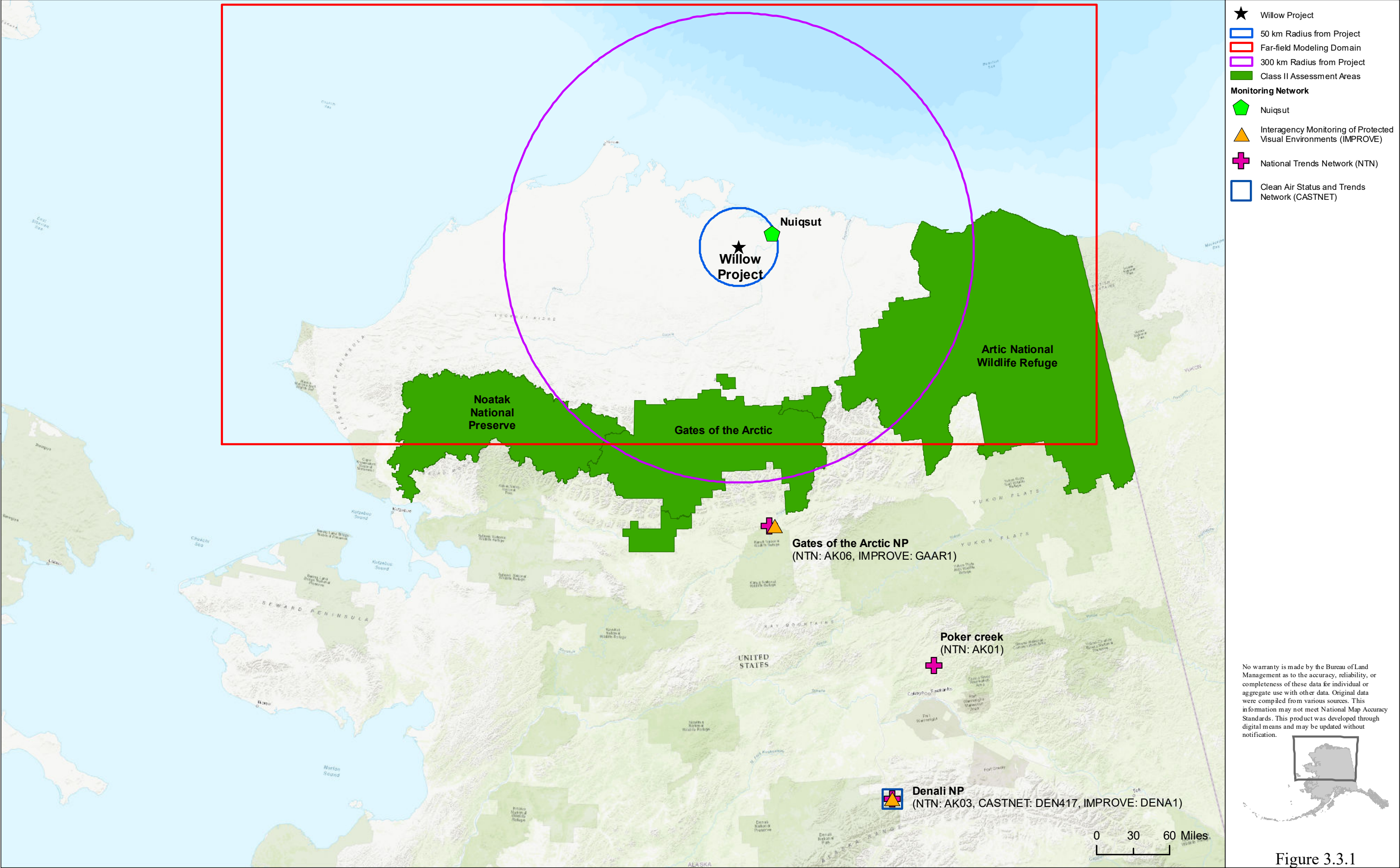
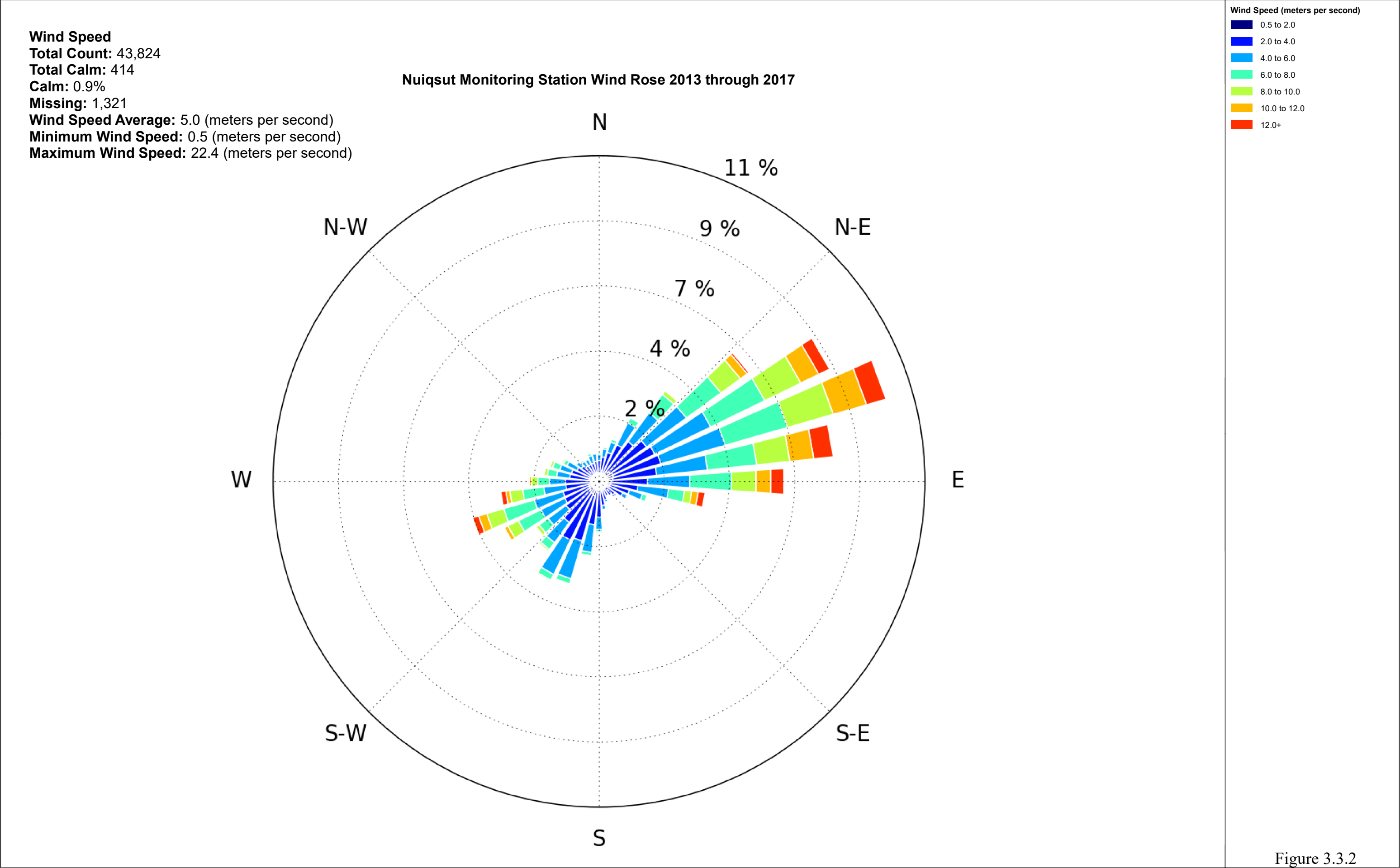
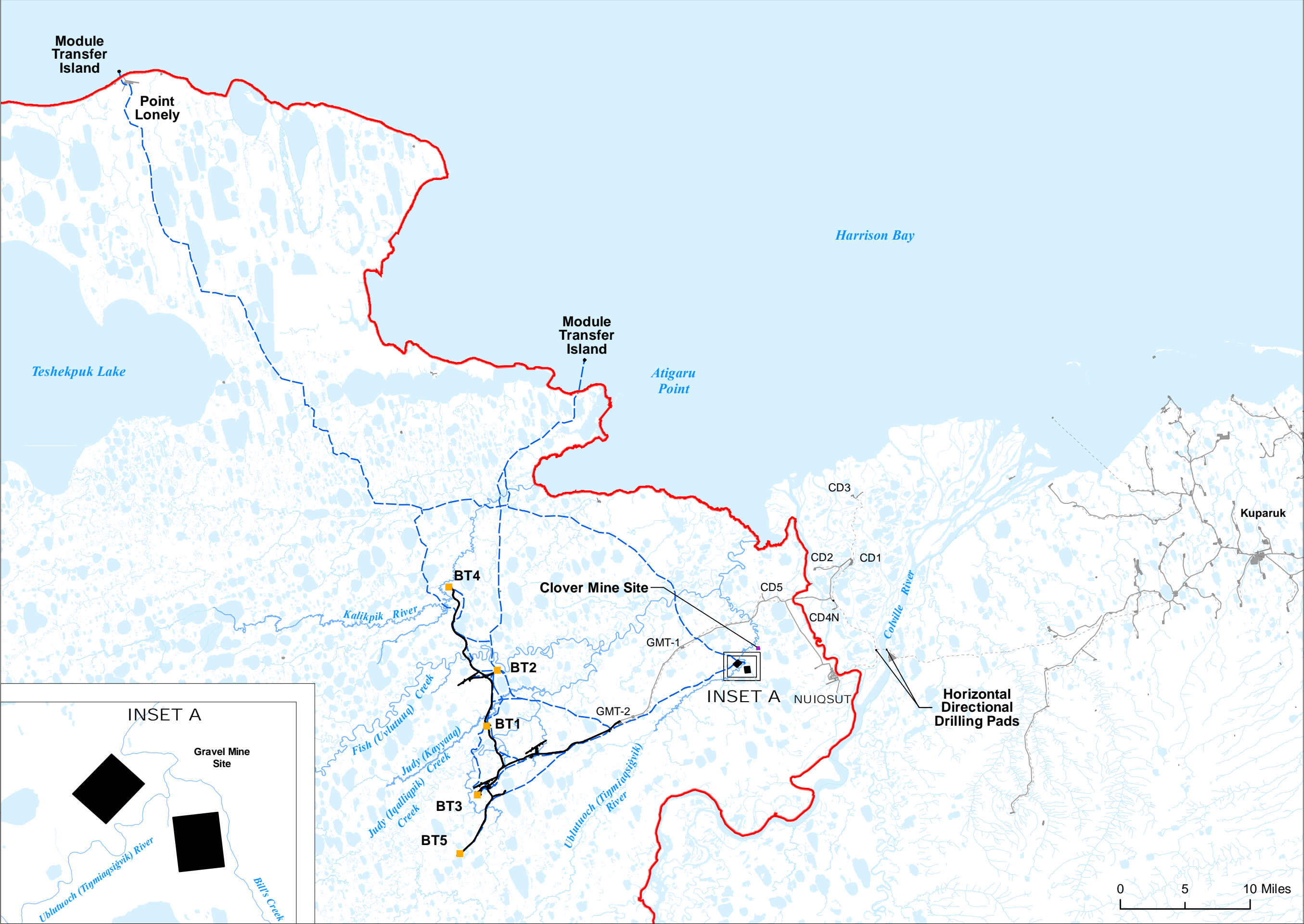


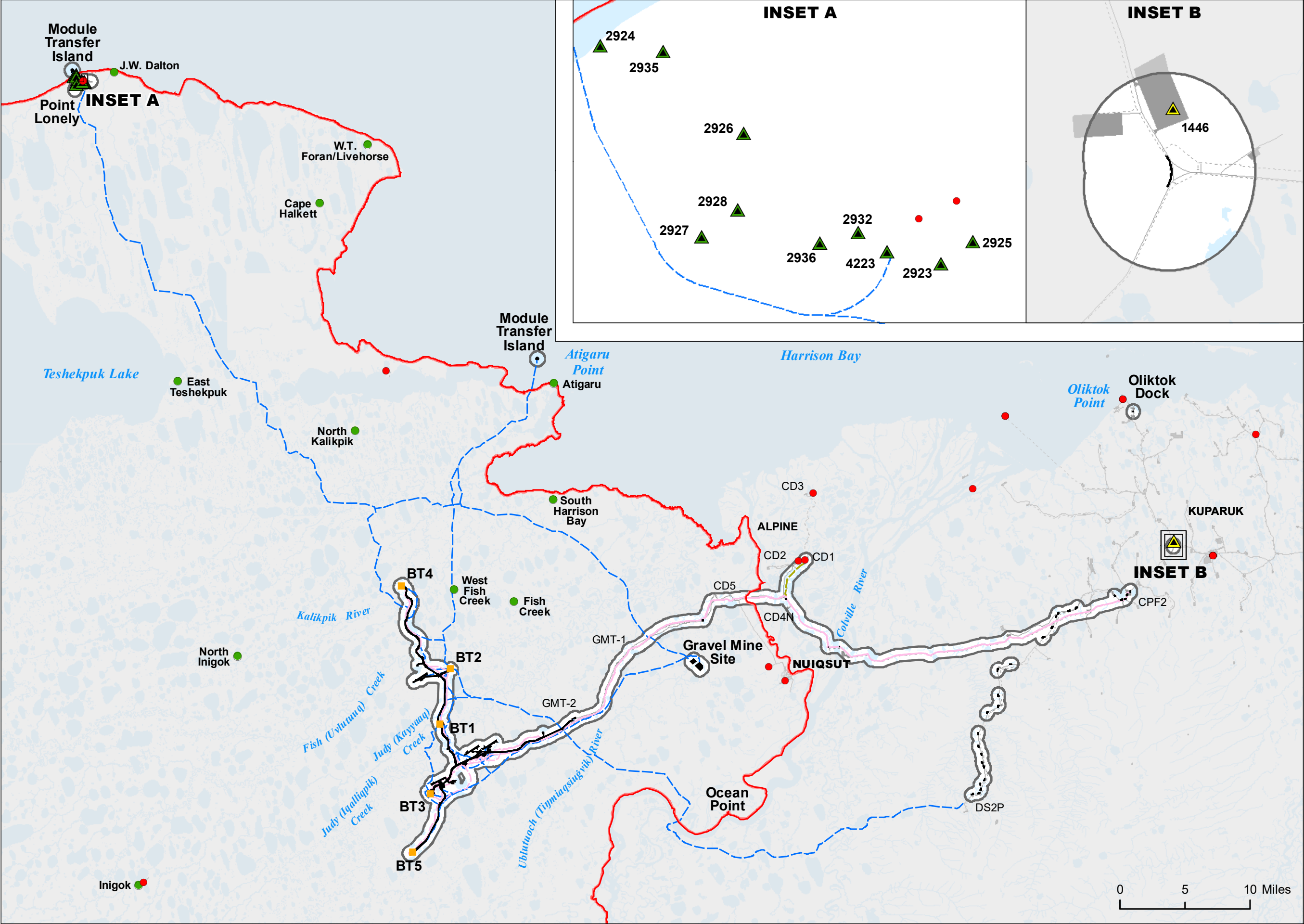
Figure 3.3.1





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Figure 3.4.1



Alaska Department of Environmental Conservation Contaminated Sites

- Cleanup Complete
- Cleanup Complete - Institutional Controls
- Legacy Wells
- Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS)

Willow Proposed Development Features

- Drill Site (Not to Scale)
- New Pipeline Existing VSM
- New Pipeline New VSM
- Ice Road
- Gravel Footprint
- Analysis Area

Other Infrastructure

- Existing Road
- Existing Pipeline
- Existing Infrastructure

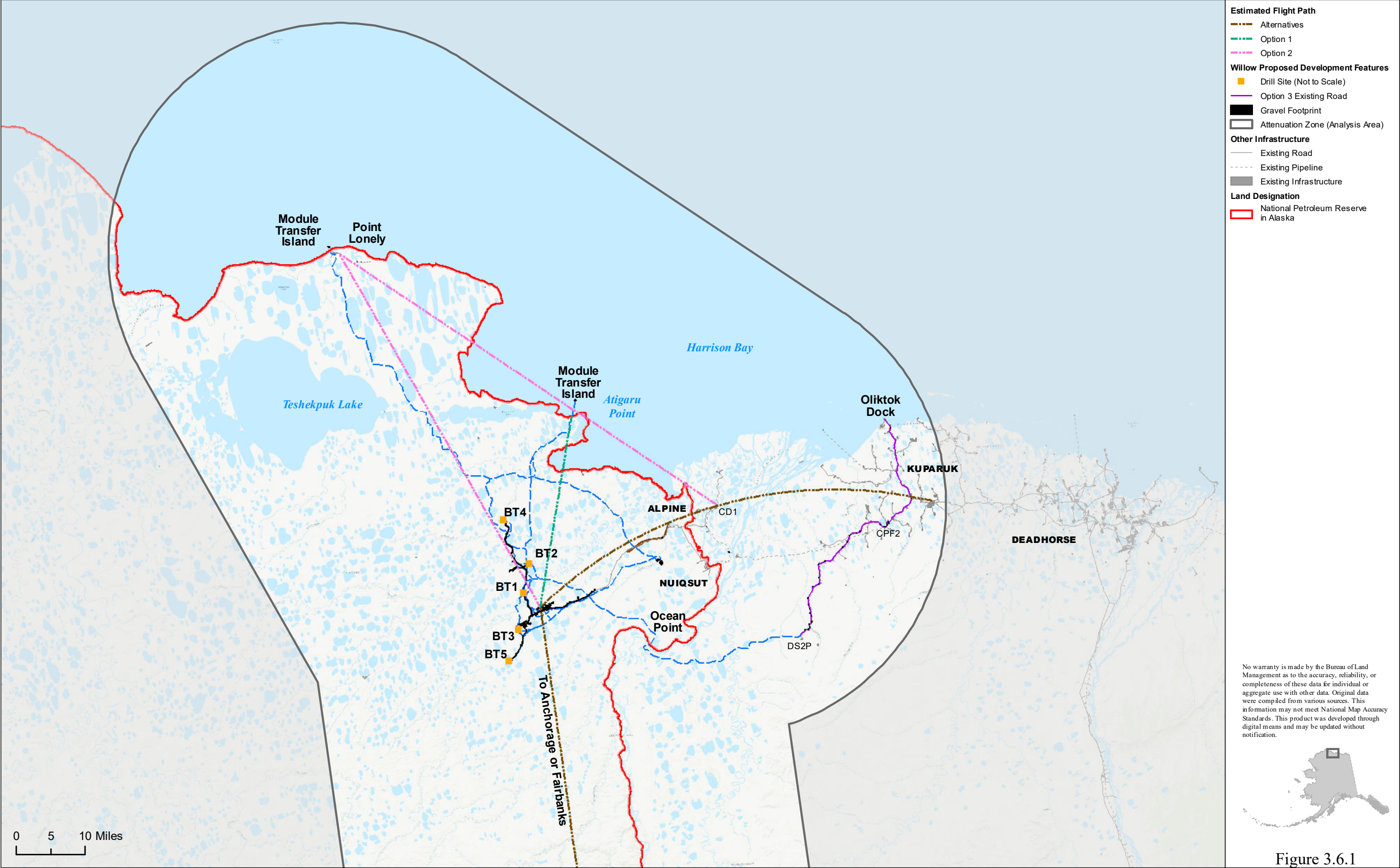
Land Designation

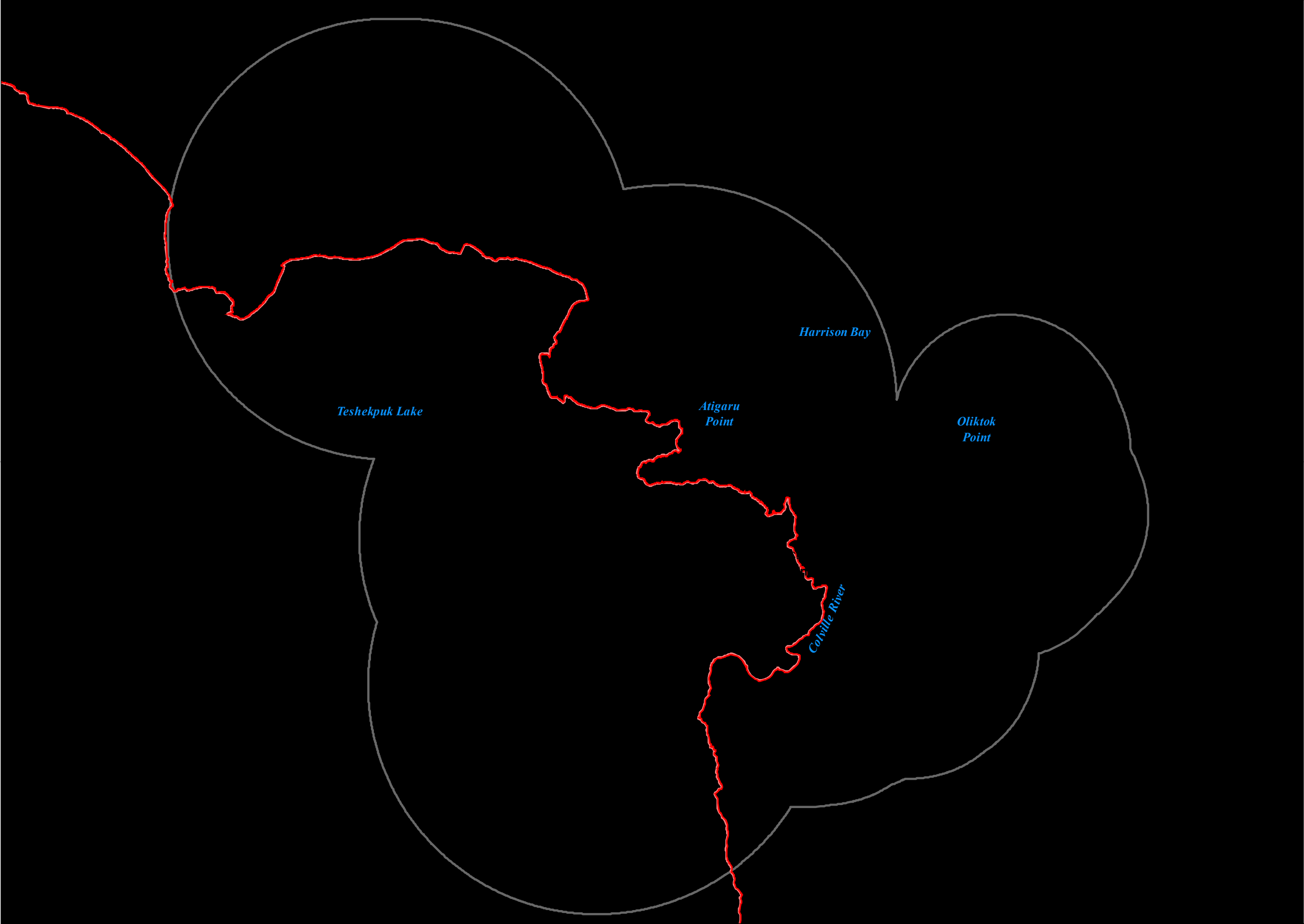
- National Petroleum Reserve in Alaska

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Figure 3.5.1



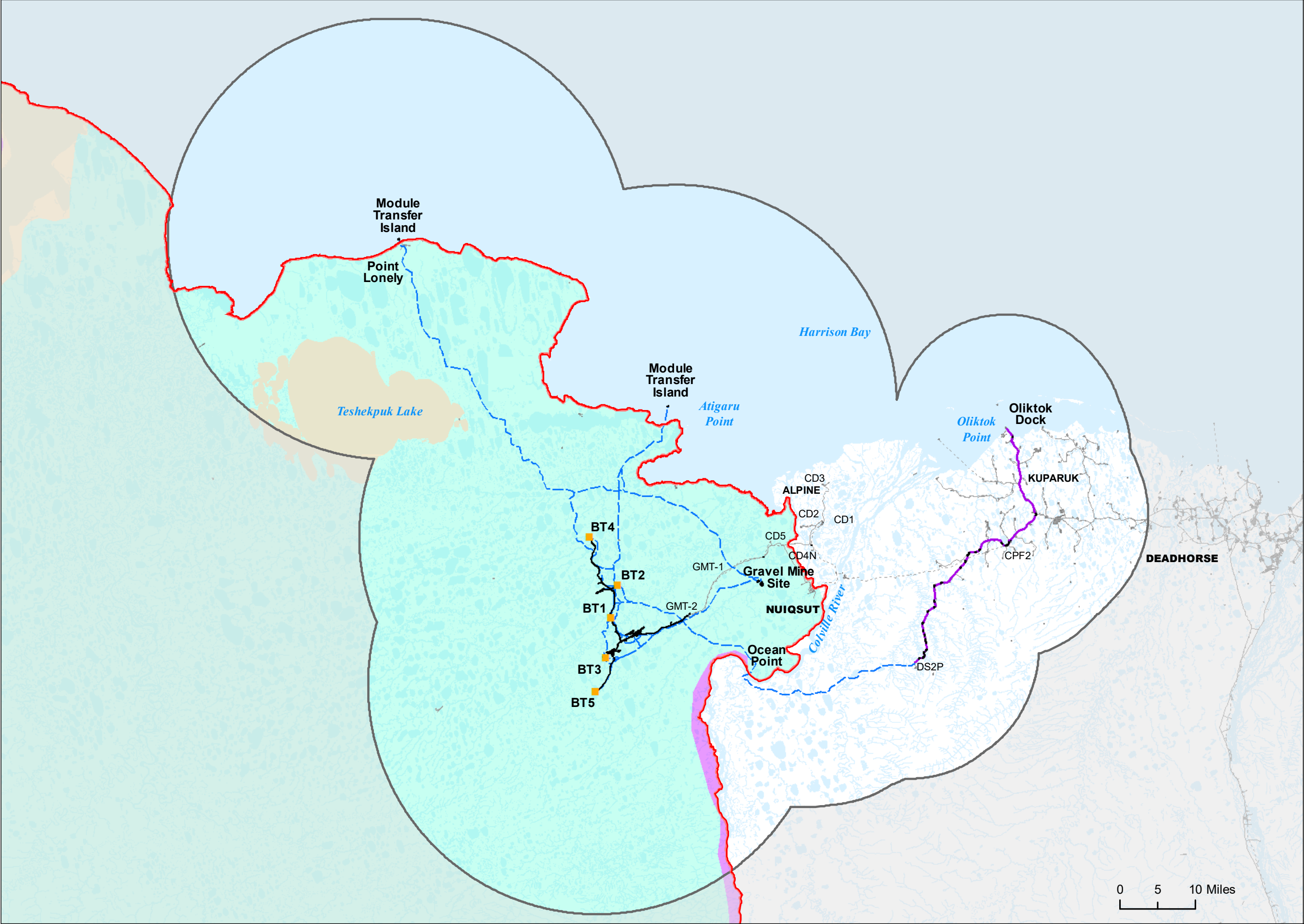


- Visual Impact Area
- Willow Proposed Development Features**
 - Drill Site (Not to Scale)
 - Ice Road
 - Option 3 Existing Road
 - Gravel Footprint
 - Analysis Area
- Other Infrastructure**
 - Existing Road
 - Existing Pipeline
 - Existing Infrastructure

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Figure 3.7.1



Visual Resource Inventory

Scenic Quality Classes

- A
- B
- C

Analysis Area

Willow Proposed Development Features

- Drill Site (Not to Scale)
- Ice Road
- Option 3 Existing Road
- Gravel Footprint

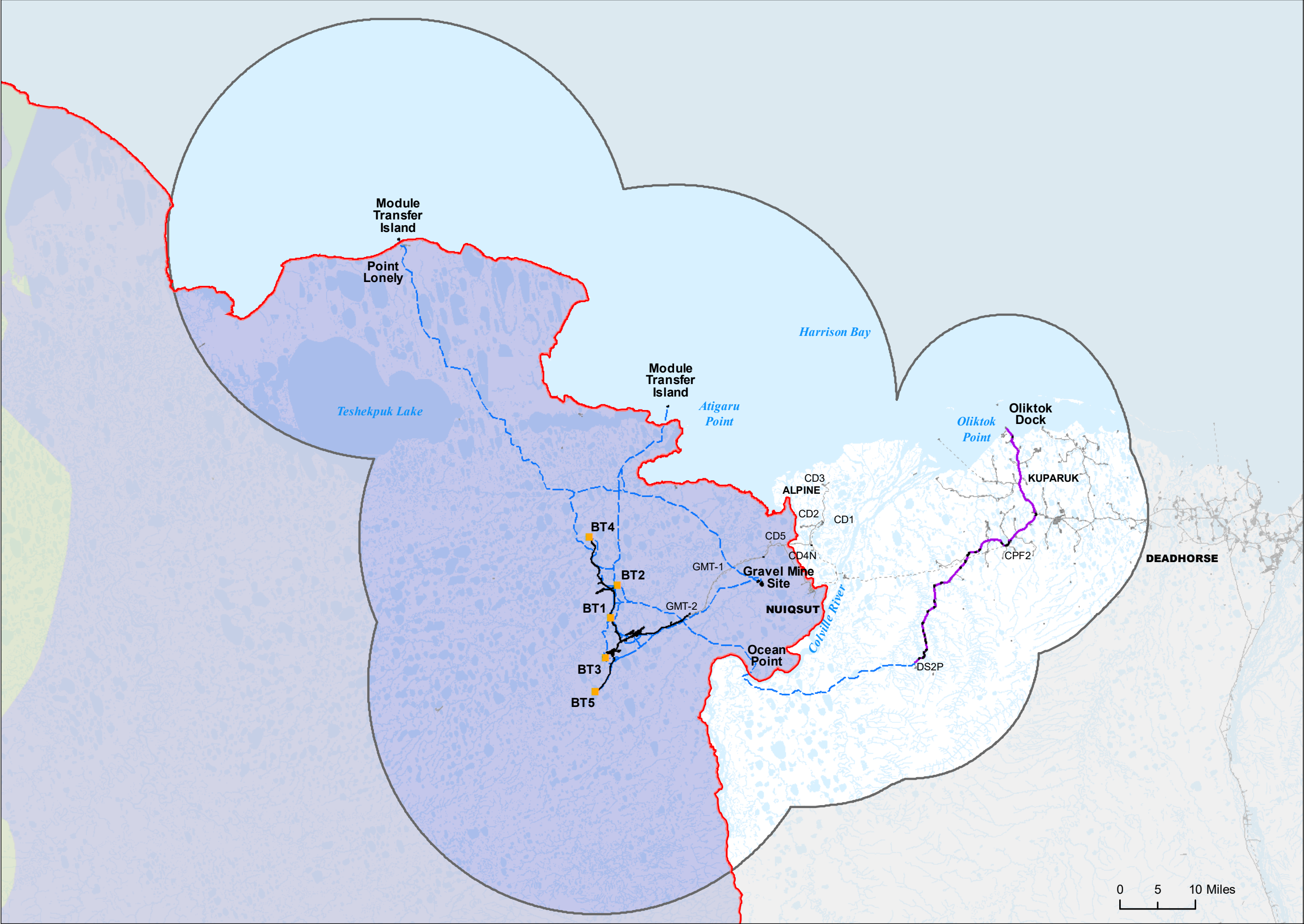
Other Infrastructure

- Existing Road
- Existing Pipeline
- Existing Infrastructure

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Figure 3.7.2



Visual Resources Inventory

Sensitivity Levels

- High
- Moderate
- Analysis Area

Willow Proposed Development Features

- Drill Site (Not to Scale)
- Ice Road
- Option 3 Existing Road
- Gravel Footprint

