Willow Master Development Plan

Environmental Impact Statement



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.
Photo by: Wendy Mahan, courtesy of ConocoPhillips.

Photo copyright 2019 ConocoPhillips Alaska, Inc. BLM is permitted to use this photo and copy for its own use; any other use or copying by any other party is prohibited without the written consent of ConocoPhillips Alaska, Inc.

DOI-BLM-AK-0000-2018-0004-EIS BLM/AK/PL-19/012+1610+F010

Willow Master Development Plan Draft Environmental Impact Statement

Volume 2: Appendix A

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

In cooperation with:

U.S. Army Corps of Engineers

U.S. Environmental Protection Agency

U.S. Fish and Wildlife Service

U.S. Coast Guard

U.S. Department of Transportation
Native Village of Nuiqsut
Iñupiat Community of the Arctic Slope
City of Nuiqsut
North Slope Borough
State of Alaska

August 2019

Estimated Total Costs Associated with Developing and Producing this EIS: \$5,281,000



LIST OF FIGURES

Figure ES.1. Willow Project Vicinity, North Slope, Alaska	1
Figure ES.2. Willow Project Area and Alternatives	2
Figure ES.3. Comparison of Action Alternatives	3
Figure 1.4.1. Willow Development Location	4
Figure 2.4.1. Alternative B: Proponent's Project	
Figure 2.4.2. Alternative C: Disconnected Infield Roads	6
Figure 2.4.3. Alternative D: Disconnected Access	7
Figure 2.4.4. Option 1: Proponent's Module Transfer Island	
Figure 2.4.5. Option 2: Point Lonely Module Transfer Island	9
Figure 2.5.1. Alternative B Pipeline Schematic	10
Figure 2.5.2. Alternative C Pipeline Schematic	11
Figure 2.5.3. Alternative D Pipeline Schematic	12
Figure 2.5.4. Tiŋmiaqsiġvik Gravel Mine Site	13
Figure 2.8.1. Comparison of Action Alternatives	
Figure 3.3.1. Analysis Area for Air Quality	15
Figure 3.3.2. Nuiqsut Monitoring Station Wind Rose	
Figure 3.4.1. Analysis Area for Soils, Permafrost, and Gravel Resources	17
Figure 3.5.1. Known Contaminated Sites or Spills within 0.5 mile of the Project	18
Figure 3.6.1. Analysis Area for Noise	19
Figure 3.7.1. Visual Resources Analysis Area, Project Viewshed, and Proposed Project Facilities	20
Figure 3.7.2. Visual Resource Inventory Scenic Quality Classes	21
Figure 3.7.3. Visual Resource Inventory Sensitivity Levels	22
Figure 3.7.4. Visual Resource Inventory Distance Zones	
Figure 3.7.5. Visual Resource Inventory Classes	
Figure 3.7.6. Visual Resource Management Classes	25
Figure 3.8.1. Watersheds in the Analysis Area for Water Resources	
Figure 3.8.2. Streams and Floodplains in the Willow Area	
Figure 3.8.3. Floodplain Detail in the Willow Area	
Figure 3.8.4. Lakes in the Water Resources Analysis Area	
Figure 3.8.5. Proximity of Water Resources to Shore-based Action Alternatives	
Figure 3.9.1. Analysis Area for Wetlands and Vegetation	
Figure 3.9.2. Wetlands in the Analysis Area	32
Figure 3.9.3. Land Cover Classes in the Analysis Area	33
Figure 3.10.1. Essential Fish Habitat in the Analysis Area	
Figure 3.10.2. Fish Habitat in the Willow Area	
Figure 3.11.1. Bird Habitat Use and Analysis Area	36
Figure 3.11.2. Spectacled Eider Pre-Breeding Density in the Analysis Area	
Figure 3.11.3. Yellow-Billed Loon Density and Nests in the Analysis Area	
Figure 3.11.4. Yellow-Billed Loon Density and Nests in the Willow Area	
Figure 3.11.5. Bird Habitat Use in the Willow Area	
Figure 3.12.1. Analysis Area for Terrestrial Mammals	
Figure 3.12.2. Annual Ranges of the Central Arctic and Teshekpuk Caribou Herds	
Figure 3.12.3. Seasonal Distribution of Female Caribou in the Teshekpuk Caribou Herd	
Figure 3.12.4. Movement of GPS-Collared Caribou of the Teshekpuk Caribou Herd 2004–2018	
Figure 3.12.5. Distribution of Calving Caribou of the Teshekpuk Caribou Herd 1990–2018	
Figure 3.12.6. Mean Caribou Density by Season 2001–2018	46

Figure 3.13.1. Polar Bear Dens, Critical Habitat, and Potential Terrestrial Denning Habitat	47
Figure 3.13.2. Polar Bear Potential Terrestrial Denning Habitat in the Willow Area	48
Figure 3.14.1. Map of Surface Land Ownership in the Analysis Area	49
Figure 3.14.2. Map of Subsurface Land Management in the Bear Tooth Unit	50
Figure 3.14.3. North Slope Borough Zoning Districts in the Analysis Area	51
Figure 3.16.1. Nuiqsut Contemporary Subsistence Use Areas with Direct Effects Area,	
All Resources	52
Figure 3.16.2. Nuiqsut Historic and Lifetime Subsistence Use Areas with Direct Effects Area,	
All Resources	53
Figure 3.16.3. Nuiqsut Caribou Subsistence Use Areas with Direct Effects Area, 2008–2016	54
Figure 3.16.4. Utqiagvik (Barrow) Contemporary Subsistence Use Areas with Direct Effects Area,	
All Resources	55
Figure 3.16.5. Utqiagvik (Barrow) Lifetime Subsistence Use Areas with Direct Effects Area,	
All Resources	
Figure 3.16.6. All Resource Subsistence Use Areas by Alternative, Nuiqsut, 1995–2006	
Figure 3.16.7. Caribou Subsistence Use Areas by Alternative, Nuiqsut, 1995–2006	58
Figure 3.16.8. Caribou Subsistence Use Areas by Alternative, Nuiqsut, 2008–2016	59
Figure 3.16.9. Wolf and Wolverine Subsistence Use Areas by Alternative, Nuiqsut, 1995–2006	60
Figure 3.16.10. Goose Subsistence Use Areas by Alternative, Nuiqsut, 1995–2006	61
Figure 3.16.11. All Resource Subsistence Use Areas by Alternative, Utqiagvik (Barrow),	
1997–2006	62
Figure 3.16.12. Caribou Subsistence Use Areas by Alternative, Utqiagvik (Barrow), 1997–2006	63
Figure 3.16.13. Wolf and Wolverine Subsistence Use Areas by Alternative, Utqiagvik (Barrow),	
1997–2006	64
Figure 3.16.14. All Resource Subsistence Use Areas by Module Delivery Option, Nuiqsut,	
1995–2006	
Figure 3.16.15. Caribou Subsistence Use Areas by Module Delivery Option, Nuiqsut, 1995–2006	
Figure 3.16.16. Caribou Subsistence Use Areas by Module Delivery Option, Nuiqsut, 2008–2016	67
Figure 3.16.17. Wolf and Wolverine Subsistence Use Areas by Module Delivery Option, Nuiqsut,	6 0
1995–2006	
Figure 3.16.18. Goose Subsistence Use Areas by Module Delivery Option, Nuiqsut, 1995–2006	
Figure 3.16.19. Seal Subsistence Use Areas by Module Delivery Option, Nuiqsut, 1995–2006	
Figure 3.16.20. Eider Subsistence Use Areas by Module Delivery Option, Nuigsut, 1995–2006	
Figure 3.16.21. Fish Subsistence Use Areas by Module Delivery Option, Nuiqsut, 1995–2006	
Figure 3.16.22. Moose Subsistence Use Areas by Module Delivery Option, Nuiqsut, 1995–2006	/3
Figure 3.16.23. All Resource Subsistence Use Areas by Module Delivery Option, Utqiagvik	7.4
(Barrow), 1997–2008Figure 3.16.24. Caribou Subsistence Use Areas by Module Delivery Option, Utqiagvik (Barrow),	/4
1997–2008	75
Figure 3.16.25. Wolf and Wolverine Subsistence Use Areas by Module Delivery Option,	13
	76
Utqiagvik (Barrow), 1997–2008	/0
Figure 3.16.26. Seal Subsistence Use Areas by Module Delivery Option, Utqiagvik	77
(Barrow), 1995–2008	/ /
Figure 3.16.27. Goose Subsistence Use Areas by Module Delivery Option, Utqiagvik	70
(Barrow), 1995–2008	
Figure 3.19.1. Past and Present Actions that may Interact with the Willow Project	
Figure 3.19.2. Reasonably Foreseeable Future Actions that may Interact with the Willow Project	ðU

Figure 4.3.1. Drill Site BT1 Reservoir Blowout Oil Fallout	81
Figure 4.3.2. Drill Site BT2 Reservoir Blowout Oil Fallout	82
Figure 4.3.3. Drill Site BT3 Reservoir Blowout Oil Fallout	83
Figure 4.3.4. Drill Site BT4 Reservoir Blowout Oil Fallout	84
Figure 4.3.5. Drill Site BT5 Reservoir Blowout Oil Fallout	85

Appendix A Figures iii

This page intentionally left blank.

Draft Environmental Impact Statement Willow Project Vicinity Executive Summary U.S. DEPARTMENT OF THE INTERIOR | BUREAU OF LAND MANAGEMENT | ALASKA | WILLOW MASTER DEVELOPMENT PLAN Willow Proposed Development Features UTQIAĠVIK (BARROW) Gravel Footprint Other Infrastructure Existing Road Existing Pipeline Existing Infrastructure **Land Designation** National Petroleum Reserve in Alaska K-5 Teshekpuk Lake Caribou Habitat Area Colville River Special Area Teshekpuk Lake Special Area Harrison Bay ATQASUK DEADHORSE No warnedy is made by the Bareau of Land Management as to the accuracy, reliability, or completeness of these data for included or aggregate use with other data for included as original data were compiled from various sources. Thus information may not meet Matsonal Map Accuracy Standards: Thus product was developed through shiplail means and may be updated without notification. ANAKTUVUK PASS 30 Miles Figure ES.1

Figure ES.1. Willow Project Vicinity, North Slope, Alaska

Draft Environmental Impact Statement Project Area and Action Alternatives Executive Summary U.S. DEPARTMENT OF THE INTERIOR | BUREAU OF LAND MANAGEMENT | ALASKA | WILLOW MASTER DEVELOPMENT PLAN Willow Proposed Development Features Module Transfer Island Drill Site (Not to Scale) - Ice Road Gravel Footprint Other Infrastructure Existing Road **Existing Pipeline** Existing Infrastructure **Land Designation** National Petroleum Reserve Harrison Bay **Best Management Practice Areas** K-1 River Buffers K-2 Deepwater Lake Buffers K-5 Teshekpuk Lake Caribou Habitat Area Oil & Gas Unavailable to Leasing Unavailable no Leasing and no new non-subsistence infrastructure Module Transfer Island Atigaru CD3 Kuparuk BT4 GMT-1 BT2 **Gravel Mine ASRC Mine Site** NUIQSUT No warranty is made by the Bureau of Land No warraty is made by the Bureau of Lard 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 Bandards: This product was developed through digital means and may be updated without notification. 10 Miles Figure ES.2

Figure ES.2. Willow Project Area and Alternatives

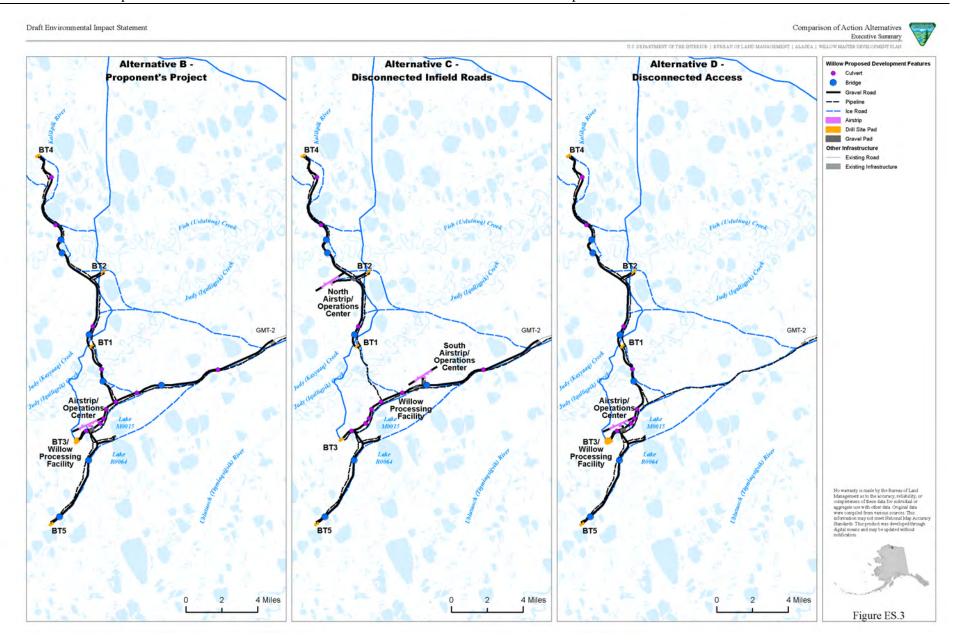


Figure ES.3. Comparison of Action Alternatives

Draft Environmental Impact Statement Willow Development Location 1.0 - Introduction and Purpose and Need U.S. DEPARTMENT OF THE INTERIOR | BUREAU OF LAND MANAGEMENT | ALASKA | WILLOW MASTER DEVELOPMENT PLAN Willow Proposed Development Features Option 2 Module Transfer Island Drill Site (Not to Scale) -- Ice Road Gravel Footprint Other Infrastructure Existing Road Existing Pipeline Existing Infrastructure **Land Designation** National Petroleum Reserve Best Management Practice Areas Harrison Bay K-1 River Buffers K-2 Deepwater Lake Buffers K-5 Teshekpuk Lake Caribou Habitat Area Oil & Gas Unavailable to Leasing Unavailable no Leasing and no new non-subsistence infrastructure Oil and Gas Lease Unit Option 1 Module Transfer Island Bear Tooth Atigaru Point CD3 **BT4** GMT-1 ASRC Mine Site **Gravel Mine** NUIQSUT No warrestly is rande by the Bureau of Land Management as to the accuracy, reliability, or complehenes of these data for individual or aggregate use with other data Original data were compled from various sources. Accuracy series of the control of the control of the information may not meet National Map Accuracy Bandards. The product was developed through digital means and may be updated without notification.

Figure 1.4.1. Willow Development Location

Appendix A Figures 4

10 Miles

Figure 1.4.1

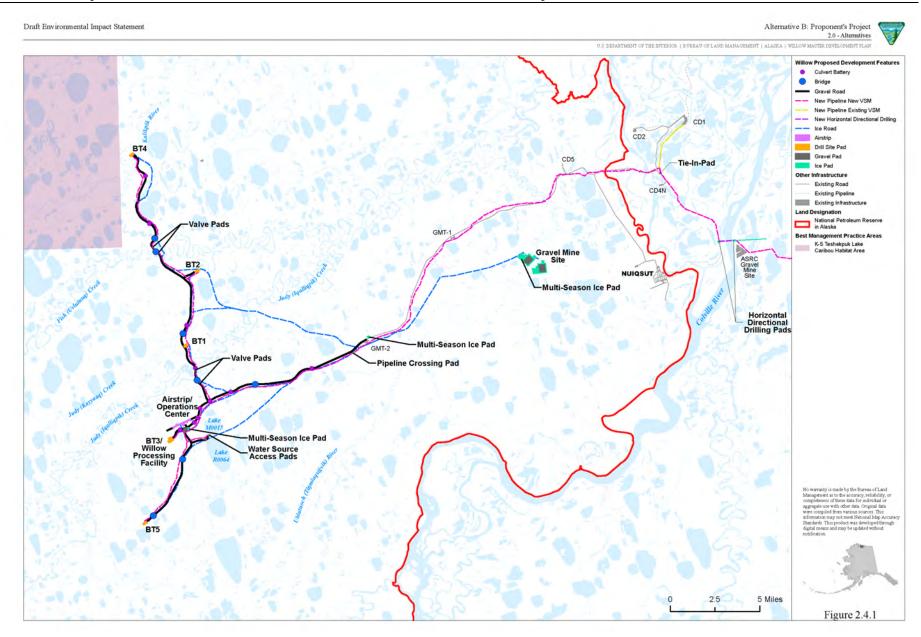


Figure 2.4.1. Alternative B: Proponent's Project

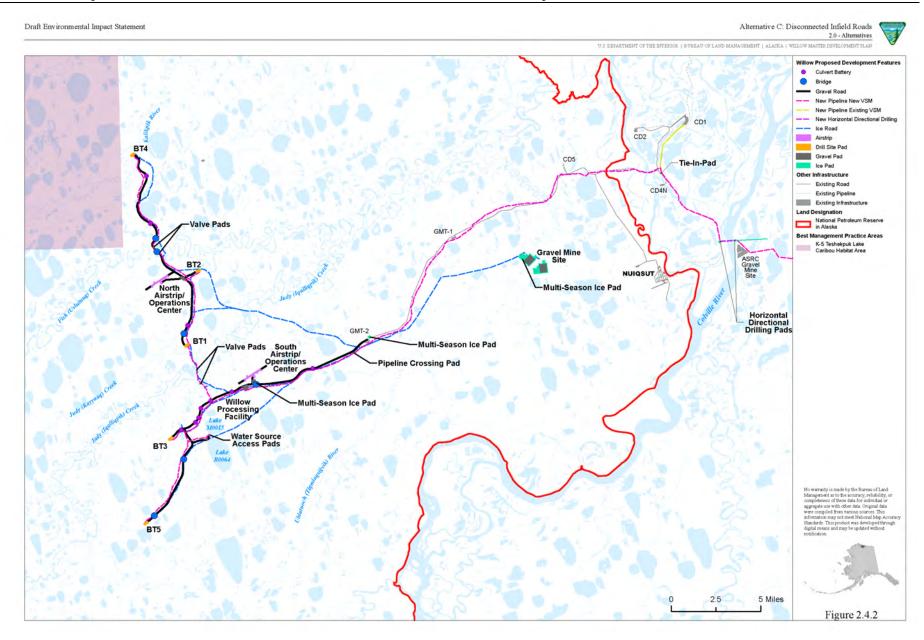


Figure 2.4.2. Alternative C: Disconnected Infield Roads

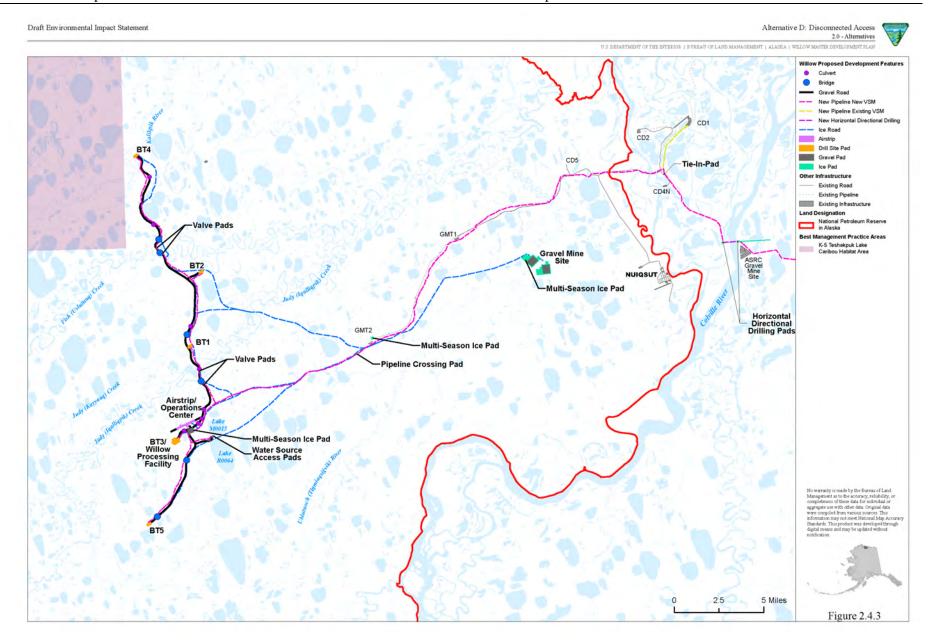


Figure 2.4.3. Alternative D: Disconnected Access

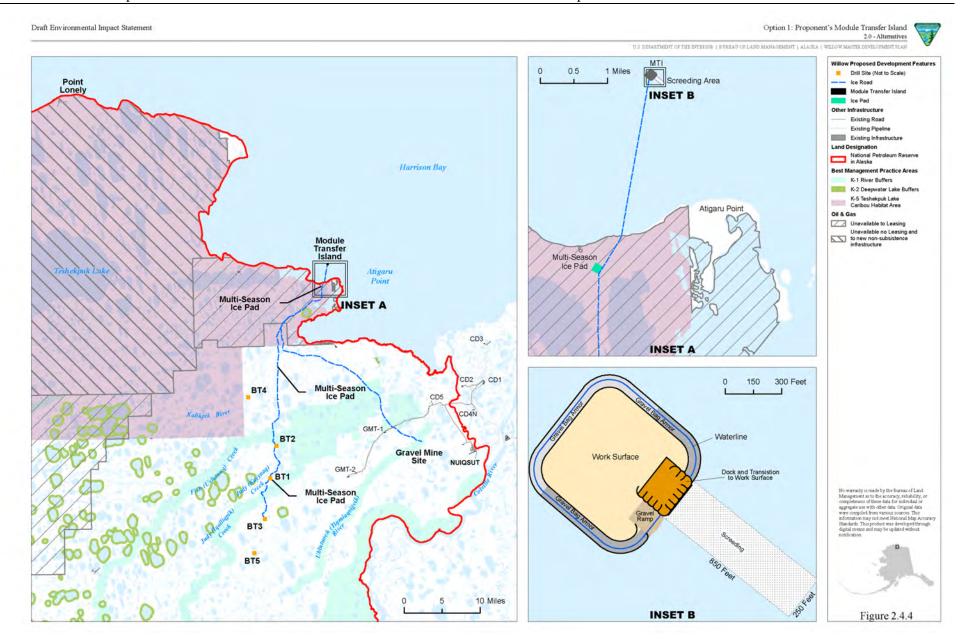


Figure 2.4.4. Option 1: Proponent's Module Transfer Island

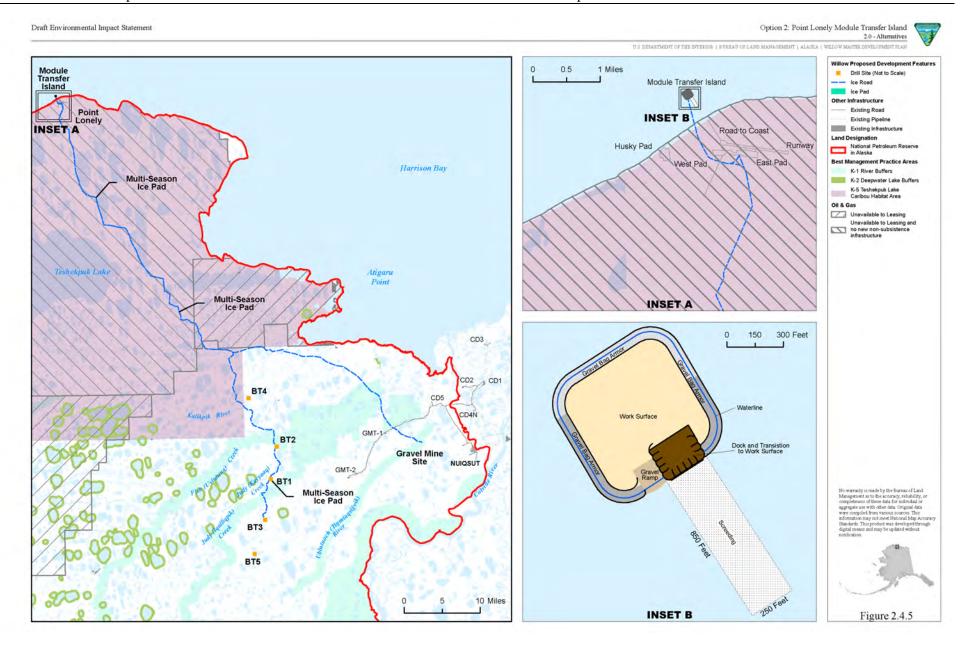


Figure 2.4.5. Option 2: Point Lonely Module Transfer Island

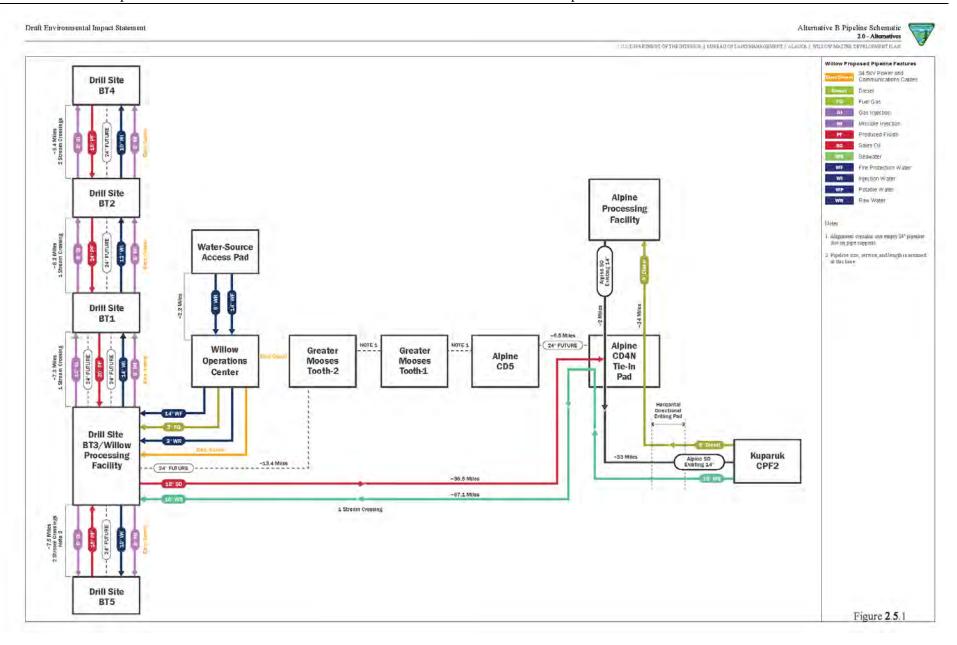


Figure 2.5.1. Alternative B Pipeline Schematic

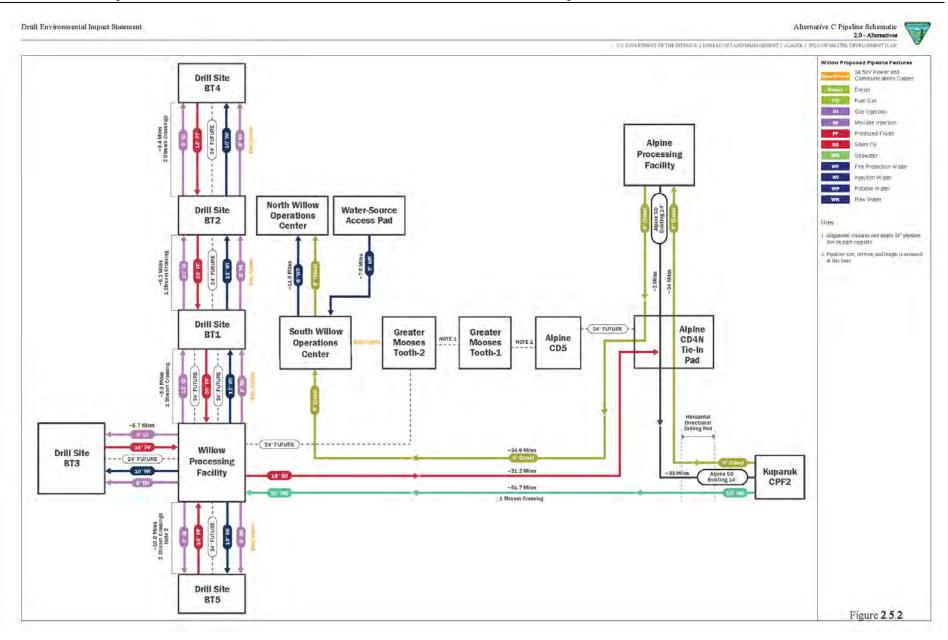


Figure 2.5.2. Alternative C Pipeline Schematic

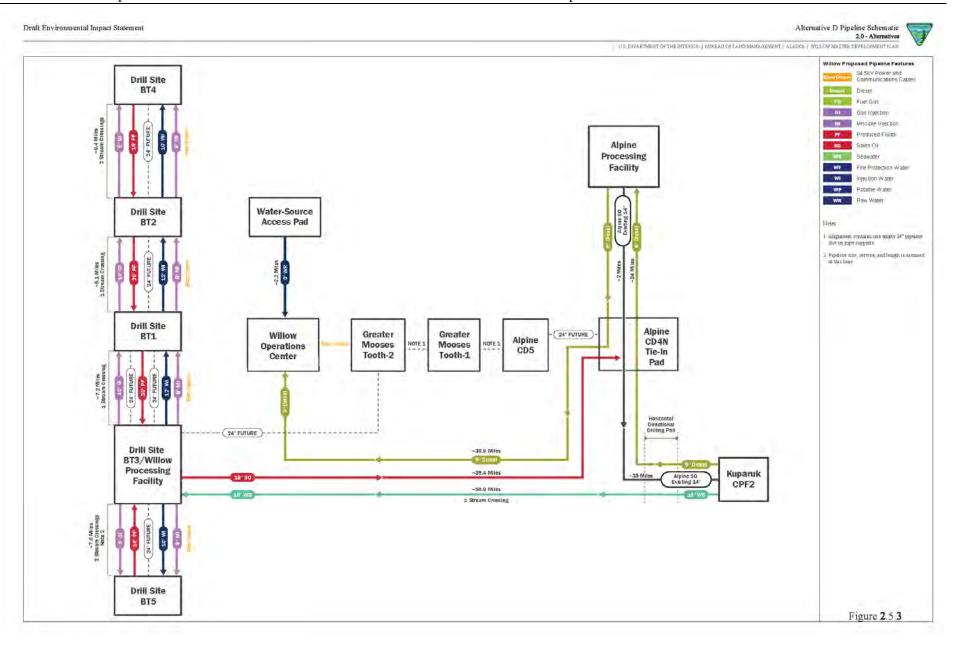


Figure 2.5.3. Alternative D Pipeline Schematic

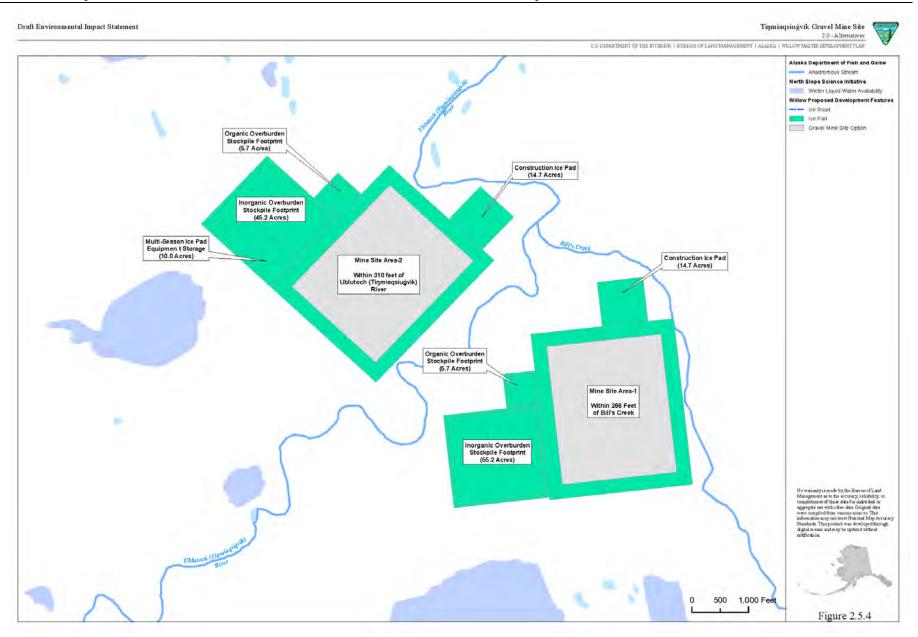


Figure 2.5.4. Tinmiaqsigvik Gravel Mine Site

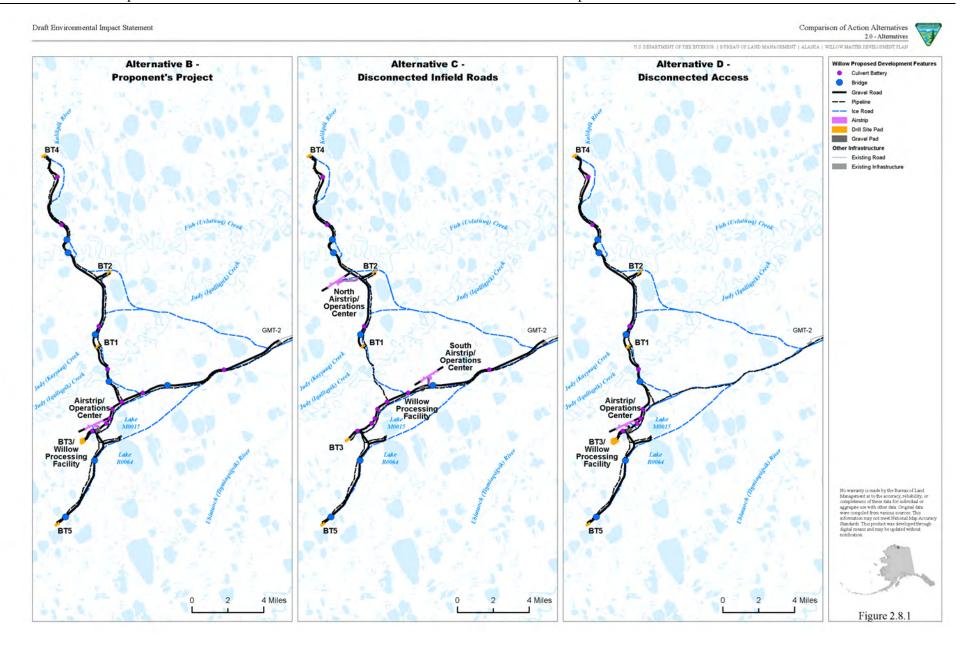


Figure 2.8.1. Comparison of Action Alternatives

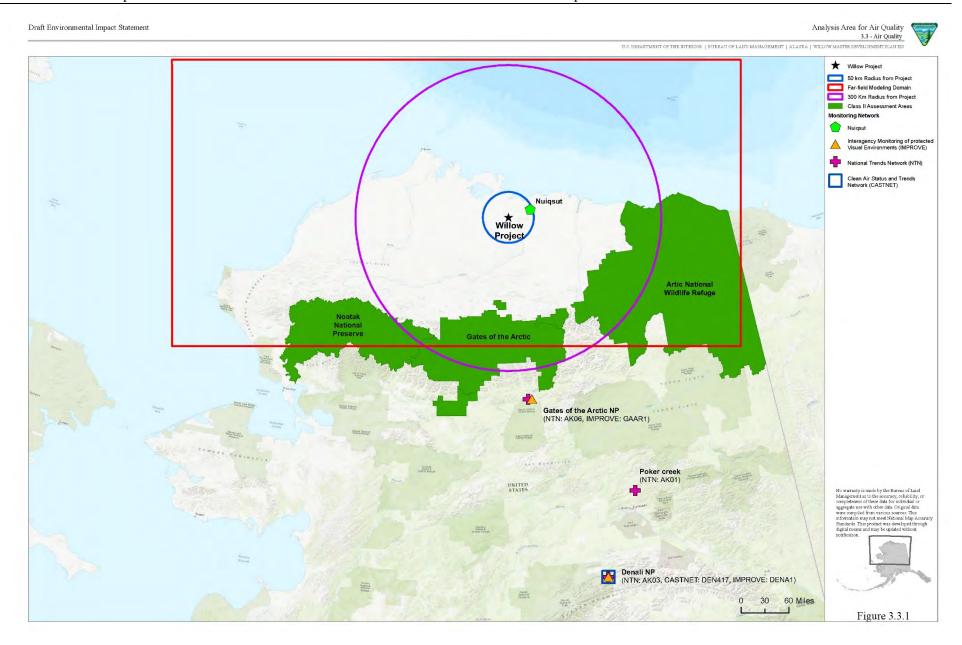


Figure 3.3.1. Analysis Area for Air Quality

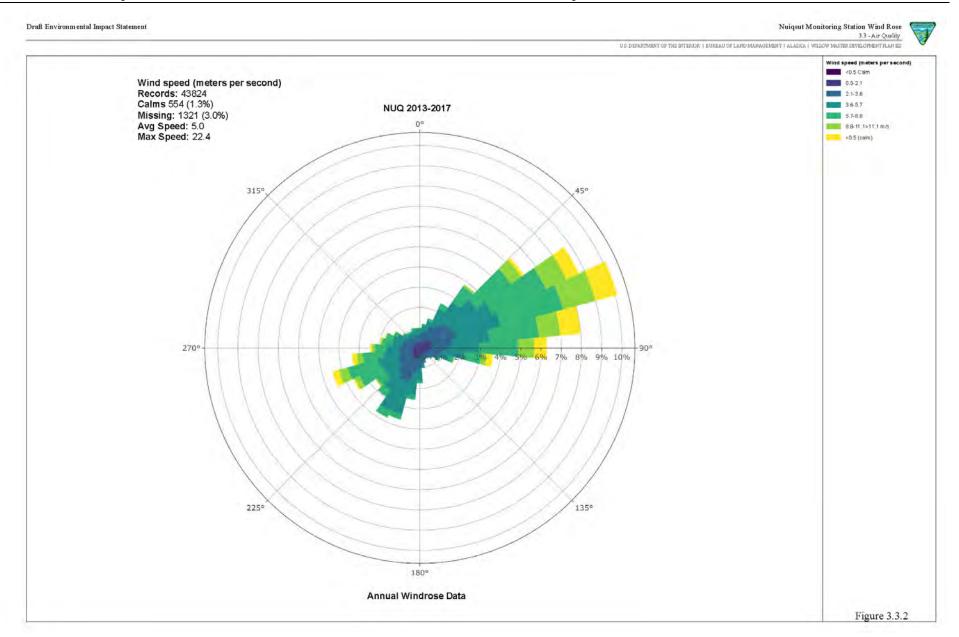


Figure 3.3.2. Nuiqsut Monitoring Station Wind Rose

Draft Environmental Impact Statement Analysis Area for Soils, Permafrost, and Gravel Resources