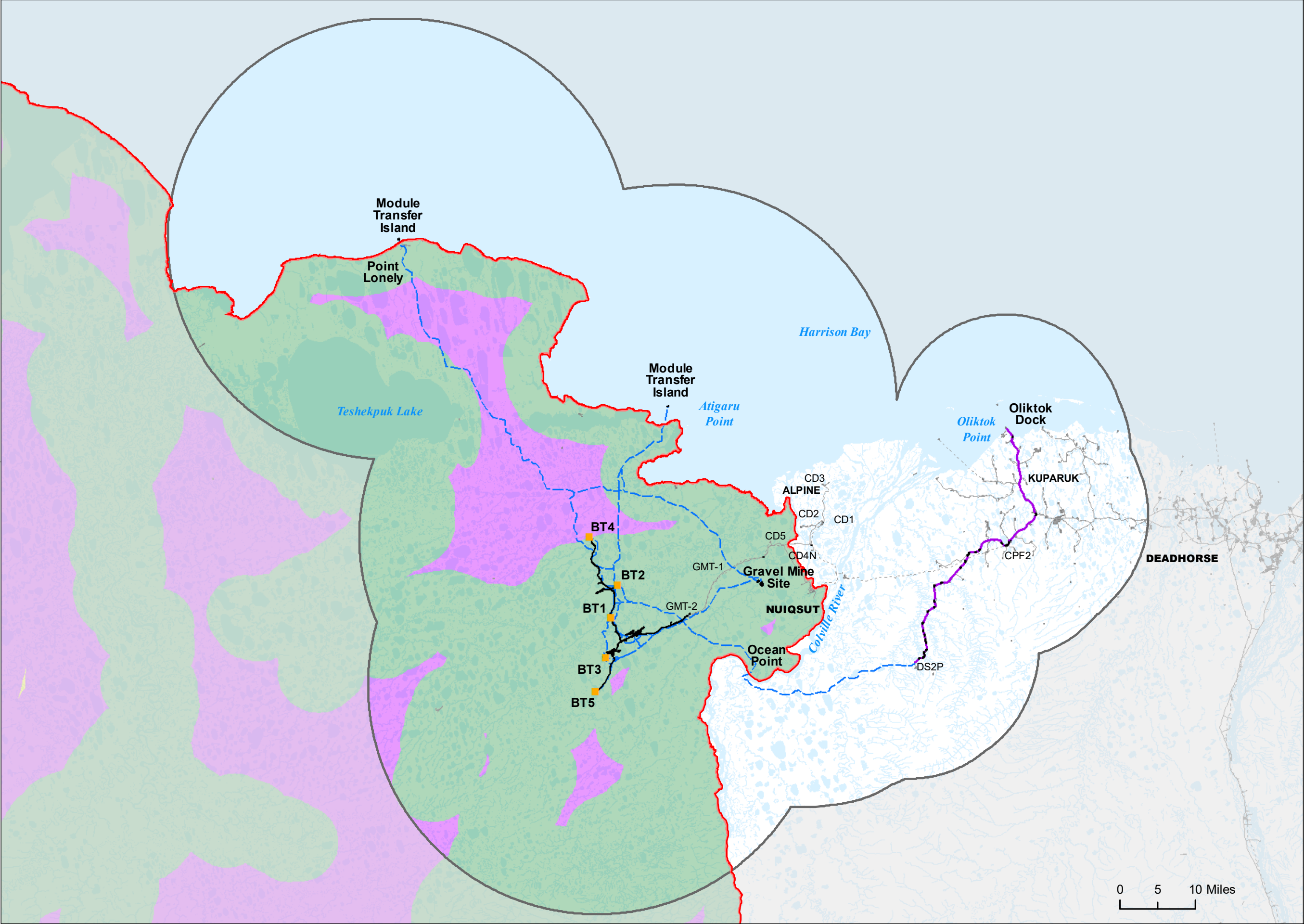
Other Infrastructure

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- Existing Pipeline
- Existing Infrastructure

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0 5 10 Miles

Figure 3.7.3

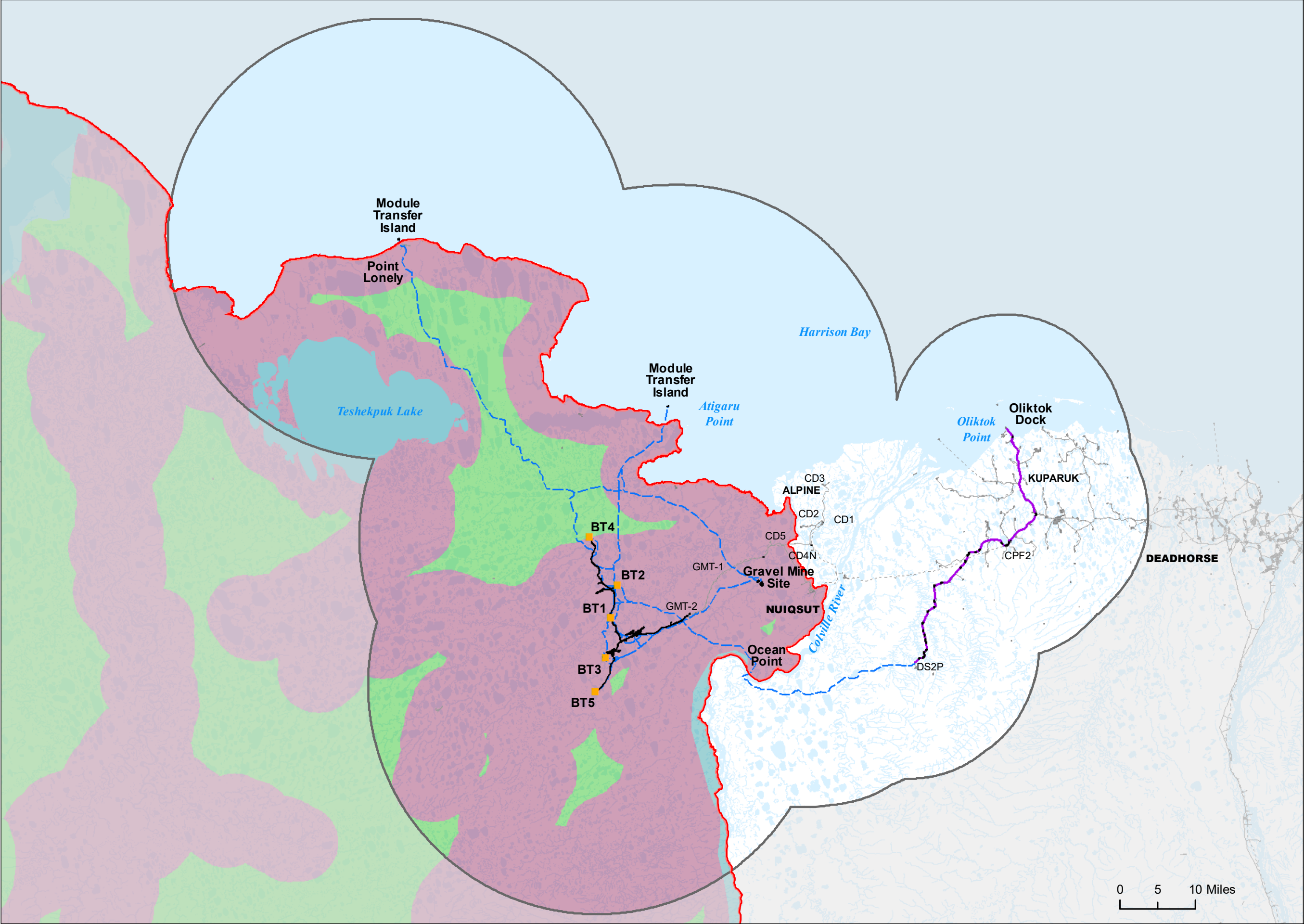


- Visual Resource Inventory**
- Distance Zones**
- Foreground
 - Background
 - Seldom Seen
- Analysis Area**
- Analysis Area
- Willow Proposed Development Features**
- Drill Site (Not to Scale)
 - Ice Road
 - Option 3 Existing Road
 - Gravel Footprint
- Other Infrastructure**
- Existing Road
 - Existing Pipeline
 - Existing Infrastructure

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.



Figure 3.7.4



Visual Resource Inventory

Classes

- II
- III
- IV

Analysis Area

Willow Proposed Development Features

- Drill Site (Not to Scale)
- Ice Road
- Option 3 Existing Road
- Gravel Footprint

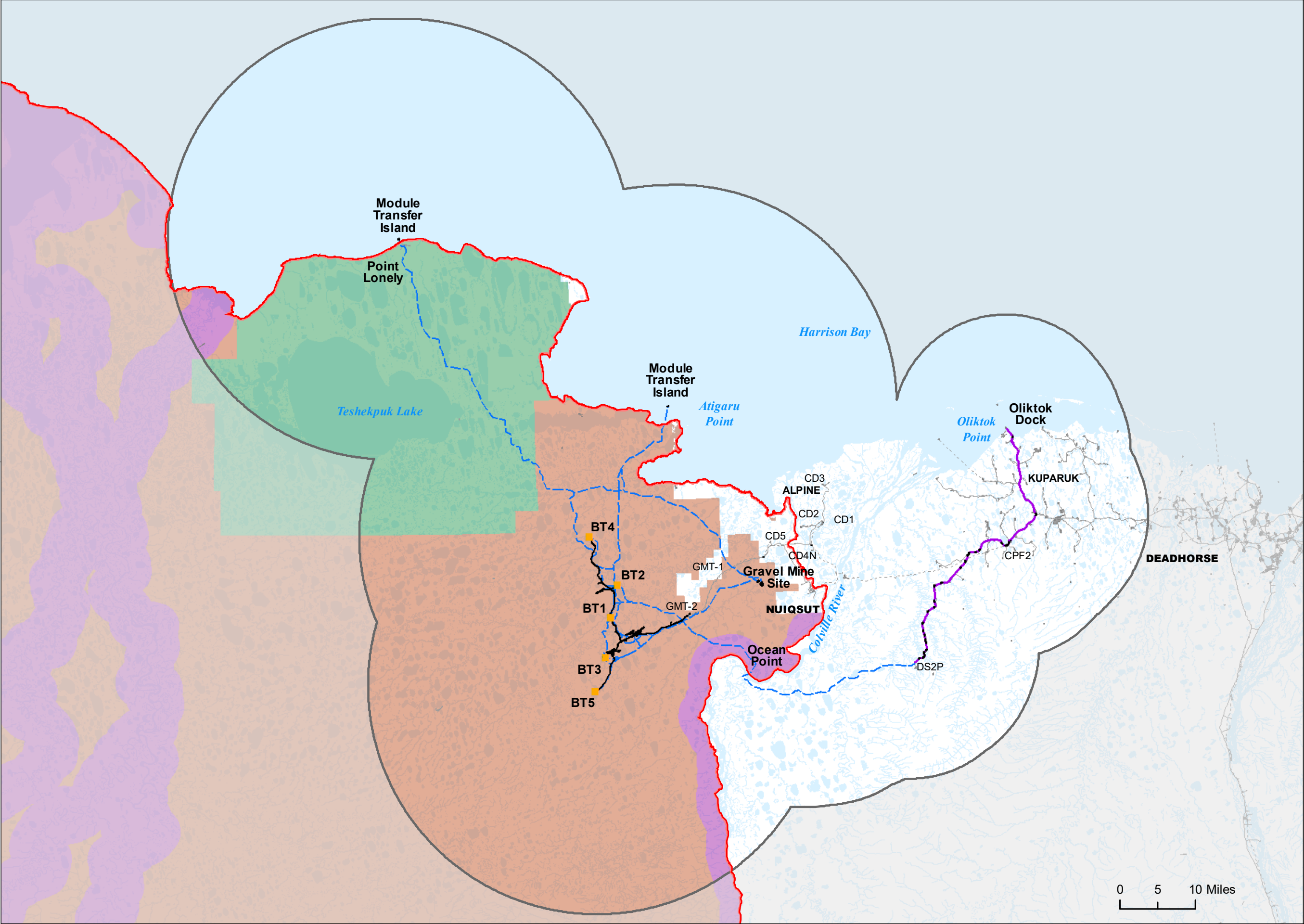
Other Infrastructure

- Existing Road
- Existing Pipeline
- Existing Infrastructure

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.



Figure 3.7.5



Visual Resource Management Class

- II
- III
- IV

Analysis Area

Willow Proposed Development Features

- Drill Site (Not to Scale)
- Ice Road
- Option 3 Existing Road
- Gravel Footprint

Other Infrastructure

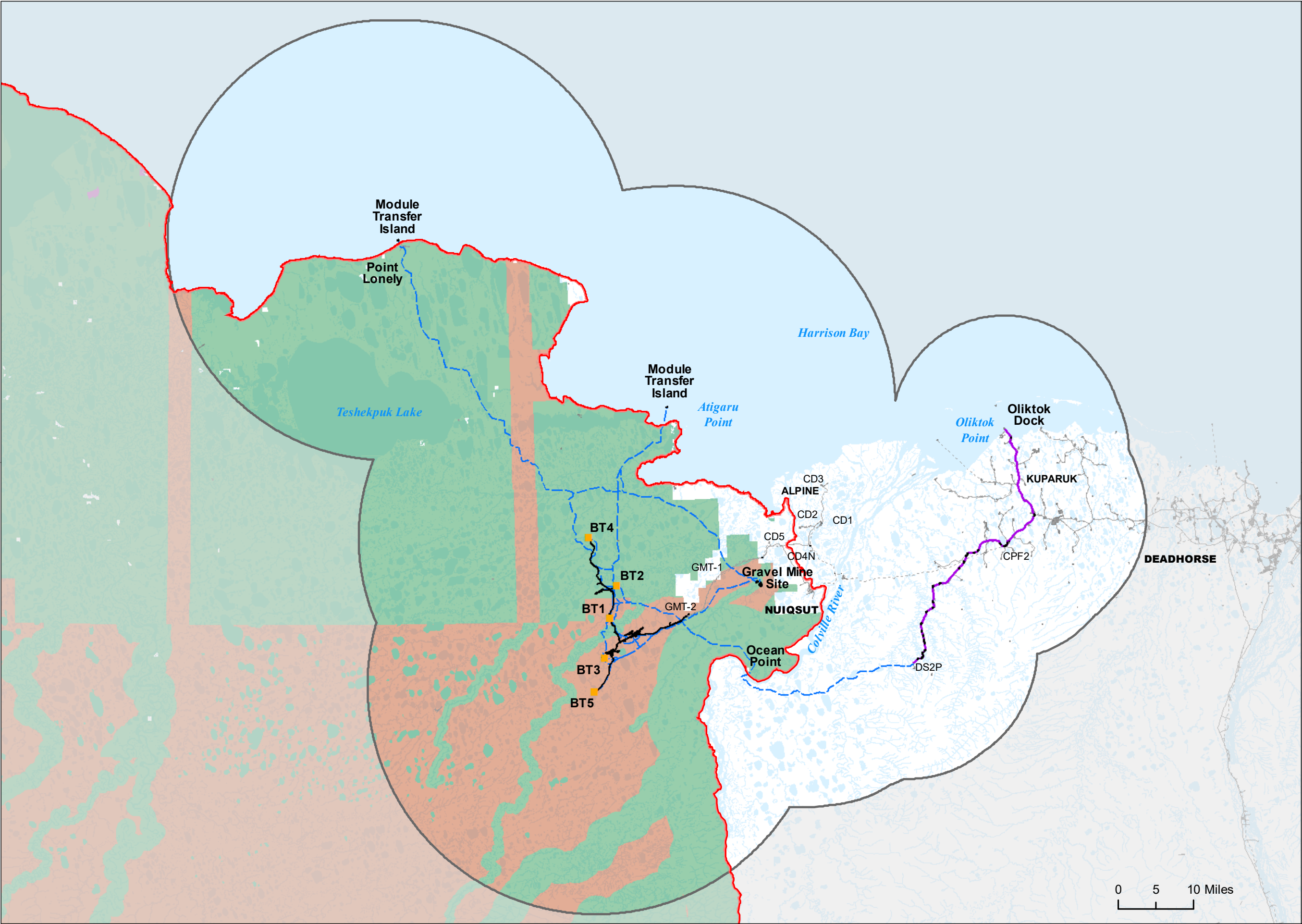
- Existing Road
- Existing Pipeline
- Existing Infrastructure

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.



0 5 10 Miles

Figure 3.7.6



Visual Resource Management Class

- II
- III
- IV

Analysis Area

Willow Proposed Development Features

- Drill Site (Not to Scale)
- Ice Road
- Option 3 Existing Road
- Gravel Footprint

Other Infrastructure

- Existing Road
- Existing Pipeline
- Existing Infrastructure

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0 5 10 Miles

Figure 3.7.7

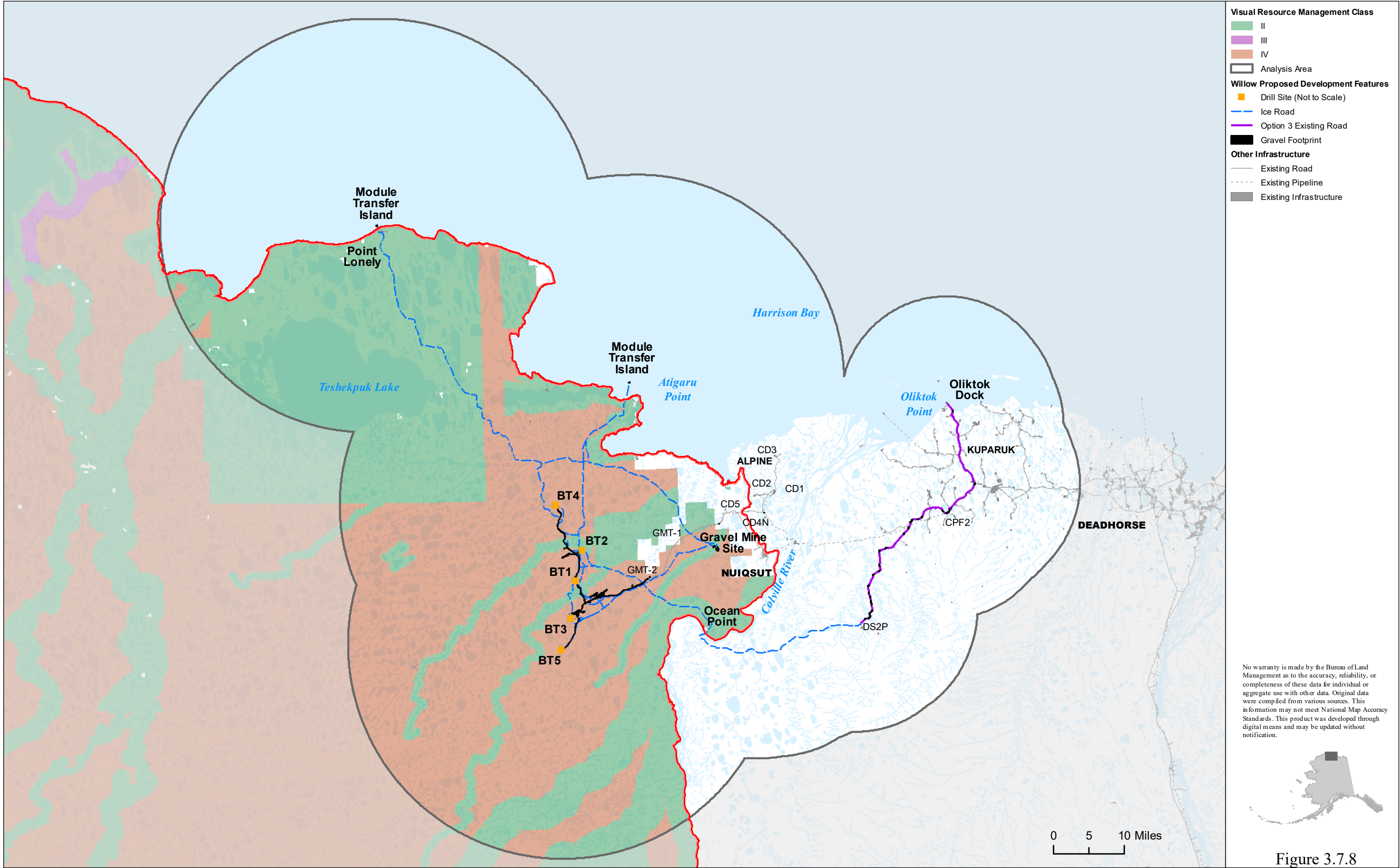
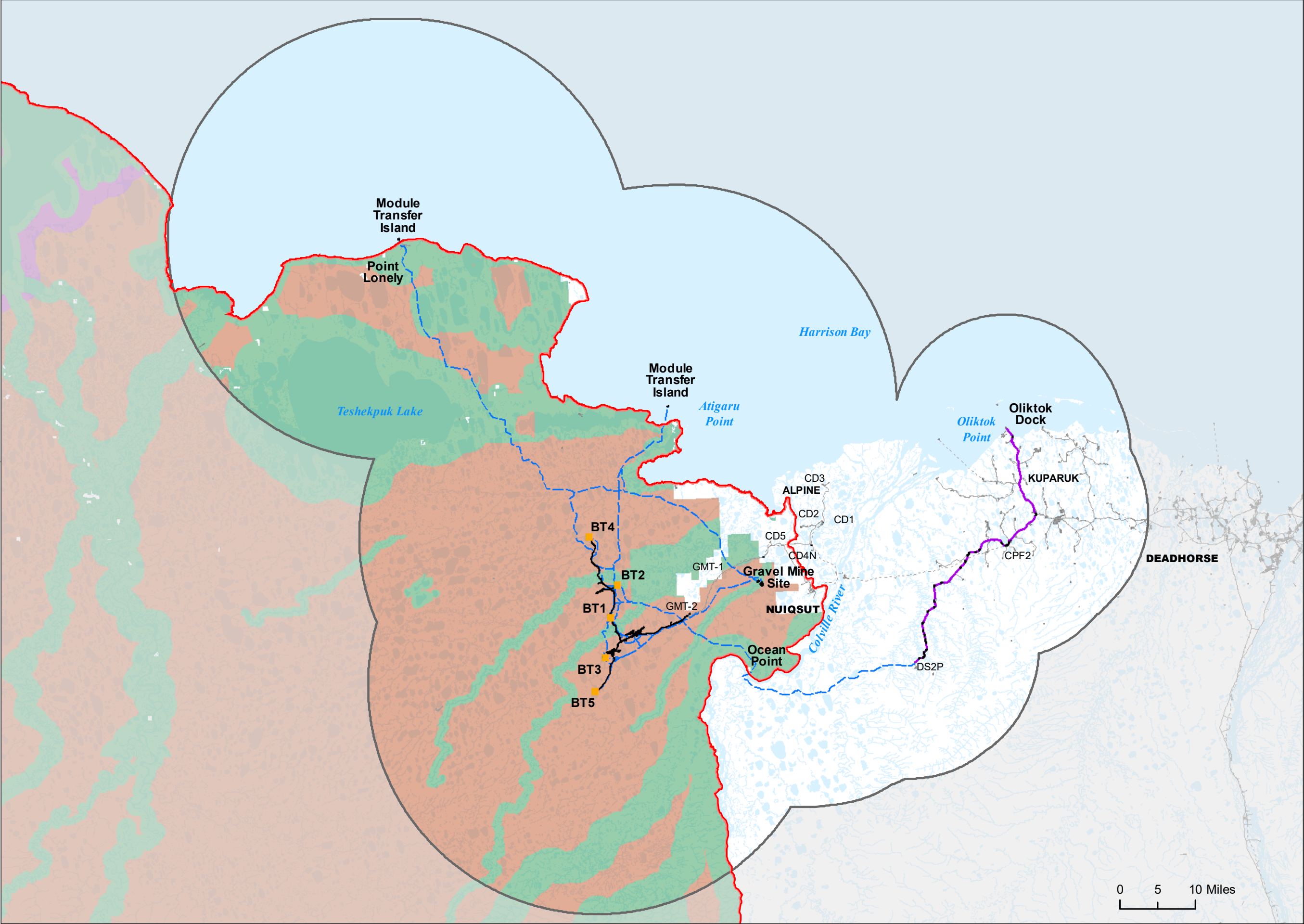


Figure 3.7.8



Visual Resources Inventory

Management Class

- II
- III
- IV

Analysis Area

Willow Proposed Development Features

- Drill Site (Not to Scale)
- Ice Road
- Option 3 Existing Road
- Gravel Footprint

Other Infrastructure

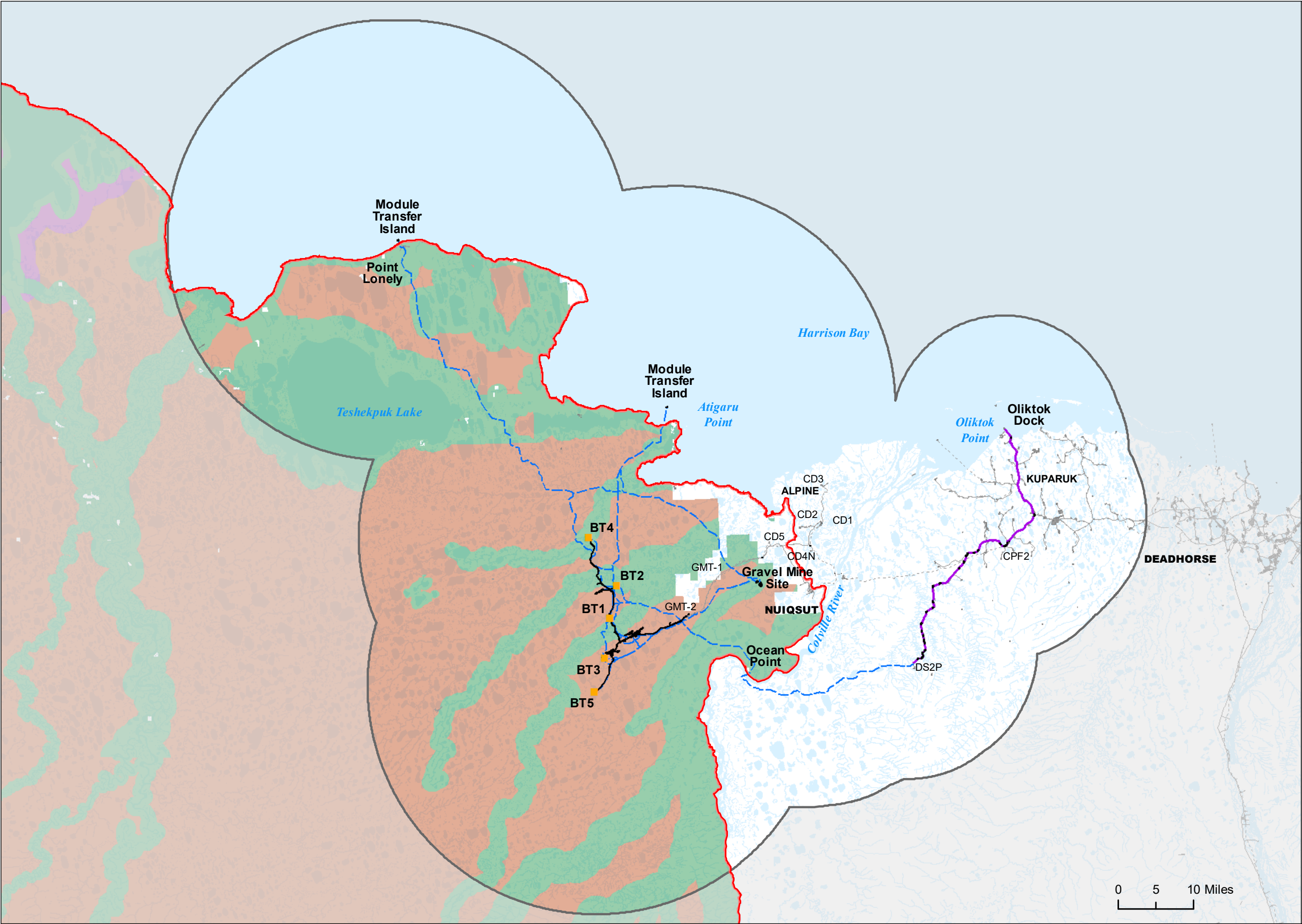
- Existing Road
- Existing Pipeline
- Existing Infrastructure

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.