3.4 - Soils , Permafrost, and Gravel Resources

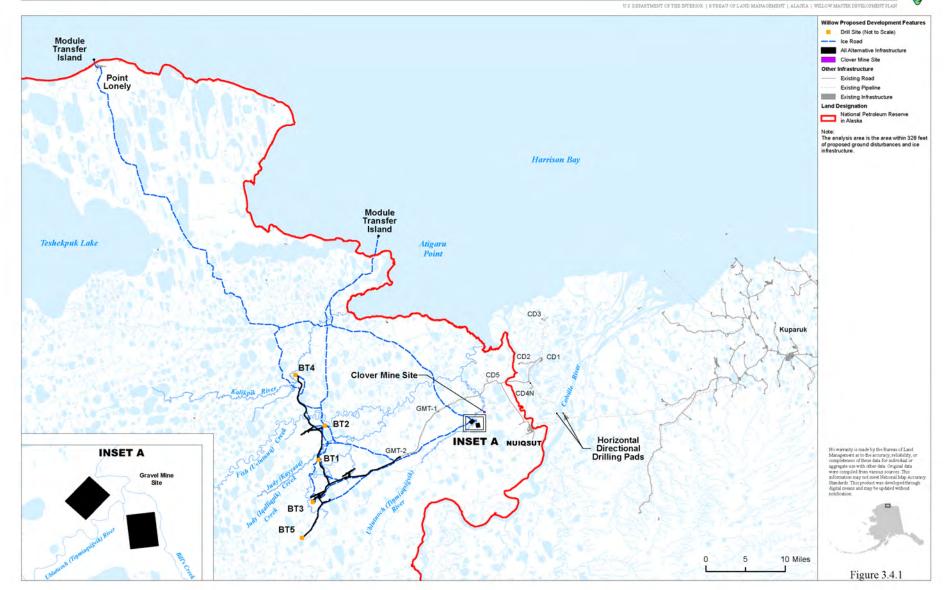


Figure 3.4.1. Analysis Area for Soils, Permafrost, and Gravel Resources

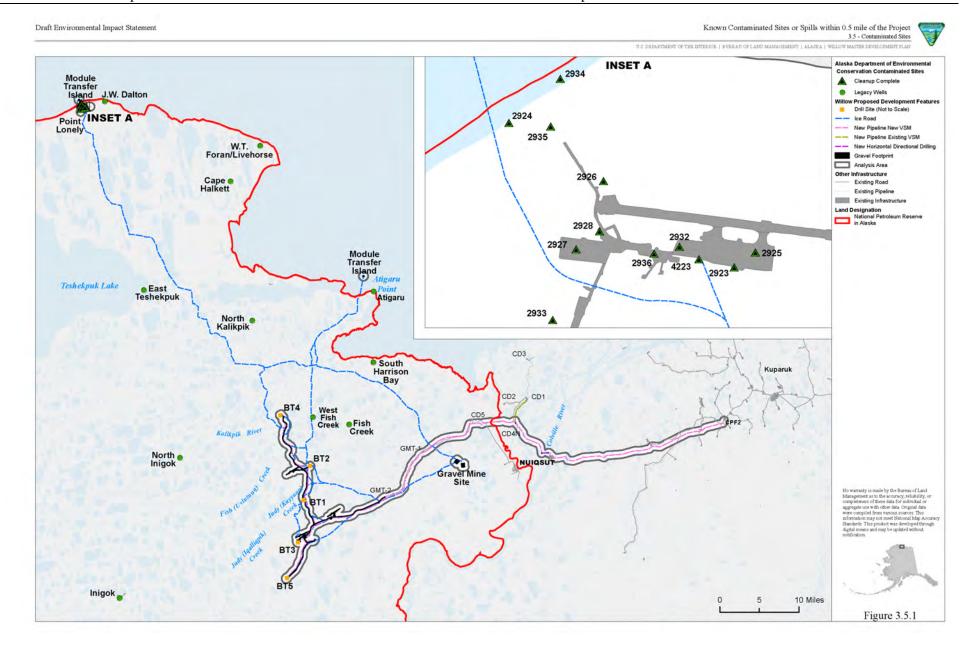


Figure 3.5.1. Known Contaminated Sites or Spills within 0.5 mile of the Project

Draft Environmental Impact Statement Analysis Area for Noise 3.6 - Noise U.S. DEPARTMENT OF THE INTERIOR | BUREAU OF LAND MANAGEMENT | ALASKA | WILLOW MASTER DEVELOPMENT PLAN Willow Proposed Development Features Drill Site (Not to Scale) - Ice Road Gravel Footprint Attenuation Zone Other Infrastructure Existing Road ---- Existing Pipeline Existing Infrastructure Land Designation National Petroleum Reserve in Alaska Module Transfer Island Point Lonely Harrison Bay Module Transfer Island Teshekpuk Lake KUPARUK ALPINE BT4 DEADHORSE BT2 NUIQSUT No warnety is mude by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for included or aggregate use with other data. Original data were compiled from various sources. Accuracy Standards: This product was developed frough digital means and may be updated without notification. 5 10 Miles Figure 3.6.1

Figure 3.6.1. Analysis Area for Noise

Draft Environmental Impact Statement Visual Resources Analysis Area, Project Viewshed, and Proposed Project Facilities 3.7 - Visual and Resources

U.S. DEPARTMENT OF THE INTERIOR | BUREAU OF LAND MANAGEMENT | ALASKA | WILLOW MASTER DEVELOPMENT PLAN

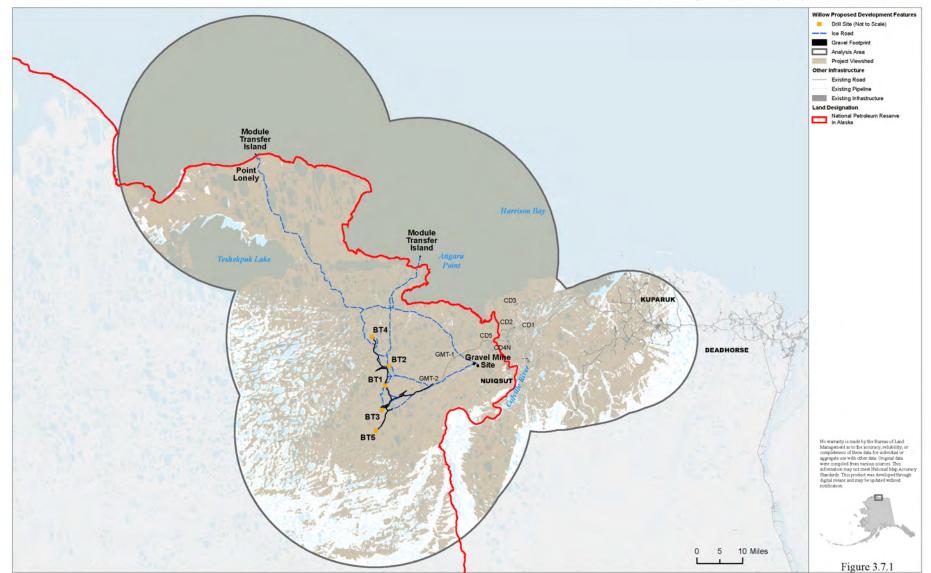
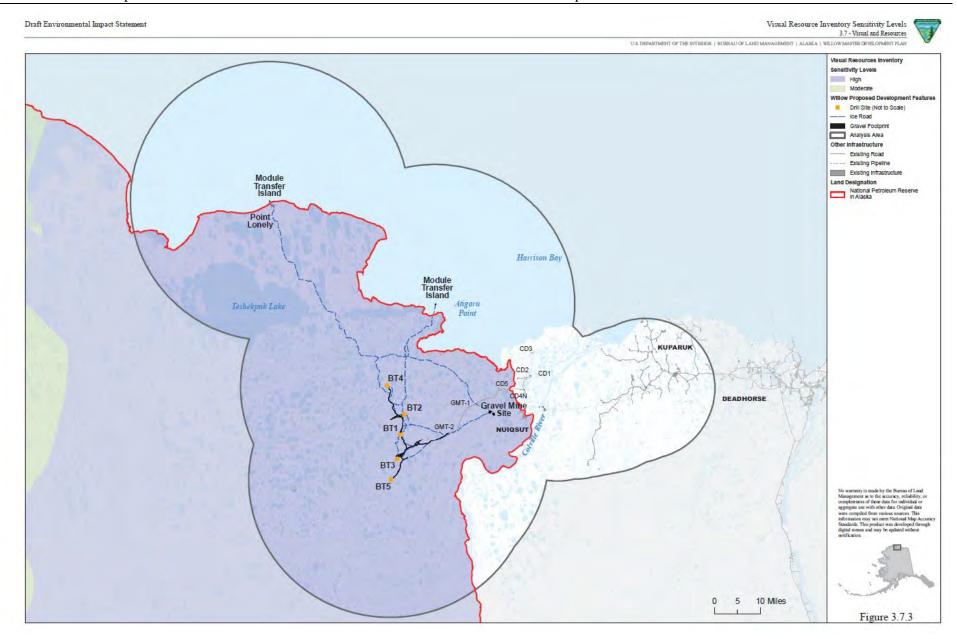


Figure 3.7.1. Visual Resources Analysis Area, Project Viewshed, and Proposed Project Facilities



Draft Environmental Impact Statement Visual Resource Inventory Scenic Quality Classes 3.7 - Visual and Resources U.S. DEPARTMENT OF THE INTERIOR | BUREAU OF LAND MANAGEMENT | ALASKA | WILLOW MASTER DEVELOPMENT PLAN Visual Resource Inventory В Drill Site (Not to Scale) - Ice Road Gravel Footprint Analysis Area Other Infrastructure Existing Road Existing Pipeline Module Transfer Island Existing Infrastructure **Land Designation** National Petroleum Reserve in Alaska Point Lonely Harrison Bay Module Transfer Island Teshekpuk Lake KUPARUK CD3 CD2 BT4 DEADHORSE Gravel Mine BT2 No warnely is made by the Bureau of Land Management as to the scorracy, reliability, or completeness of these data for individual or aggregate use with other data. Original data were compiled from vanous sources: This information may not meet National Map. Accuracy Standards: This product was developed through digital means and may be updated without notification. 5 10 Miles Figure 3.7.2

Figure 3.7.2. Visual Resource Inventory Scenic Quality Classes



 ${\bf Figure~3.7.3.~Visual~Resource~Inventory~Sensitivity~Levels}$

Draft Environmental Impact Statement Visual Resource Inventory Distance Zones 3.7 - Visual and Resources U.S. DEPARTMENT OF THE INTERIOR | BUREAU OF LAND MANAGEMENT | ALASKA | WILLOW MASTER DEVELOPMENT PLAN Visual Resources Inventory Foreground Background Seldom Seen Willow Proposed Develops Drill Site (Not to Scale) - Ice Road Gravel Footprint Analysis Area Other Infrastructure Existing Road Existing Pipeline Module Transfer Island Existing Infrastructure Land Designation National Petroleum Reserve in Alaska Point Lonely Harrison Bay Module Transfer Island CD3 KUPARUK CD2 BT4 CD5 DEADHORSE Gravel Mine No warrarby 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 courses: This information may not meet National Map. Accuracy Inhardard: This product was developed through digital means and may be updated without notification. 5 10 Miles Figure 3.7.4

Figure 3.7.4. Visual Resource Inventory Distance Zones



Draft Environmental Impact Statement Visual Resource Inventory Classes 3.7 - Visual and Resources U.S. DEPARTMENT OF THE INTERIOR | BUREAU OF LAND MANAGEMENT | ALASKA | WILLOW MASTER DEVELOPMENT PLAN Visual Resources Inventory HI HI Willow Proposed Develop Drill Site (Not to Scale) - Ice Road Gravel Footprint Analysis Area Other Infrastructure Existing Road Existing Pipeline Module Transfer Island Existing Infrastructure **Land Designation** National Petroleum Reserve in Alaska Point Lonely Harrison Bay Module Transfer Island CD3 KUPARUK CD2 BT4 DEADHORSE Gravel Mine No warrarby 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 warious courses: This information may not meet National Map. Accuracy Inhardard: This product was developed through digital means and may be updated without notification.

Figure 3.7.5. Visual Resource Inventory Classes

Appendix A Figures 24

5 10 Miles

Figure 3.7.5

Visual Resource Management Classes Draft Environmental Impact Statement 3.7 - Visual and Resources U.S. DEPARTMENT OF THE INTERIOR | BUREAU OF LAND MANAGEMENT | ALASKA | WILLOW MASTER DEVELOPMENT PLAN Visual Resources Inventory Management Class -Willow Proposed Develop Drill Site (Not to Scale) - Ice Road Gravel Footprint Analysis Area Other Infrastructure Existing Road Existing Pipeline Module Transfer Island Existing Infrastructure Land Designation National Petroleum Reserve in Alaska Point Lonely Harrison Bay Module Transfer Island CD3 KUPARUK BT4 DEADHORSE GMT-1 Gravel Mine No warrarby is made by the Bureau of Land Management at to the accuracy, reliability, or completeness of these data for undividual or aggregate use with other data Original data were compiled from various sources. This information may not meet National Map. Accuracy Bandards. This product was developed through digital means and may be updated without notification.

Figure 3.7.6. Visual Resource Management Classes

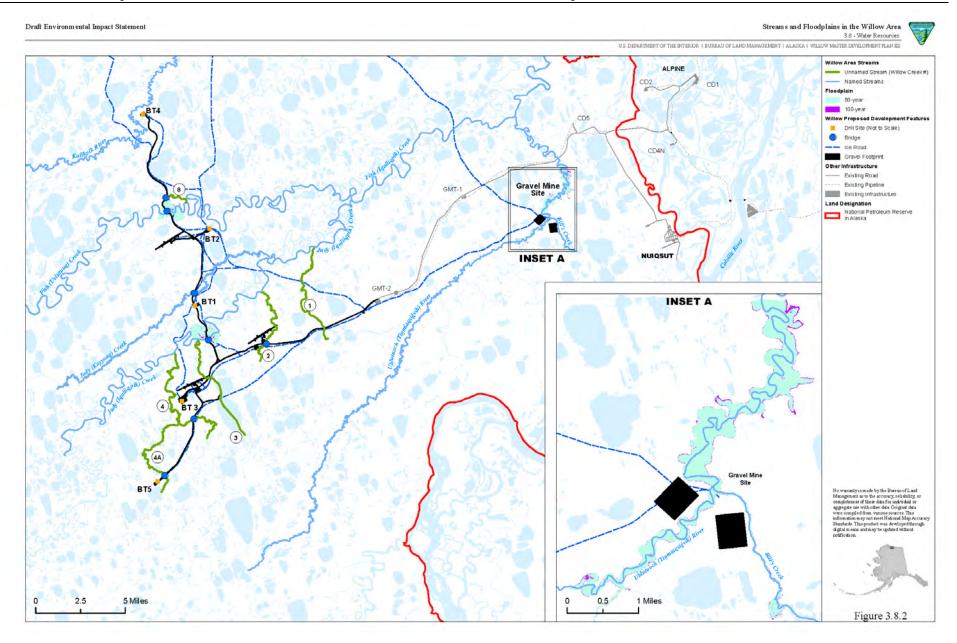
Appendix A Figures 25

5 10 Miles

Figure 3.7.6

Draft Environmental Impact Statement Watersheds in the Analysis Area for Water Resources 3.8 - Water Resources U.S. DEPARTMENT OF THE INTERIOR | BUREAU OF LAND MANAGEMENT | ALASKA | WILLOW MASTER DEVELOPMENT PLAN EIS **United States Geological Survey** Module Transfer Island Hydrologic Unit 10 Atigaru Point Colville River Delta Garry Creek Kalikpik River Kogru River McLeod Point Harrison Bay Outlet Fish Creek Outlet Judy Creek Pogik Bay Smith River Teshekpuk Lake Ublutuoch River Willow Proposed Development Features Drill Site (Not to Scale) Bridge Module - Ice Road Analysis Area Gravel Footprint Teshekpuk Lake Other Infrastructure **Existing Road** Existing Pipeline Existing Infrastructure Land Designation National Petroleum Reserve Horizontal Directional Drilling Pads 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 May Accur information may not meet National May Accur INSET A 10 Miles Figure 3.8.1

Figure 3.8.1. Watersheds in the Analysis Area for Water Resources



 $Figure \ 3.8.2. \ Streams \ and \ Floodplains \ in \ the \ Willow \ Area$

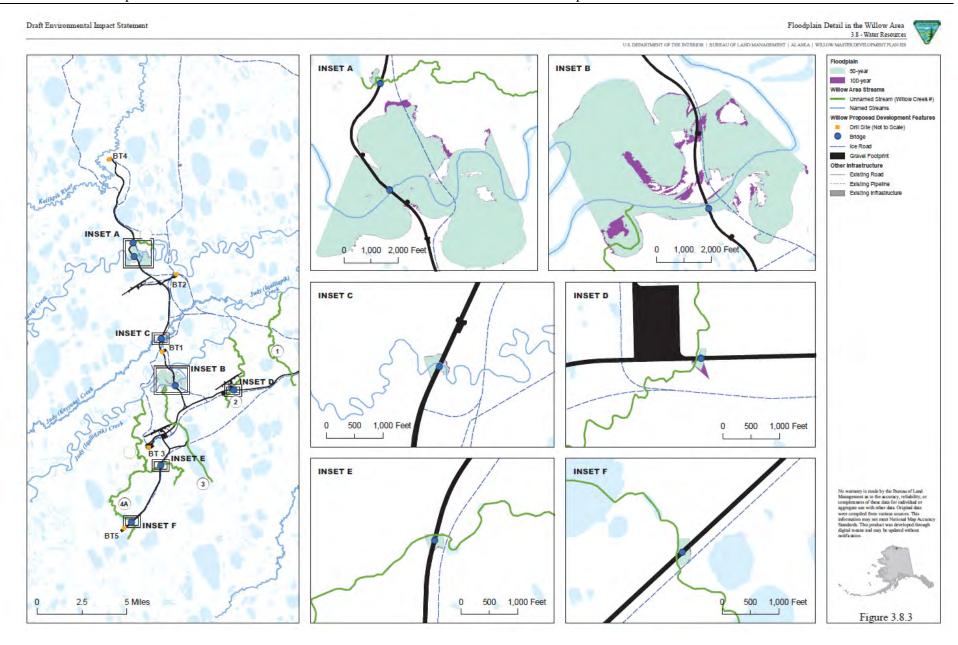


Figure 3.8.3. Floodplain Detail in the Willow Area

Draft Environmental Impact Statement Lakes in the Water Resources Analysis Area 3.8 - Water Resources U.S. DEPARTMENT OF THE INTERIOR | BUREAU OF LAND MANAGEMENT | ALASKA | WILLOW MASTER DEVELOPMENT PLAN EIS North Slope Science Initiative (2009) Module Transfer Island Winter Liquid Water Availability Willow Proposed Development Features Drill Site (Not to Scale) Bridge Gravel Footprint Analysis Area Harrison Bay Other Infrastructure Existing Road Existing Pipeline Existing Infrastructure **Land Designation** National Petrole in Alaska Module Teshekpuk Lake Horizontal Directional Drilling Pads 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 May Accur information may not meet National May Accur INSET A 10 Miles Figure 3.8.4

Figure 3.8.4. Lakes in the Water Resources Analysis Area

Draft Environmental Impact Statement Proximi

Proximity of Water Resources to Shore-based Action Alternatives

3.8 - Water Resources

U.S. DEPARTMENT OF THE DITERIOR | BUREAU OF LAND MAIMORMENT | ALASKA | WILLOW MUP RES

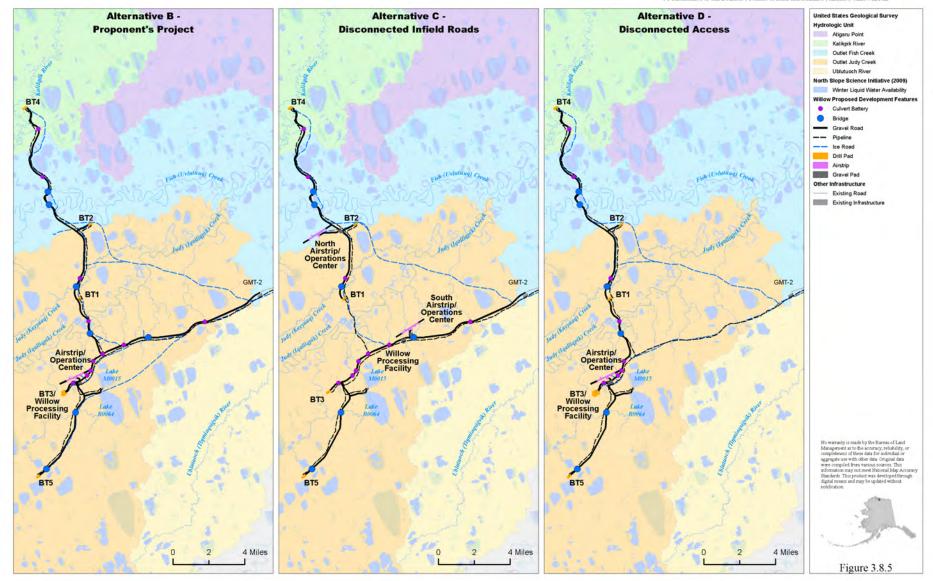


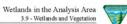
Figure 3.8.5. Proximity of Water Resources to Shore-based Action Alternatives

Draft Environmental Impact Statement Analysis Area for Wetlands and Vegetation 3.9 - Wetlands and Vegetation U.S. DEPARTMENT OF THE INTERIOR | BUREAU OF LAND MANAGEMENT | ALASKA | WILLOW MASTER DEVELOPMENT PLAN EL Module Transfer Island Willow Proposed Development Features Hydrologic Unit 10 Atigaru Point Colville River Delta Garry Creek Kalikpik River Kogru River McLeod Point Harrison Bay Outlet Fish Creek Outlet Judy Creek Pogik Bay Smith River Teshekpuk Lake Ublutuoch River Willow Proposed Development Features Drill Site (Not to Scale) Bridge Module Transfer - Ice Road Gravel Footprint Analysis Area Teshekpuk Lake Other Infrastructure Existing Road Existing Pipeline Existing Infrastructure Land Designation National Petroleu in Alaska Horizontal Directional Drilling Pads 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 May Accur information may not meet National May Accur INSET A 10 Miles Figure 3.9.1

Figure 3.9.1. Analysis Area for Wetlands and Vegetation

Draft Environmental Impact Statement 3.9 - Wetlands and Vegetation U.S. DEPARTMENT OF THE INTERIOR | BUREAU OF LAND MANAGEMENT | ALASKA | WILLOW MASTER DEVELOPMENT PLAN EL Module Transfer Island National Wetlands Inventory E1, M1 E2, M2 L1, L2 PEM1, PEM2 - C, F, H Modifiers PEM1 - A, B, E Modifiers PSS1 PUB PUS Harrison Bay R2, R3, R5 Willow Proposed Development Features Drill Site (Not to Scale) Bridge - Ice Road Gravel Footprint Other Infrastructure Module Transfer Island - Existing Road ---- Existing Pipeline Existing Infrastructure Teshekpuk Lake Land Designation National Petroleum Reserve Horizontal Directional Drilling Pads 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 May Accur information may not meet National May Accur 10 Miles Figure 3.9.2

Figure 3.9.2. Wetlands in the Analysis Area



Draft Environmental Impact Statement Land Cover Classes in the Analysis Area 3.9 - Wetlands and Vegetation U.S. DEPARTMENT OF THE INTERIOR | BUREAU OF LAND MANAGEMENT | ALASKA | WILLOW MASTER DEVELOPMENT PLAN ED North Slope Science Initiative Land Cover Module Transfer Unclassified Bare Ground Sparsely Vegetated Open Water FWM: Arctophila Fulva FWM: Carex Aquatillis Wet Sedge Harrison Bay Mesic Herbaceous Tussock Tundra Tussock Shrub Tundra Mesic Sedge-Dwarf Shrub Tundra Dwarf Shrub - Dryas Dwarf Shrub - Other Birch Ericaceous Low Shrub Low-Tall Willow Alder Module Transfer Coastal Marsh lce / Snow Burned Area unclassified Willow Proposed Development Features Drill Site (Not to Scale) Bridge Ice Road Gravel Footprint Analysis Area Other Infrastructure Existing Road Existing Pipeline Existing Infrastructure **Land Designation** National Petrole Horizontal Directional Drilling Pads No warranty is made by the Bureau of Lend Management as to the accuracy, reliability, or completeness of these data for indoductal or aggregate use with other data. Original data were complete from various sources: This information may not mee! National Map Accuracy Standards. This product was developed through digital means and may be updated without notification. 10 Miles

Figure 3.9.3. Land Cover Classes in the Analysis Area

Appendix A Figures 33

Figure 3.9.3

Draft Environmental Impact Statement Essential Fish Habitat in the Analysis Area 3.10 - Fish U.S. DEPARTMENT OF THE INTERIOR | BUREAU OF LAND MANAGEMENT | ALASKA | WILLOW MASTER DEVELOPMENT PLAN Module Transfer Island Resistant Fish Anadromous Streams Freshwater Essential Fish Habitat Overwinter Fish Habitat Point Marine Essential Fish Habitat Willow Proposed Development Features Drill Site (Not to Scale) - Ice Road Analysis Area Gravel Footprint Other Infrastructure - Existing Road Harrison Bay Existing Pipeline Existing Infrastructure **Land Designation** National Petroleum Reserve in Alaska Module Transfer Island Teshekpuk Lake Horizontal INSET A NUIQSUT Directional Drilling Pads 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 information may not meet National Map. Accuracy 10 Miles

Figure 3.10.1. Essential Fish Habitat in the Analysis Area

Appendix A Figures 34

Figure 3.10.1

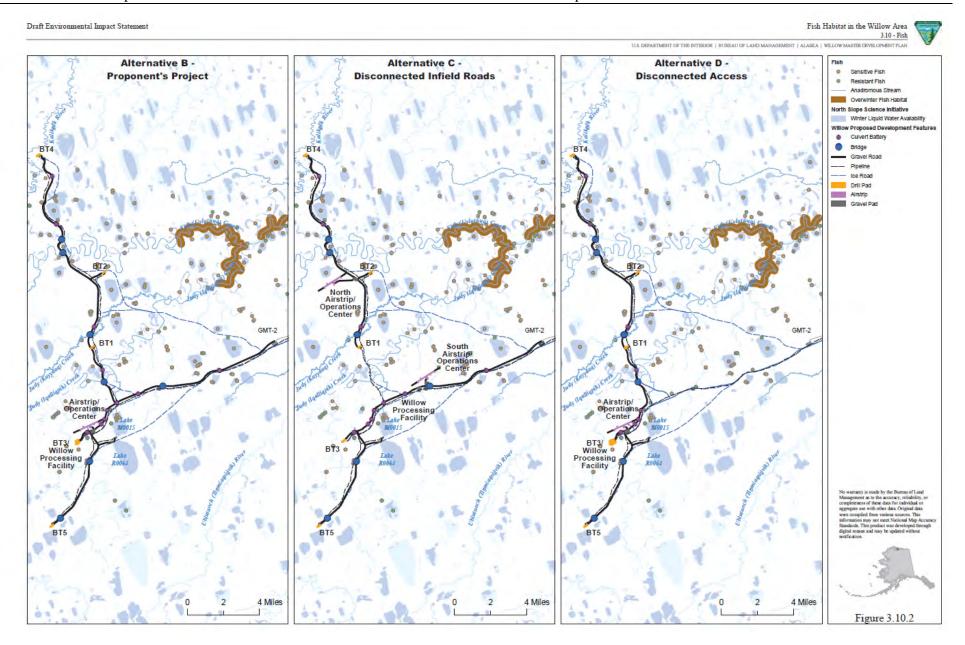


Figure 3.10.2. Fish Habitat in the Willow Area

Draft Environmental Impact Statement Bird Habitat Use and Analysis Area 3.11 - Birds U.S. DEPARTMENT OF THE INTERIOR | BUREAU OF LAND MANAGEMENT | ALASKA | WILLOW MASTER DEVELOPMENT PLAN **Bird Habitat** (No. of Speices Using) Module 11 - 20 Transfer 21 - 30 Island >30 Willow Proposed Development Features Point Drill Site (Not to Scale) Lonely - Ice Road New Pipeline New VSM -- New Pipeline Existing VSM New Horizontal Directional Drilling Gravel Footprint Analysis Area Other Infrastructure Existing Road Harrison Bay Existing Infrastructure Land Designation National Petroleum Reserve in Alaska Module Transfer Island Teshekpuk Lake Kuparuk GMT-1 Horizontal Directional Drilling Pads INSET A No warrardy 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 togores. This information may not meet National Map Accuracy Standards. This product was developed through digital means and may be updated without notification. INSET A 10 Miles Figure 3.11.1

Figure 3.11.1. Bird Habitat Use and Analysis Area

Draft Environmental Impact Statement Spectacled Eider Pre-Breeding Density in the Analysis Area 3.11 - Birds U.S. DEPARTMENT OF THE INTERIOR | BUREAU OF LAND MANAGEMENT | ALASKA | WILLOW MASTER DEVELOPMENT PLAN Spectacled Eider Pre-nesting Observations Module Estimated June Density, 2012 to 2015 Transfer (Birds per square mile) Island 0 to 0.08 >0.08 to 0.26 >0.26 to 0.51 >0.51 to 0.87 >0.87 to 2.22 >2.22 Willow Proposed Development Features Drill Site (Not to Scale) - Ice Road New Pipeline New VSM New Pipeline Existing VSM Harrison Bay New Horizontal Directional Drilling Gravel Footprint Analysis Area Other Infrastructure - Existing Road **Existing Pipeline** Module Transfer Existing Infrastructure **Land Designation** Island National Petroleum Reserve in Alaska Data Sources: Data Sources:

Observations were collected during 19922018 avian studies conducted by ABR and funded by ConcooPhillips Alaska, Inc.
Surveys were not conducted the same number of years across the area displayed; surveys were conducted 17 years in NPRA, 25 years on the Colville River Delta, and 24 25 years on the Colville River Delta, and 24 years in Kuppauls. 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 Plan earth breeding waterbird under the Coastal Plan earth breeding waterbird under 2012 25 Fauriery 2012-2015. Refer to Lamed et al. 2012 for survey methodology. BT4 CPF2 GMT-1 BT2 Horizontal
Directional
Drilling Pads INSET A GMT-2 No warranty is made by the Bureau of Land INSET A No warrarly 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 Mag. Accuracy Bandards. This product was developed through BT1 BT3 BT5 10 Miles Figure 3.11.2

Figure 3.11.2. Spectacled Eider Pre-Breeding Density in the Analysis Area

Draft Environmental Impact Statement Yellow-Billed Loon Density and Nests in the Analysis Area 3.11 - Birds U.S. DEPARTMENT OF THE INTERIOR | BUREAU OF LAND MANAGEMENT | ALASKA | WILLOW MASTER DEVELOPMENT PLAN Yellow-Billed Loon Nests Module Lake/Nest Buffer Transfer Estimated June Density, 2012 to 2015 Island (Birds per square mile) 0 to 0.05 >0.05 to 0.16 Lonely >0.16 to 0.31 >0.31 to 0.50 >0.50 to 1.30 Pads Drill Site (Not to Scale) -- Ice Road New Pipeline New VSM New Pipeline Existing VSM Harrison Bay New Horizontal Directional Drilling Gravel Footprint Analysis Area Other Infrastructure - Existing Road **Existing Pipeline** Module Transfer Existing Infrastructure Land Designation Island National Petroleum Reserve in Alaska Teshekpuk Lake Sources:
Observations were collected during 1992-2018 avian studies conducted by ABR and funded by ConocoPhilips 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 25 years on the Colville River Delta, and 24 years in Kuparuk. Unpublished Data Estimated density from USFWS 2016, unpublished data, produced by interpolation using a linear repression spine model based on a 10 x 10 km sample grid of Arctic surveys, 2012-2015. Refer to Lamed et al. 2012 for survey methodology. CD3 Kuparuk CD2 **BT4** CPF2 GMT-1 Horizontal
Directional
Drilling Pads **INSET A** No warranty is made by the Bureau of Land INSET A No warraty 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. BT3 BT5 10 Miles Figure 3.11.3

Figure 3.11.3. Yellow-Billed Loon Density and Nests in the Analysis Area



Draft Environmental Impact Statement Yellow-Billed Loon Density and Nests in the Willow Area

3.11 - Birds U.S. DEPARTMENT OF THE INTERIOR | BUREAU OF LAND MANAGEMENT | ALASKA | WILLOW MASTER DEVELOPMENT PLAN

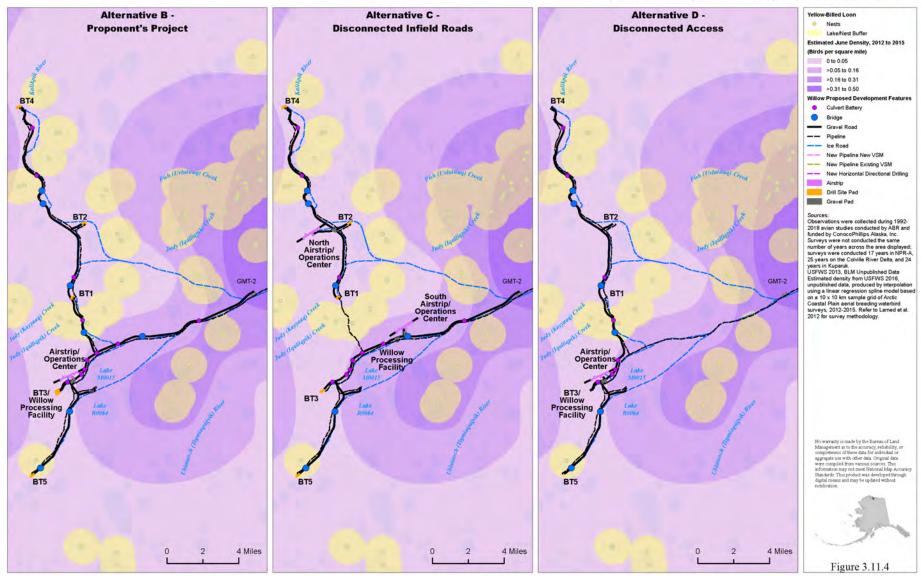


Figure 3.11.4. Yellow-Billed Loon Density and Nests in the Willow Area

Draft Environmental Impact Statement Bird Habitat Use in the Willow Area 3.11 - Birds U.S. DEPARTMENT OF THE INTERIOR | BUREAU OF LAND MANAGEMENT | ALASKA | WILLOW MASTER DEVELOPMENT PLAN Alternative B -Alternative C -Alternative D -**Bird Habitat** (No. of Speices Using) **Proponent's Project Disconnected Infield Roads Disconnected Access** 11 - 20 21 - 30 >30 Culvert Battery BT4 **BT4** Airstrip Drill Site Pad Gravel Pad Other Infrastructure Existing Road Existing Infrastructure North Airstrip/ Operations Center GMT-2 GMT-2 South Airstrip/ Airstrip/ Operations Center Airstrip/ Operations Center Willow Processing Facility BT3/ Willow Processing Facility BT3/ Willow Processing Facility 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 May Accur information may not meet National May Accur BT5 4 Miles 4 Miles 4 Miles Figure 3.11.5

Figure 3.11.5. Bird Habitat Use in the Willow Area

Analysis Area for Terrestrial Mammals Draft Environmental Impact Statement 3.12 - Terrestrial Mammals U.S. DEPARTMENT OF THE DITERIOR | BUREAU OF LAND MANAGEMENT | ALASKA | WILLOW MASTER DEVELOPMENT PLAN Terrestrial Mammal Habitat Module Transfer 6-8 Island Willow Proposed Develope Point Lonely Drill Site (Not to Scale) - Ice Road New Pipeline New VSM New Pipeline Existing VSM New Horizontal Directional Drilling Gravel Footprint Analysis Area Other Infrastructure Existing Road Harrison Bay Existing Infrastructure **Land Designation** National Petroleum Reserve in Alaska **Best Management Practice Areas** K-5 Teshekpuk Lake Caribou Habitat Area Module Transfer Island CD3 Kuparuk GMT-1 Gravel Mine Site NUIQSUT Horizontal No warrarby is made by the Bureau of Land Management as to the scorney, reliability, or completeness of these data for individual or aggregate use with other data. Original data were compiled from winous sources: This information may not meet National Map. Accuracy Standard. This product was developed through digital means and may be updated without notification. Directional **Drilling Pads**

Figure 3.12.1. Analysis Area for Terrestrial Mammals

Appendix A Figures 41

10 Miles

Figure 3.12.1

Draft Environmental Impact Statement Annual Ranges of the Central Arctic and Teshekpuk Caribou Herds 3.12 - Terrestrial Mammals

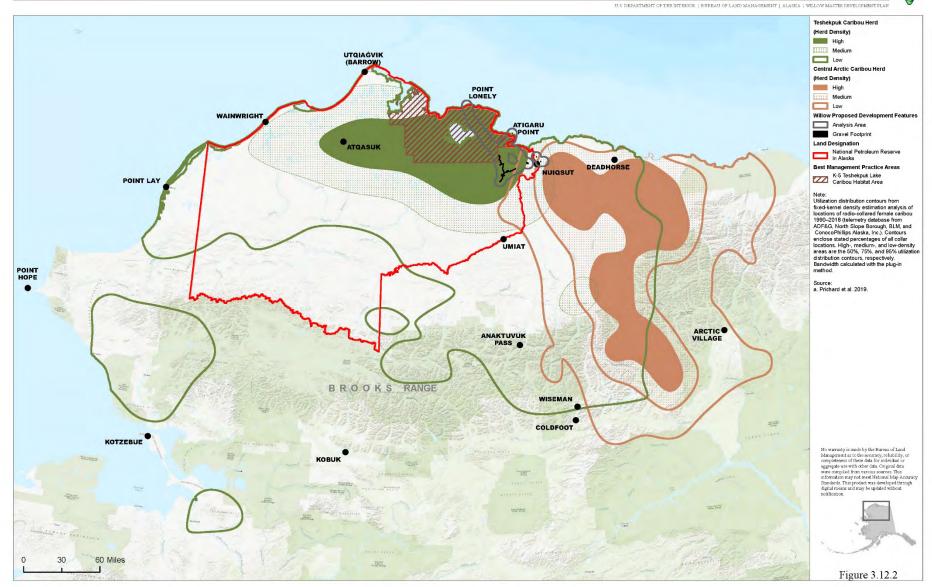


Figure 3.12.2. Annual Ranges of the Central Arctic and Teshekpuk Caribou Herds

Draft Environmental Impact Statement Seasonal Distribution of Female Caribou in the Teshekpuk Caribou Herd