0 5 10 Miles

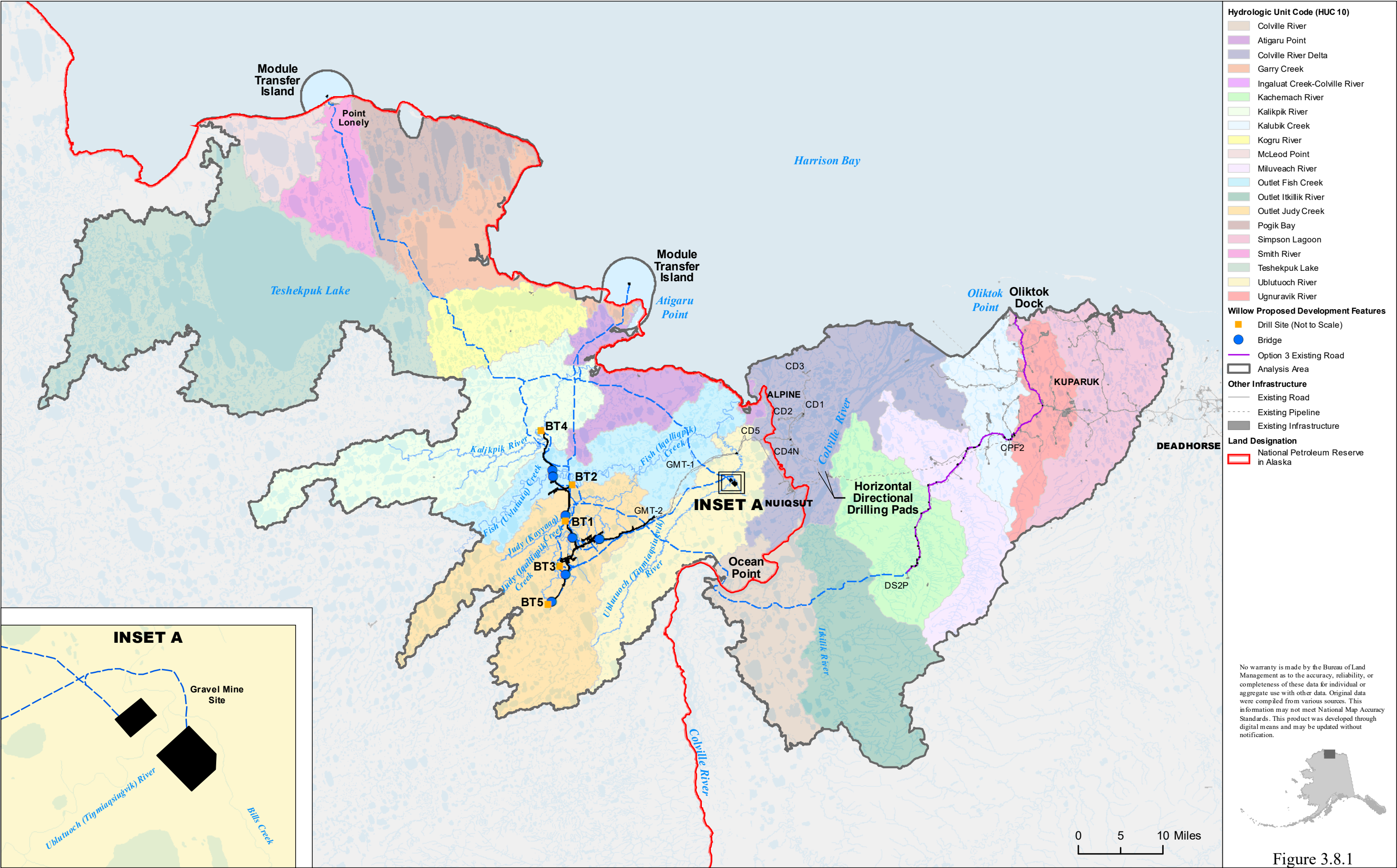
Figure 3.7.9

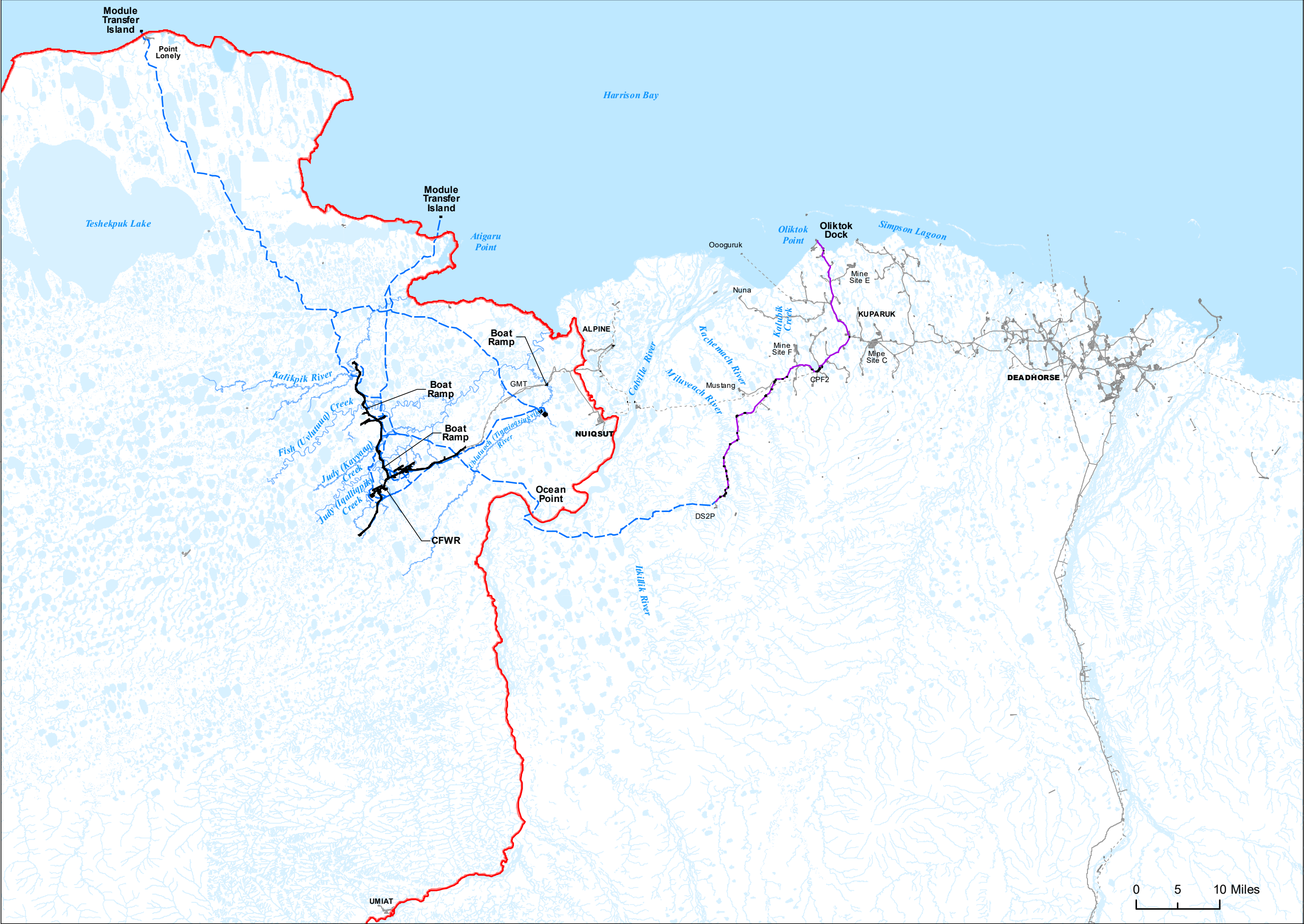


No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual or aggregate use with other data. Original data were compiled from various sources. This information may not meet National Map Accuracy Standards. This product was developed through digital means and may be updated without notification.



Figure 3.7.10





Willow Proposed Development Features

- Gravel Footprint
- Ice Road

Other Infrastructure

- Existing Road
- Existing Pipeline
- Existing Infrastructure

Land Designation

- National Petroleum Reserve in Alaska

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Figure 3.8.2

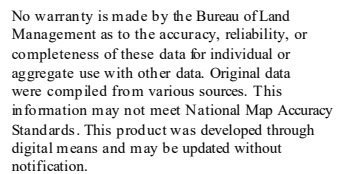
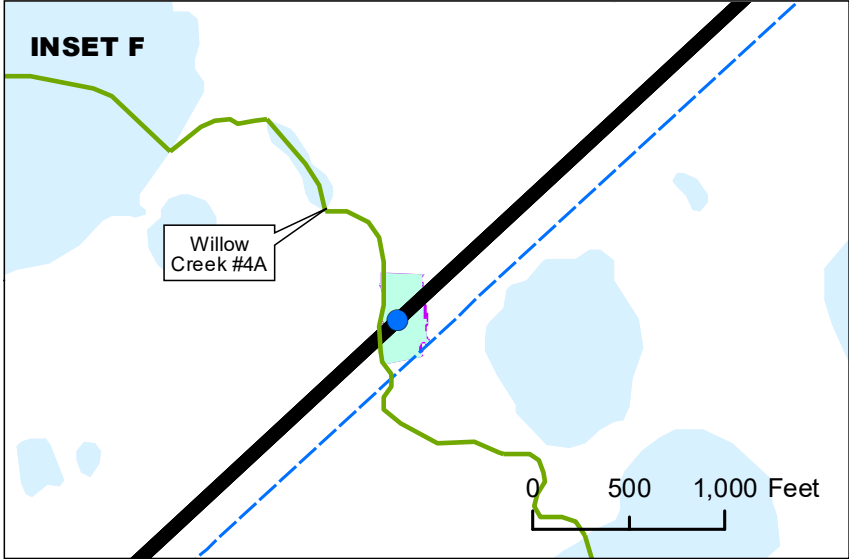
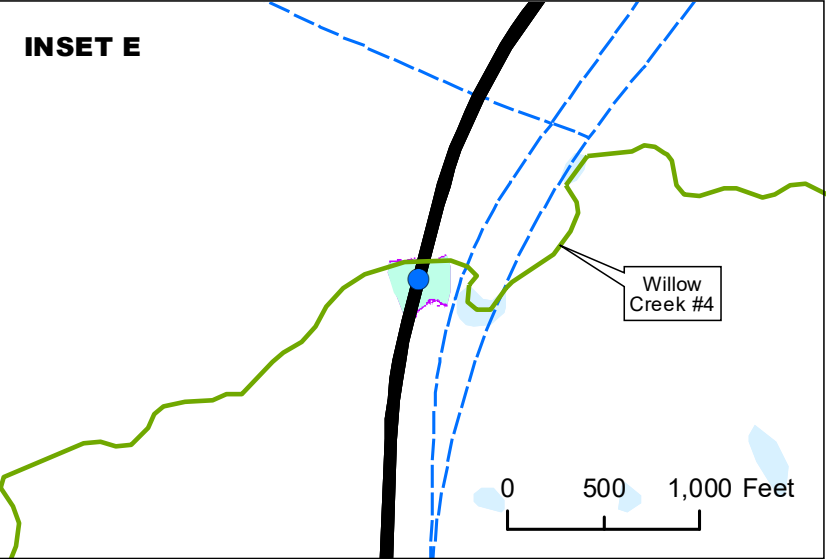
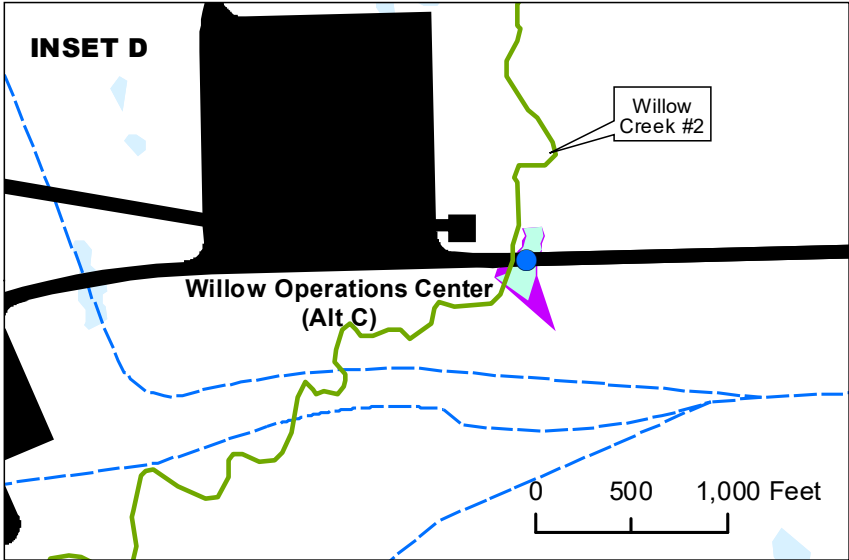
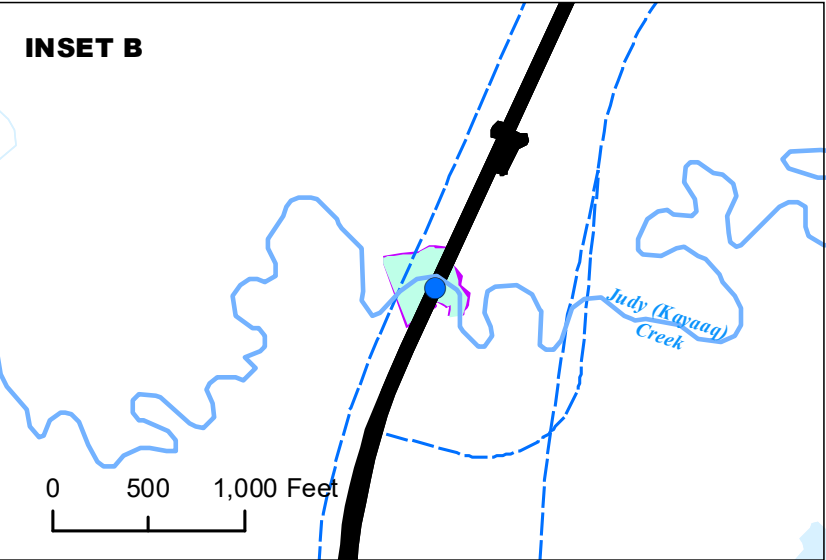
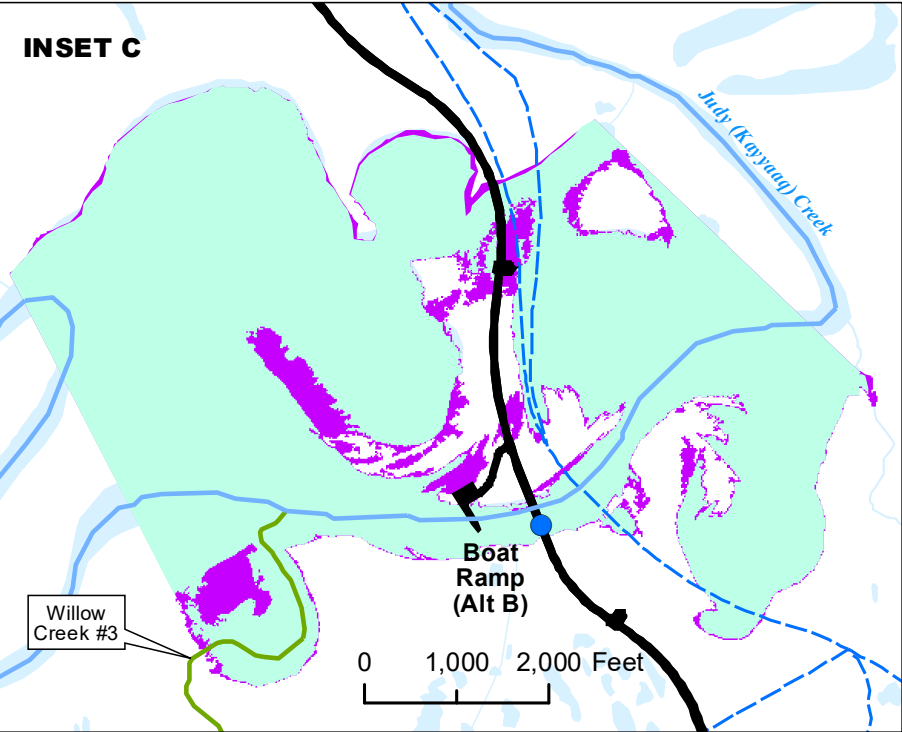
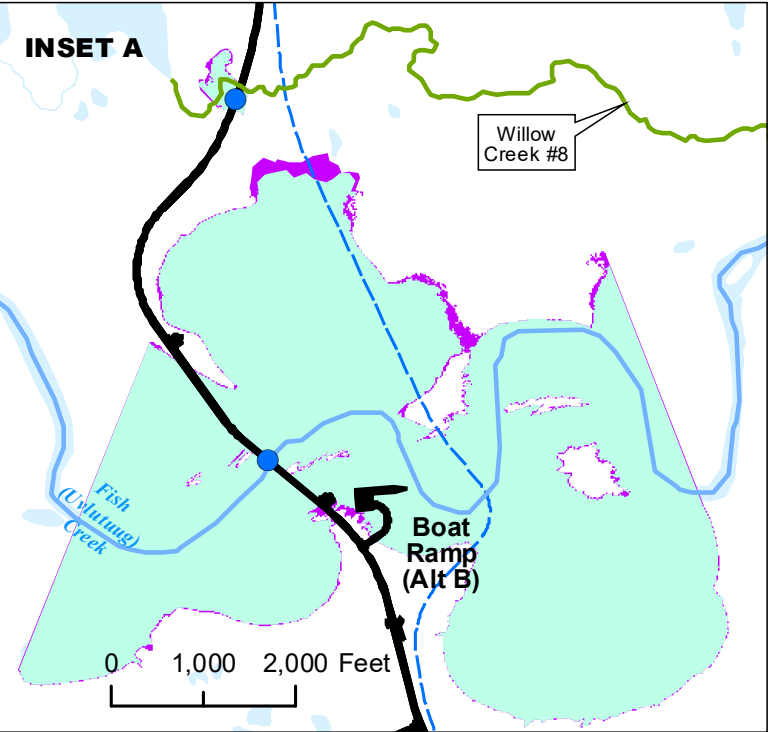
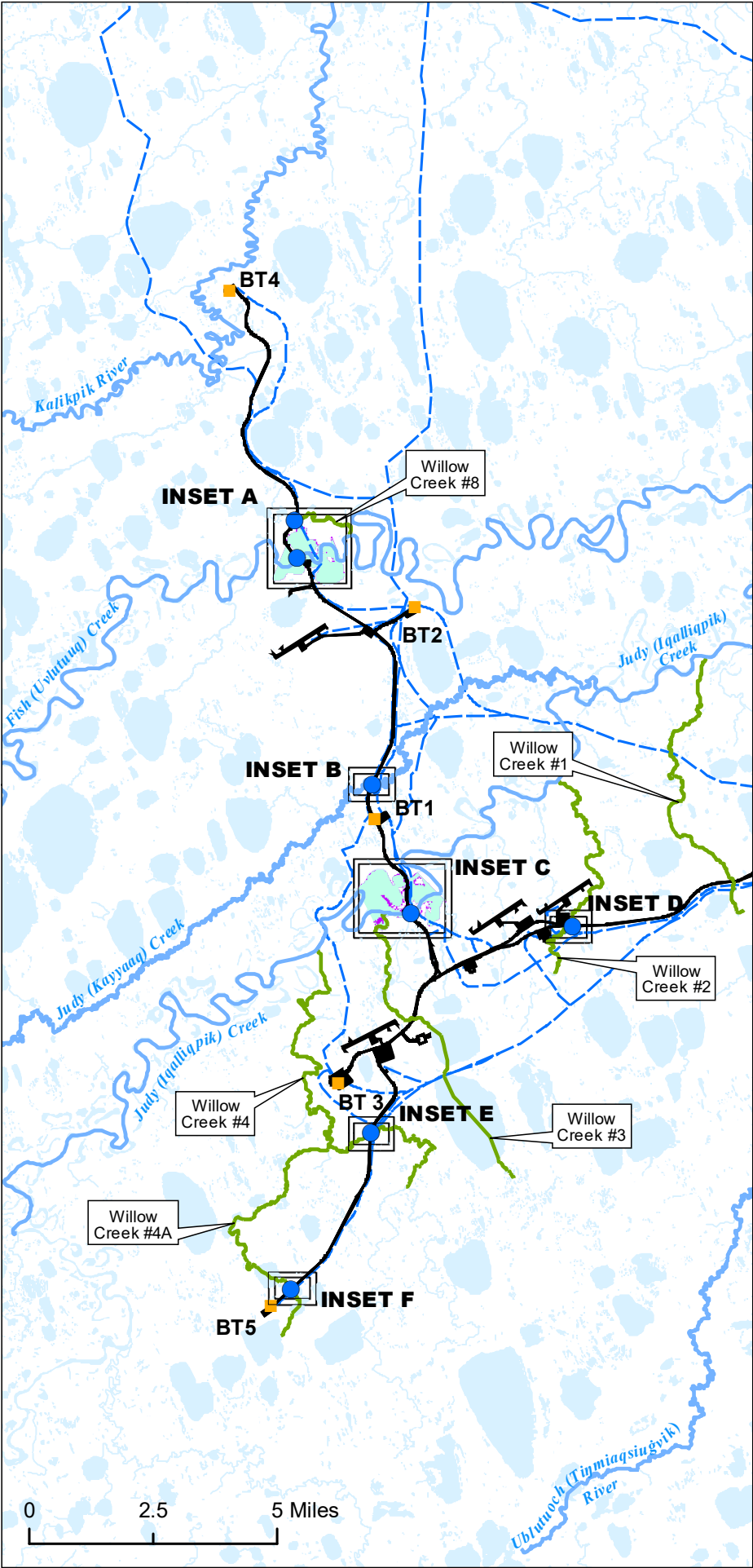


Figure 3.8.3



Floodplain

- 50-Year
- 100-Year

Willow Area Streams

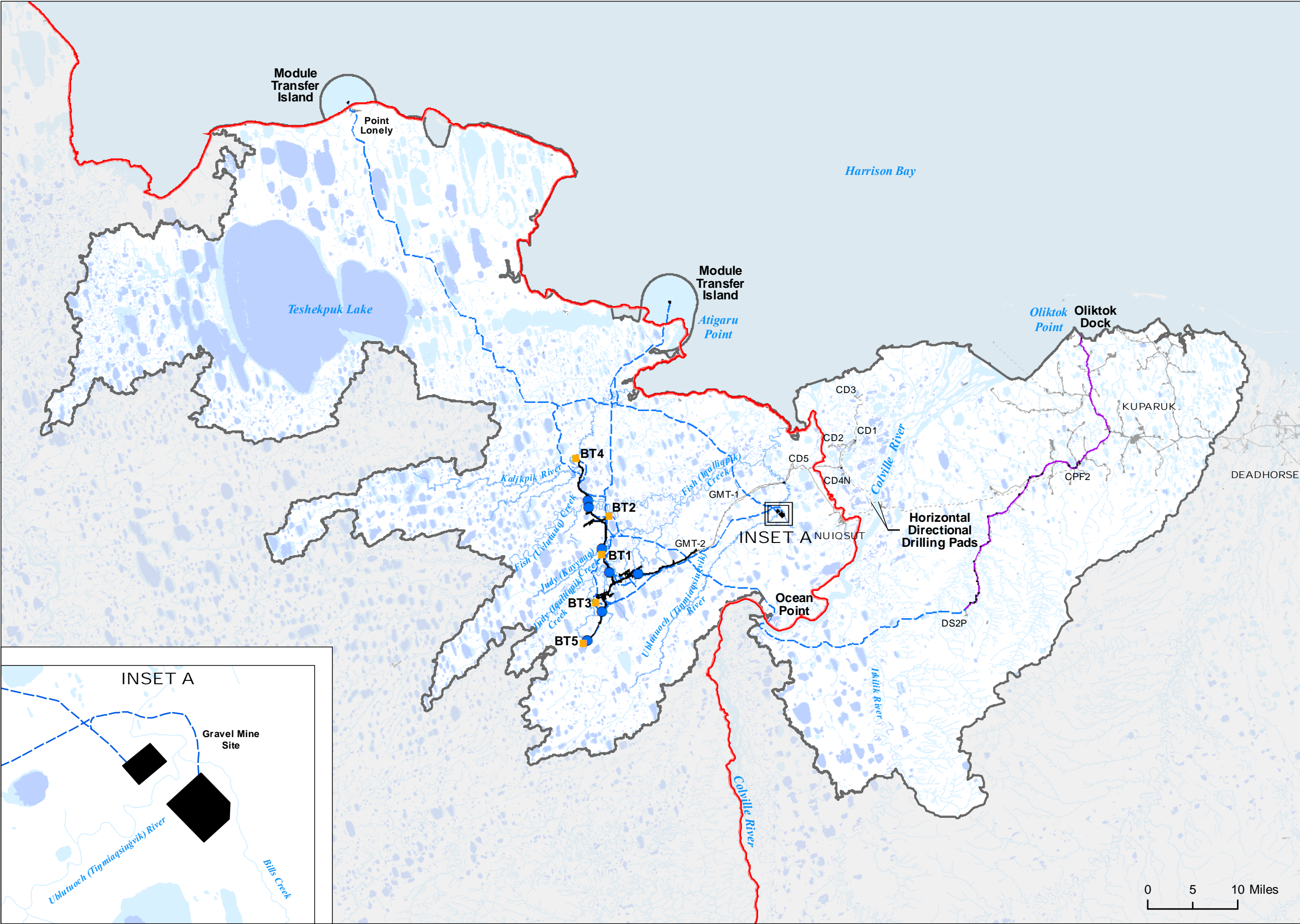
- Unnamed Stream (Willow Creek #)
- Named Streams

Willow Proposed Development Features

- Drill Site (Not to Scale)
- Bridge
- Ice Road
- Gravel Footprint

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.

Figure 3.8.4

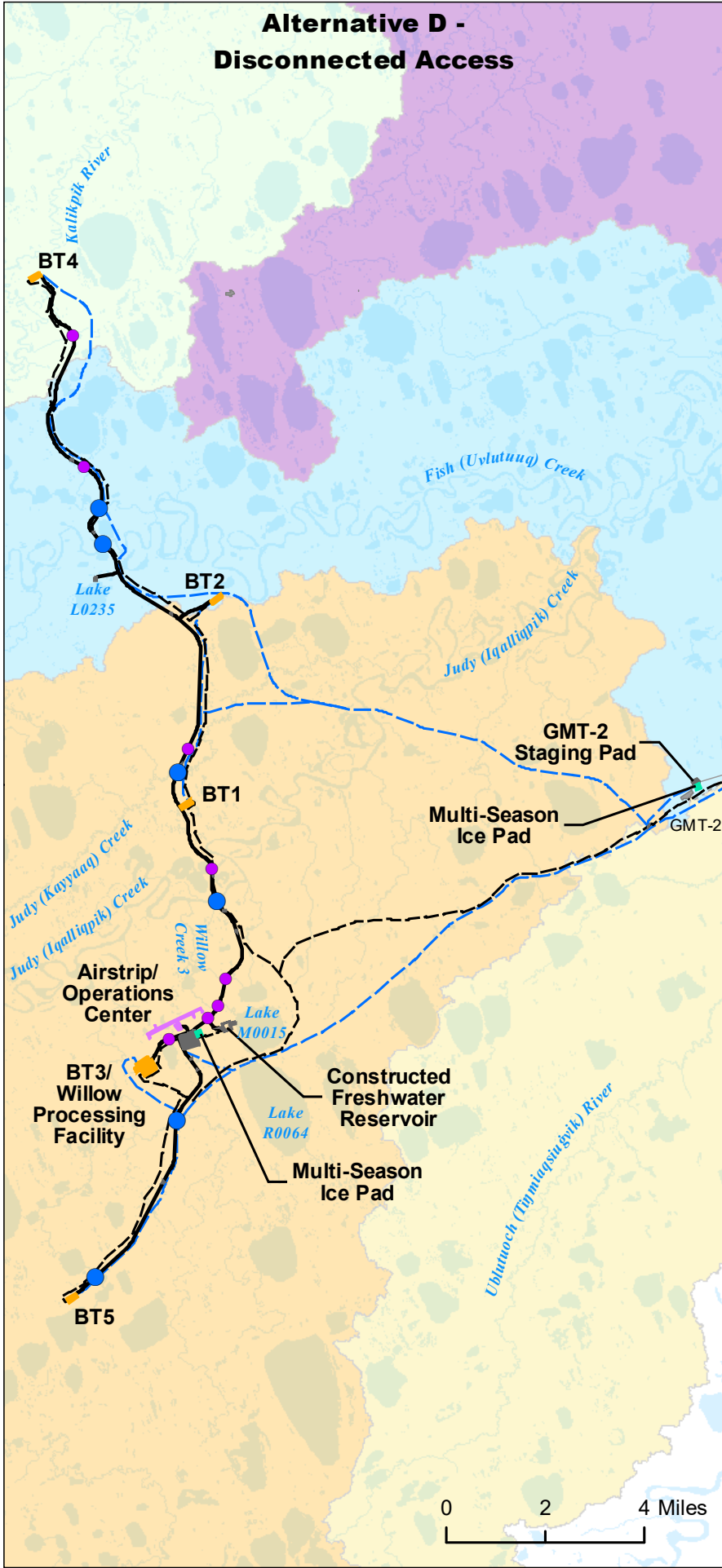
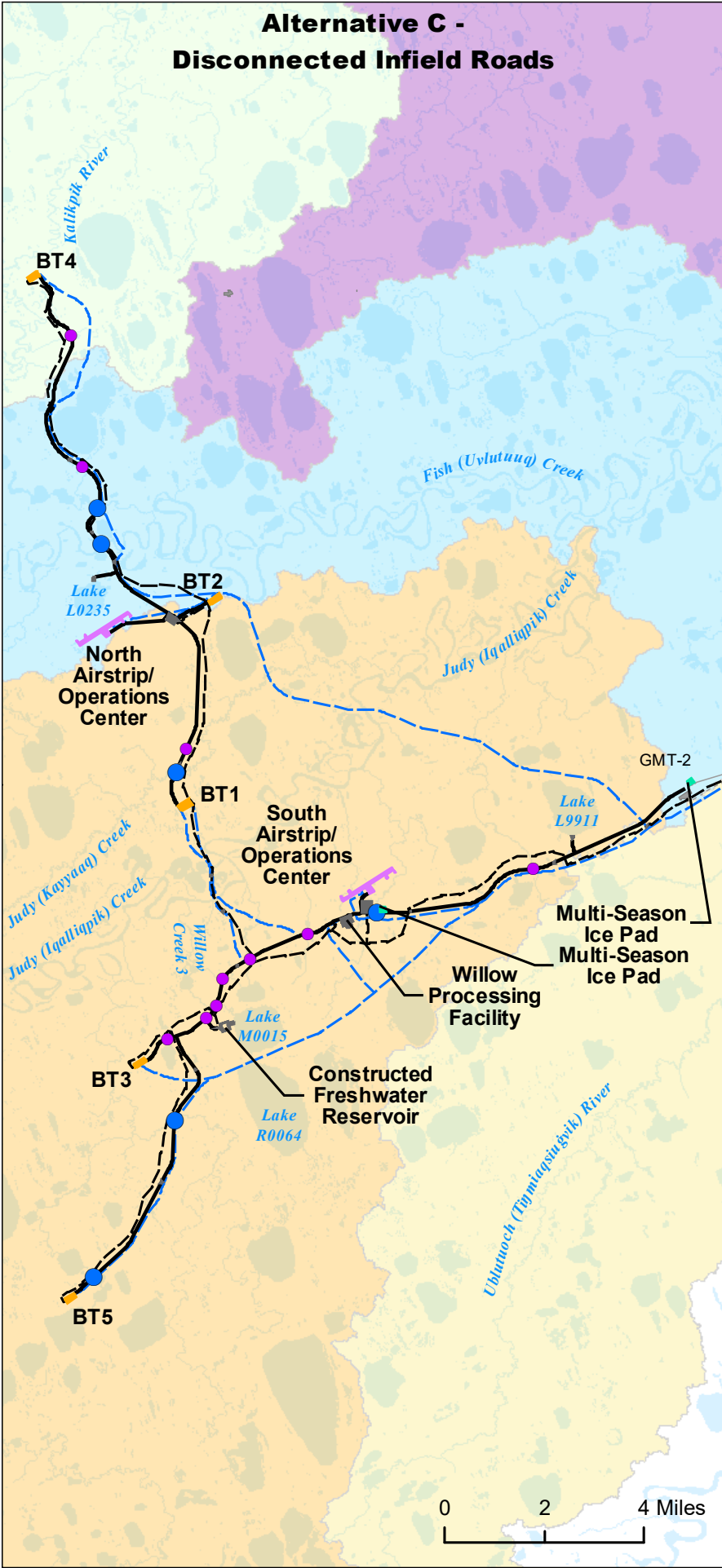
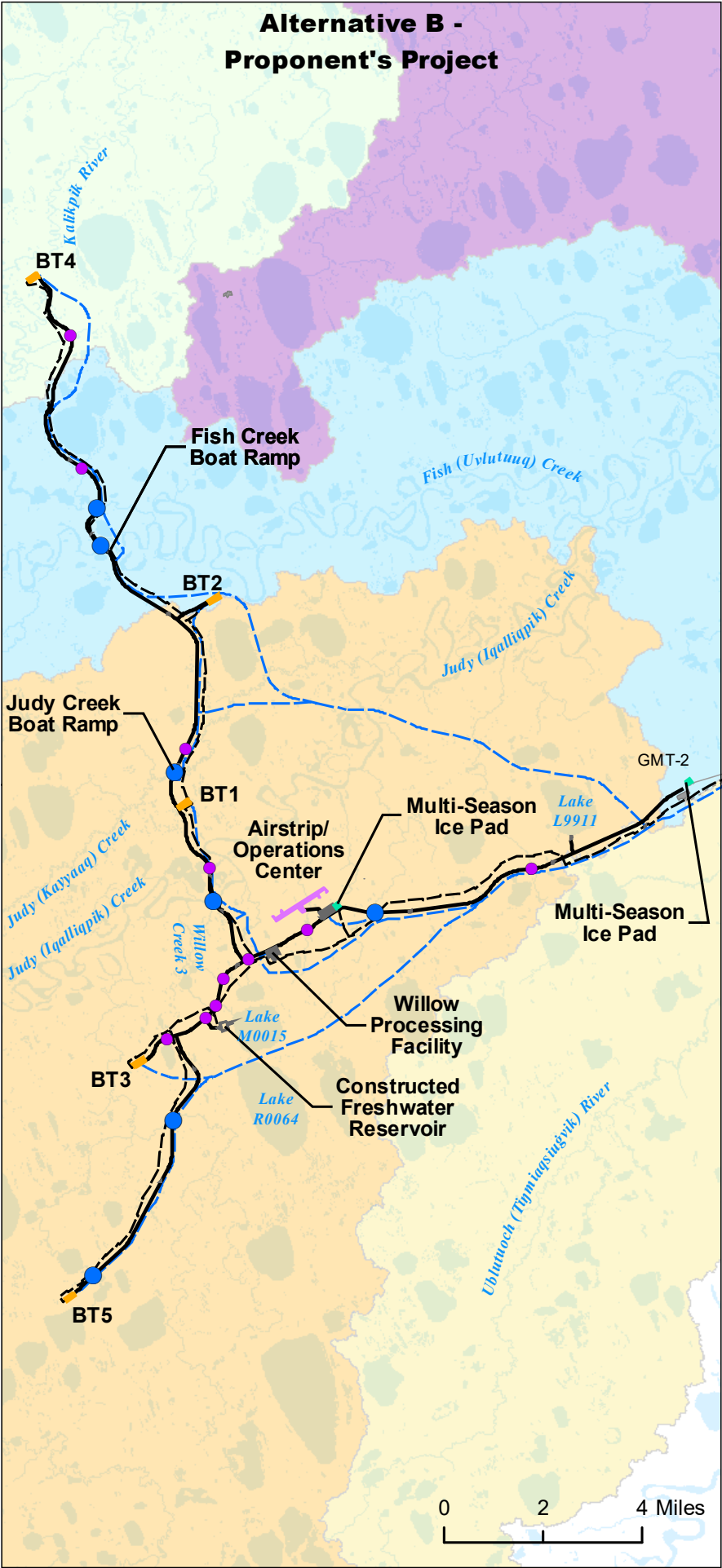