3.12 - Terrestrial Mammals

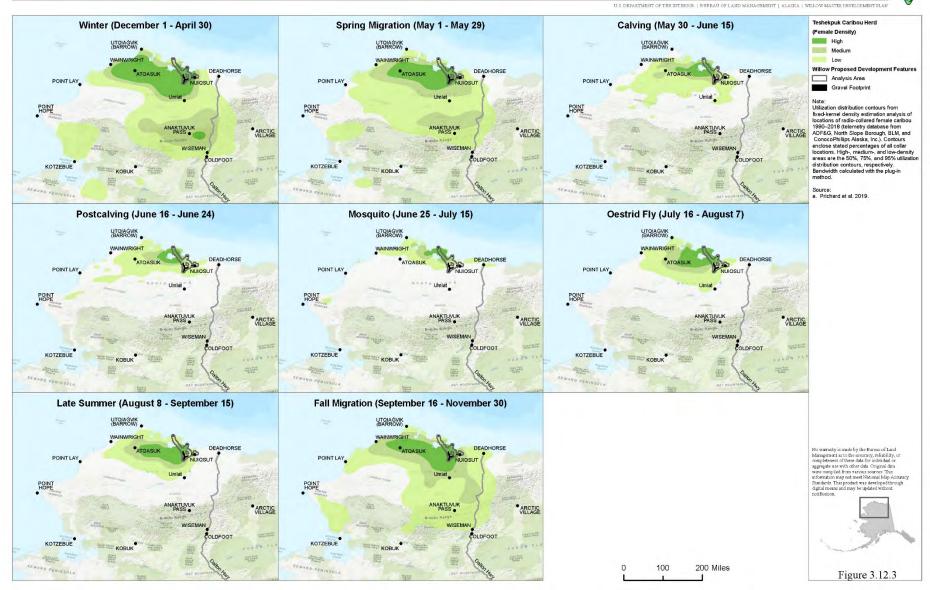


Figure 3.12.3. Seasonal Distribution of Female Caribou in the Teshekpuk Caribou Herd

Draft Environmental Impact Statement Movement of GPS-Collared Caribou of the Teshekpuk Caribou Herd 2004-2018 3.12 - Terrestrial Mammals Teshekpuk Caribou Herd GPS Collars* Winter (December 1 - April 30) Spring Migration (May 1 - May 29) Calving (May 30 - June 15) (Portion of Collars) Analysis Area Gravel Footprint Notes a. Prichard et al. 2018 Postcalving (June 16 - June 24) Mosquito (June 25 - July 15) Oestrid Fly (July 16 - August 7) Late Summer (August 8 - September 15) Fall Migration (September 16 - November 30) 30 Miles Figure 3.12.4

Figure 3.12.4. Movement of GPS-Collared Caribou of the Teshekpuk Caribou Herd 2004–2018

Draft Environmental Impact Statement Distribution of Calving Caribou of the Teshekpuk Caribou Herd 1990-2018 3.12 - Terrestrial Mammals U.S. DÉPARTMENT OF THE DITERIOR | EUREAU OF LAND MANAGEMENT | ALASKA | WILLOW MASTER DEVELOPMENT PLAN Teshekpuk Caribou Herd (Calving Density*) Module High Transfer Medium Island Low Drill Site (Not to Scale) Lonely -- Ice Road -- New Pipeline New VSM -- New Pipeline Existing VSM New Horizontal Directional Drilling Gravel Footprint Analysis Area Other Infrastructure - Existing Road Harrison Bay Existing Infrastructure **Land Designation** National Petroleum Reserve in Alaska Teshekpuk Lake Special Area Module K-5 Teshekpuk Lake Caribou Habitat Area Transfer Caribou Habitat Area
Note:
Ublization distribution contours from
Kack-kernel density estimation analysis of
locations of radio-collared female caribou
1990-2018 (leelmenty database from
ADF&G, North Slope Borough, BLM, and
ConcocPhilips Alaskin, Inc.). Contours
enclose stated percentages of all collar
locations. High, medium, and low-density
areas are the 50%, 75%, and 65% utilization
Bandwidth calculated with the plug-in
method. Island Teshekpuk Lake CD3 Source: a. Prichard et al. 2019. b. BLM 2013a. Kuparuk GMT-BT2 **Gravel Mine** NUIQSUT Horizontal No warranty is made by the Bureau of Land. Directional No warrady is made by the Bureau of Land Minagement is to the accuracy, reliability, or completeness of these data for individual or aggregate use with other data for individual or aggregate use with other data for individual or saggregate use with other data for individual or saggregate use with other data for individual or saggregate use with other data for individual or mortanism and may be updated without notification. **Drilling Pads** 10 Miles

Figure 3.12.5. Distribution of Calving Caribou of the Teshekpuk Caribou Herd 1990–2018

Appendix A Figures 45



Figure 3.12.5

Draft Environmental Impact Statement Mean Caribou Density by Season 2001-2018 3.12 - Terrestrial Mammals U.S. DEPARTMENT OF THE INTERIOR | BUREAU OF LAND MANAGEMENT | ALASKA | WILLOW MASTER DEVELOPMENT PLAN Mean Caribour Density® 0.0 - 0.1 0.1 - 0.2 0.2 - 0.3 0.3 - 0.4 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 ____ Analysis Area Gravel Footprint Notes a. Prichard et al. 2018 Winter (December 1 - April 30) Spring Migration (May 1 - May 29) Calving (May 30 - June 15) Postcalving (June 16 - June 24) Mosquito (June 25 - July 15) Oestrid Fly (July 16 - August 7) No warranty is made by the Bureau of Lend Management as to the accuracy, reliability, or completeness of these data for individual or aggregate use with other data. Original data were completed from various tources: This information may not meet National May Accuracy Standards. This product was developed through digital means and may be updated without notification. 5 10 Miles Late Summer (August 8 - September 15) Fall Migration (September 16 - November 30) Figure 3.12.6

Figure 3.12.6. Mean Caribou Density by Season 2001–2018

Draft Environmental Impact Statement

Polar Bear Dens, Critical Habitat, and Potential Terrestrial Denning Habitat
3.13 - Marine Mammals

US DEPARTMENT OF THE DRIVEROR | BUREAU OF LAND MAINAGEMENT | ALASEA | WILLOW MASTER DEVELOPMENT PLANS

OF THE PROPERTY OF THE DRIVEROR | BUREAU OF LAND MAINAGEMENT | ALASEA | WILLOW MASTER DEVELOPMENT PLANS

OF THE PROPERTY OF THE DRIVEROR | BUREAU OF LAND MAINAGEMENT | ALASEA | WILLOW MASTER DEVELOPMENT PLANS

OF THE PROPERTY OF THE DRIVEROR | BUREAU OF LAND MAINAGEMENT | ALASEA | WILLOW MASTER DEVELOPMENT PLANS

OF THE PROPERTY OF THE DRIVEROR | BUREAU OF LAND MAINAGEMENT | ALASEA | WILLOW MASTER DEVELOPMENT PLANS

OF THE PROPERTY OF THE DRIVEROR | BUREAU OF LAND MAINAGEMENT | ALASEA | WILLOW MASTER DEVELOPMENT PLANS

OF THE PROPERTY OF THE DRIVEROR | BUREAU OF LAND MAINAGEMENT | ALASEA | WILLOW MASTER DEVELOPMENT PLANS

OF THE PROPERTY OF THE DRIVEROR | BUREAU OF LAND MAINAGEMENT | ALASEA | WILLOW MASTER DEVELOPMENT PLANS

OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY PLANS

OF THE PROPERTY OF THE PROPERTY PLANS

OF THE PROPERTY OF THE PROPERTY PLANS

OF THE PROPERTY P

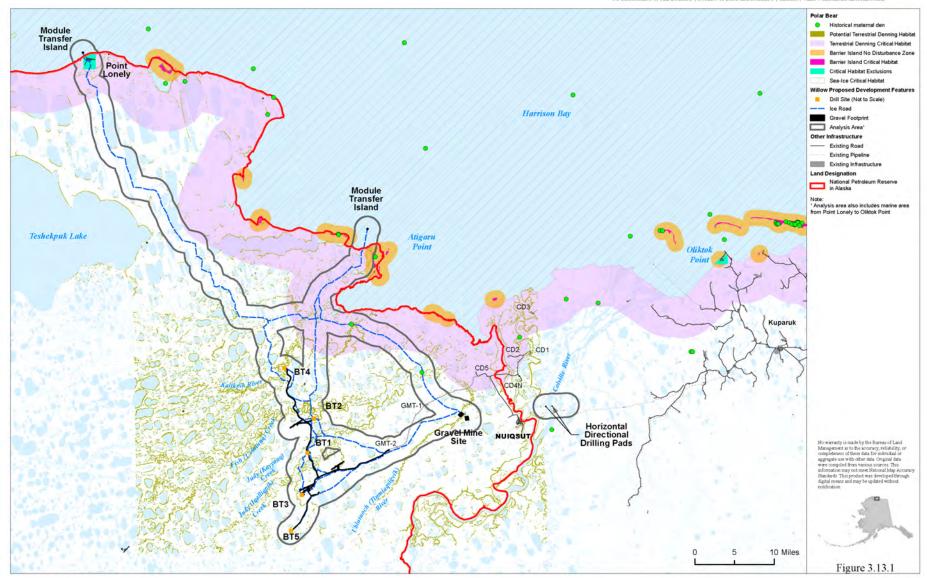


Figure 3.13.1. Polar Bear Dens, Critical Habitat, and Potential Terrestrial Denning Habitat

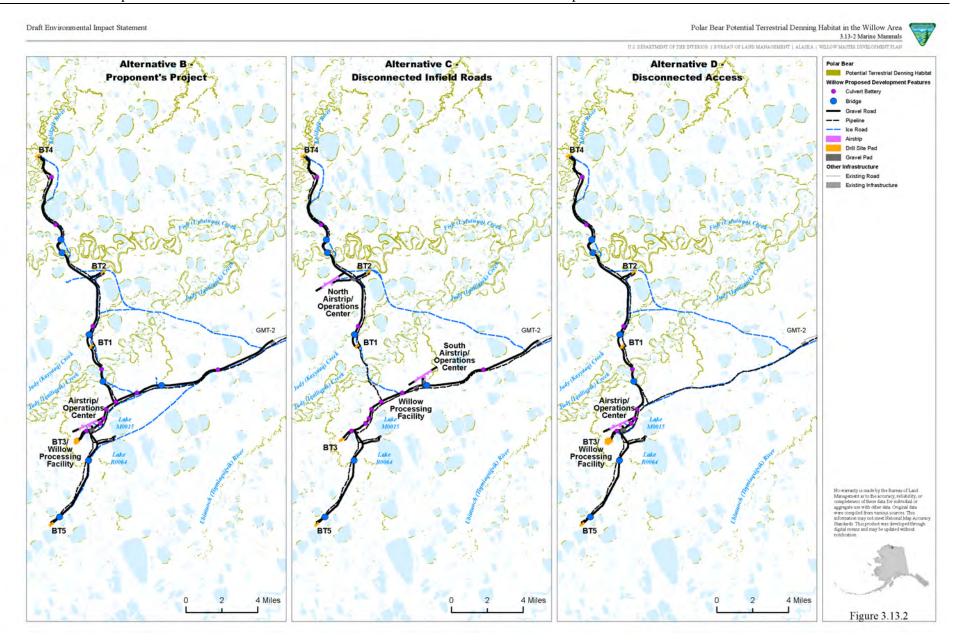


Figure 3.13.2. Polar Bear Potential Terrestrial Denning Habitat in the Willow Area

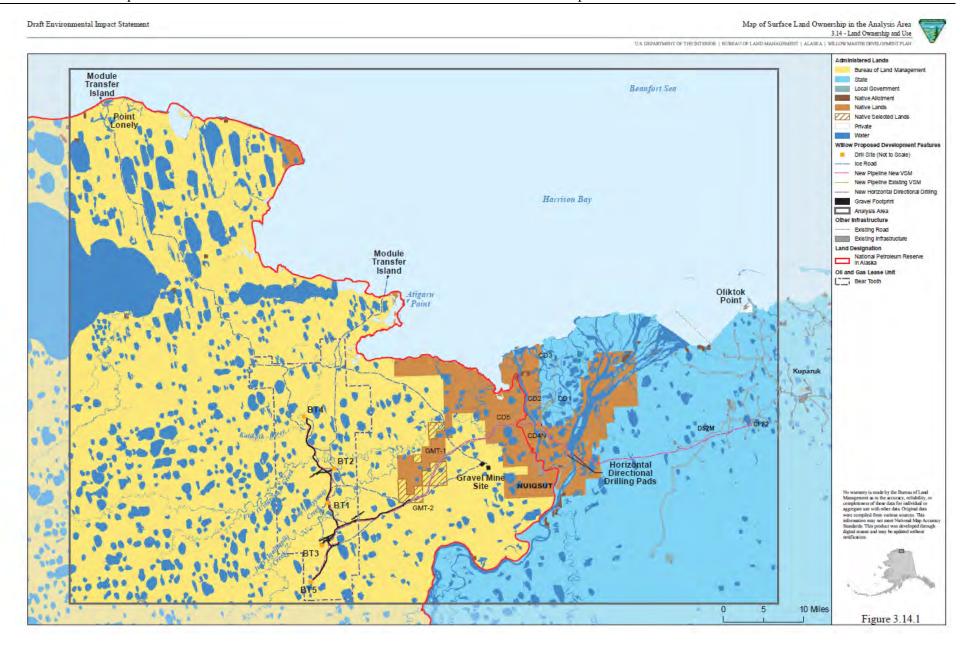


Figure 3.14.1. Map of Surface Land Ownership in the Analysis Area

Draft Environmental Impact Statement

Map of Subsurface Land Management in the Bear Tooth Unit
3.14 • Land Ownership and Use

U.S. DEPARTMENT OF THE INTERIOR | BUREAU OF LAND MANAGEMENT | ALASKA | WILLOW MASTER DEVELOPMENT PLAN

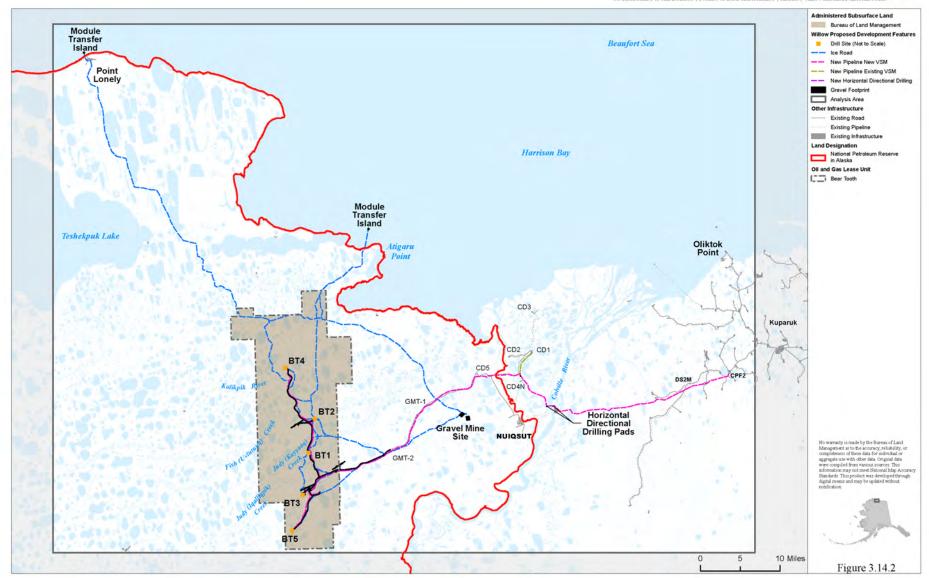


Figure 3.14.2. Map of Subsurface Land Management in the Bear Tooth Unit

Draft Environmental Impact Statement North Slope Borough Zoning Districts in the Analysis Area 3.14 - Land Ownership and Use U.S. DEPARTMENT OF THE DITERIOR | BUREAU OF LAND MANAGEMENT | ALASKA | WILLOW MASTER DEVELOPMENT PLAN North Slope Borough Zones Resource Development Module Transfer Island Conservation Beaufort Sea Willow Proposed Development Features Drill Site (Not to Scale) - Ice Road Point Lonely -- New Pipeline New VSM -- New Pipeline Existing VSM New Horizontal Directional Drilling Gravel Footprint Analysis Area Existing Road **Existing Pipeline** Existing Infrastructure Harrison Bay **Land Designation** National Petroleum Reserve in Alaska Oil and Gas Lease Unit Bear Tooth Oliktok CD3 Kuparuk CD1 CD2 **BT4** GMT-1 BT2 Horizontal
Directional
Drilling Pads **Gravel Mine** NUIQSUT No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual or aggregate us 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 more has underso. 10 Miles Figure 3.14.3

Figure 3.14.3. North Slope Borough Zoning Districts in the Analysis Area

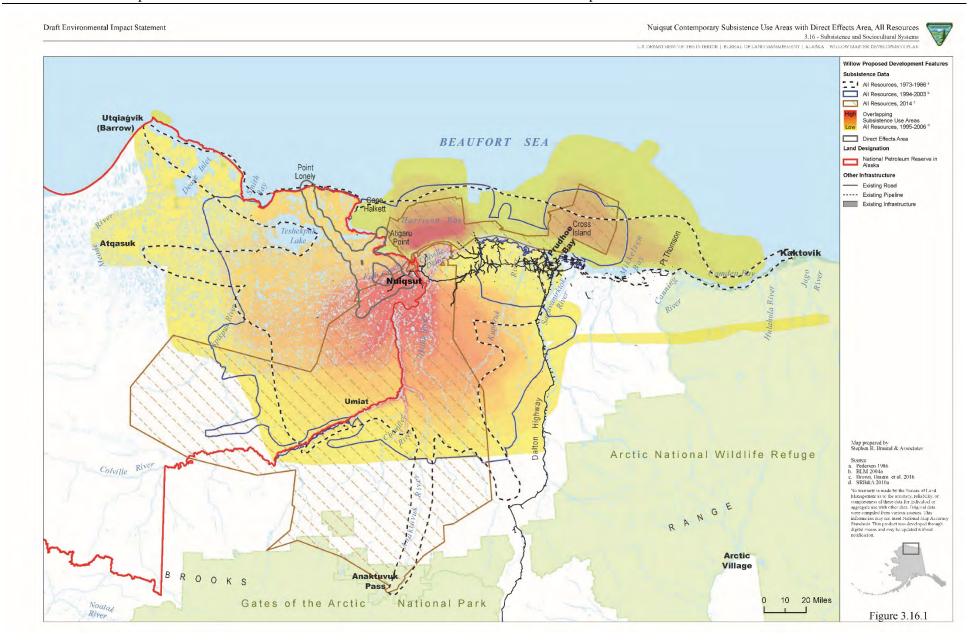


Figure 3.16.1. Nuiqsut Contemporary Subsistence Use Areas with Direct Effects Area, All Resources



Figure 3.16.2. Nuiqsut Historic and Lifetime Subsistence Use Areas with Direct Effects Area, All Resources



Figure 3.16.3. Nuiqsut Caribou Subsistence Use Areas with Direct Effects Area, 2008–2016

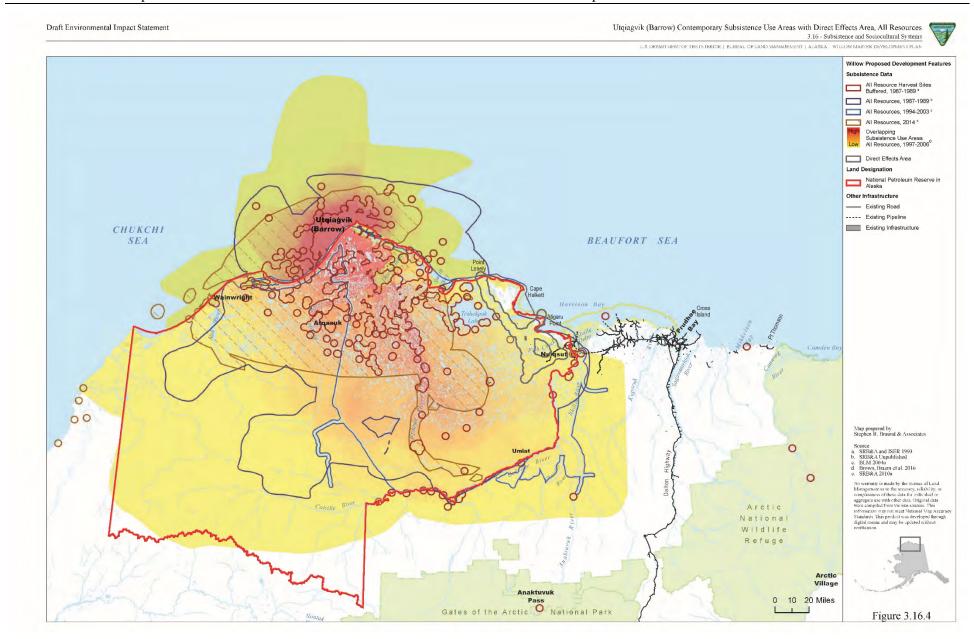


Figure 3.16.4. Utqiagʻvik (Barrow) Contemporary Subsistence Use Areas with Direct Effects Area, All Resources

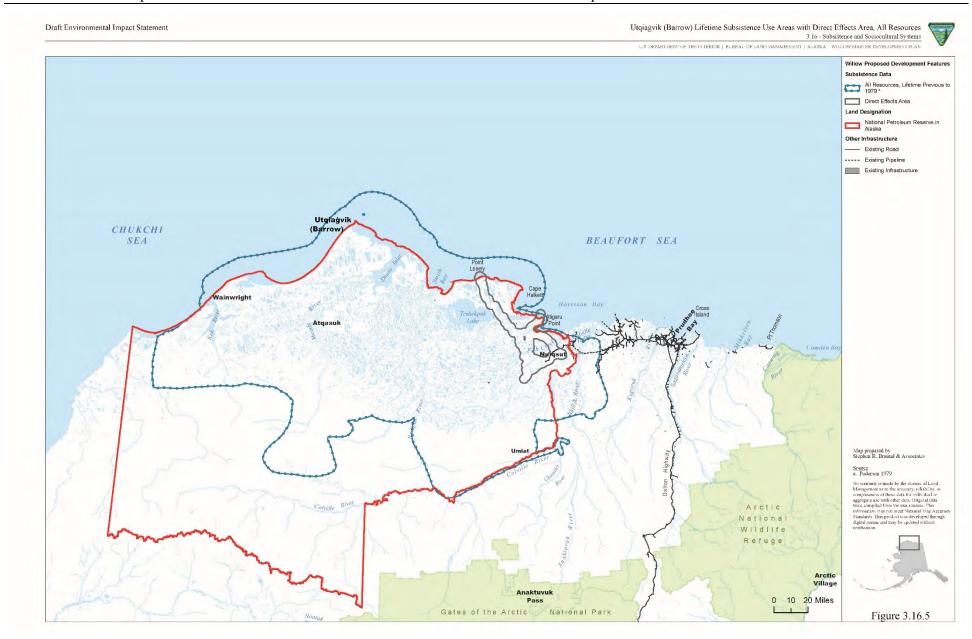


Figure 3.16.5. Utqiagʻvik (Barrow) Lifetime Subsistence Use Areas with Direct Effects Area, All Resources

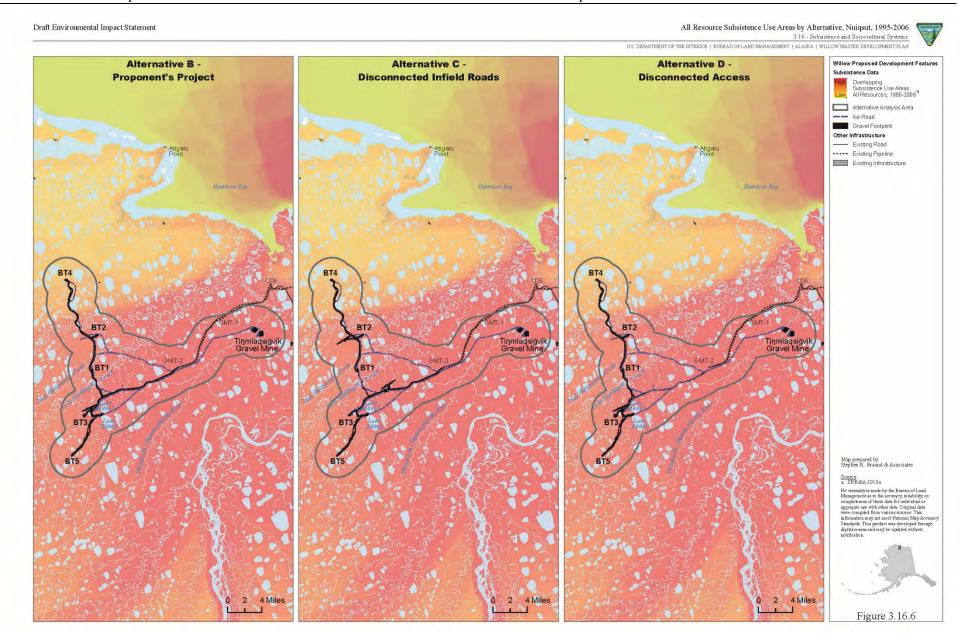


Figure 3.16.6. All Resource Subsistence Use Areas by Alternative, Nuiqsut, 1995–2006

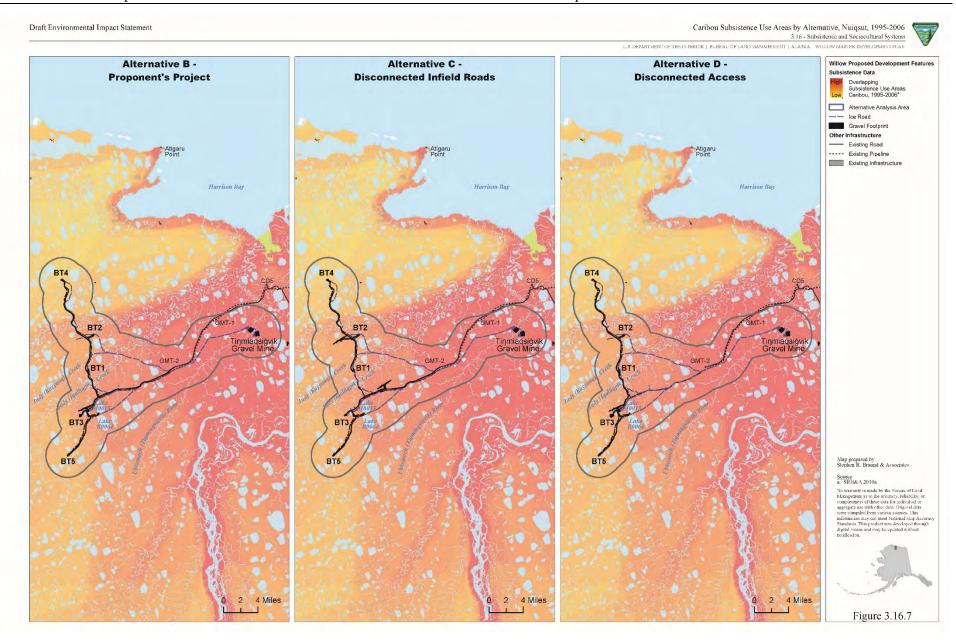


Figure 3.16.7. Caribou Subsistence Use Areas by Alternative, Nuiqsut, 1995–2006

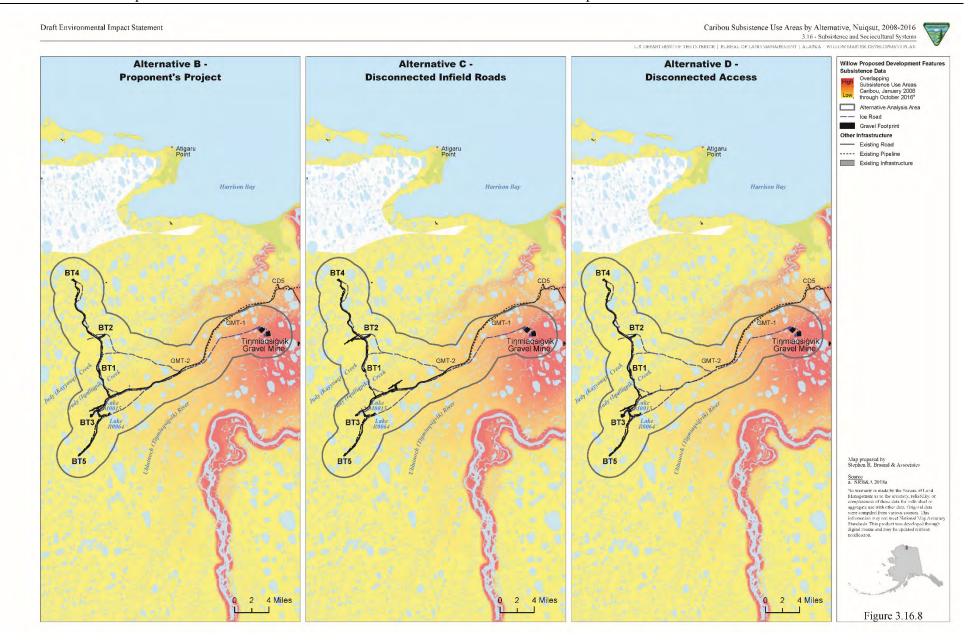


Figure 3.16.8. Caribou Subsistence Use Areas by Alternative, Nuiqsut, 2008–2016

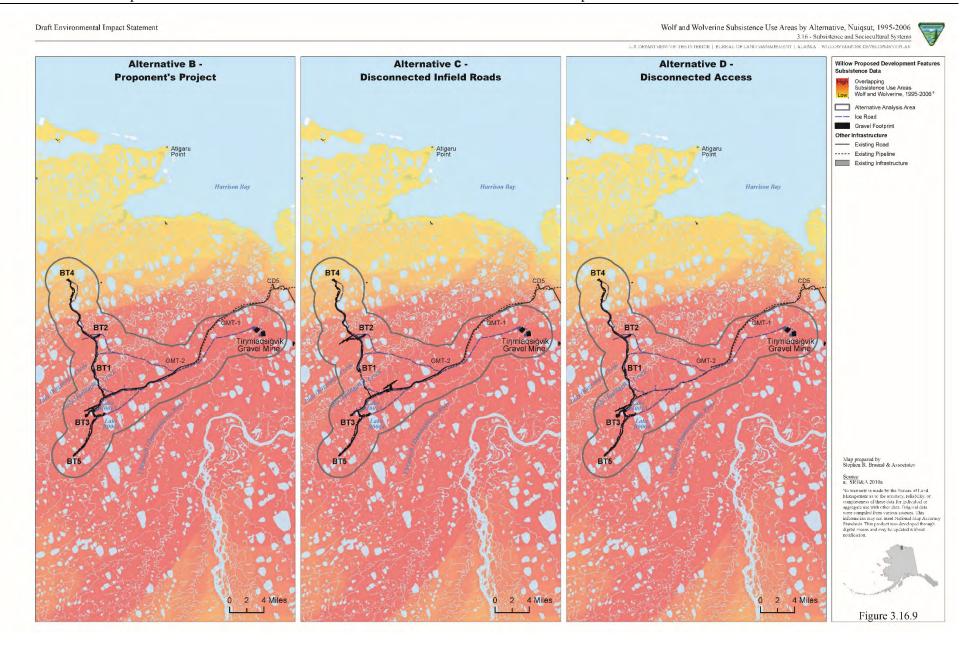


Figure 3.16.9. Wolf and Wolverine Subsistence Use Areas by Alternative, Nuiqsut, 1995–2006

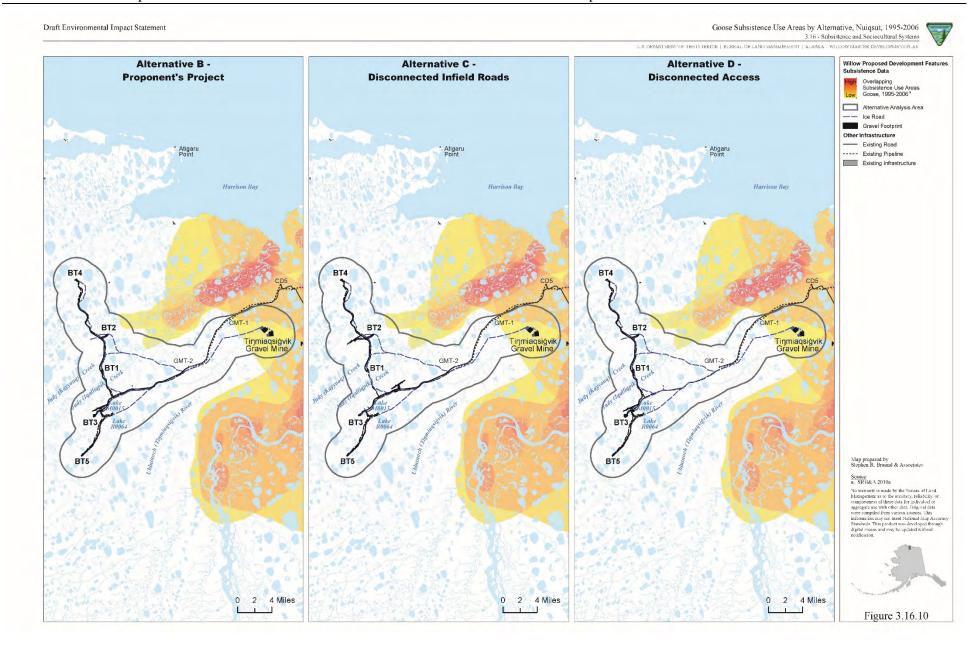


Figure 3.16.10. Goose Subsistence Use Areas by Alternative, Nuiqsut, 1995–2006

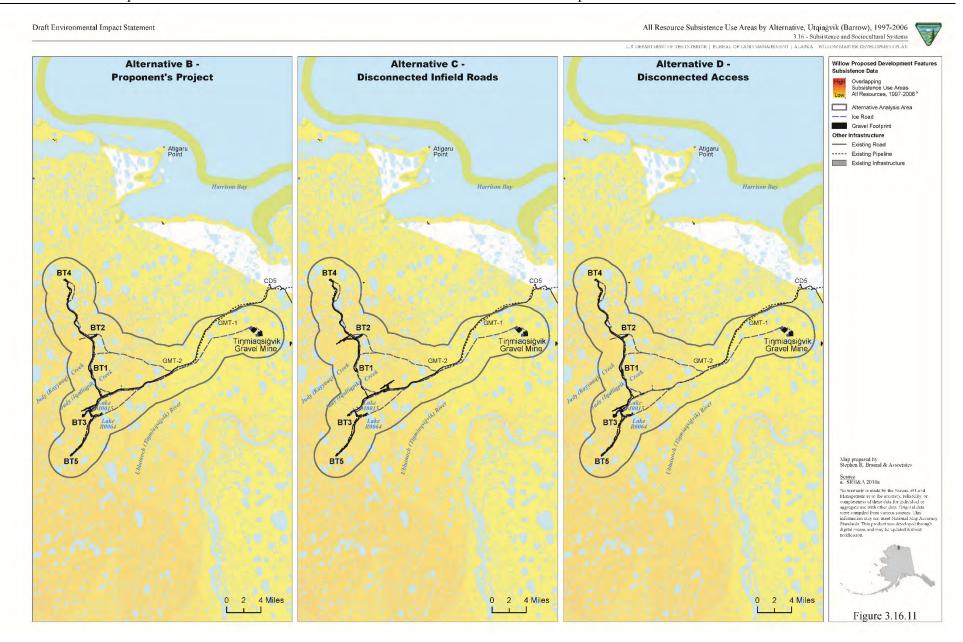


Figure 3.16.11. All Resource Subsistence Use Areas by Alternative, Utqiagʻvik (Barrow), 1997–2006

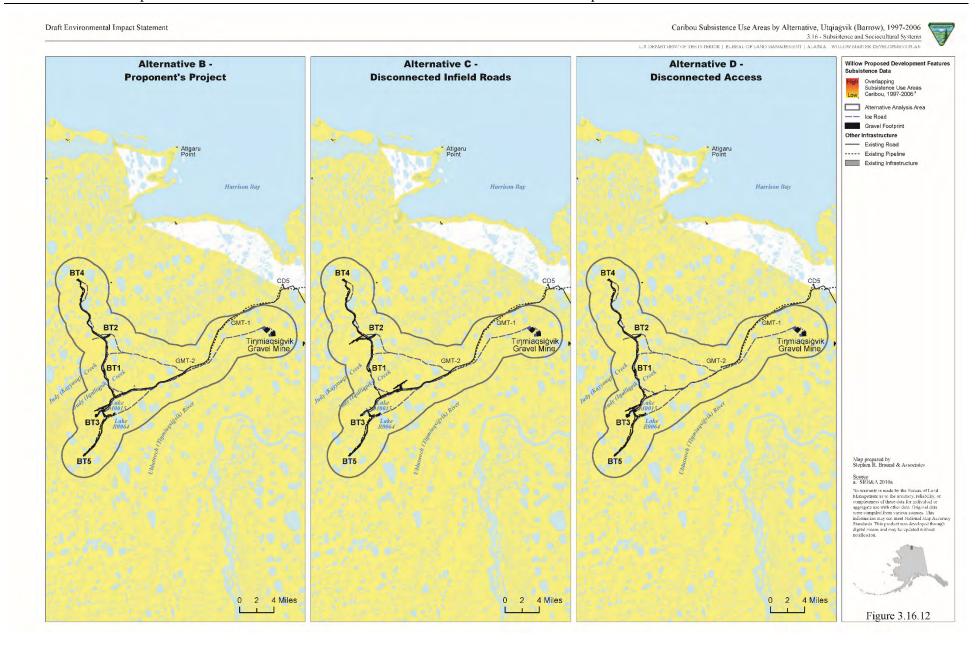


Figure 3.16.12. Caribou Subsistence Use Areas by Alternative, Utqiagʻvik (Barrow), 1997–2006

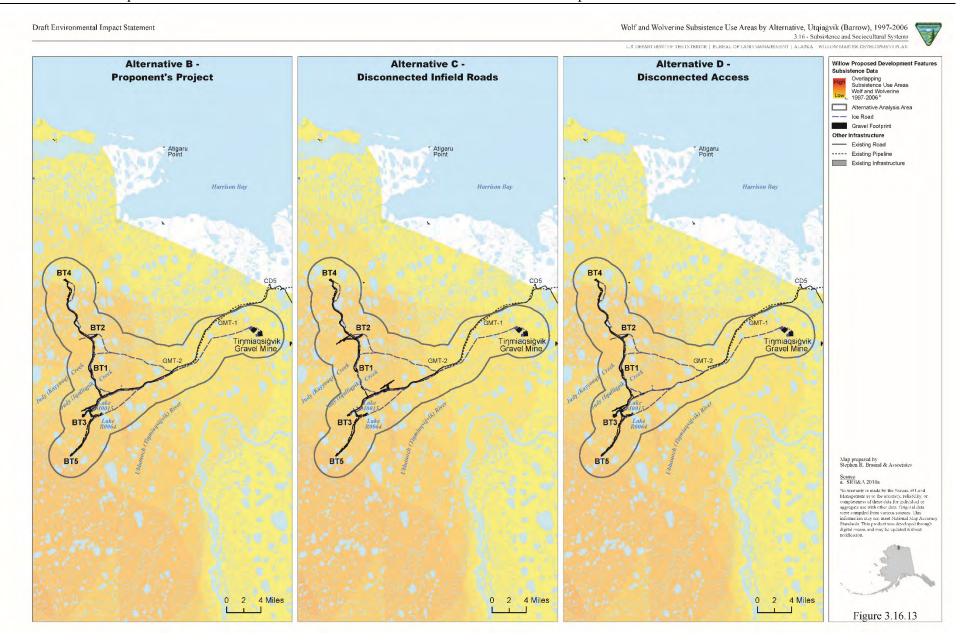


Figure 3.16.13. Wolf and Wolverine Subsistence Use Areas by Alternative, Utqiagʻvik (Barrow), 1997–2006