- Waterbodies**
- Winter Liquid Water Availability
- Willow Proposed Development Features**
- Drill Site (Not to Scale)
 - Bridge
 - Option 3 Existing Road
 - Analysis Area
- Other Infrastructure**
- Existing Road
 - Existing Pipeline
 - Existing Infrastructure
- Land Designation**
- National Petroleum Reserve in Alaska
- Data Source:
North Slope Science Initiative (2011)

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Figure 3.8.5



Hydrologic Unit Code (HUC 10)

- Atigaru Point
- Kalikpik River
- Outlet Fish Creek
- Outlet Judy Creek
- Ublutnooch River

Willow Proposed Development Features

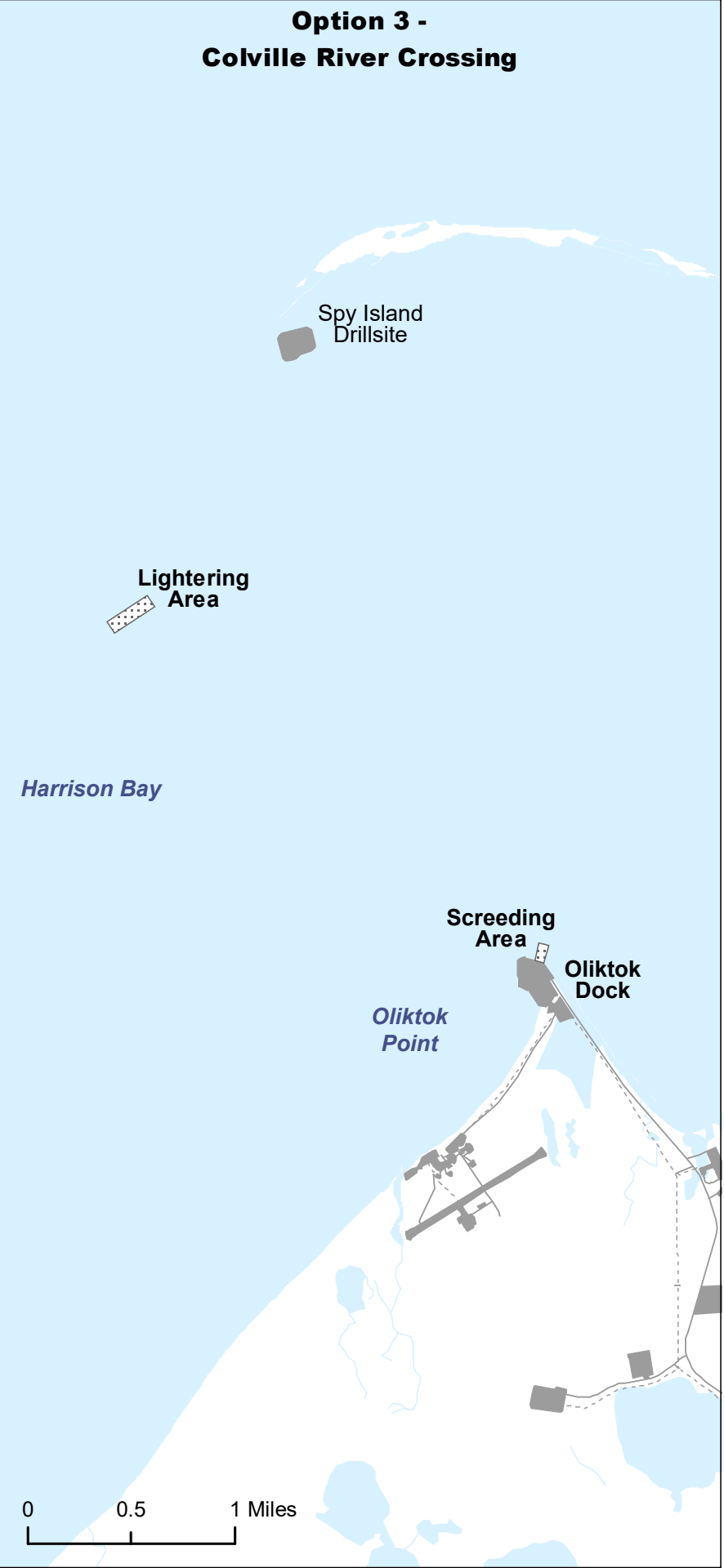
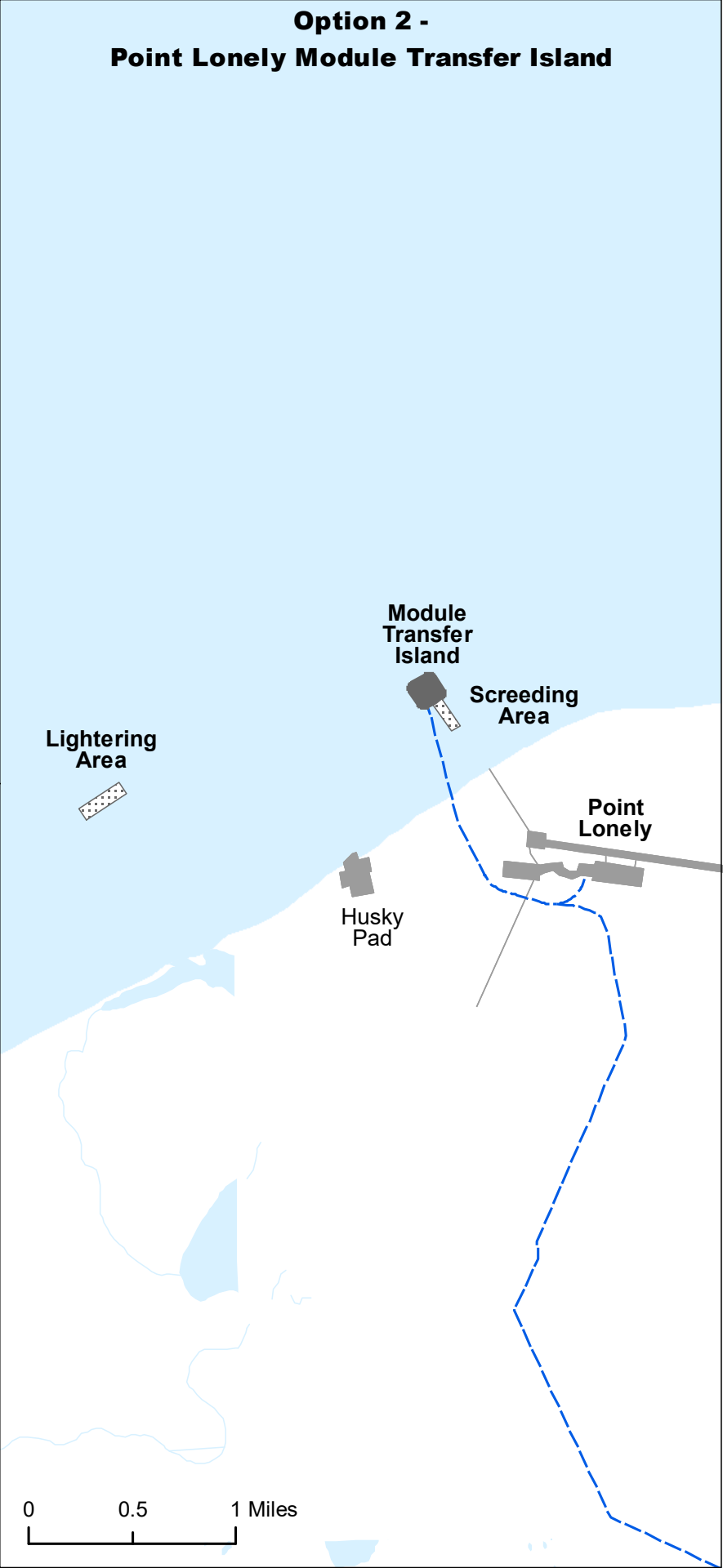
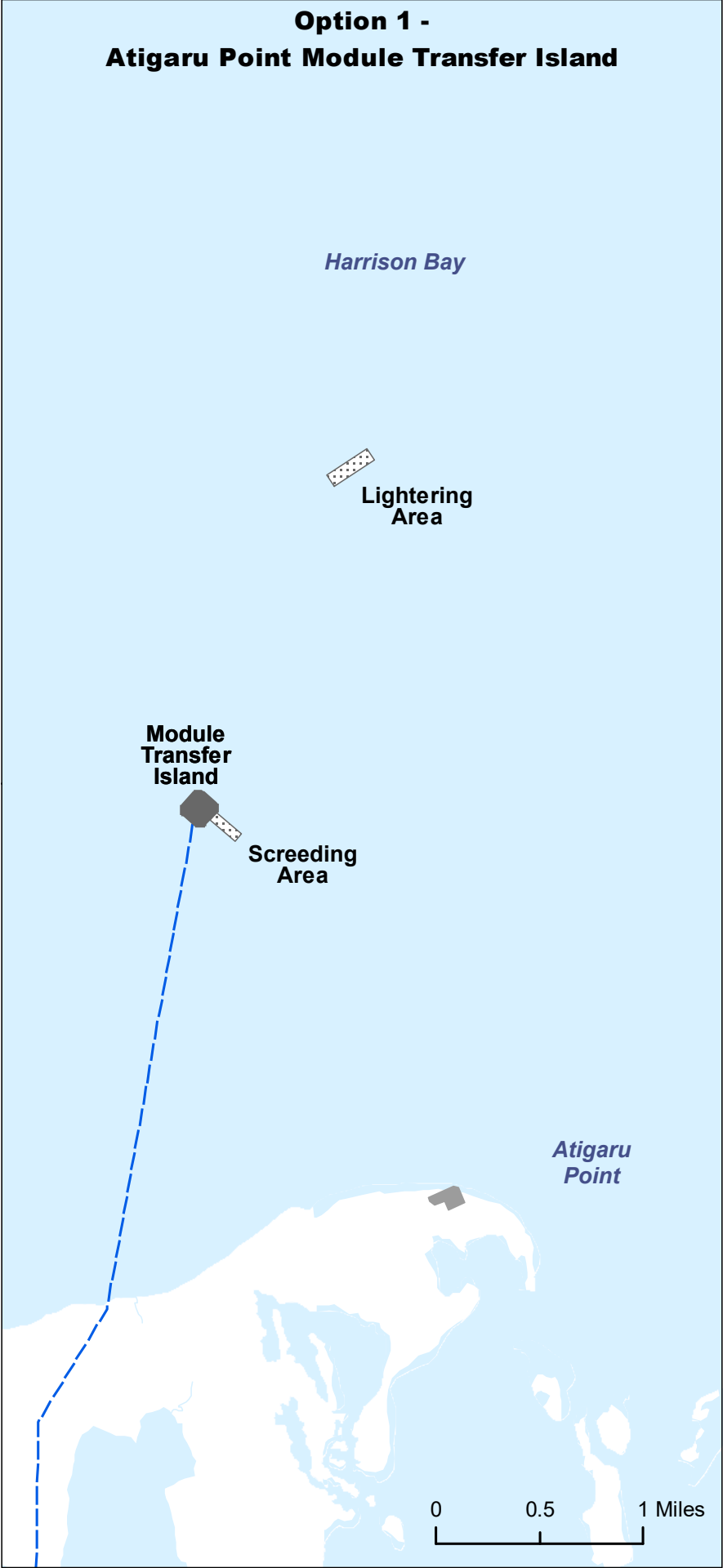
- Culvert Battery
- Bridge
- Gravel Road
- Pipeline
- Ice Road
- Airstrip
- Drill Site Pad
- Gravel Pad
- Ice Pad

Other Infrastructure

- Existing Road
- Existing Infrastructure

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Figure 3.8.6



Willow Proposed Development Features

- Ice Road
- Module Transfer Island
- Screeding

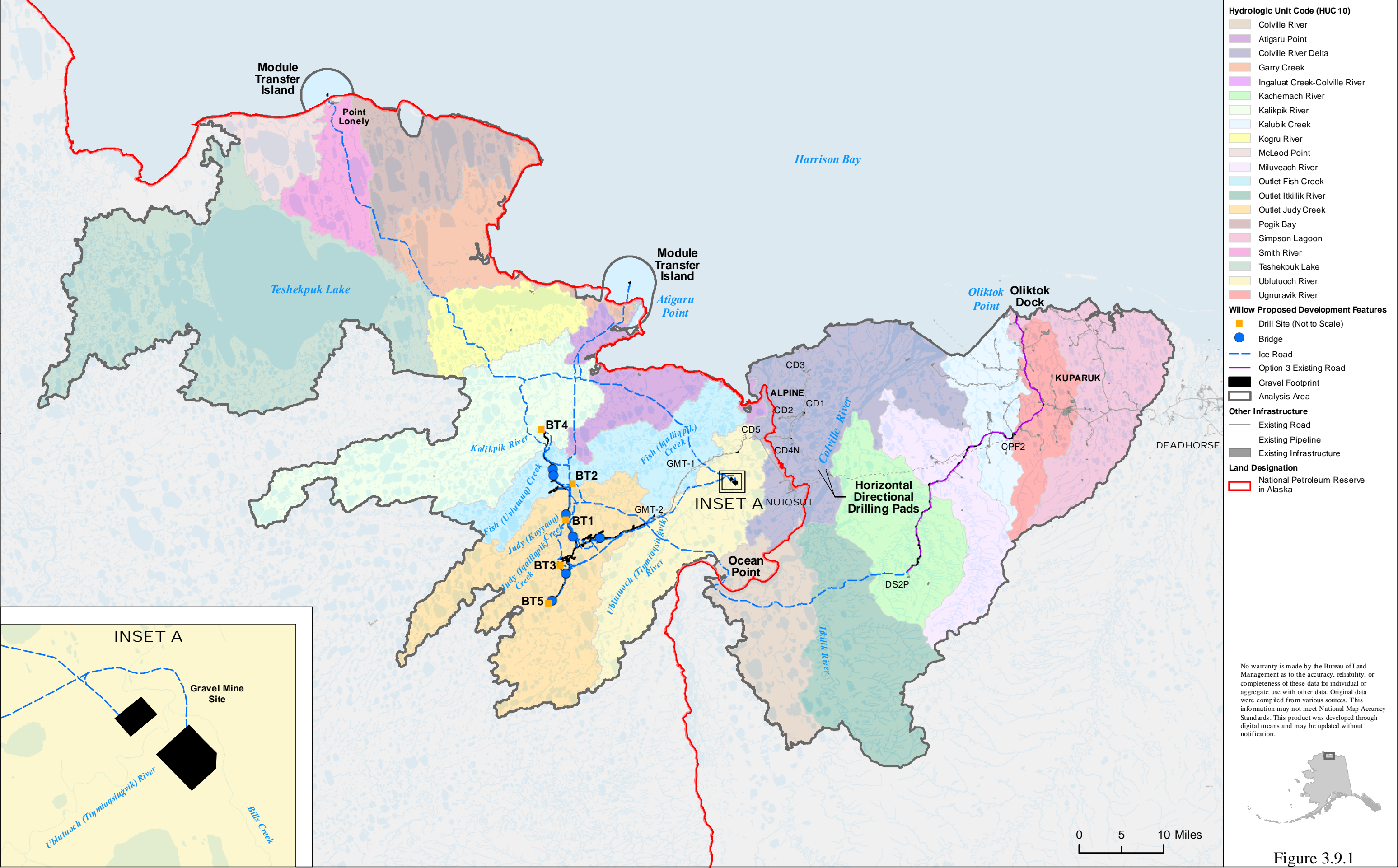
Other Infrastructure

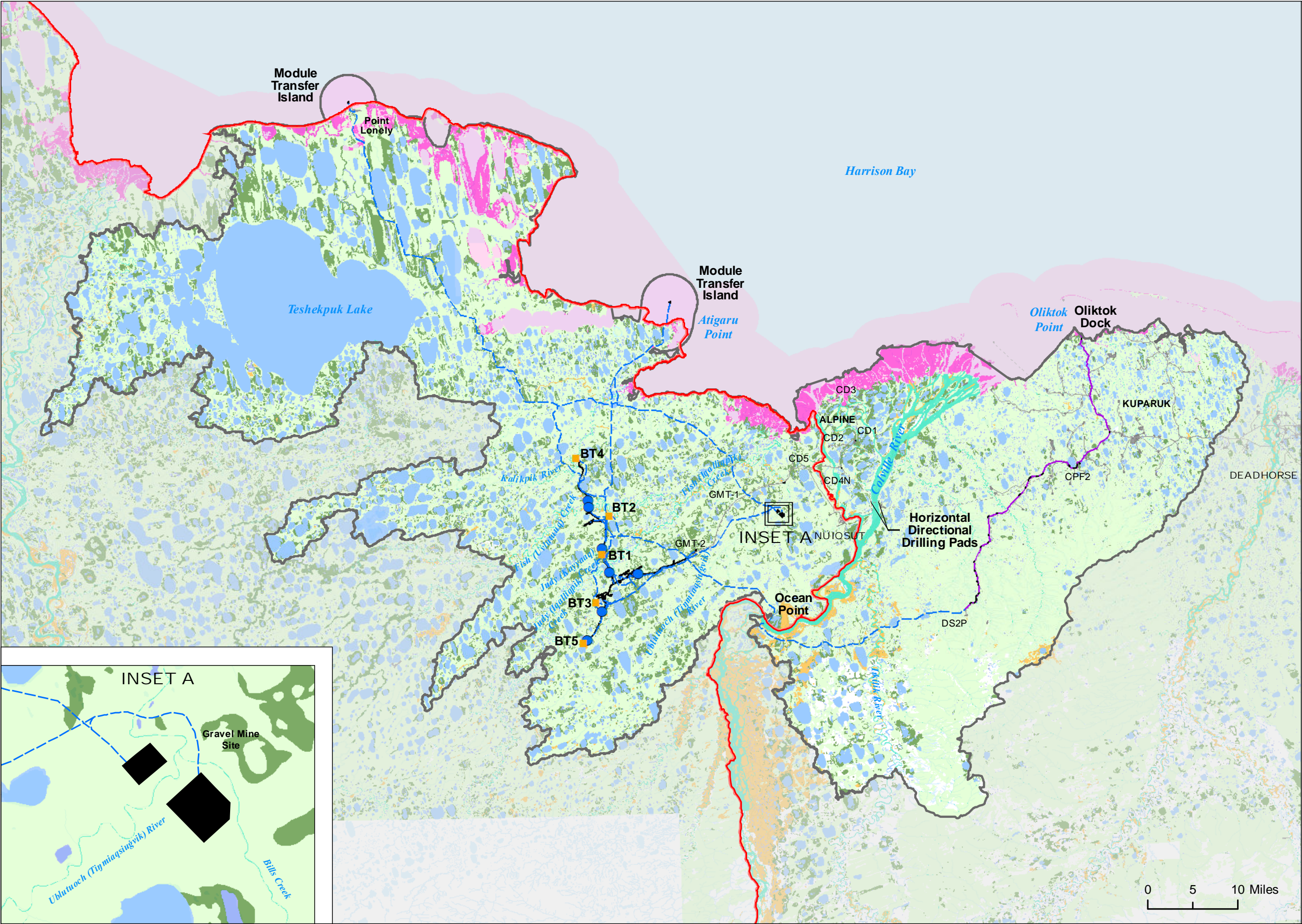
- Existing Road
- Existing Infrastructure

Note:
1. Oliktok Dock activity would occur under all action alternatives and Option 3: Colville River Crossing.

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Figure 3.8.7





National Wetlands Inventory
Cowardin Class System and Subsystem

- E1, M1
- E2, M2
- L1, L2
- PEM1, PEM2 - C, F, H Modifiers
- PEM1 - A, B, E Modifiers
- PSS1
- PUB
- PUS
- R2, R3, R5

Willow Proposed Development Features

- Drill Site (Not to Scale)
- Bridge
- Ice Road
- Option 3 Existing Road
- Gravel Footprint
- Analysis Area