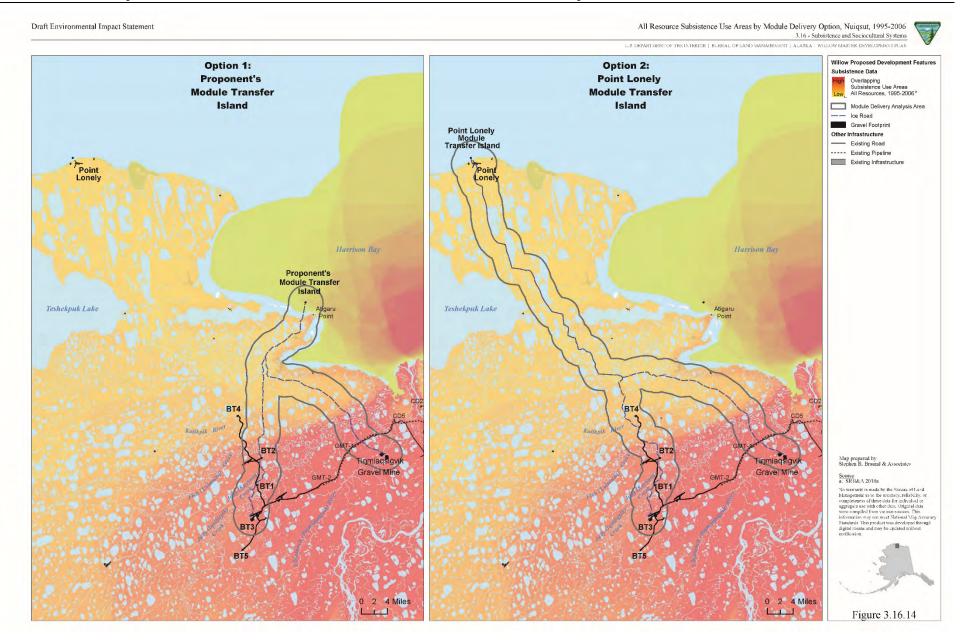


Figure 3.16.14. All Resource Subsistence Use Areas by Module Delivery Option, Nuiqsut, 1995–2006

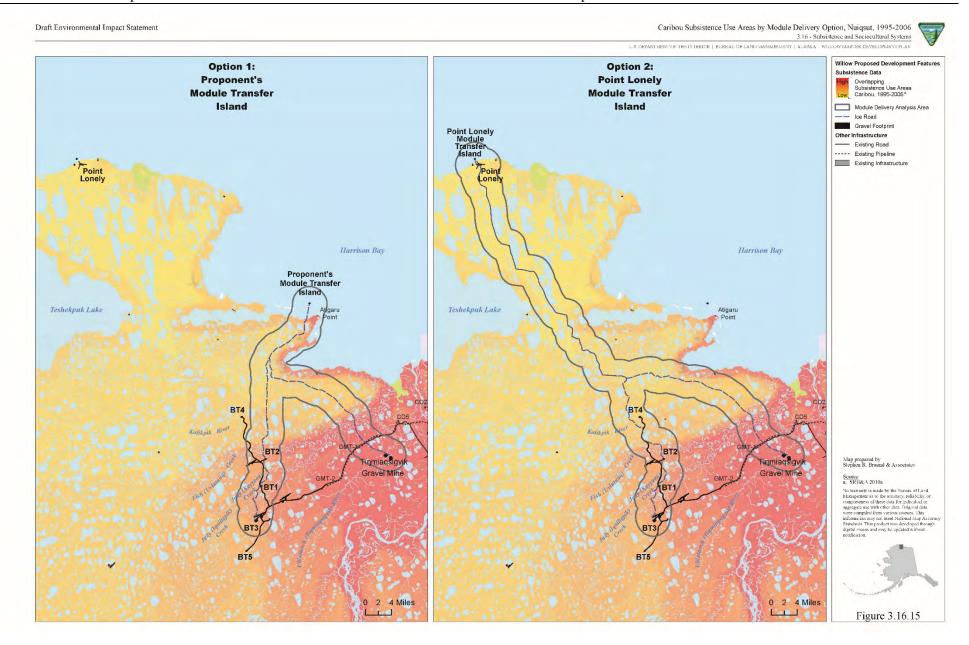


Figure 3.16.15. Caribou Subsistence Use Areas by Module Delivery Option, Nuiqsut, 1995–2006

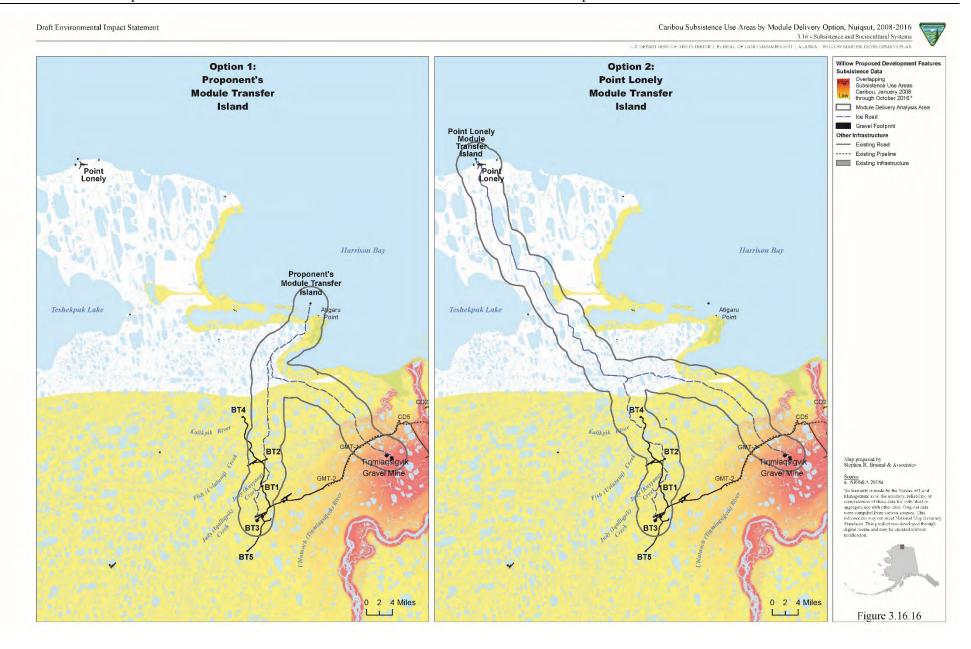


Figure 3.16.16. Caribou Subsistence Use Areas by Module Delivery Option, Nuiqsut, 2008–2016

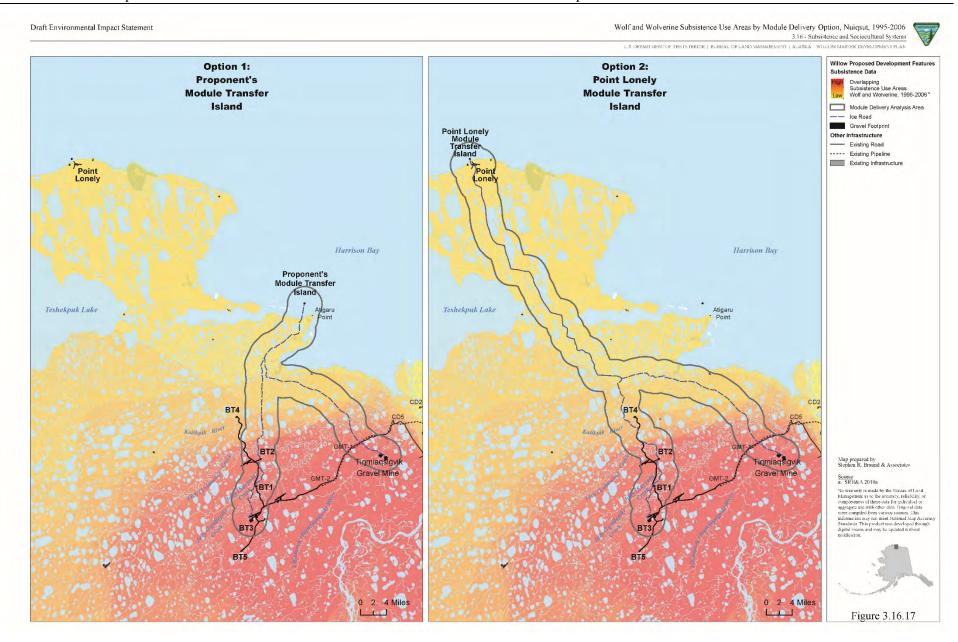


Figure 3.16.17. Wolf and Wolverine Subsistence Use Areas by Module Delivery Option, Nuiqsut, 1995–2006

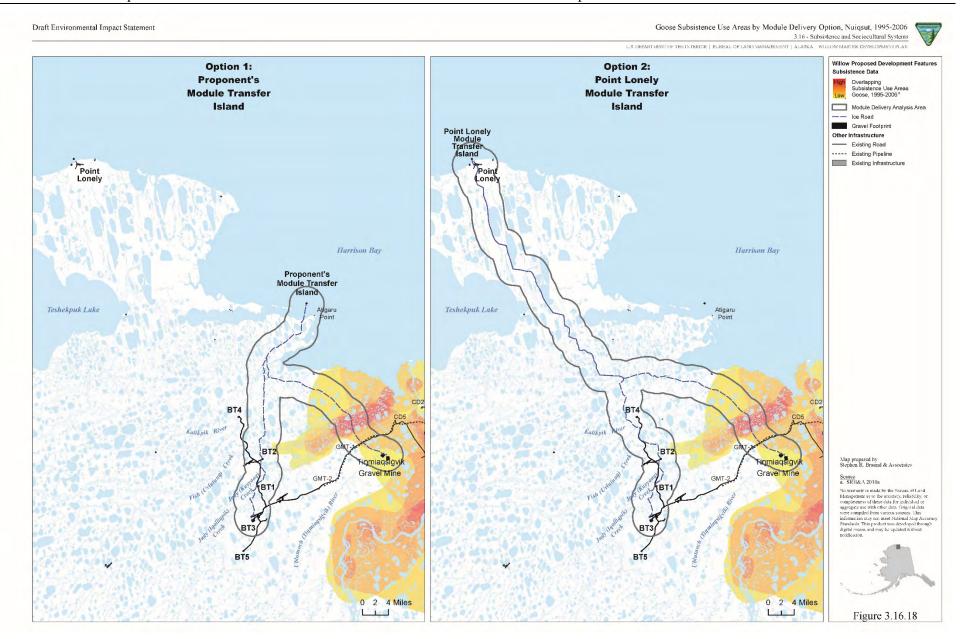


Figure 3.16.18. Goose Subsistence Use Areas by Module Delivery Option, Nuiqsut, 1995–2006

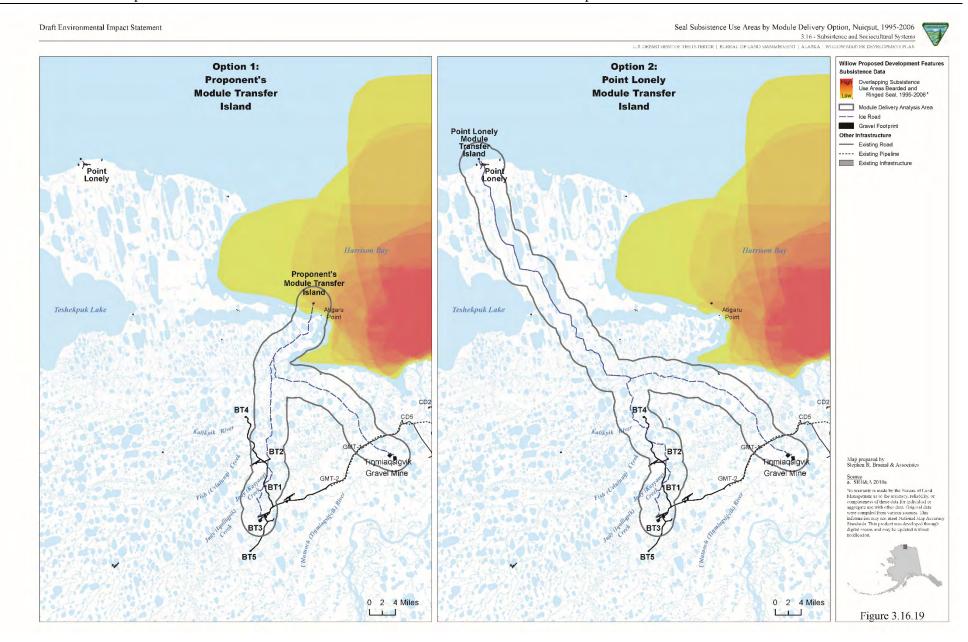


Figure 3.16.19. Seal Subsistence Use Areas by Module Delivery Option, Nuiqsut, 1995–2006

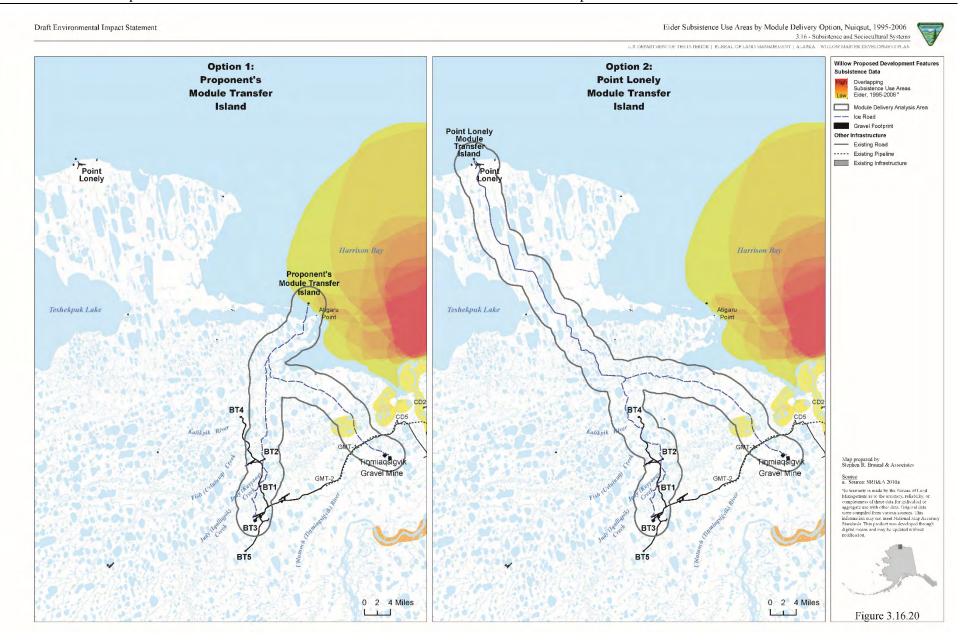


Figure 3.16.20. Eider Subsistence Use Areas by Module Delivery Option, Nuiqsut, 1995–2006

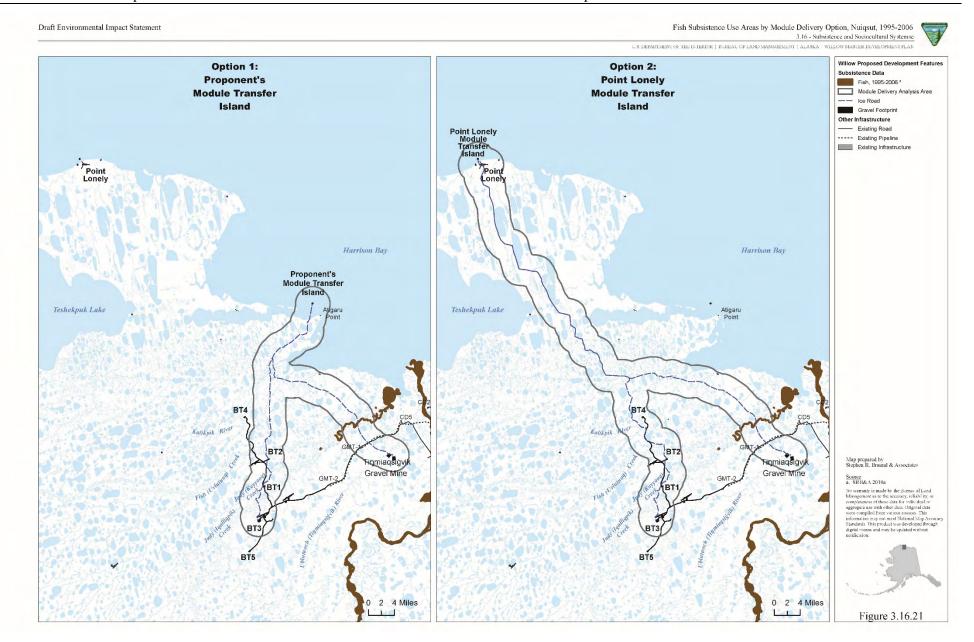


Figure 3.16.21. Fish Subsistence Use Areas by Module Delivery Option, Nuiqsut, 1995–2006

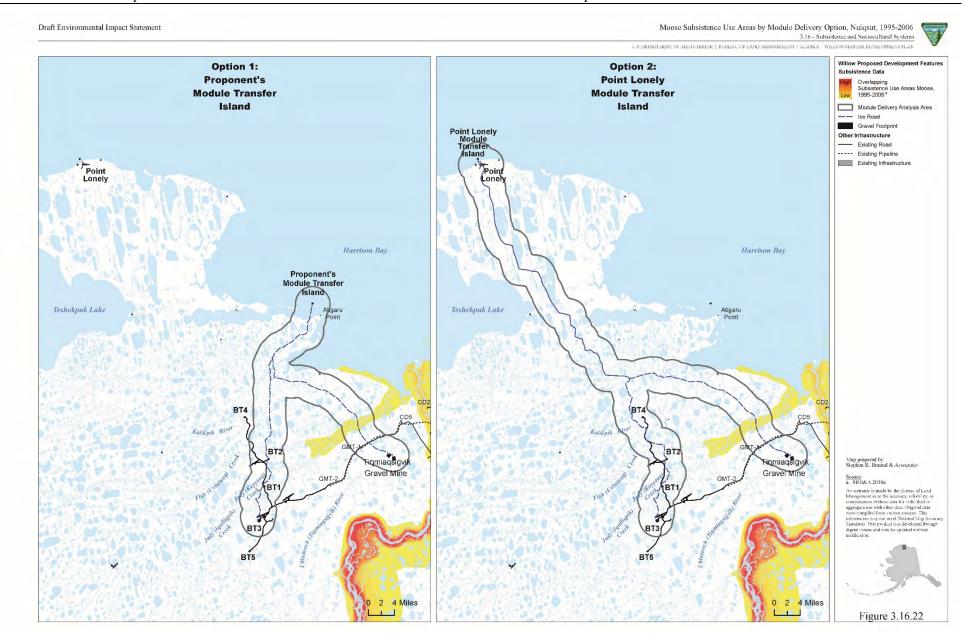


Figure 3.16.22. Moose Subsistence Use Areas by Module Delivery Option, Nuiqsut, 1995–2006