Other Infrastructure

- Existing Road
- Existing Pipeline
- Existing Infrastructure

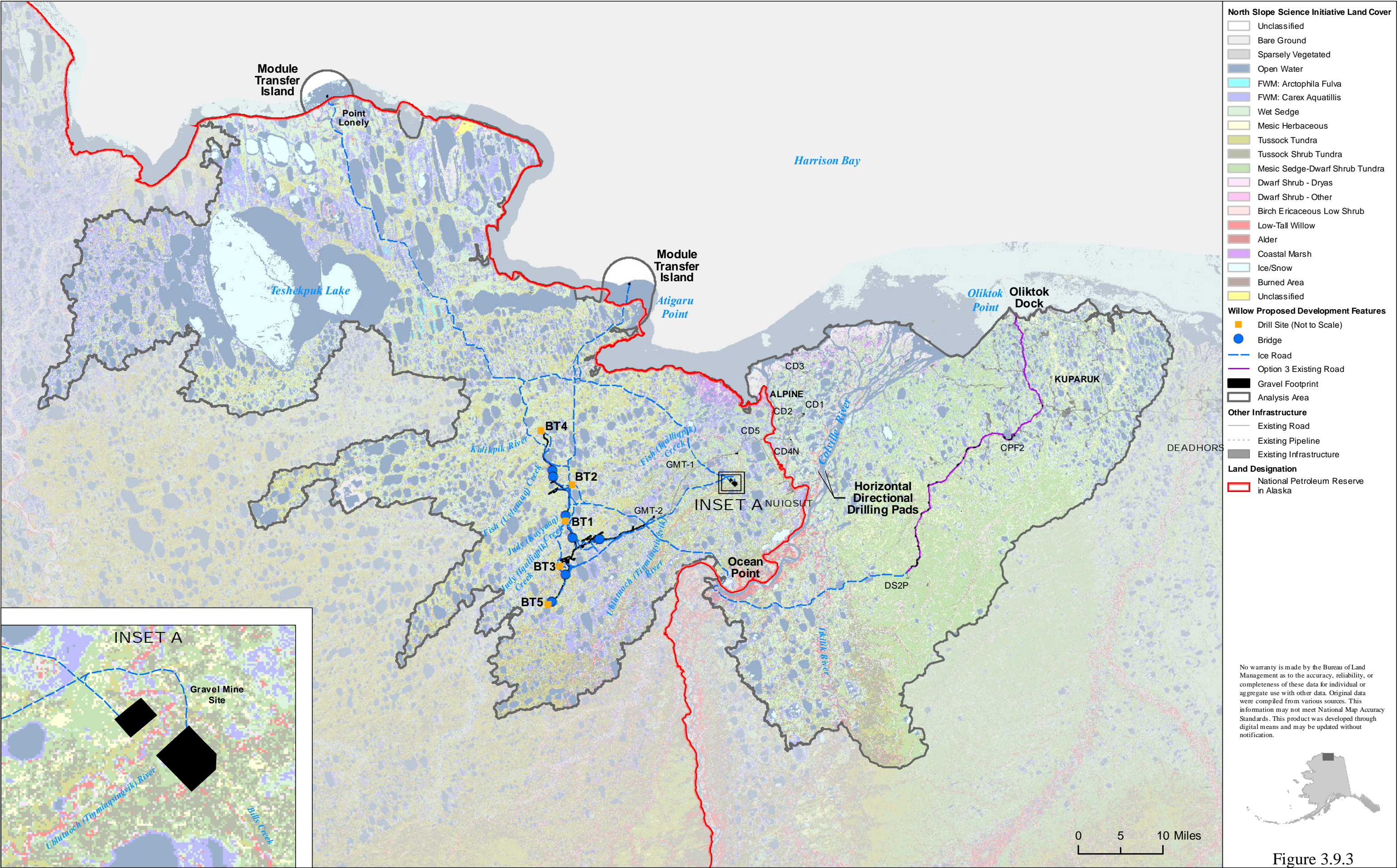
Land Designation

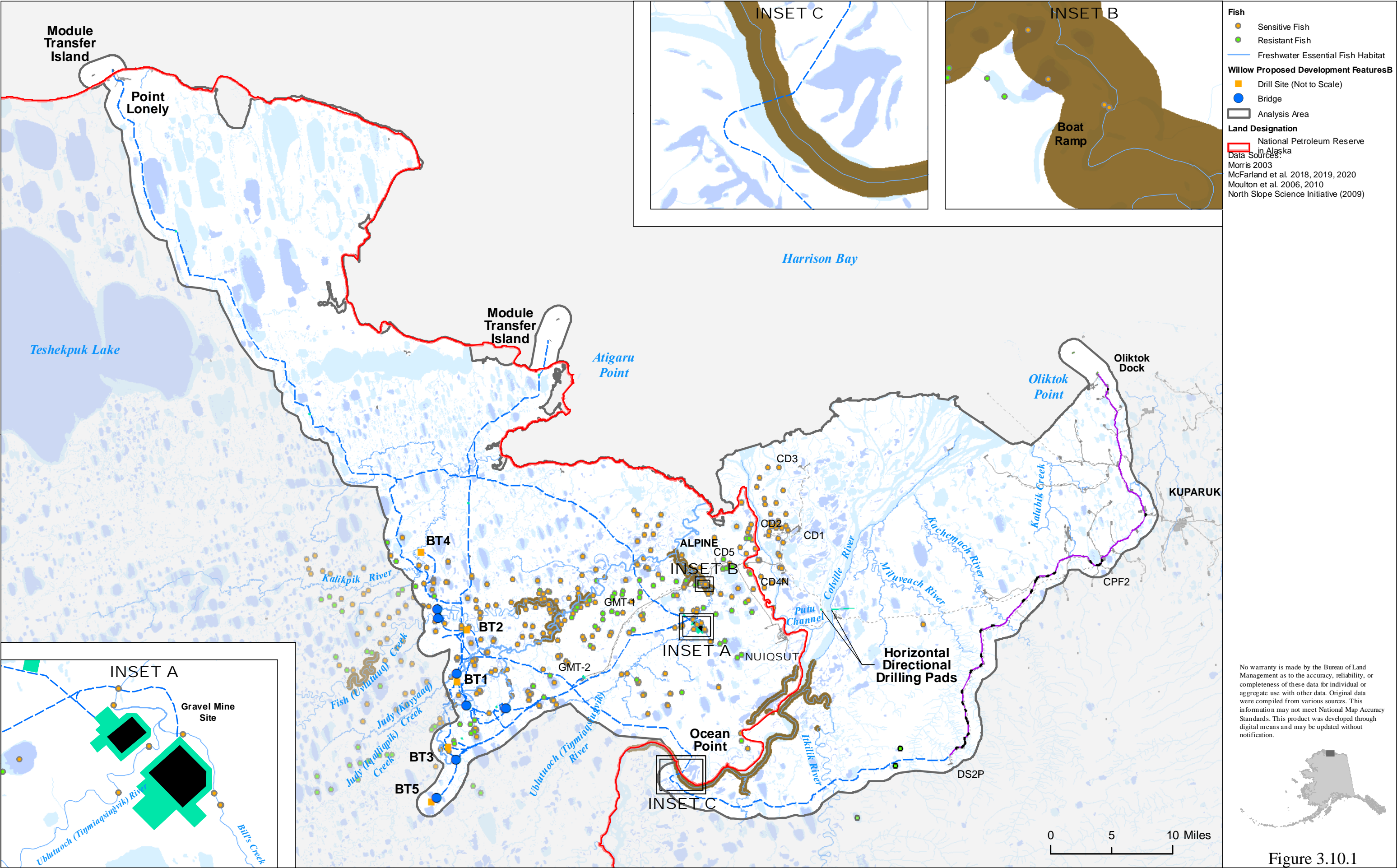
- National Petroleum Reserve in Alaska

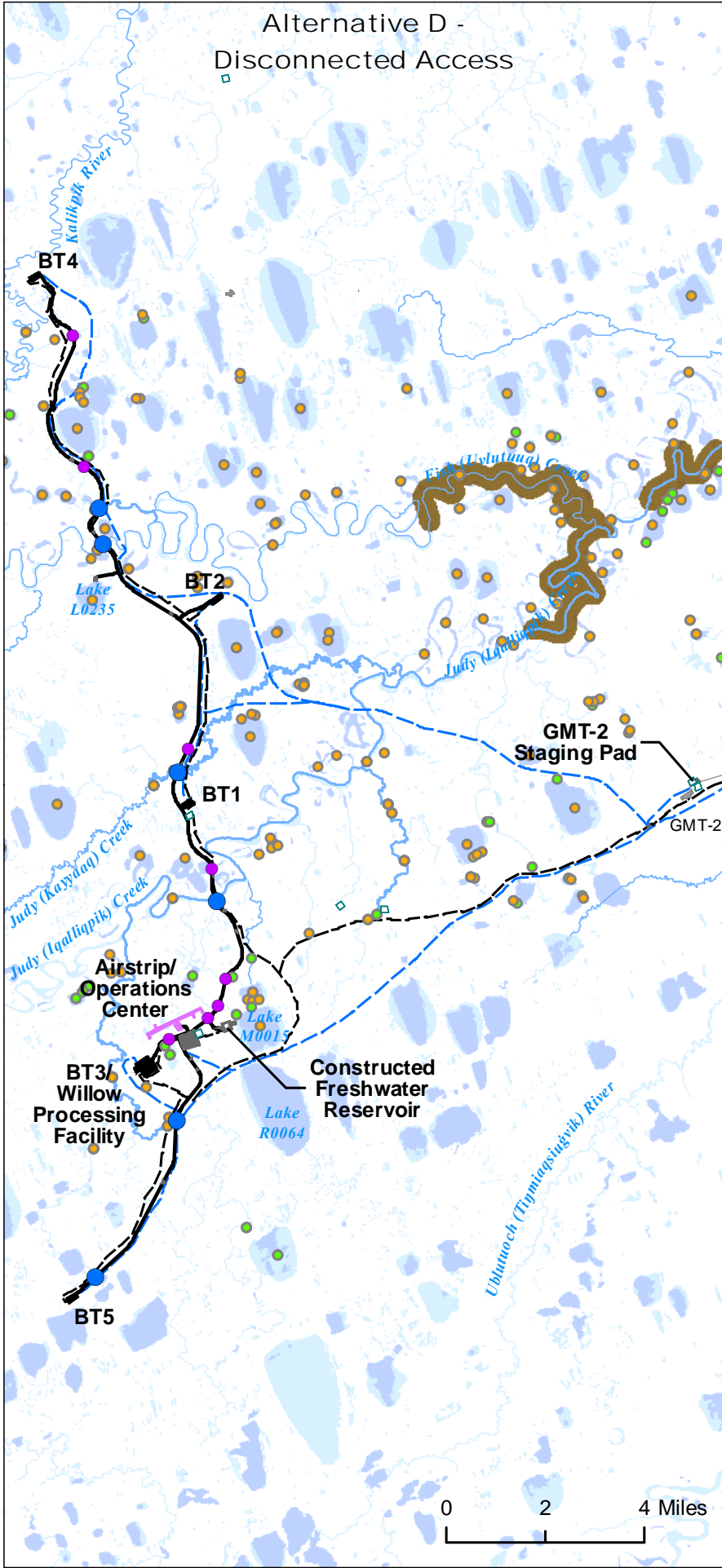
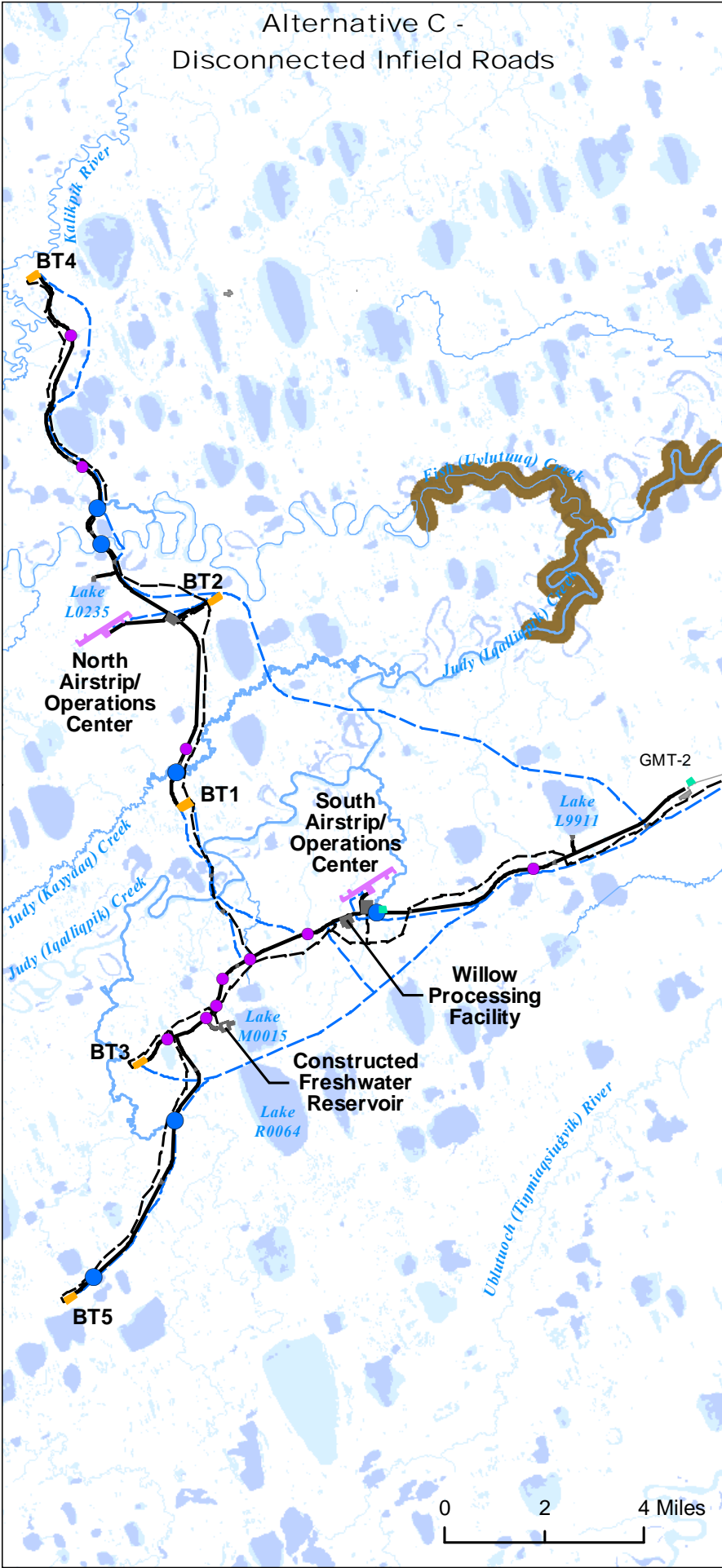
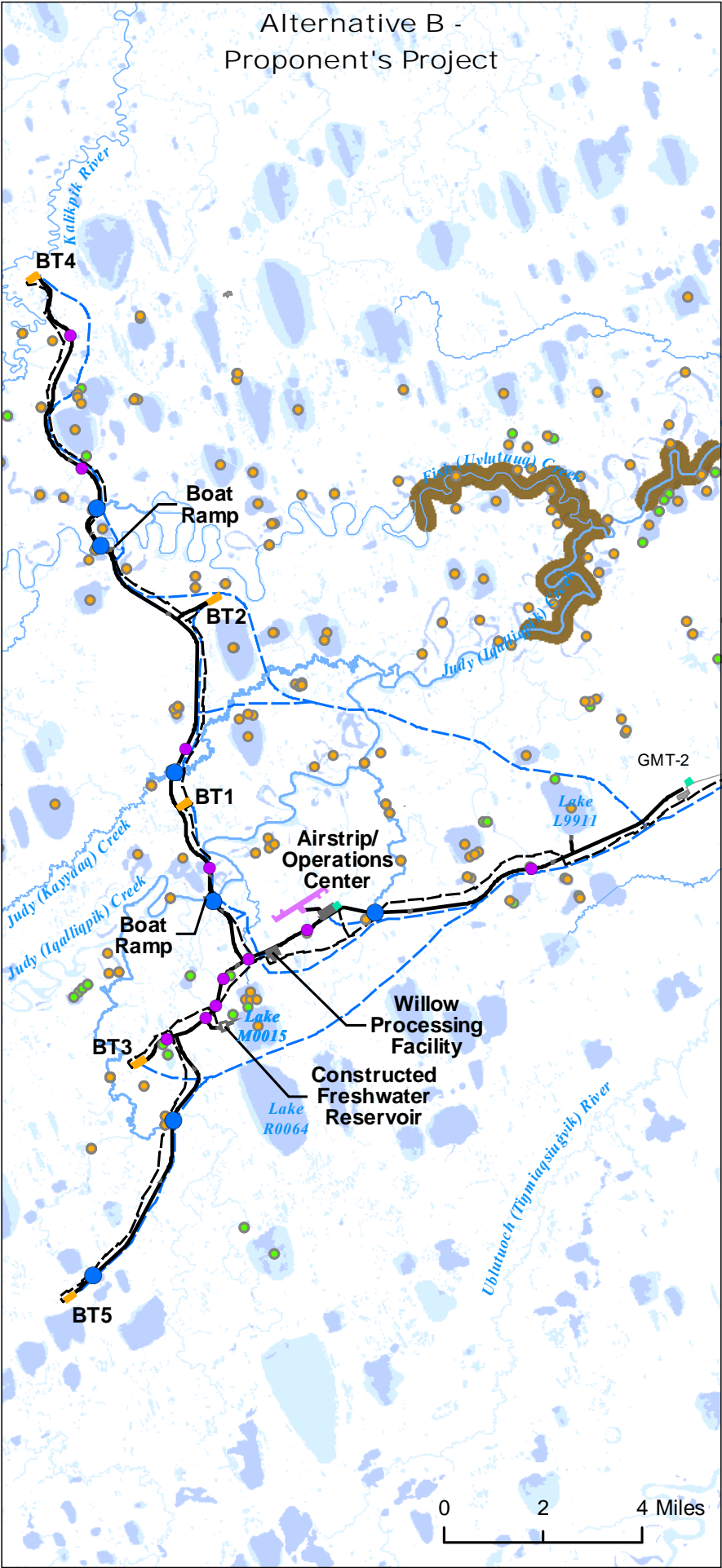
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Figure 3.9.2







Fish

- Sensitive Fish
- Resistant Fish
- Freshwater Essential Fish Habitat
- Overwintering Fish Habitat
- Winter Liquid Water Availability

Willow Proposed Development Features

- Culvert Battery
- Bridge
- Gravel Road
- Pipeline
- Ice Road
- Airstrip
- Dill Site Pad
- Gravel Pad
- Ice Pad

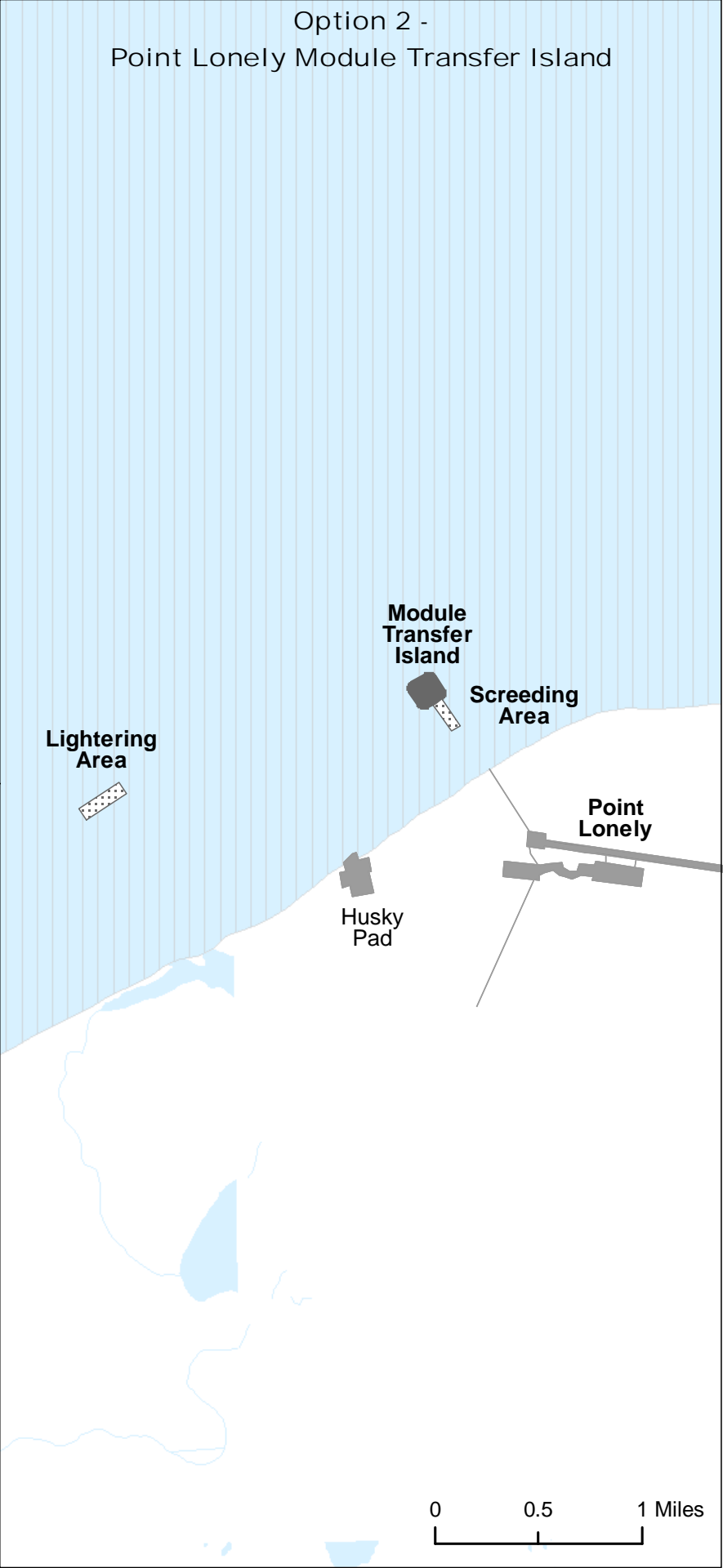
Other Infrastructure

- Existing Road
- Existing Infrastructure

Data Sources:
Morris 2003
McFarland et al. 2018, 2019, 2020
Moulton et al. 2006, 2010
North Slope Science Initiative (2009)

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Figure 3.10.2



Fish

- Marine Essential Fish Habitat

Willow Proposed Development Features

- Screeding

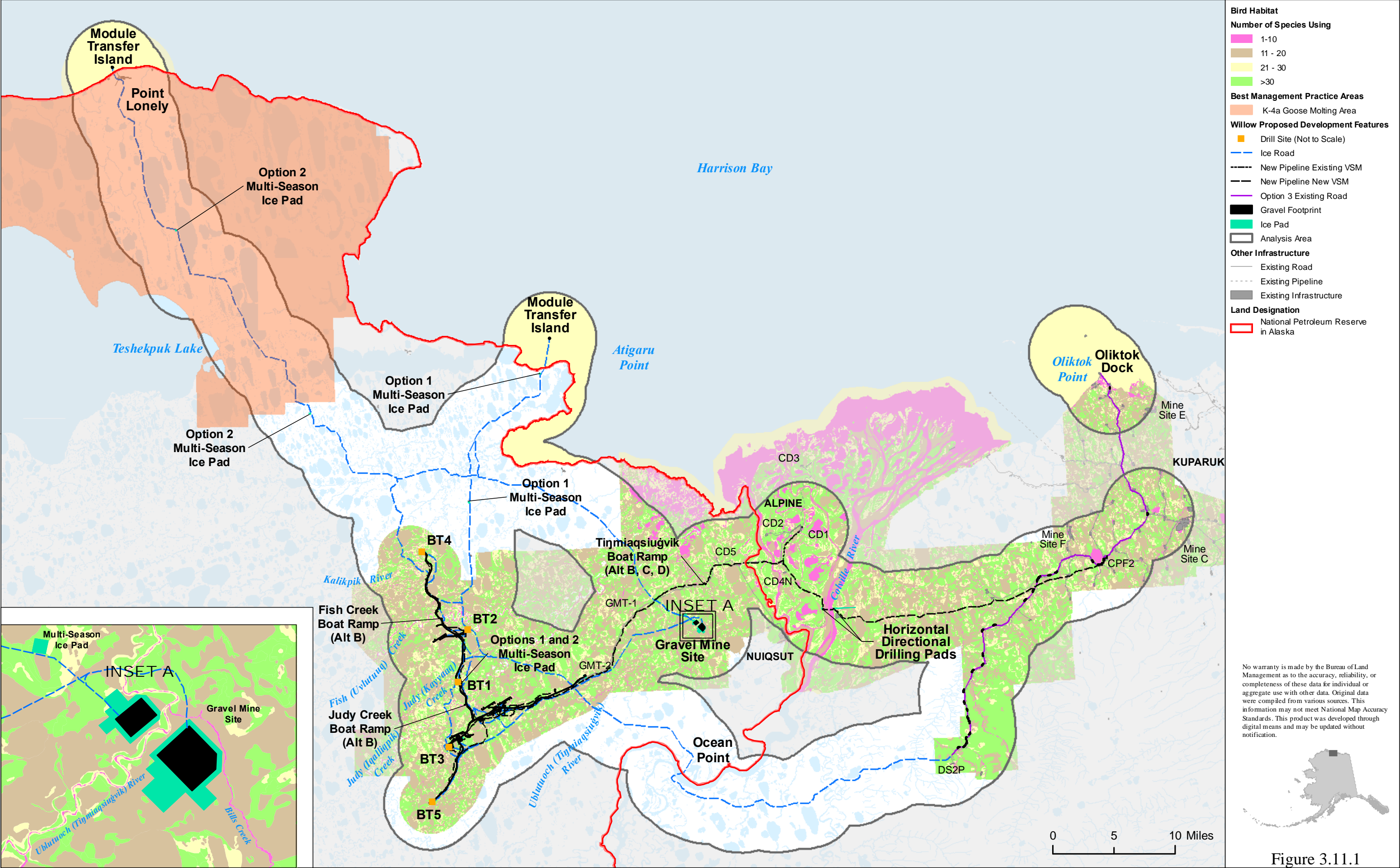
Other Infrastructure

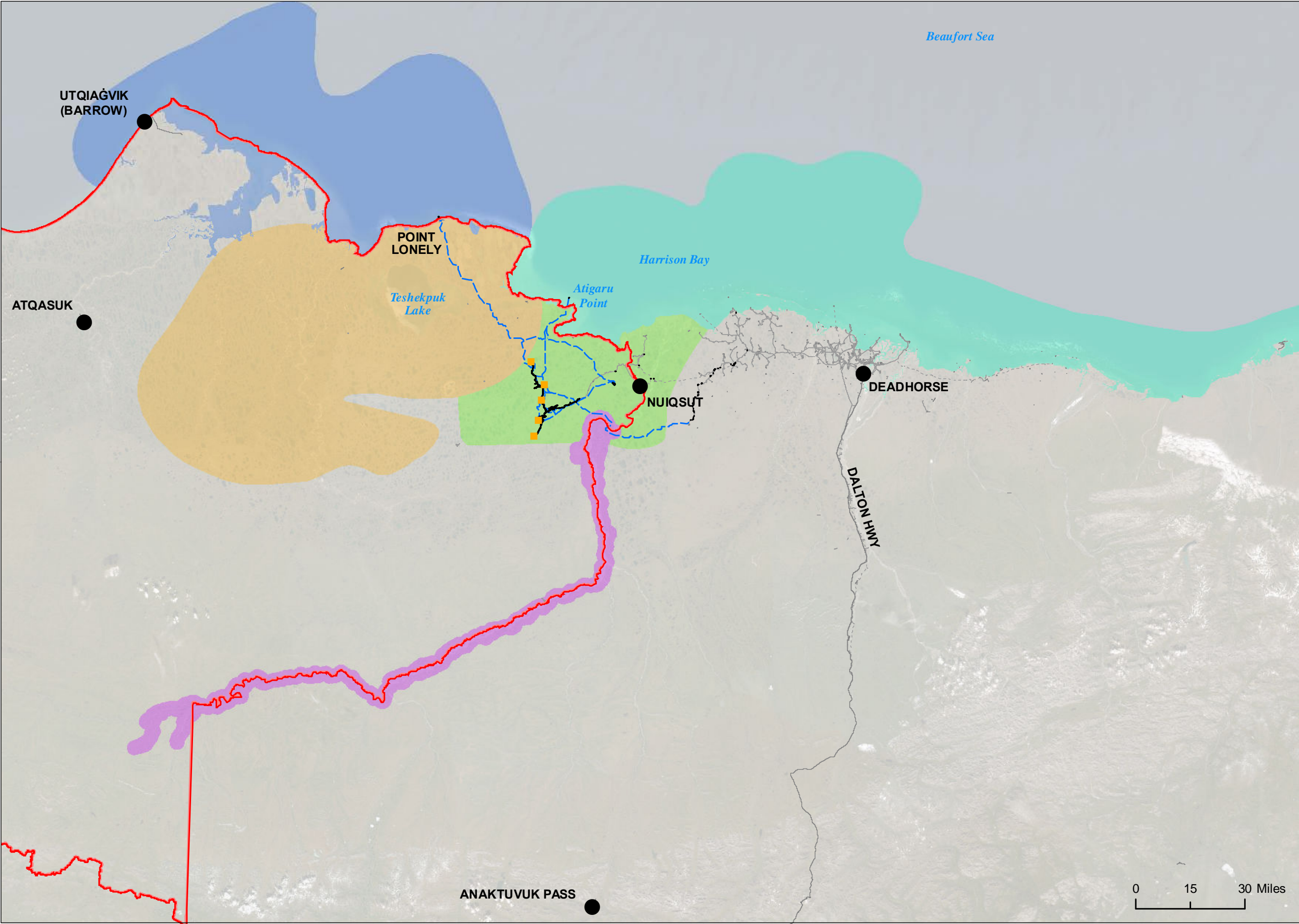
- Existing Road
- Existing Pipeline
- Existing Infrastructure

Note:
1. Oliktok Dock activity would occur under all action alternatives and Option 3: Colville River Crossing.

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.

Figure 3.10.3





Important Bird Areas of Alaska, v3

- Barrow Canyon & Smith Bay
- Beaufort Sea Nearshore
- Colville River Delta
- Lower Colville River
- Teshekpuk Lake Area

Willow Proposed Development Features

- Drill Site (Not to Scale)
- Ice Road
- Gravel Footprint

Other Infrastructure

- Existing Road
- Existing Pipeline
- Existing Infrastructure

Data Source:
Audubon Alaska (2020)

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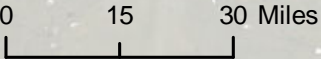
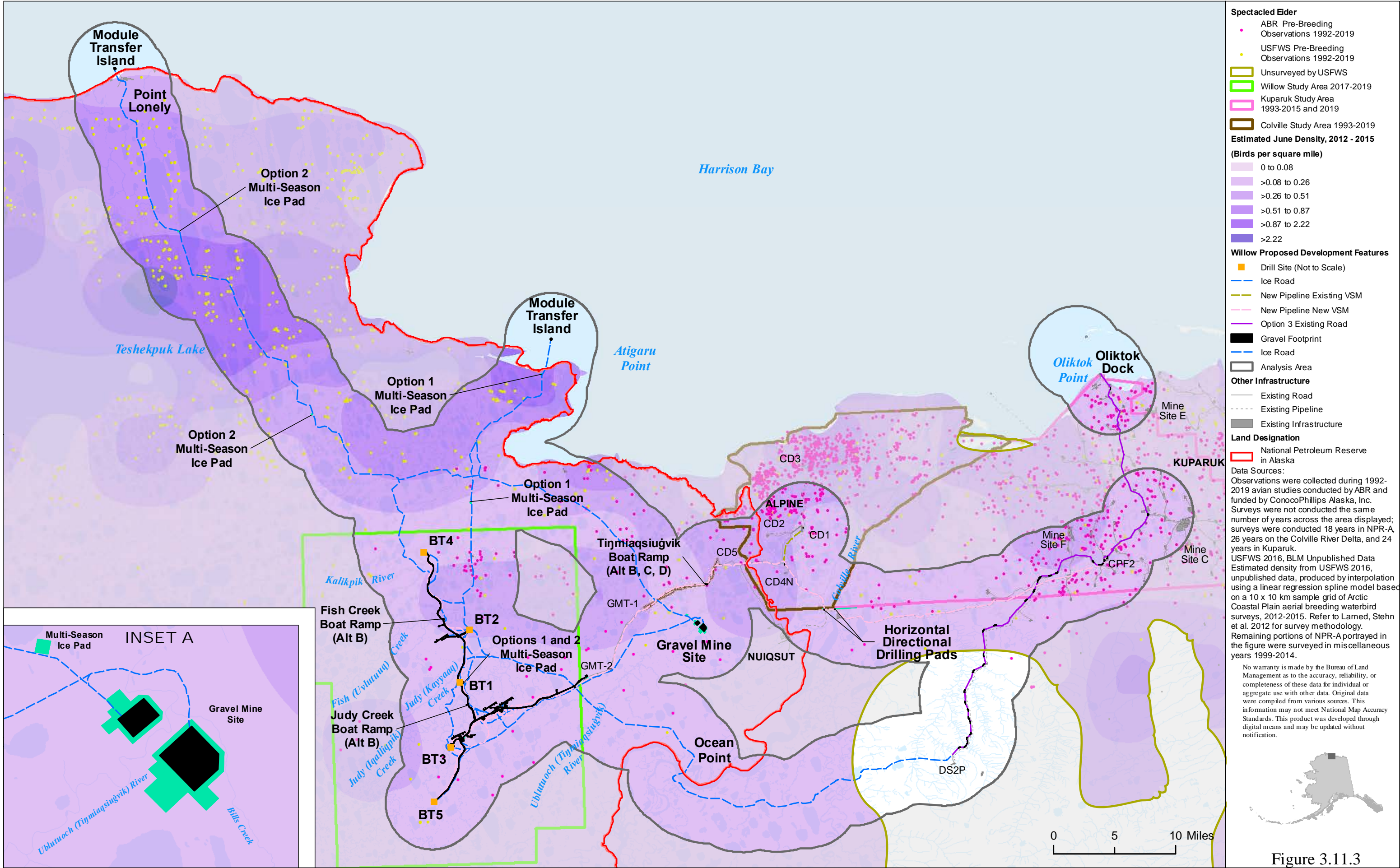
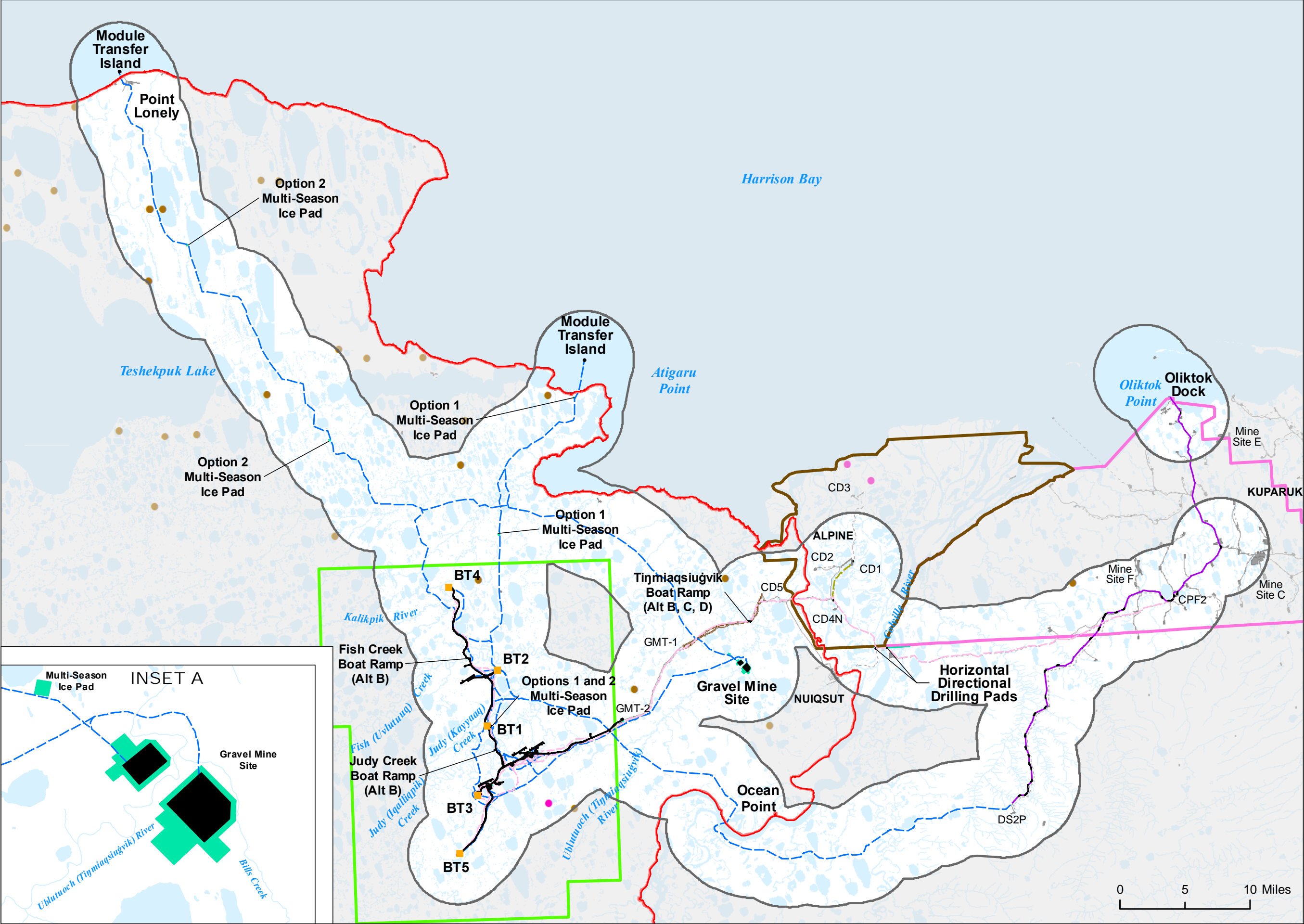


Figure 3.11.2





Steller's Eider

- ABR Pre-breeding Observations 1992-2019
- USFWS Pre-Breeding Observations 1992-2019
- ▭ Willow Study Area 2017-2019
- ▭ Kuparuk Study Area 1993-2015 and 2019
- ▭ Colville Study Area 1993-2019

Willow Proposed Development Features

- Drill Site (Not to Scale)
- Ice Road
- New Pipeline Existing VSM
- New Pipeline New VSM
- Option 3 Existing Road
- Gravel Footprint
- Ice Road
- ▭ Analysis Area

Other Infrastructure

- Existing Road
- Existing Pipeline
- Existing Infrastructure

Land Designation

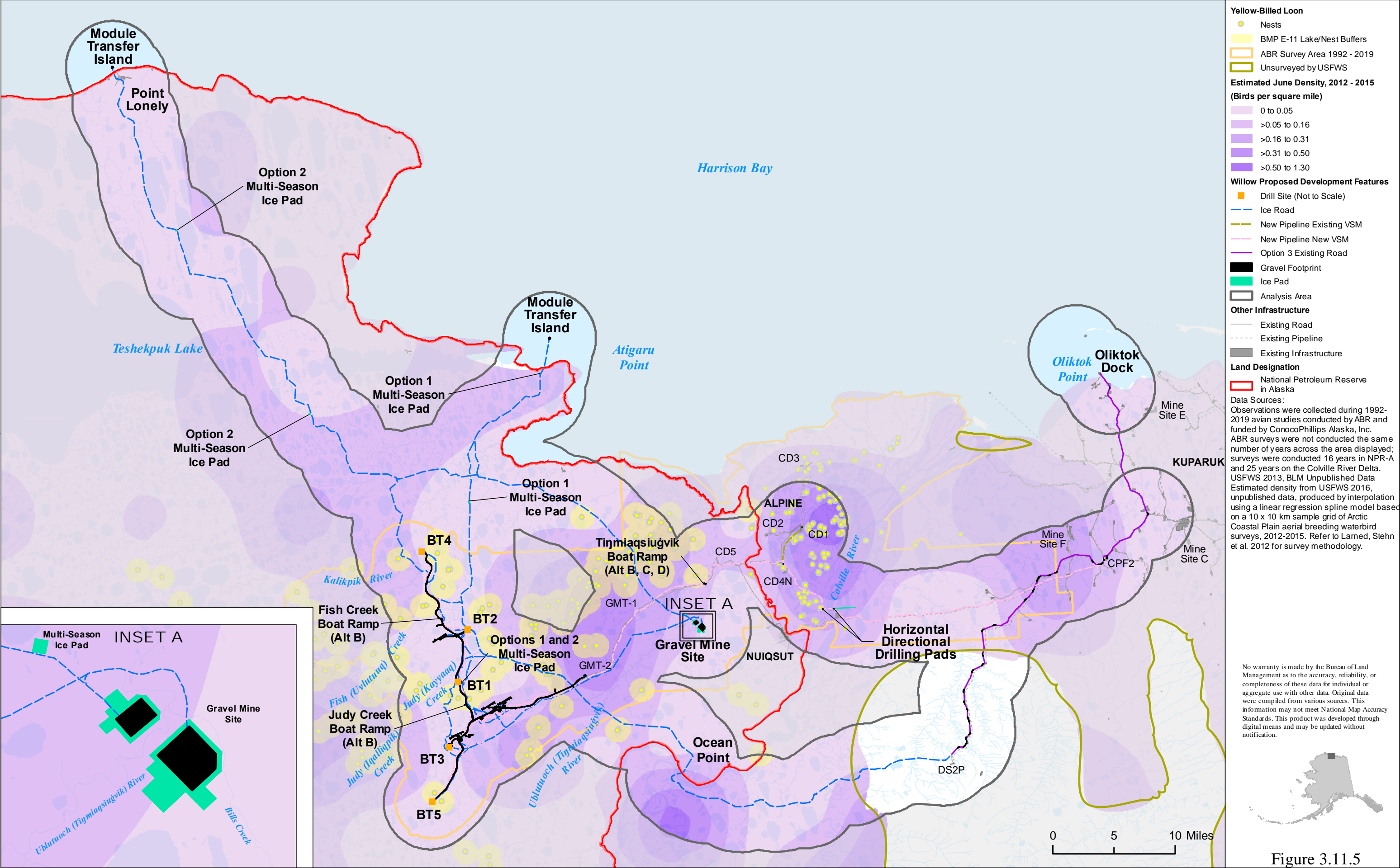
- ▭ National Petroleum Reserve in Alaska

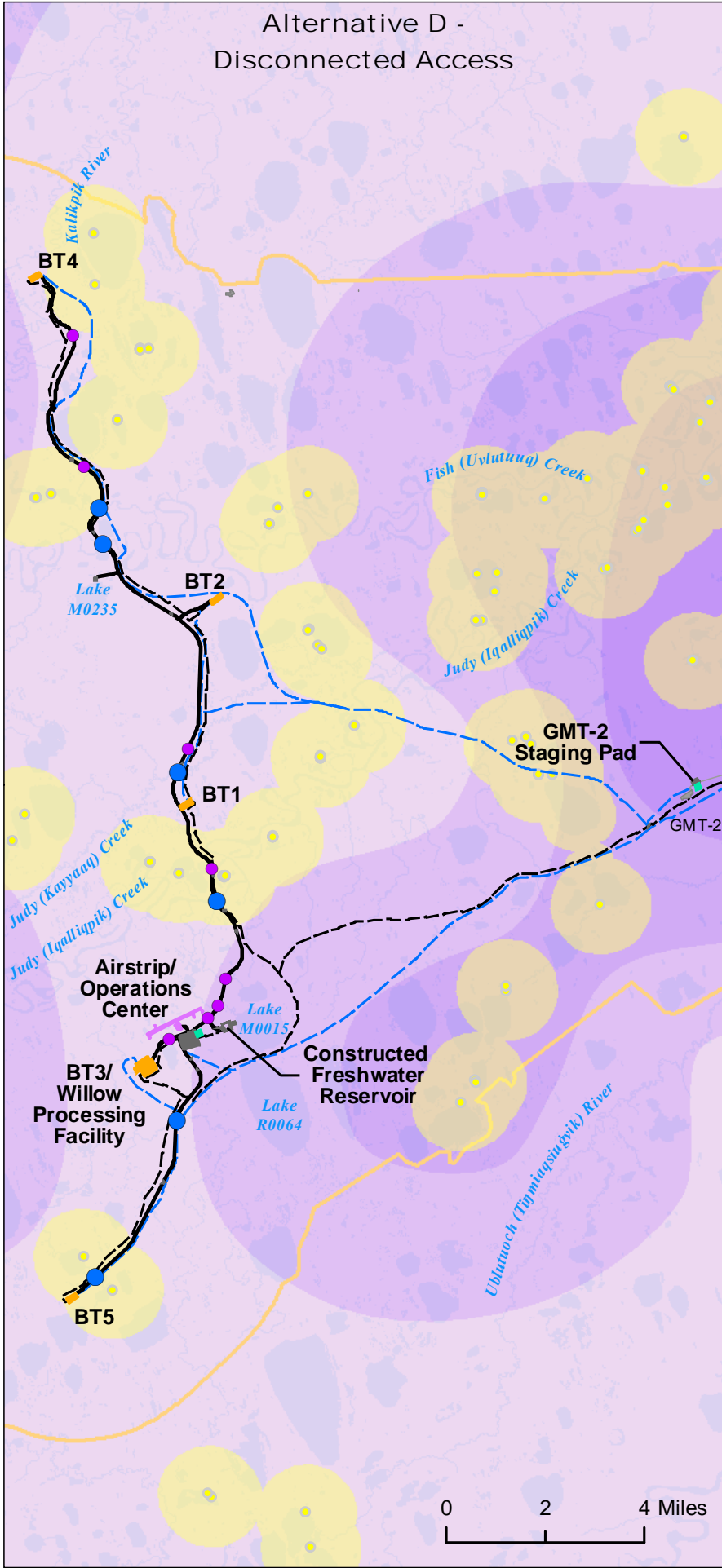
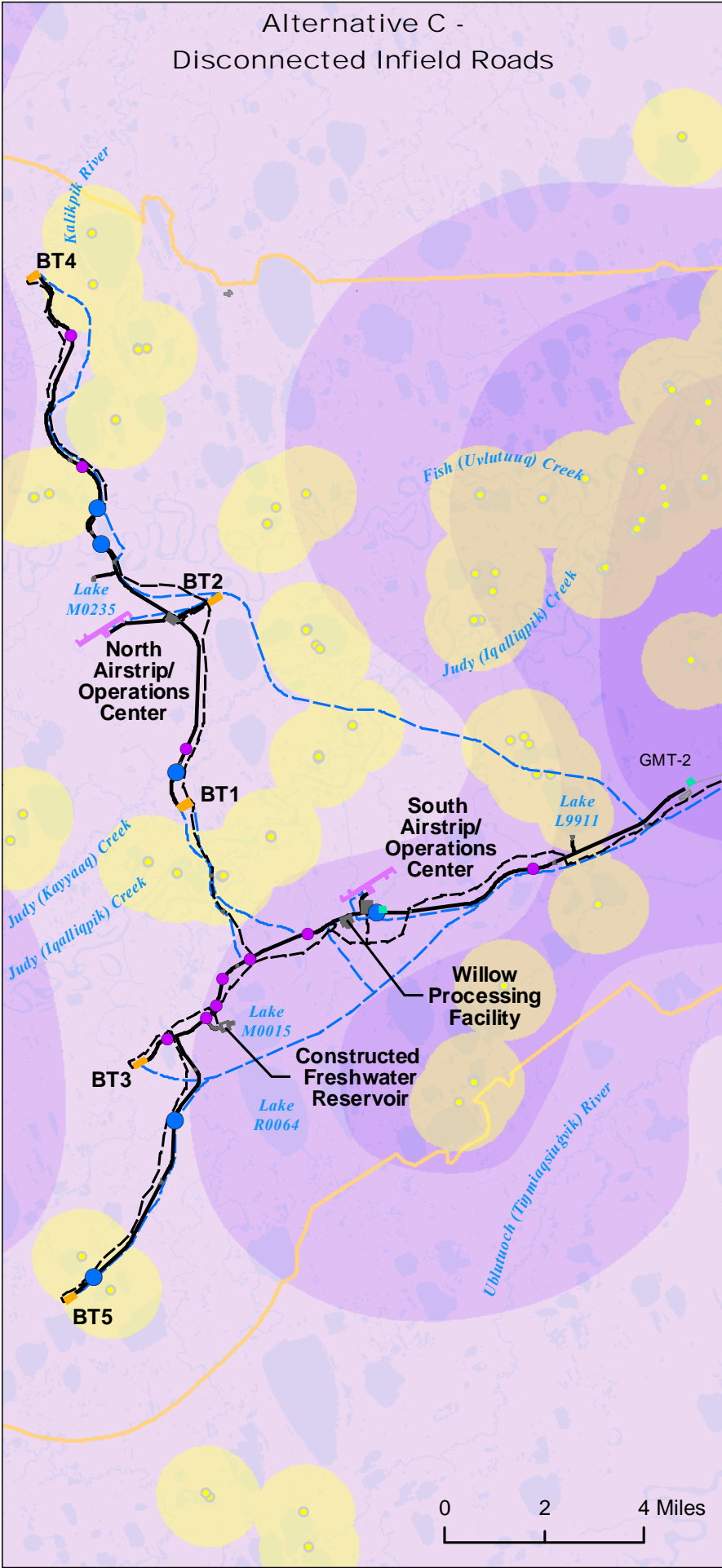
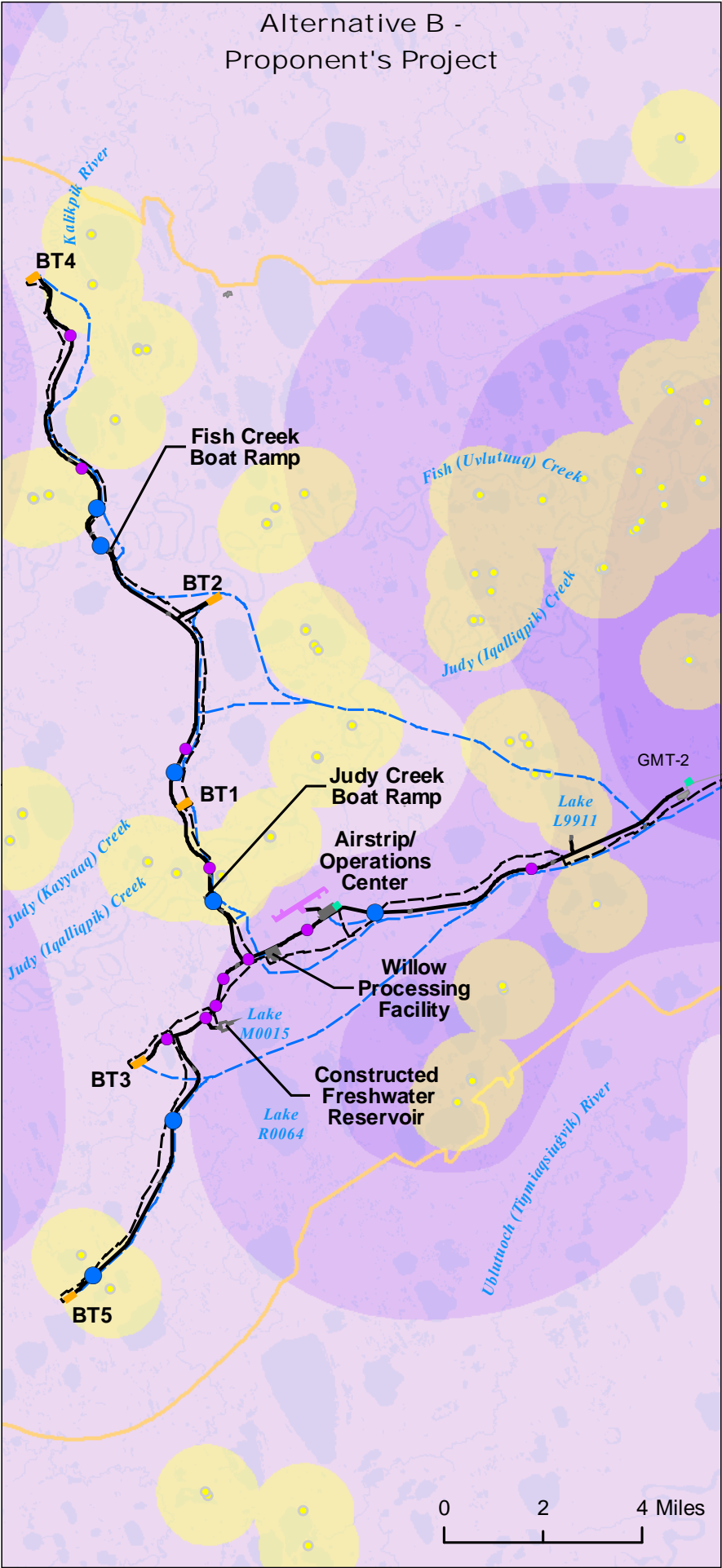
Data Sources:
Observations were collected during 1992-2019 avian studies conducted by ABR and funded by ConocoPhillips Alaska, Inc. Surveys were not conducted the same number of years across the area displayed; surveys were conducted 18 years in NPR-A, 26 years on the Colville River Delta, and 24 years in Kuparuk. USFWS 2019, Unpublished Data. Refer to Larned, Stehn et al. 2012 for survey methodology. Remaining portions of NE NPR-A portrayed in the figure north and east of the Willow study area were surveyed by ABR in miscellaneous years 1999-2014.

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Figure 3.11.4





Yellow-Billed Loon

- Nests
- BMP E-11 Lake/Nest Buffers
- ABR Survey Area 1992 - 2019

Estimated June Density, 2012 - 2015
(Birds per square mile)

- 0 to 0.05
- >0.05 to 0.16
- >0.16 to 0.31
- >0.31 to 0.50
- >0.50 to 1.30

Willow Proposed Development Features

- Culvert Battery
- Bridge
- Gravel Road
- Pipeline
- Ice Road
- Airstrip
- Drill Site Pad
- Gravel Pad
- Ice Pad

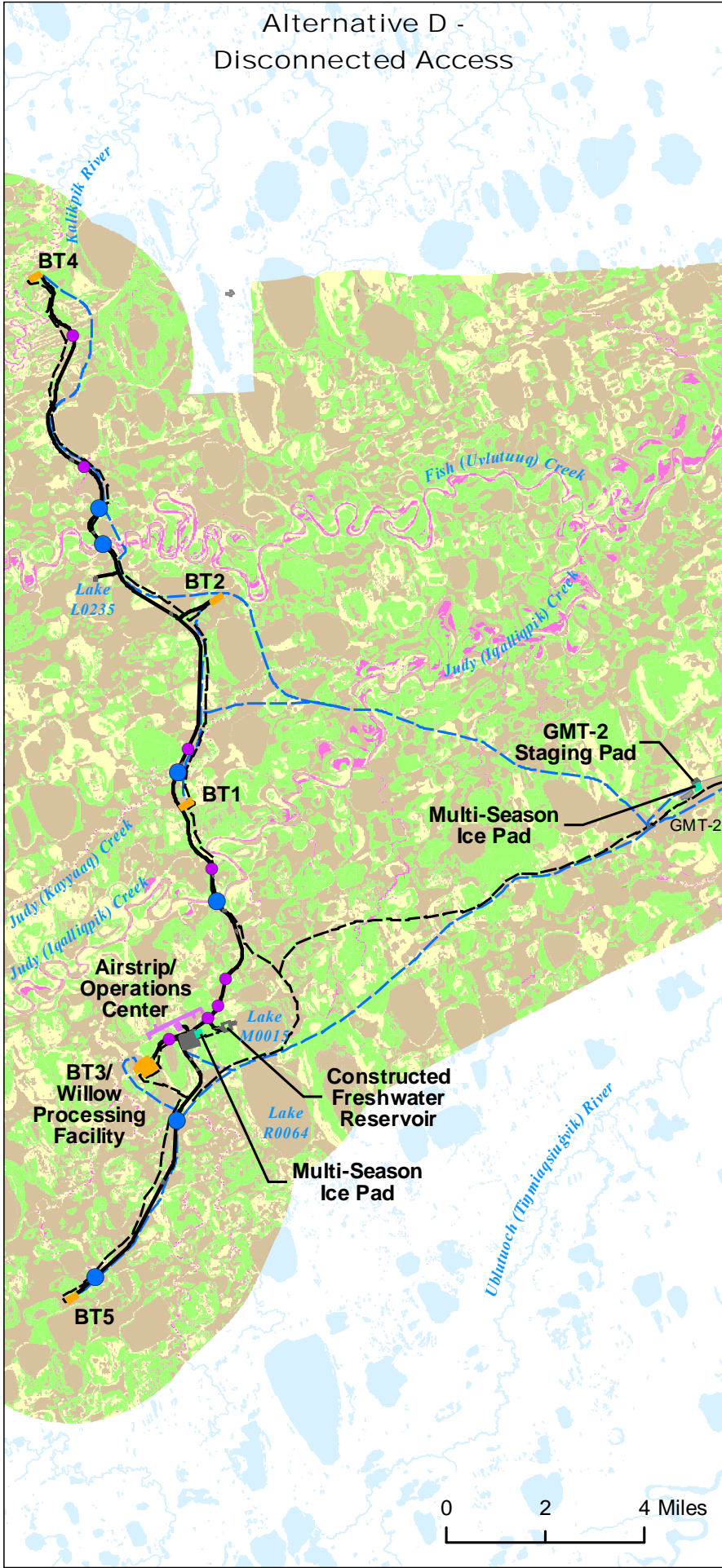
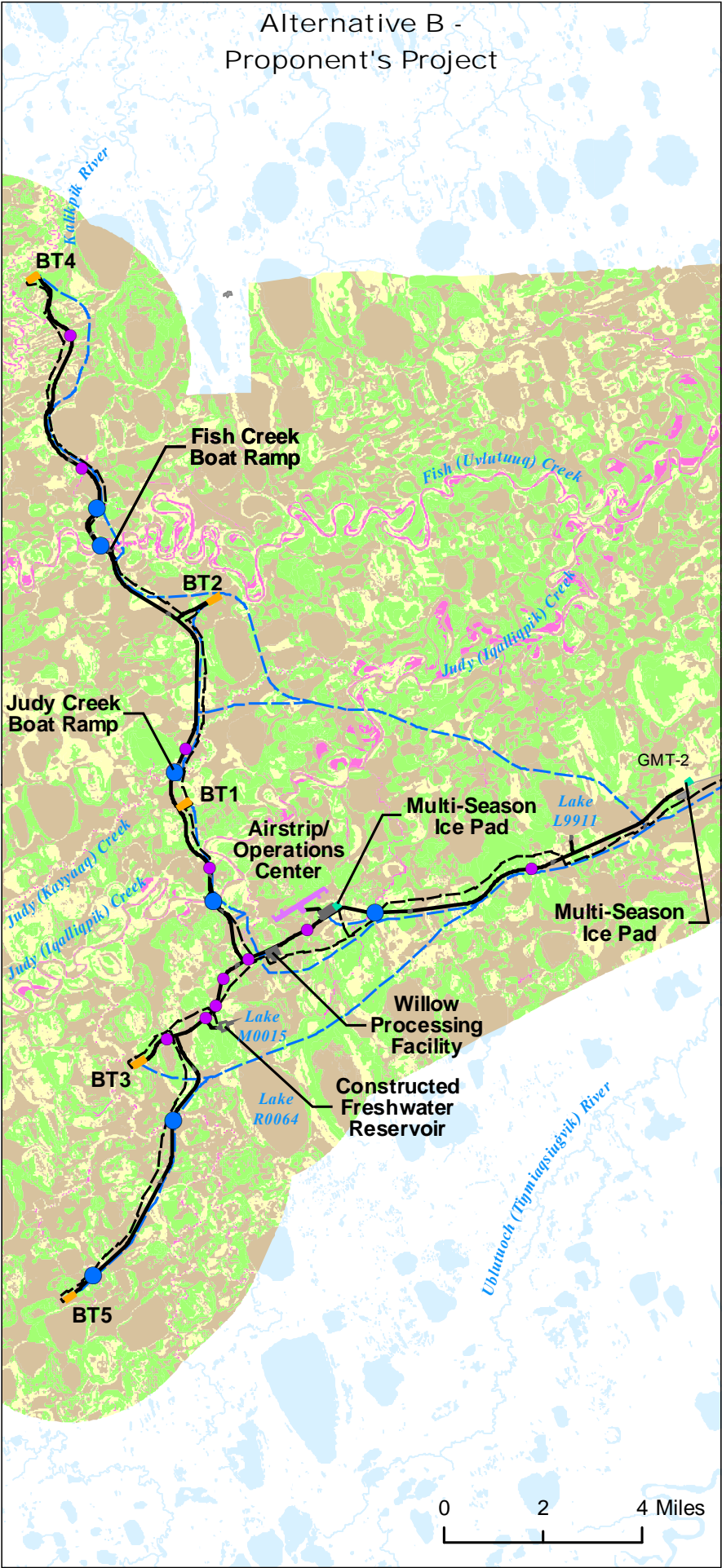
Other Infrastructure

- Existing Road
- Existing Pipeline
- Existing Infrastructure

Data Sources:
Observations were collected during 2001-2010, 2014, 2017-2019 2019 avian studies conducted by ABR and funded by ConocoPhillips Alaska, Inc. ABR surveys were not conducted the same number of years across the area displayed; surveys were conducted 16 years in NPR-A, 25 years on the Colville River Delta. USFWS 2013, BLM Unpublished Data. Estimated density from USFWS 2016, unpublished data, produced by interpolation using a linear regression spline model based on a 10 x 10 km sample grid of Arctic Coastal Plain aerial breeding waterbird surveys, 2012-2015. Refer to Larned, Stehn et al. 2012 for survey methodology.

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Figure 3.11.6



Bird Habitat

Number of Species Using

- 1-10
- 11 - 20
- 21 - 30
- >30

Willow Proposed Development Features

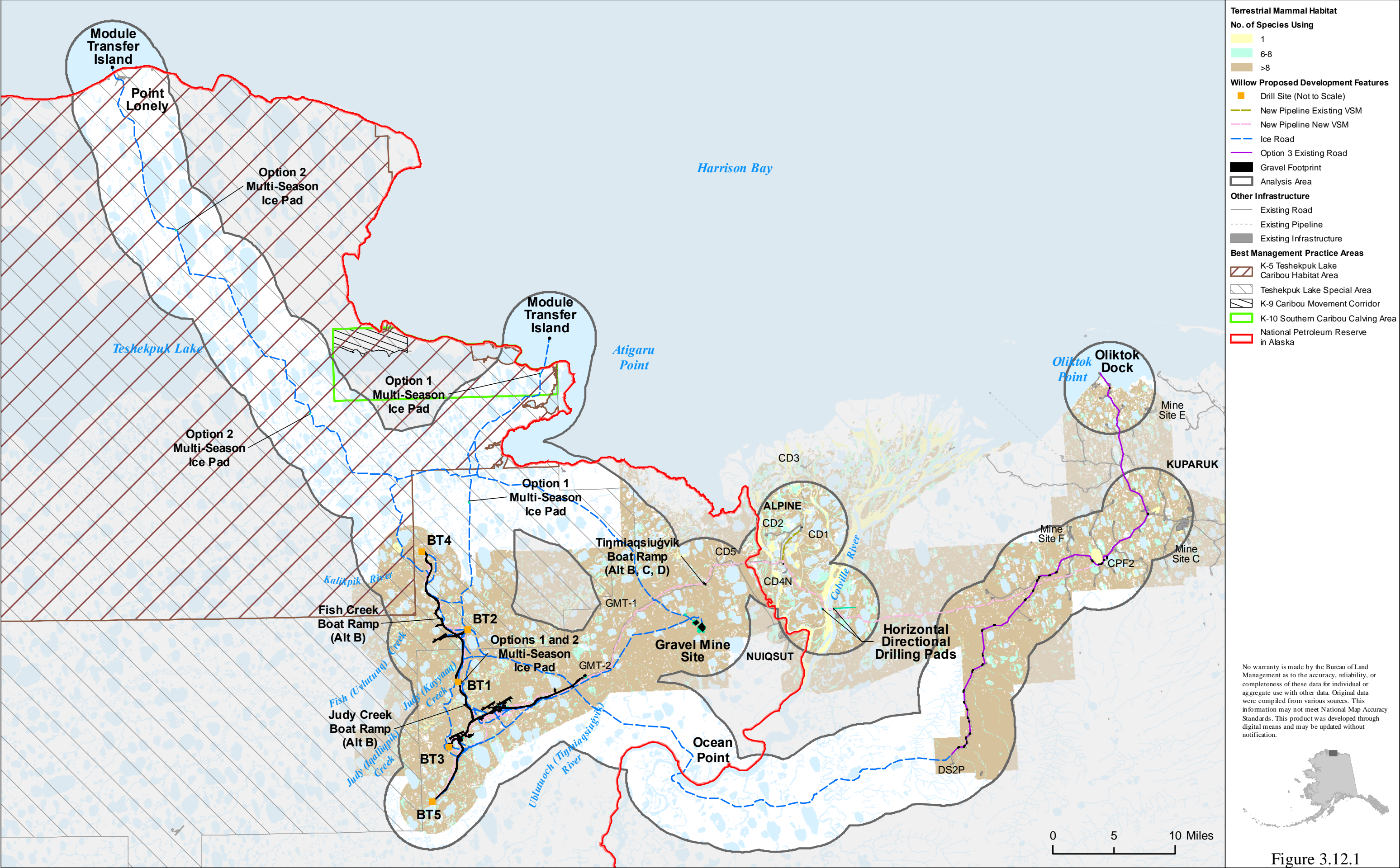
- Culvert Battery
- Bridge
- Gravel Road
- Pipeline
- Ice Road
- Airstrip
- Drill Site Pad
- Gravel Pad
- Ice Pad