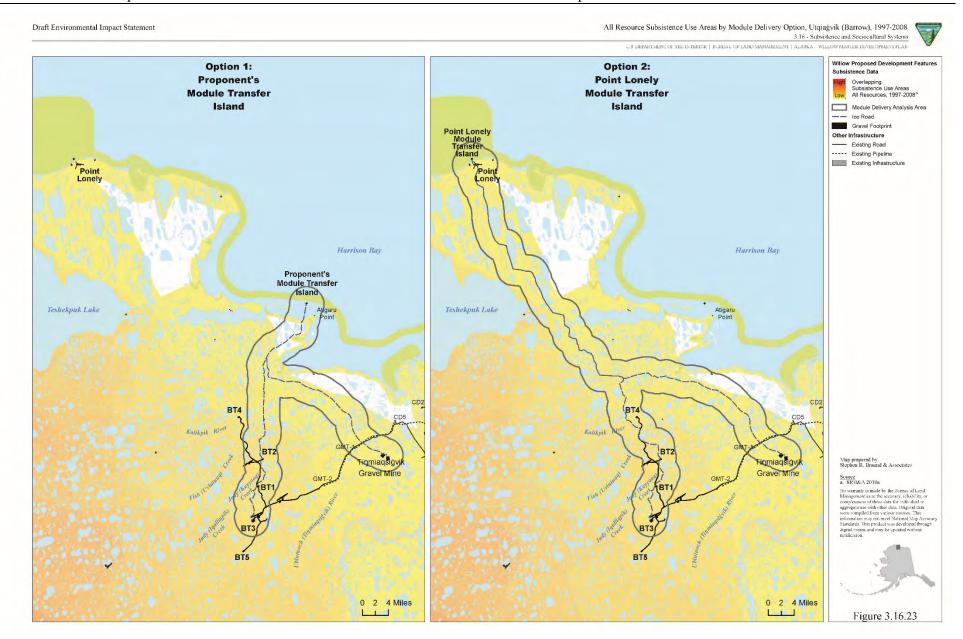


Figure 3.16.23. All Resource Subsistence Use Areas by Module Delivery Option, Utqiagʻvik (Barrow), 1997–2008

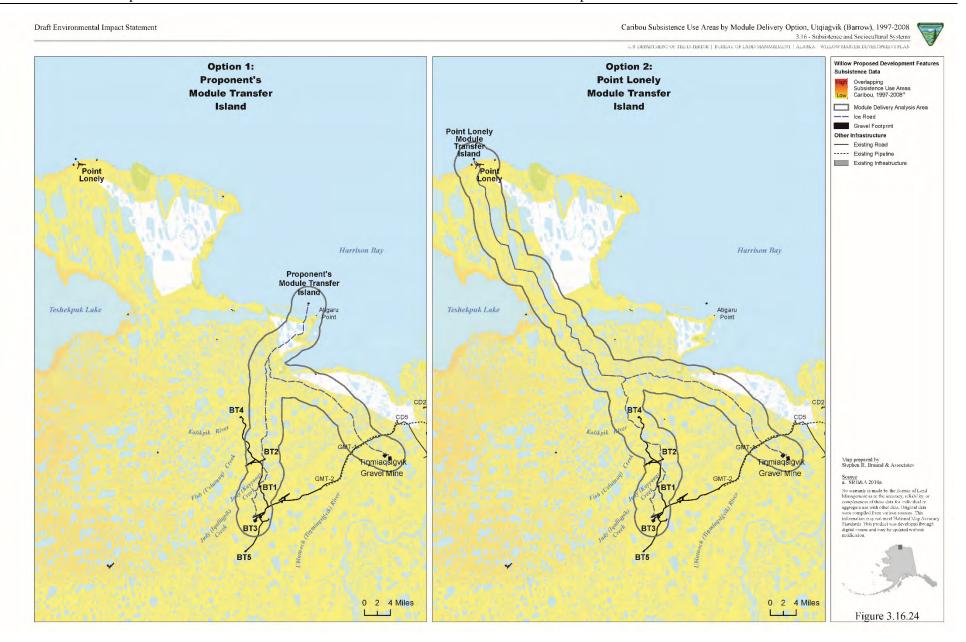


Figure 3.16.24. Caribou Subsistence Use Areas by Module Delivery Option, Utqiagʻvik (Barrow), 1997–2008

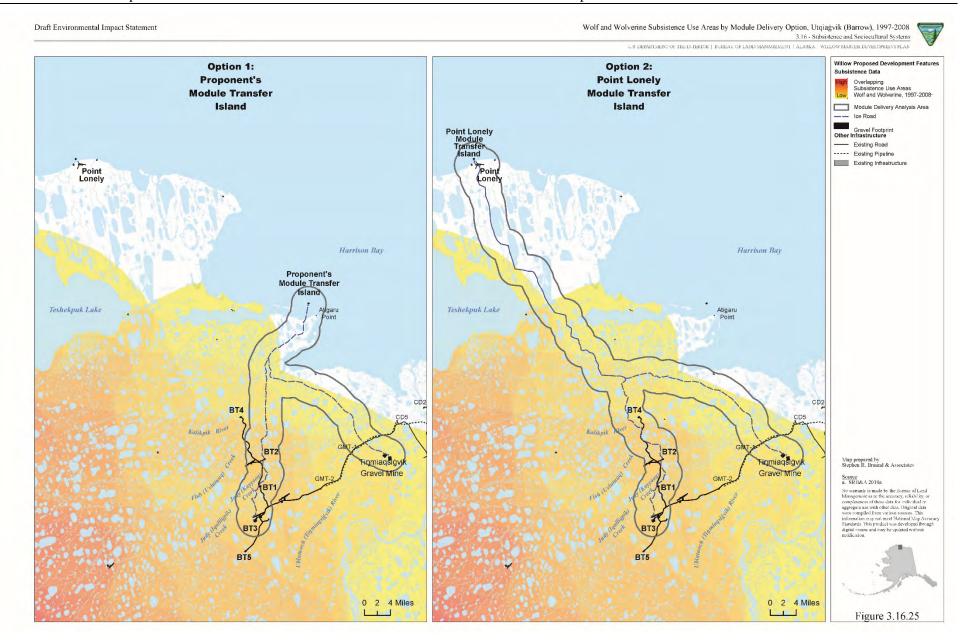


Figure 3.16.25. Wolf and Wolverine Subsistence Use Areas by Module Delivery Option, Utqiagvik (Barrow), 1997–2008

Draft Environmental Impact Statement

Seal Subsistence Use Areas by Module Delivery Option, Utqiagvik (Barrow), 1997-2008
3.16 - Subsistence and Sociocultural Systems

U.S. DEPARTMENT OF THE INTERIOR | BUREAU OF LANDMANAGEMENT | ALASKA | WILLOW MASTER DEVELOPMENT PLAN



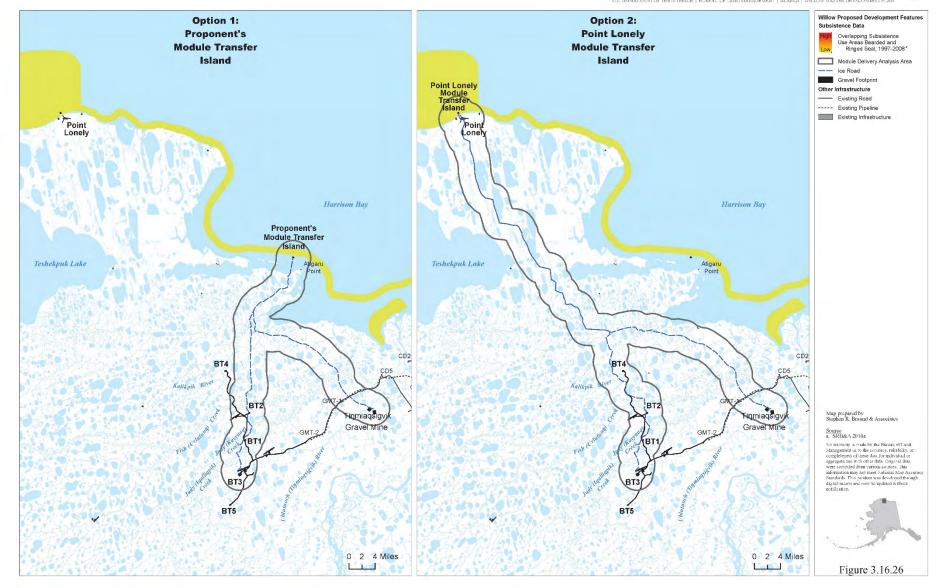


Figure 3.16.26. Seal Subsistence Use Areas by Module Delivery Option, Utqiagʻvik (Barrow), 1995–2008

Draft Environmental Impact Statement

Goose Subsistence Use Areas by Module Delivery Option, Utqiagvik (Barrow), 1997-2008
3.16 - Subsistence and Sociocultural Systems

U.S. DEPARTMENT OF THE INTERIOR | BUREAU OF LAND MANAGEMENT | ALASKA | WILLOW MASTER DEVELOPMENT PLAN



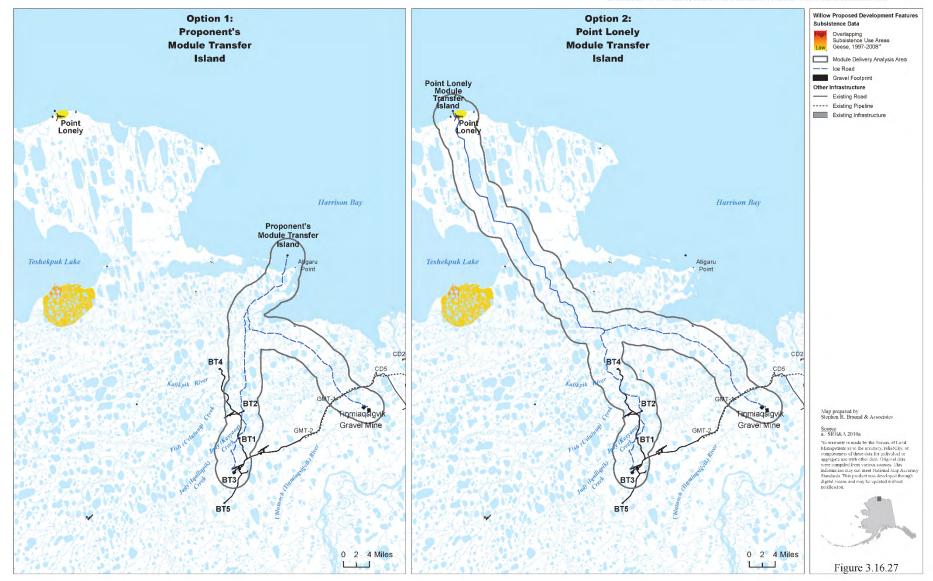


Figure 3.16.27. Goose Subsistence Use Areas by Module Delivery Option, Utqiagʻvik (Barrow), 1995–2008

Draft Environmental Impact Statement Past and Present Actions that may Interact with the Willow Project

3.19 - Cumulative Effects



Figure 3.19.1. Past and Present Actions that may Interact with the Willow Project

Draft Environmental Impact Statement Reasonably Foreseeable Future Actions that may Interact with the Willow Project 3.19 - Cumulative Effects U.S. DEPARTMENT OF THE INTERIOR | BUREAU OF LAND MANAGEMENT | ALASKA | WILLOW MASTER DEVELOPMENT PLAN EIS Reasonably Foreseeable Future Action Projects - Unear Projects Willow Proposed Development Features Drill Site (Not to Scale) -- New Pipeline New VSM -- New Pipeline Existing VSM -- New Horizontal Directional Drilling Gravel Footprint Other Infrastructure - Existing Road --- Existing Pipeline Harrison Bay Community Winter Access
Trail Project Existing Infrastructure Land Designation National Petroleum Reserve in Alaska Arctic National Wildlife Refuge Teshekpuk Lake 1002 Area Coastal Plain Arctic National Wildlife Refuge Projects Not Shown: Miscellaneous Sesimic Exploration Arctic Strategic Transportation and Resources (ASTAR) NPR-A Integrated Activity Plan Revisions Gravel Mine NUIQSUT Collville River Site Alaska LNG No wexestly is made by the Bureau of Lead Management as to the securacy, reliability, or completions of these data for institution of aggregate use with other data Original data were completed from warmans secures. The information may not ment National Maga Access Resultants. The procedure was weeking of Baroagh digital means and may be updated without modification. 5 10 Miles Figure 3.19.2

Figure 3.19.2. Reasonably Foreseeable Future Actions that may Interact with the Willow Project

Draft Environmental Impact Statement Drill Site BT1 Reservoir Blowout Oil Fallout 4.0 - Spill Risk Assessment U.S. DEPARTMENT OF THE INTERIOR | BUREAU OF LAND MANAGEMENT | ALASKA | WILLOW MASTER DEVELOPMENT PLAN Simulated Oil Plume Winter Plume Scenario **Summer Plume Scenario** 70% Fallout 90% Fallout Oil Plume Trajectory Willow Proposed Development Features Bridge Gravel Road New Pipeline New VSM Airstrip Drill Site Pad Gravel Pad BT2 BT2 90% Fallout 90% Fallout 80% Fallout 80% Fallout BT 70% Fallout 70% Fallout No warrestly is rande by the Bureau of Land Management as to the accuracy, reliability, or complehenes of these data for includuals or aggregate use with other data Original data were compled from various sources. Accuracy series of the control of the control of the information may not meet Mational Map Accuracy Bandards. The product was developed drough digital means and may be updated without notification. Airstrip/ Operations Center Airstrip/ Operations Center BT3/ Willow Processing Facility BT3/ Willow Processing Facility 2 Miles 2 Miles Figure 4.3.1

Figure 4.3.1. Drill Site BT1 Reservoir Blowout Oil Fallout

Draft Environmental Impact Statement Drill Site BT2 Reservoir Blowout Oil Fallout 4.0 - Spill Risk Assessment U.S. DEPARTMENT OF THE INTERIOR | BUREAU OF LAND MANAGEMENT | ALASKA | WILLOW MASTER DEVELOPMENT PLAN Simulated Oil Plume Winter Plume Scenario Summer Plume Scenario 70% Fallout BT4 BT4 90% Fallout Oil Plume Trajectory Willow Proposed Development Features Bridge Gravel Road New Pipeline New VSM Drill Site Pad Gravel Pad 90% Fallout 90% Fallout 80% Fallout 80% Fallout 70% Fallout No warrestly is rande by the Bureau of Land Management as to the accuracy, reliability, or compleheness of these data for includuals or aggregate use with other data Original data were compled from various sources. Accuracy server compled from various sources Accuracy Standards. That product was developed drough digital means and may be updated without notification. BT1 BT1

Figure 4.3.2. Drill Site BT2 Reservoir Blowout Oil Fallout

Appendix A Figures 82

Figure 4.3.2

2 Miles

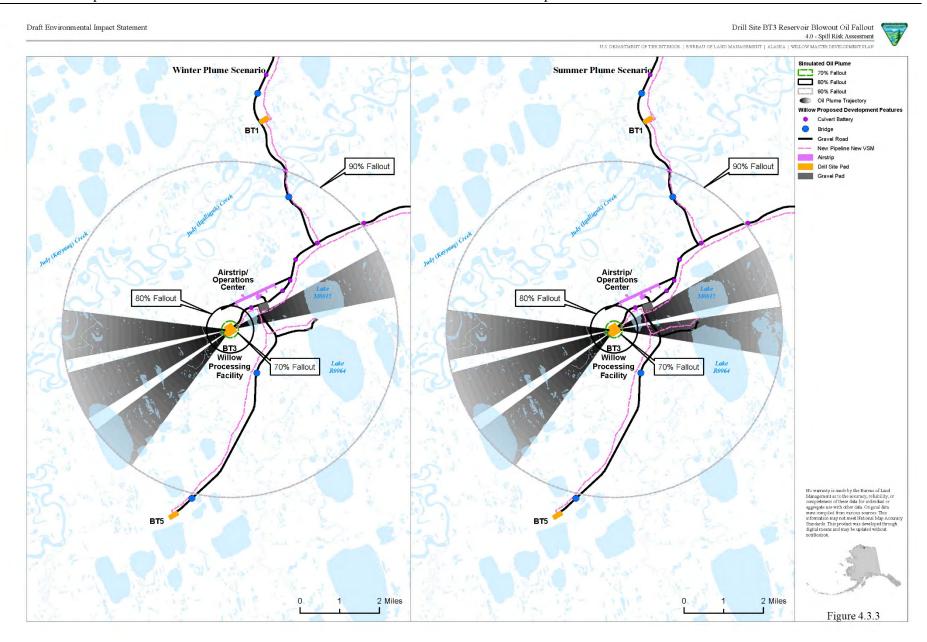


Figure 4.3.3. Drill Site BT3 Reservoir Blowout Oil Fallout

Draft Environmental Impact Statement Drill Site BT4 Reservoir Blowout Oil Fallout

4.0 - Spill Risk Assessment U.S. DEPARTMENT OF THE INTERIOR | BUREAU OF LAND MANAGEMENT | ALASKA | WILLOW MASTER DEVELOPMENT PLAN

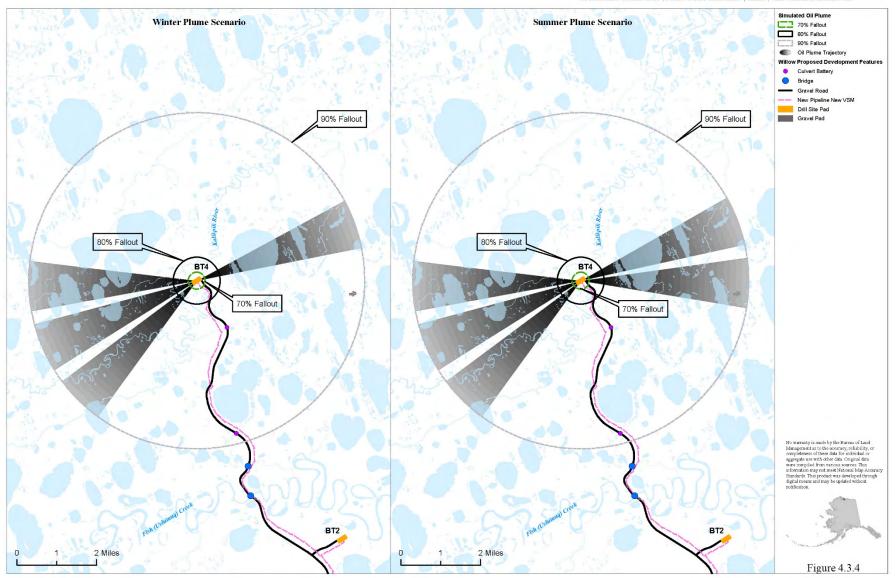


Figure 4.3.4. Drill Site BT4 Reservoir Blowout Oil Fallout

Draft Environmental Impact Statement Drill Site BT5 Reservoir Blowout Oil Fallout 4.0 - Spill Risk Assessment U.S. DEPARTMENT OF THE INTERIOR | BUREAU OF LAND MANAGEMENT | ALASKA | WILLOW MASTER DEVELOPMENT PLAN Simulated Oil Plume Winter Plume Scenario **Summer Plume Scenario** 70% Fallout 80% Fallout 90% Fallout Oil Plume Trajectory Willow Proposed Development Features Airstrip/ Operations Center Airstrip/ Operations Center Bridge Gravel Road BT3/ Willow Processing Facility BT3/ Willow Processing Facility New Pipeline New VSM Airstrip Drill Site Pad Gravel Pad 90% Fallout 90% Fallout 80% Fallout 80% Fallout 70% Fallout 70% Fallout No warranty is made by the Bureau of Land Idanagement as to the accuracy, reliability, or completeness of these data for individuals or aggregate use with other data Original data ware complete 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 4.3.5

Figure 4.3.5. Drill Site BT5 Reservoir Blowout Oil Fallout