Other Infrastructure

- Existing Road
- Existing Pipeline
- Existing Infrastructure

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Figure 3.11.7



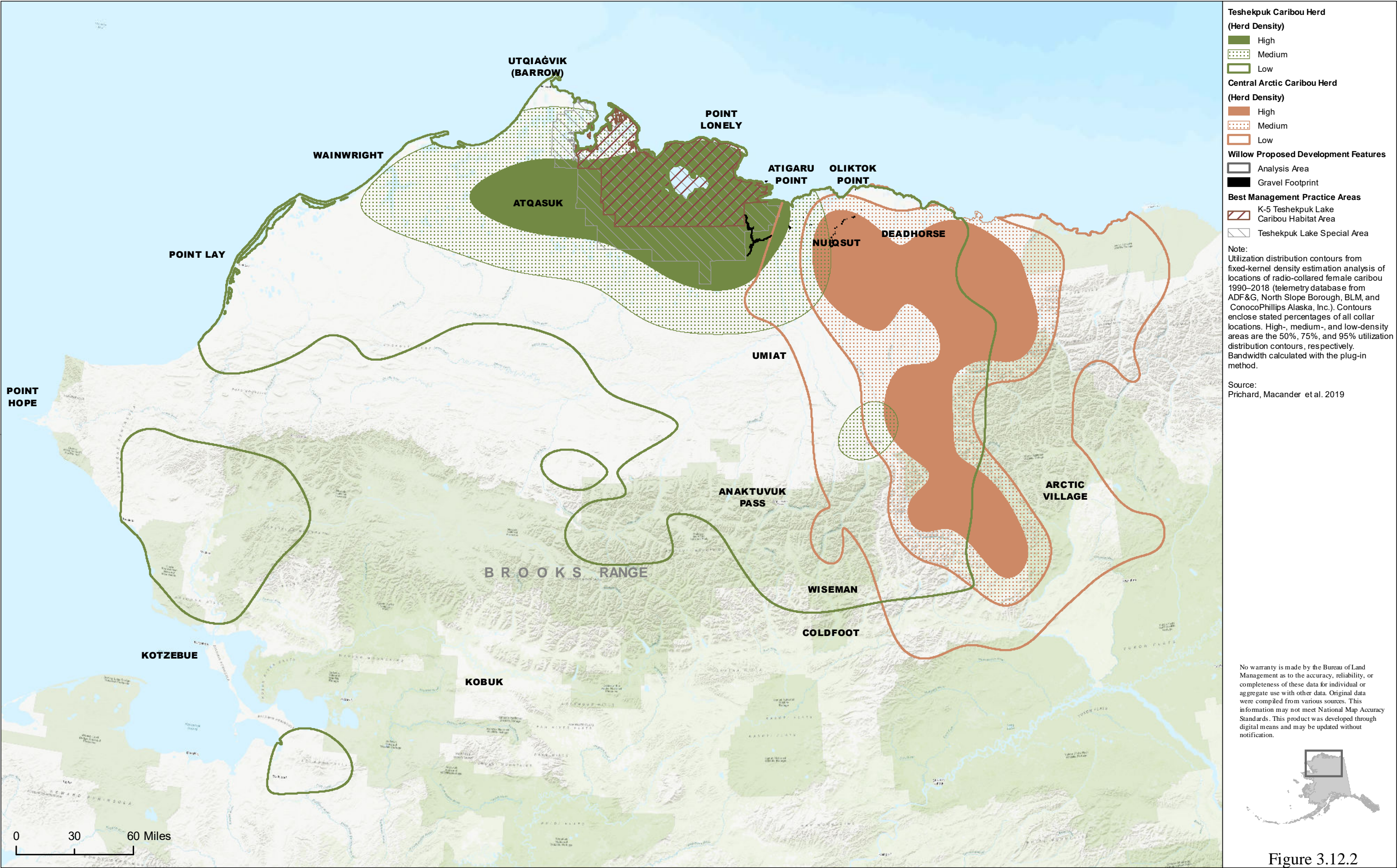
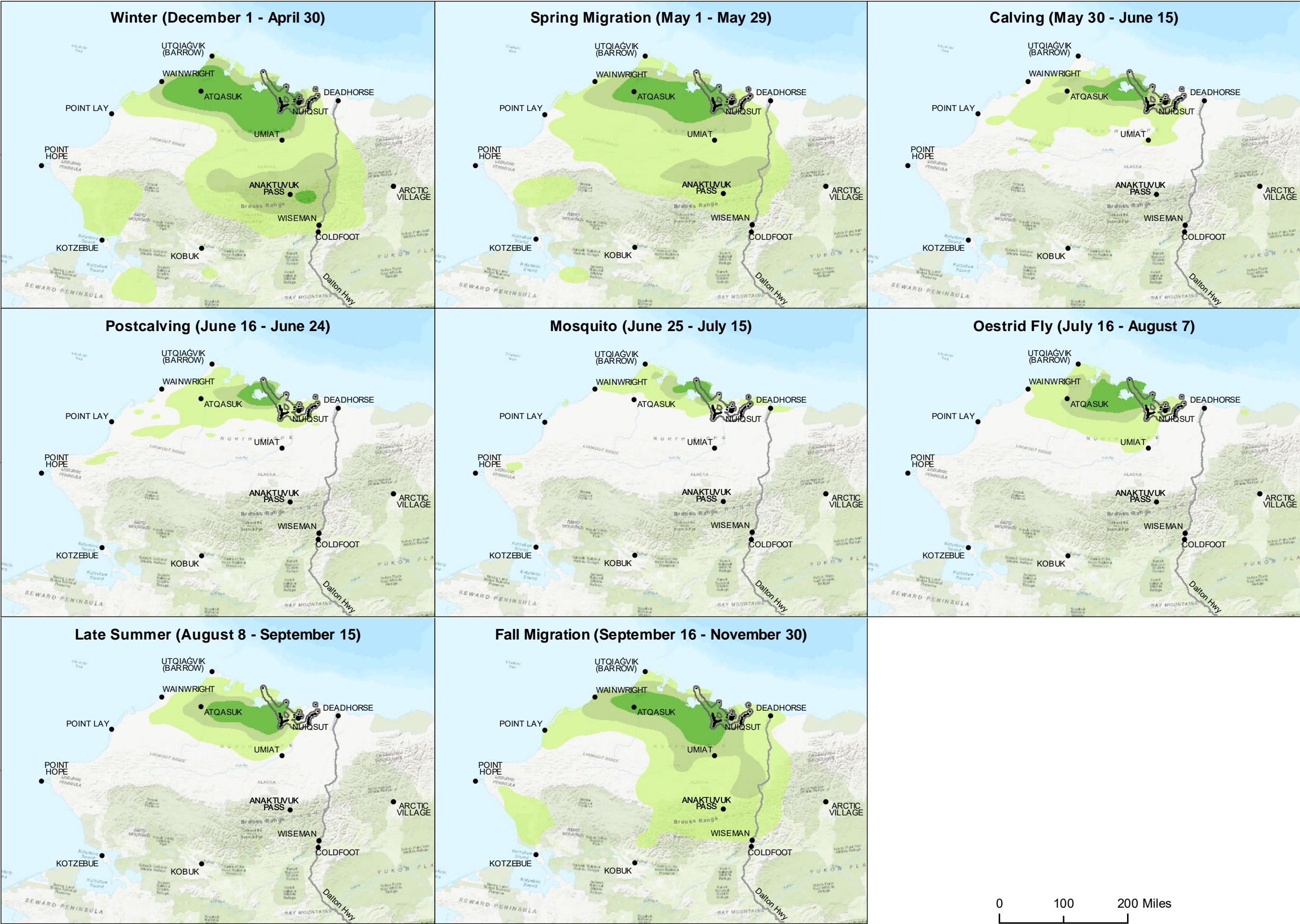


Figure 3.12.2



Teshekpuk Caribou Herd (Female Density)

- High
- Medium
- Low

Willow Proposed Development Features

- Analysis Area
- Gravel Footprint

Note: Utilization distribution contours from fixed-kernel density estimation analysis of locations of radio-collared female caribou 1990–2018 (telemetry database from ADF&G, North Slope Borough, BLM, and ConocoPhillips Alaska, Inc.). Contours enclose stated percentages of all collar locations. High-, medium-, and low-density areas are the 50%, 75%, and 95% utilization distribution contours, respectively. Bandwidth calculated with the plug-in method.

Source: Prichard, Macander et al. 2019

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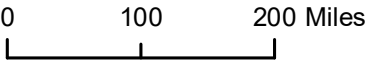
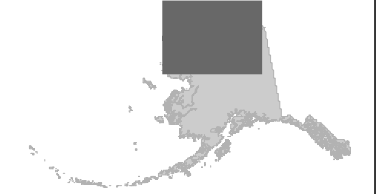
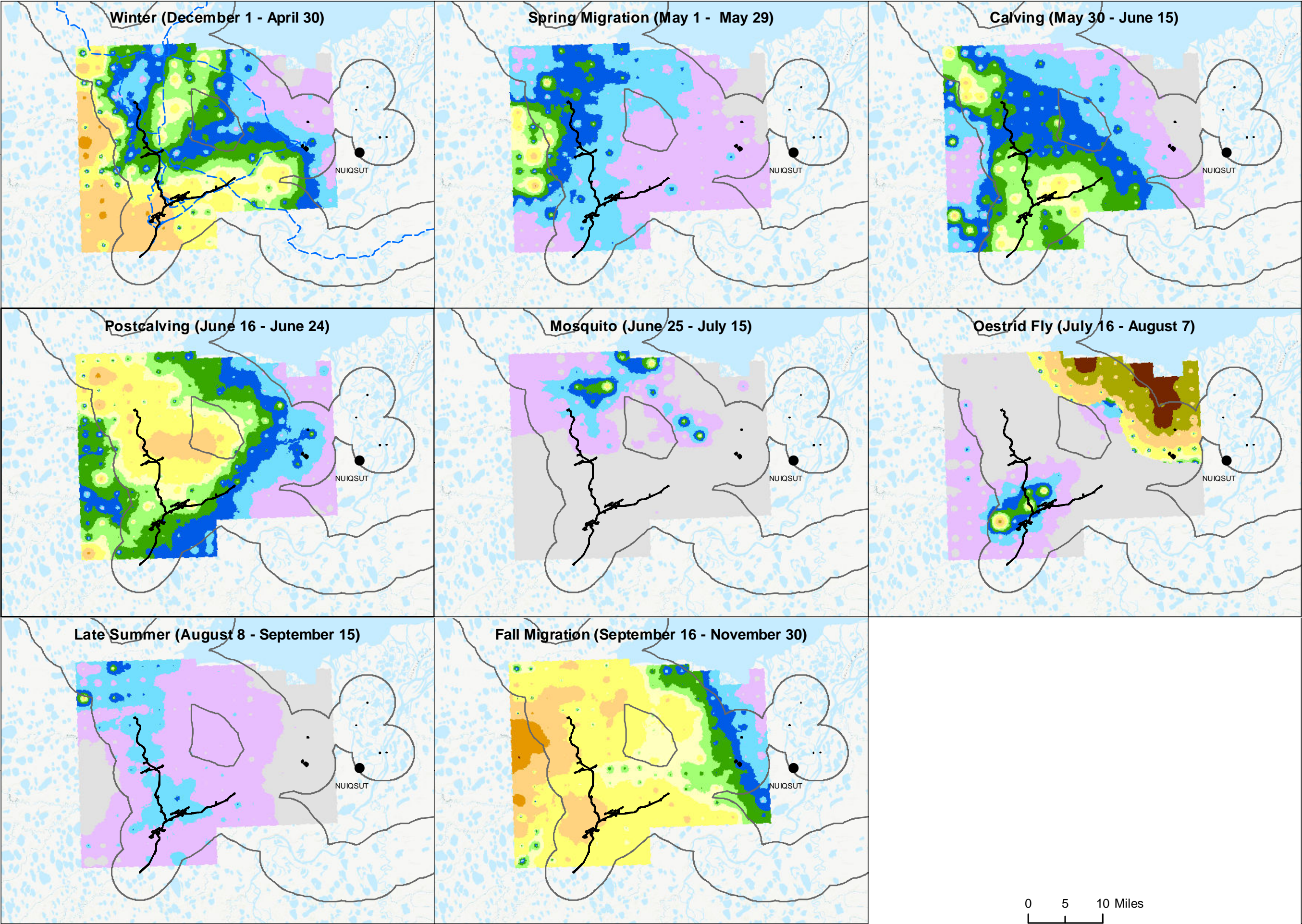


Figure 3.12.3



Mean Caribou Density
(Caribou Per Square Kilometer)

0.0 - 0.1
0.1 - 0.2
0.2 - 0.3
0.3 - 0.4
0.4 - 0.5
0.5 - 0.6
0.6 - 0.7
0.7 - 1
1.0 - 2.0
2.0 - 5.0
5.0 - 100.0

Willow Proposed Development Features

- Ice Road
- Analysis Area
- Gravel Footprint

Note:
Figure shows all females (calving and non-calving) during the calving period.

Source:
Prichard, Macander et al. 2018

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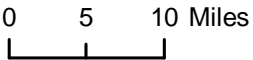
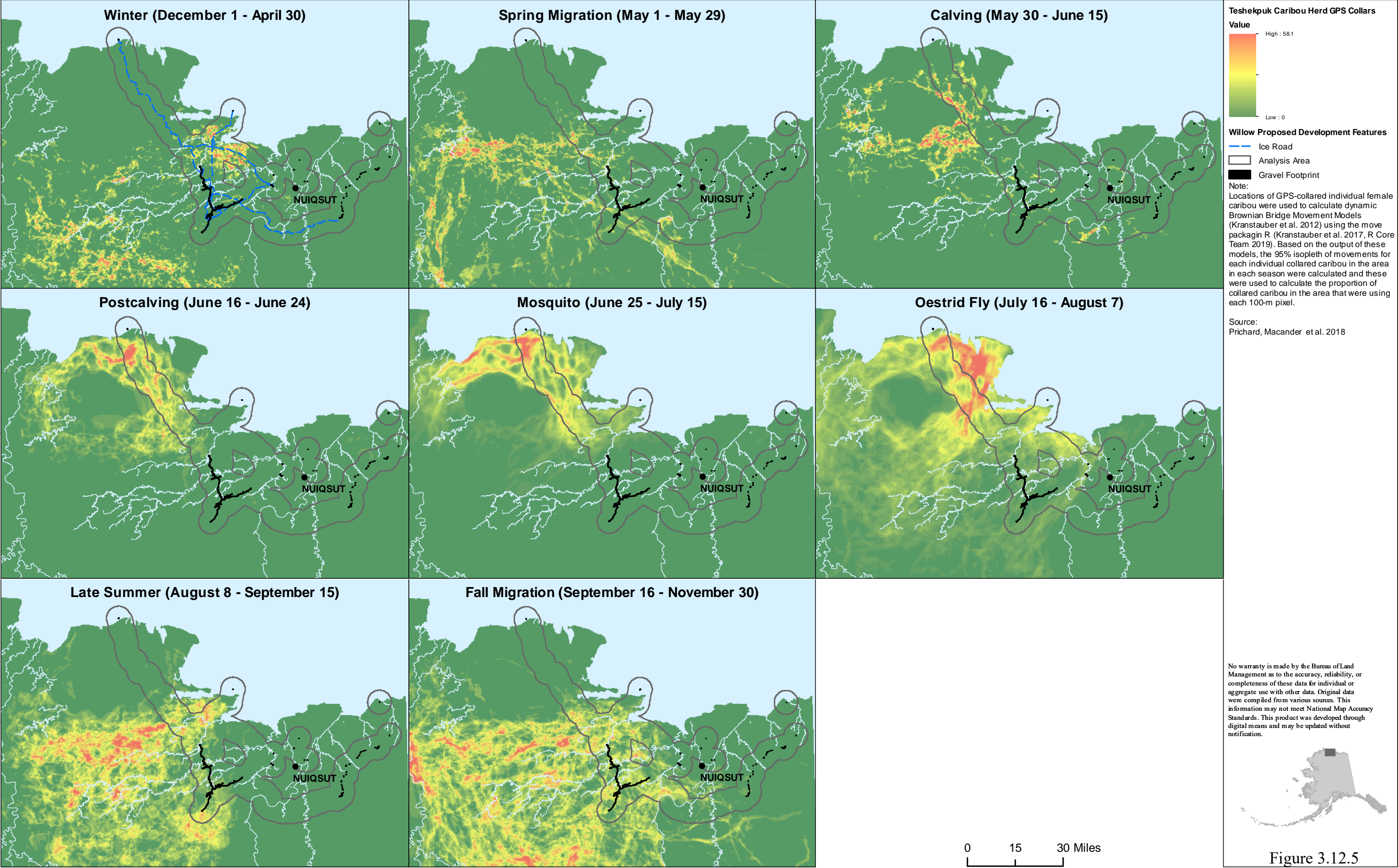
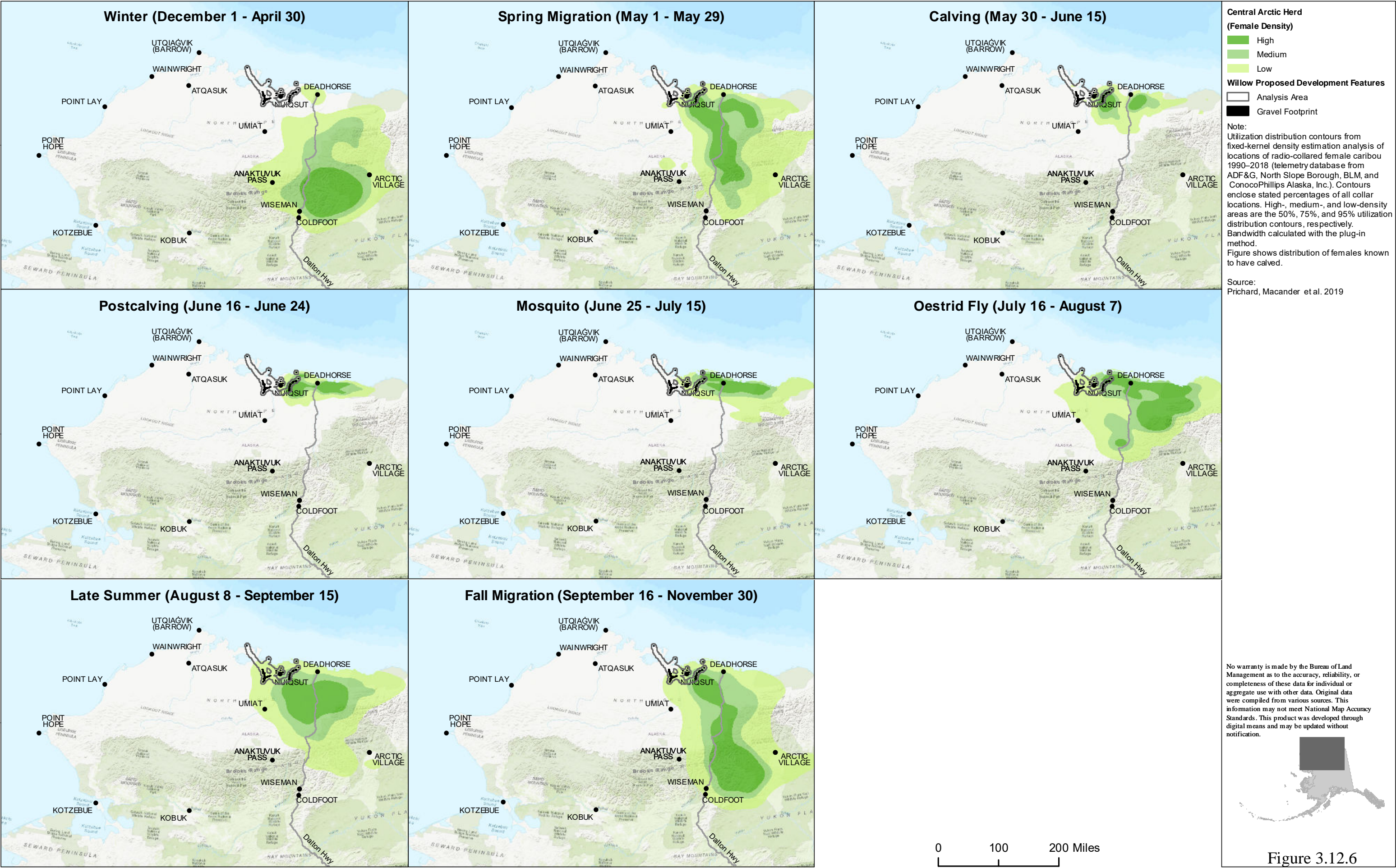


Figure 3.12.4





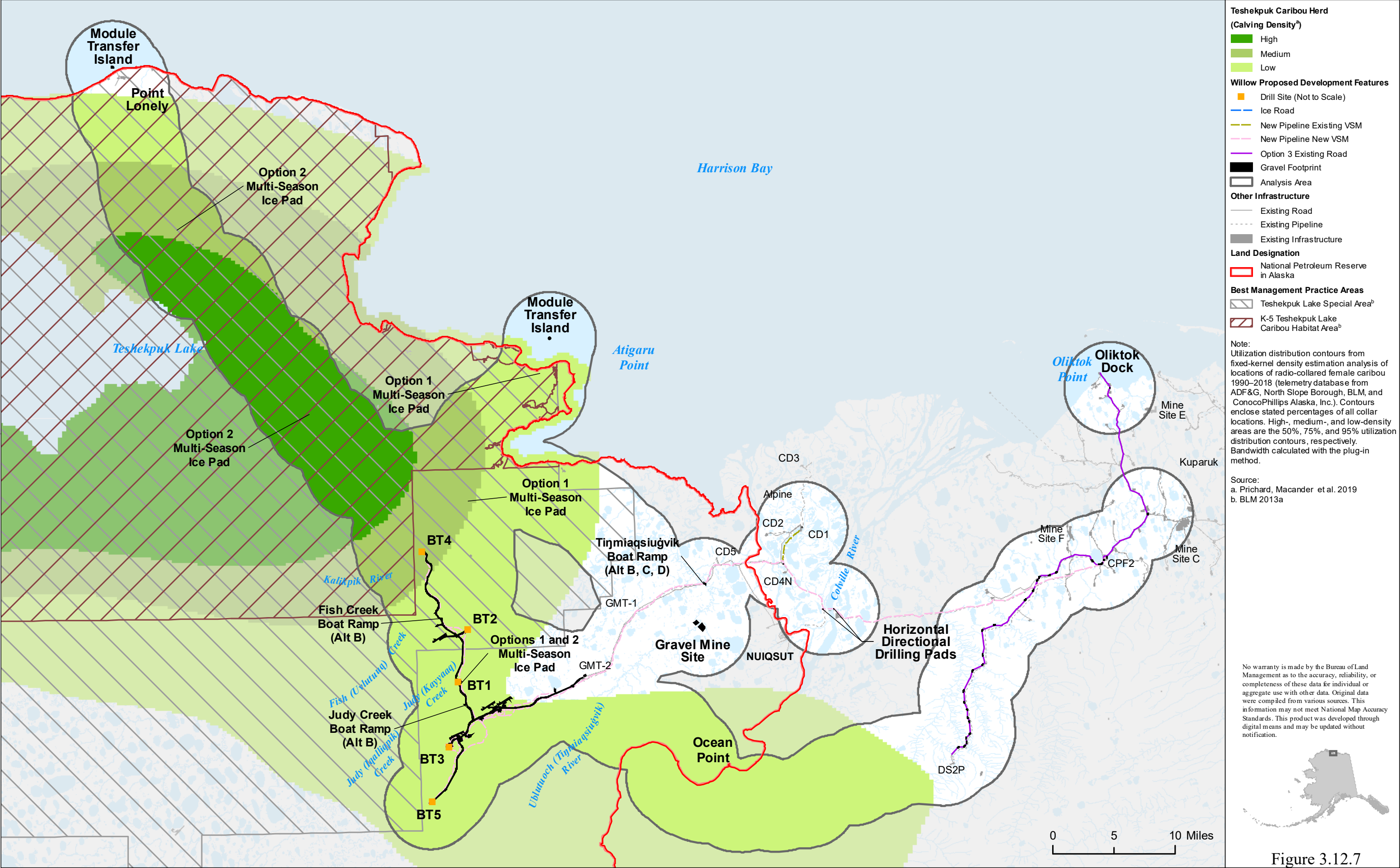
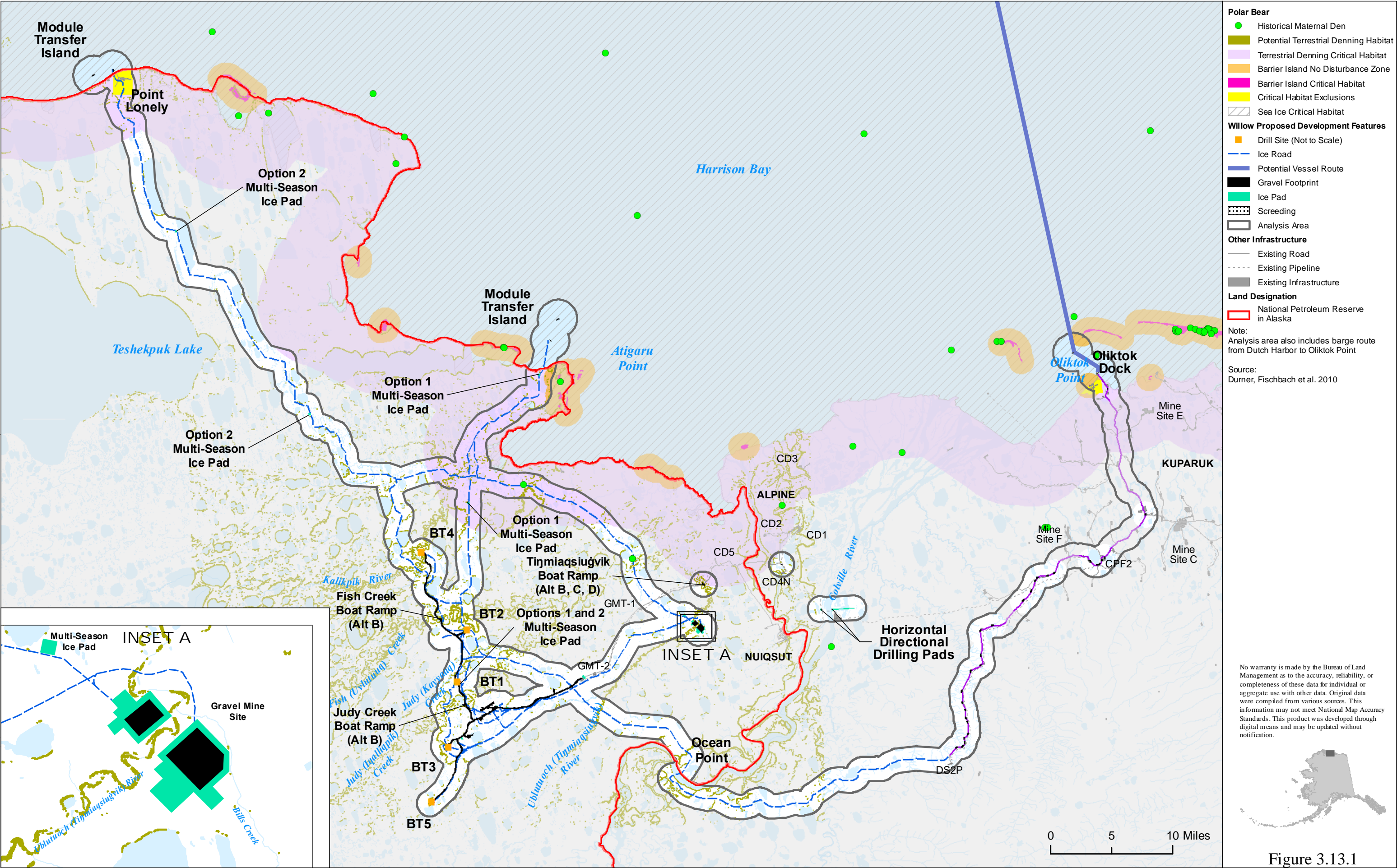
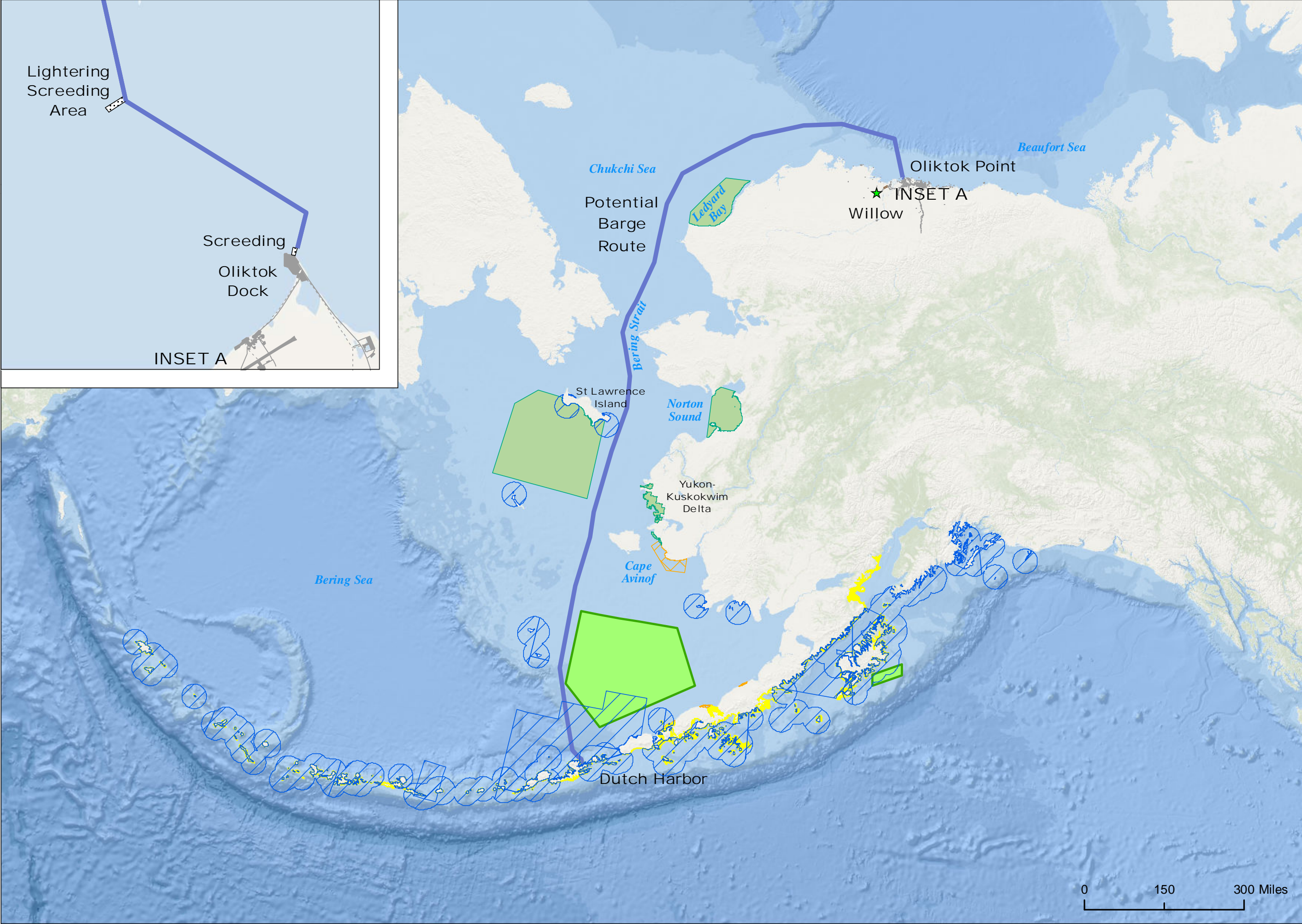


Figure 3.12.7





Potential Marine Vessel Route

- Potential Vessel Route

National Marine Fisheries Service Critical Habitat

- Stellar Sea Lion Critical Habitat (Foraging area and 20 nautical mile aquatic zone)
- North Pacific Right Whale Critical Habitat

United States Fish and Wildlife Service Critical Habitat

- Sea Otter Critical Habitat
- Steller's Eider Critical Habitat
- Spectacled Eider Critical Habitat

Willow Proposed Development Features

- Willow Project
- Screeding

Other Infrastructure

- Existing Road
- Existing Pipeline
- Existing Infrastructure

Note: Action Area encompasses a 1.5 mile radius around barge route, support vessel route, screeding and 1 mile radius around onshore project components.

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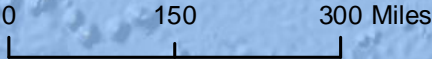
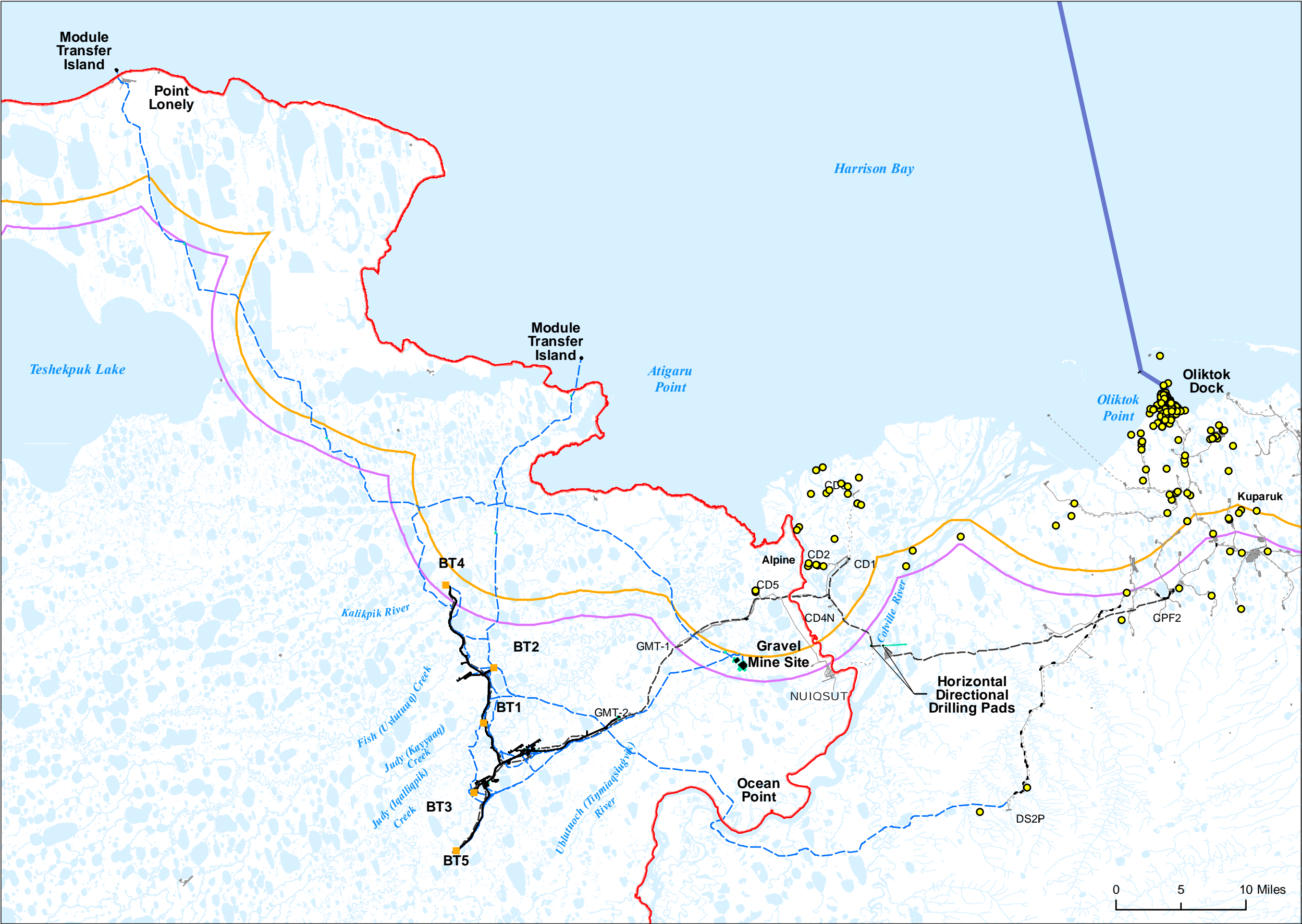


Figure 3.13.2



Polar Bear

- CPAI Observations (1993-2019)
- 90th Percentile (Observations) 7.7 Miles From Coast
- 95th Percentile (Observations) 9.6 Miles From Coast

Willow Proposed Development Features

- Drill Site (Not to Scale)
- Ice Road
- New Pipeline
- Potential Vessel Route
- Gravel Footprint
- Screeding
- Ice Pad

Other Infrastructure

- Existing Road
- Existing Pipeline
- Existing Infrastructure

Land Designation

- National Petroleum Reserve in Alaska

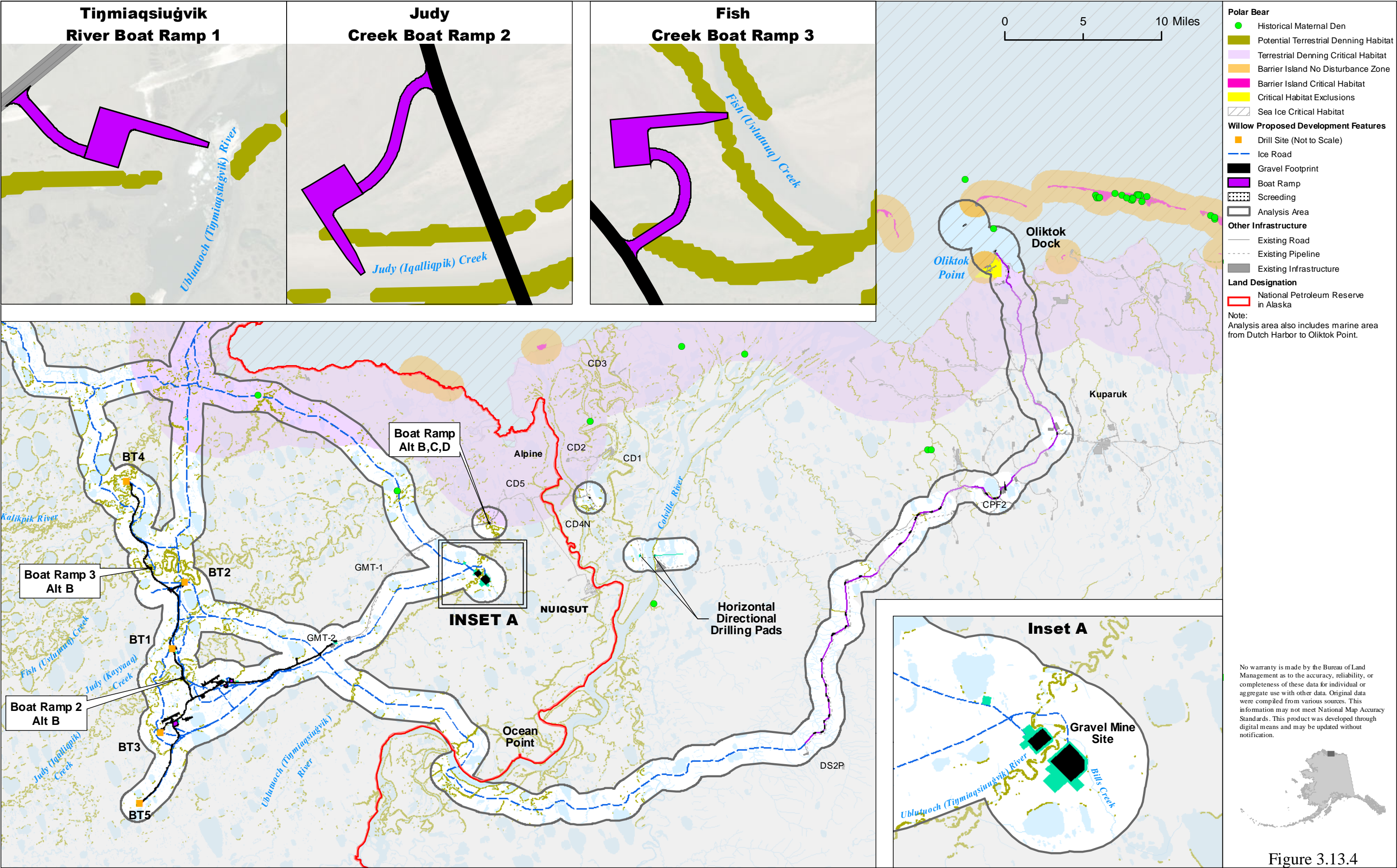
Data Source: CPAI 2020

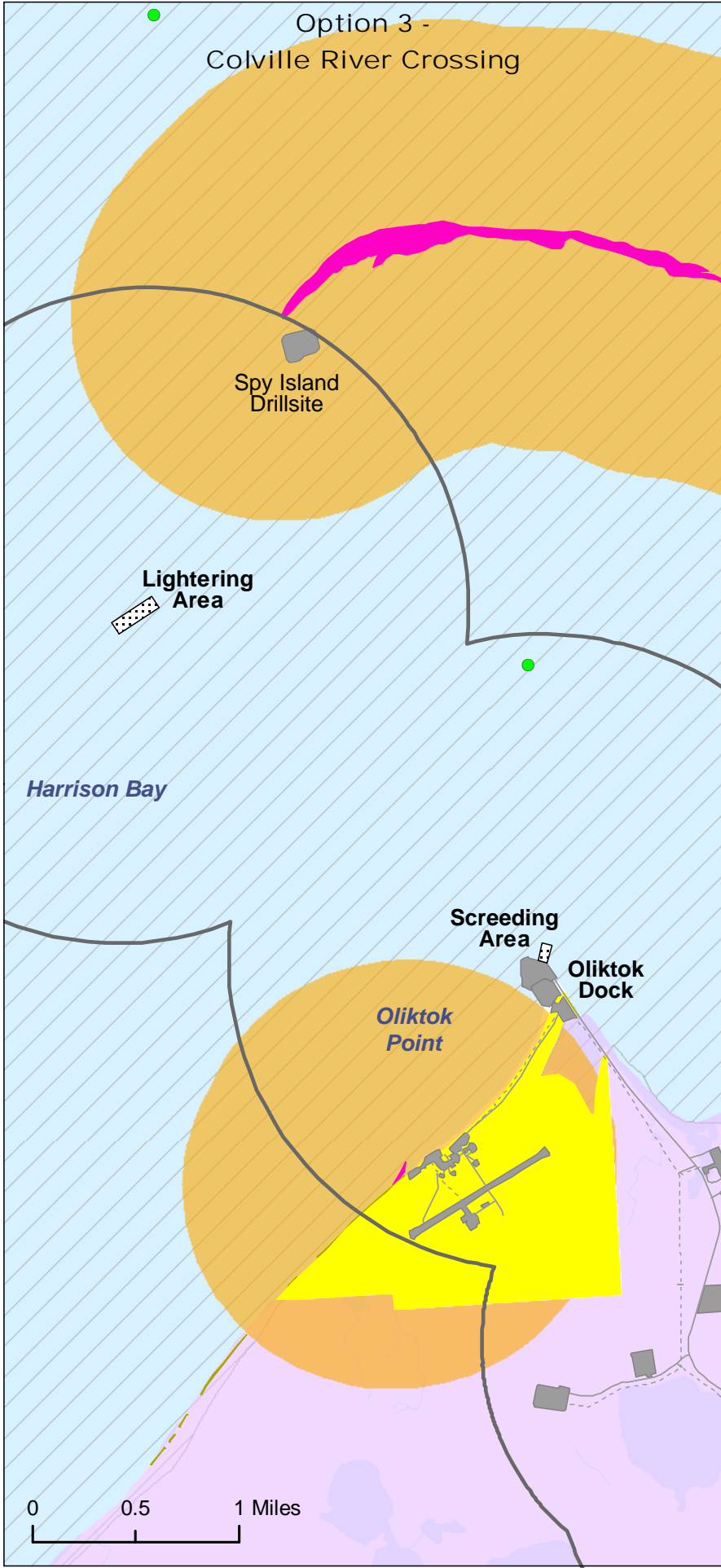
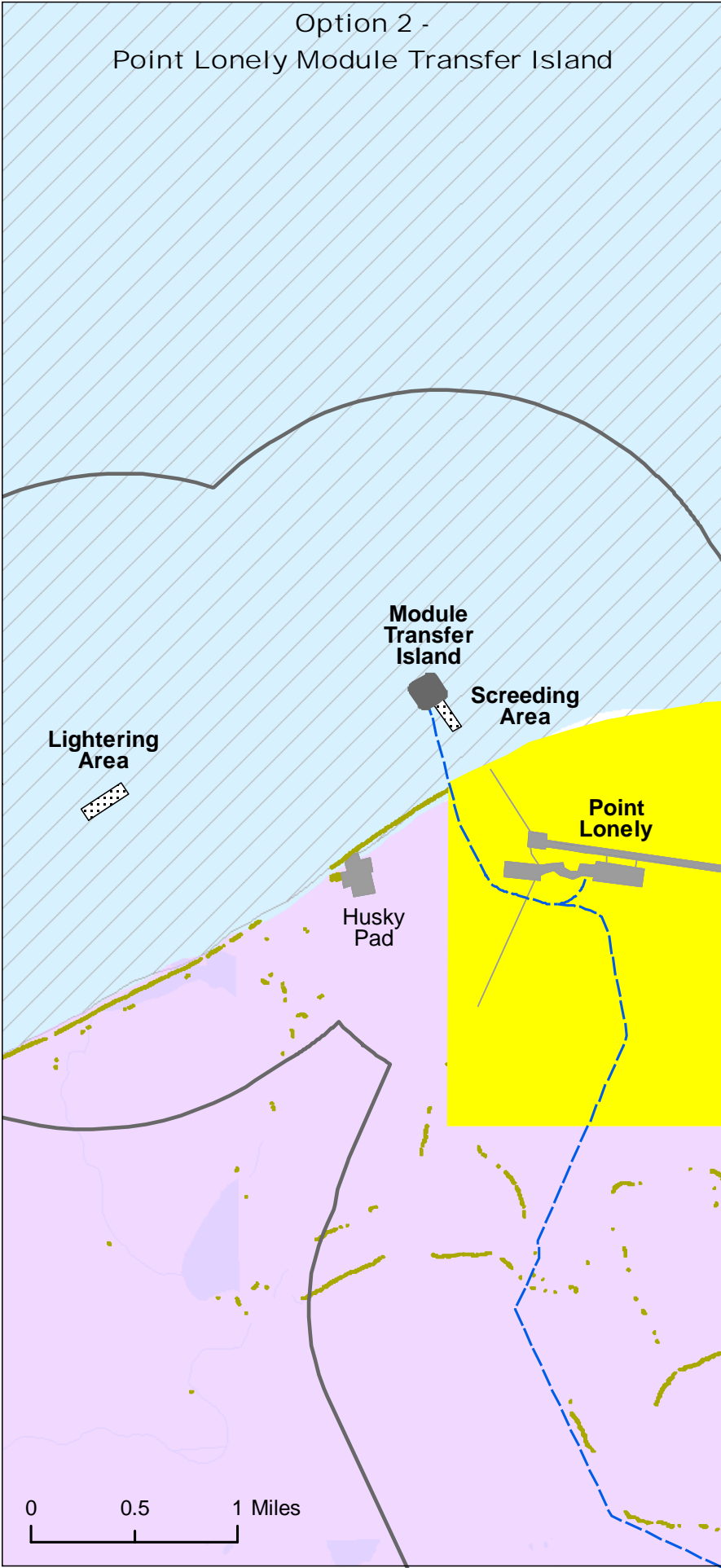
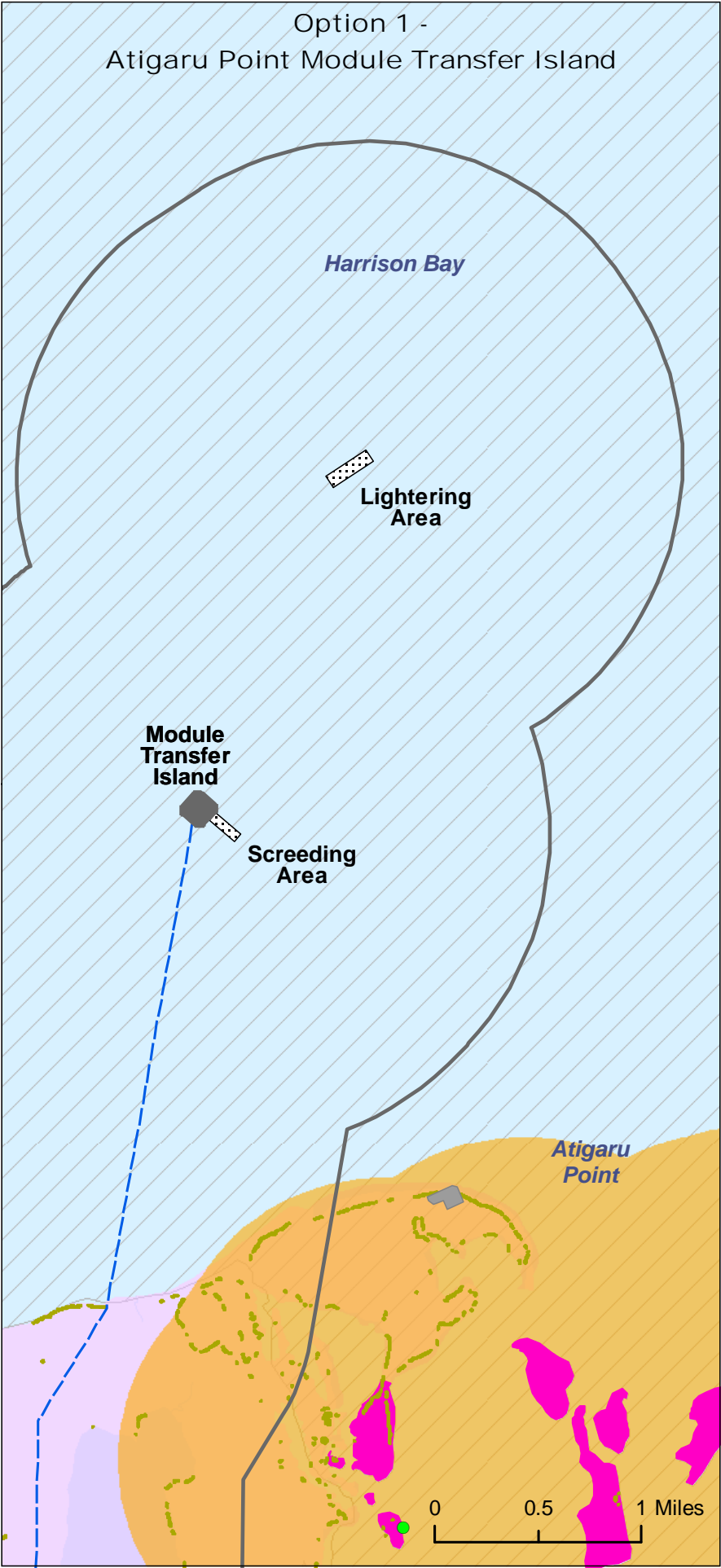
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0 5 10 Miles

Figure 3.13.3





Polar Bear

- Historical Maternal Den
- Potential Terrestrial Denning Habitat
- Terrestrial Denning Critical Habitat
- Barrier Island No Disturbance Zone
- Barrier Island Critical Habitat
- Critical Habitat Exclusions
- Sea Ice Critical Habitat

Willow Proposed Development Features

- Ice Road
- Screeding

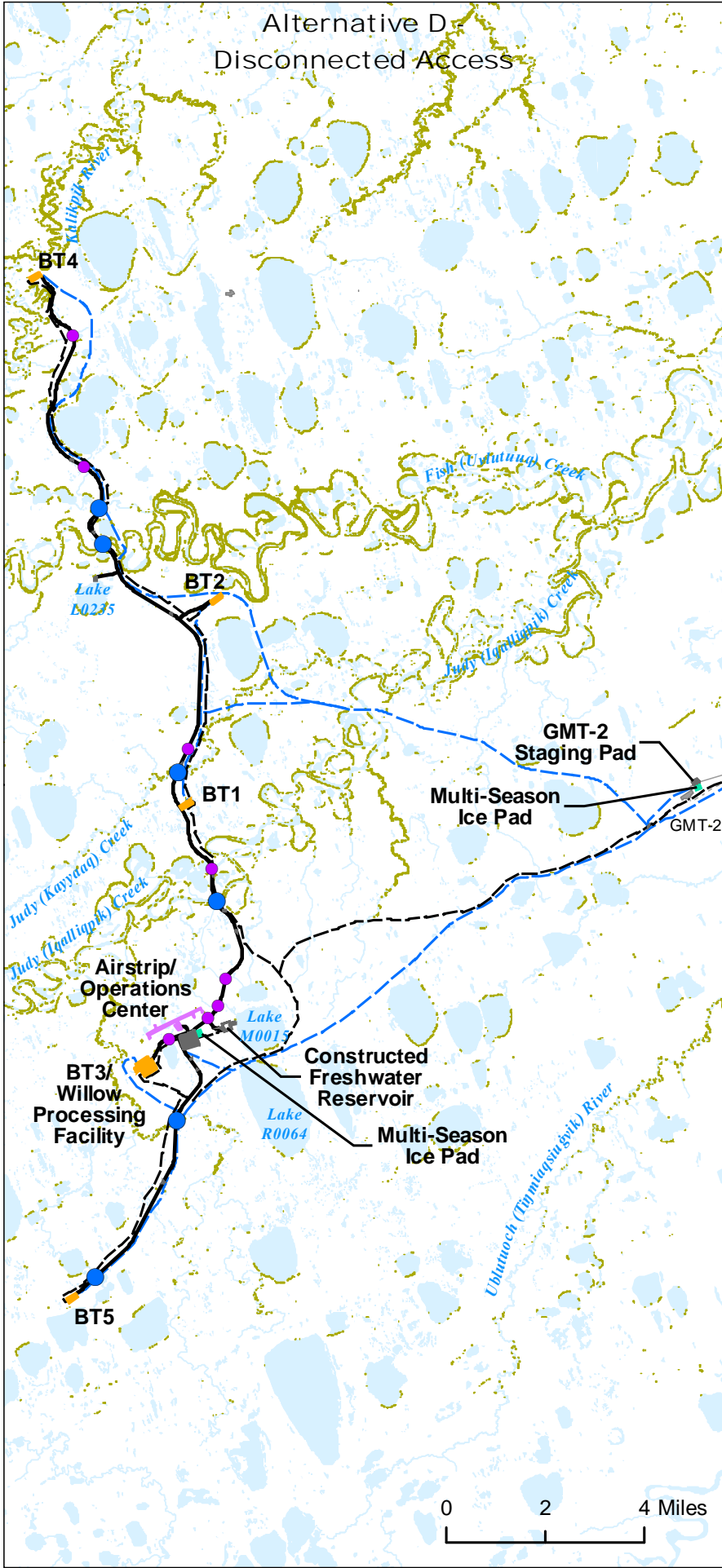
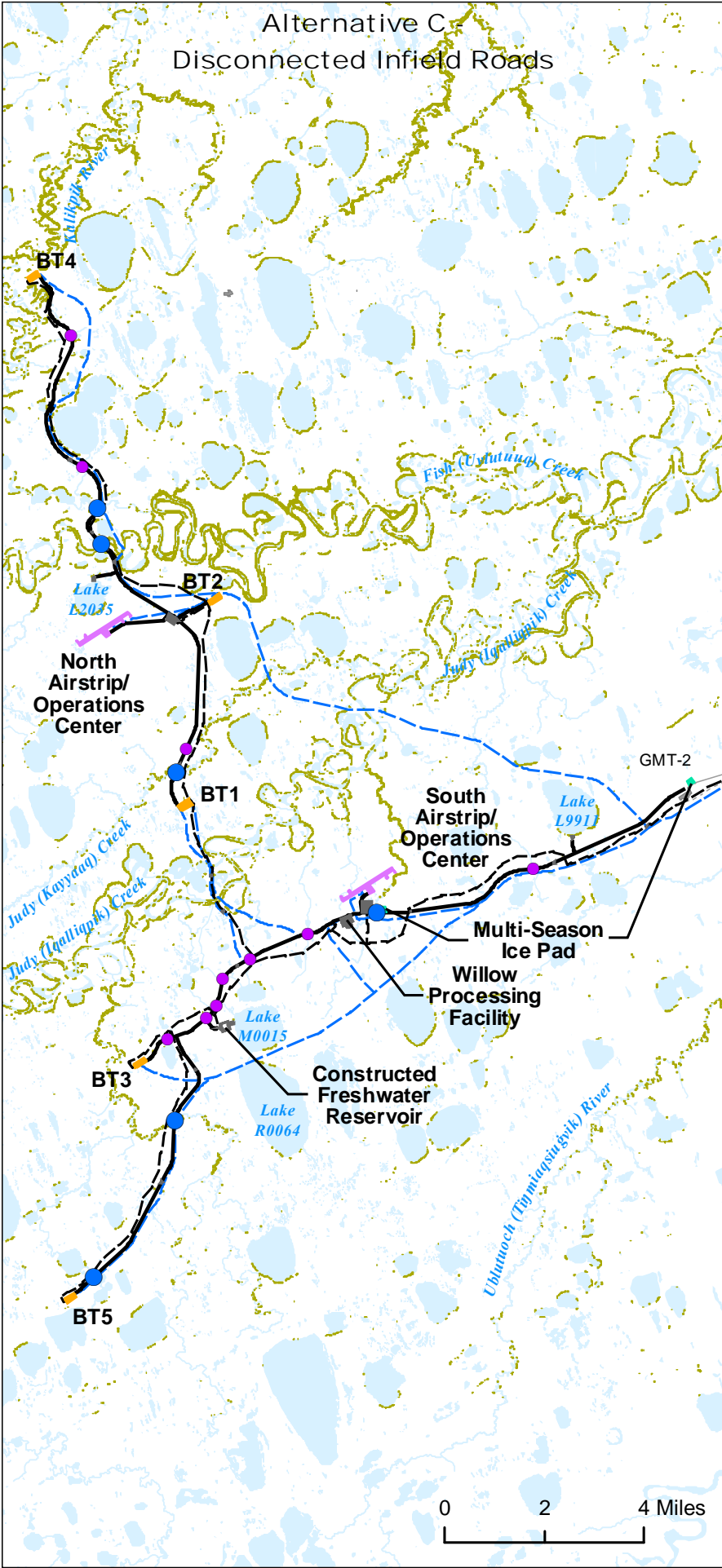
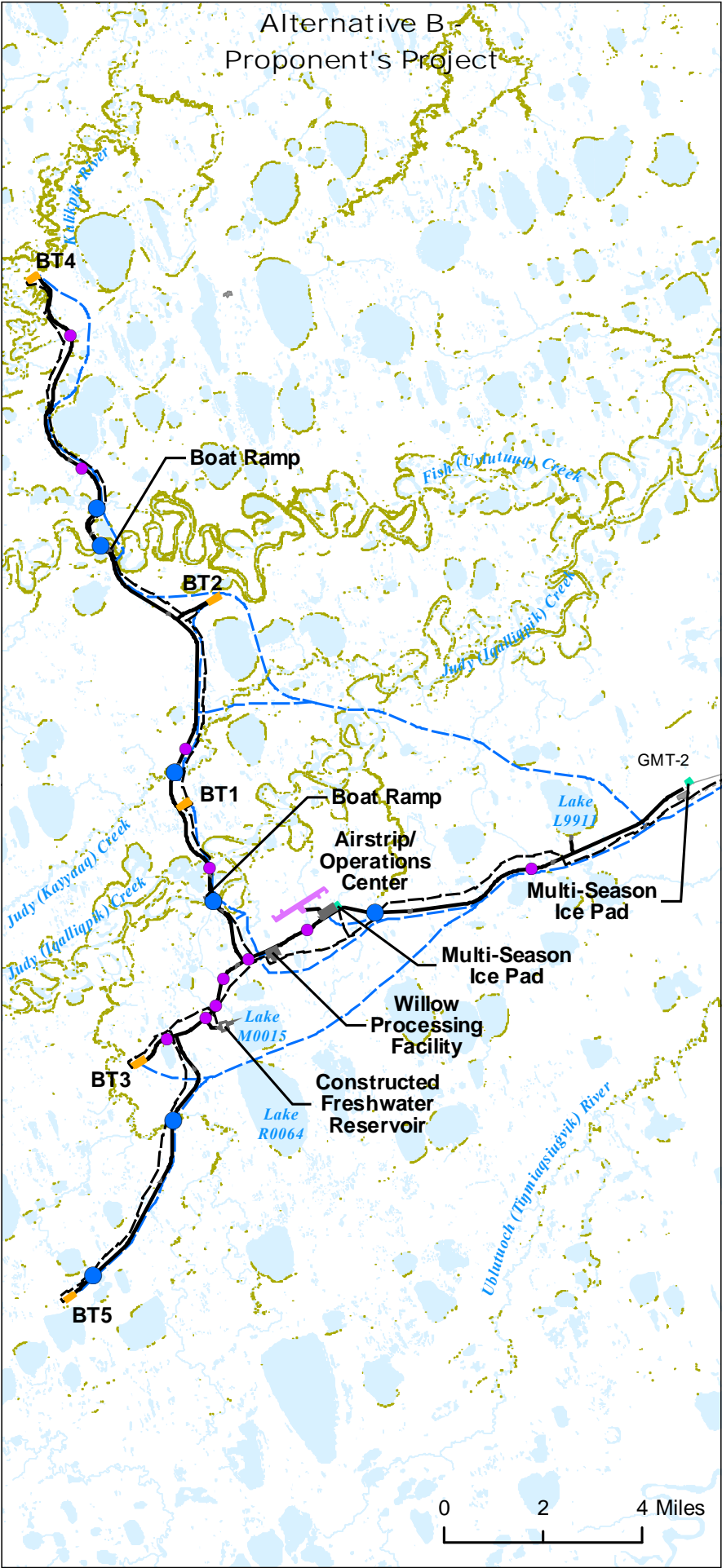
Other Infrastructure

- Existing Road
- - - Existing Pipeline
- Existing Infrastructure
- Analysis Area

Notes:
1. Oliktok Dock activity would occur under all action alternatives and Option 3: Colville River Crossing.

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Figure 3.13.5



Polar Bear

- Potential Terrestrial Denning Habitat

Willow Proposed Development Features

- Culvert Battery
- Bridge
- Gravel Road
- Pipeline
- Ice Road
- Airstrip
- Drill Site Pad
- Gravel Pad
- Ice Pad

Other Infrastructure

- Existing Road
- Existing Pipeline
- Existing Infrastructure

Sources:
Durner, Fischbach et al. 2010, USGS Unpublished Data
Observations were collected during 1992-2018 avian studies conducted by ABR and funded by ConocoPhillips Alaska, Inc. Surveys were not conducted the same number of years across the area displayed; surveys were conducted 17 years in NPR-A, 25 years on the Colville River Delta, and 24 years in Kuparuk.
USFWS 2013, BLM Unpublished Data
Estimated density from USFWS 2016, unpublished data, produced by interpolation using a linear regression spline model based on a 10 x 10 km sample grid of Arctic Coastal Plain aerial breeding waterbird surveys, 2012-2015. Refer to Larned et al. 2012 for survey methodology.

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Figure 3.13.6