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4B DIRECT AND INDIRECT IMPACTS – ALTERNATIVE B

4B.1 INTRODUCTION

This section provides an analysis of the environmental consequences that would result from implementation of Alternative B, CPAI Development Plan and FFD.

Except for those aspects specifically discussed below, the components of Alternative B are the same as those for Alternative A. Differences between the two alternatives provide for conformance to Northeast NPR-A IAP/EIS development stipulations, and include:

- Moving proposed permanent oil infrastructure to a distance at least 3 miles from Fish Creek (Stipulation 39[d]). This requires that CD-6 and associated roads and pipelines be moved from within the setback.
- Moving proposed permanent oil infrastructure to a distance of at least 500 feet from waterbodies, excepting essential pipeline and road crossings (Stipulation 41). Roads and pipelines would be moved to conform to this provision to the maximum extent possible
- Eliminating roads to a road network outside BLM-managed lands in NPR-A (Stipulation 48). Road connection between CD-6 and CD-7, on the one hand, and other facilities, on the other hand, are eliminated

In addition, access to roads would be restricted to industry personnel only.

Alternative B FFD also would conform to Northeast NPR-A IAP/EIS development stipulations. The Teshek-puk Lake Surface Protection Area would preclude development in the northwestern part of the Plan Area near the Kogru River. This would eliminate hypothetical CD-29. Several other facilities would have to be relocated outside the Fish Creek buffer.

4B.2 PHYSICAL CHARACTERISTICS

4B.2.1 Terrestrial Environment

4B.2.1.1 Physiography

Alternative B – CPAI Development Plan Impacts on Physiography

Construction Period

The effects on physiography would result from changes to landforms by construction of roads, pads, airstrips, and gravel mines. The impacts are therefore similar to those discussed in Section 4A.2.1.1 for Alternative B.

Areas where gravel mining operations would directly affect the physiography include 37 acres (refer to Section 4B.2.1.4) of gravel mine. Placement of gravel on the tundra would directly affect physiography on 195 acres (refer to Table 2.5-1).

Operation Period

Effects during the operation period would be similar to those of Alternative A.

Alternative B – Full-Field Development Plan Impacts on Physiography

Areas that would experience direct physiographic effects from gravel mining operations include approximately 287 acres. Areas that would experience direct physiographic impacts from placement of gravel on tundra include 1,152 acres.

Alternative B – Summary of Impacts (CPAI and FFD) on Physiography

Impacts to physiography occur primarily during the construction phase and result from changes to landforms by construction of roads, pads, airstrips, and mine sites. If not properly designed and constructed, these landforms can adversely affect thermal stability of the tundra and hydrology through thermokarsting and increased ponding.

Alternative B – Potential Mitigation Measures (CPAI and FFD) for Physiography

No measures have been identified to mitigate impacts to physiography under Alternative B or Alternative B FFD.

4B.2.1.1 Geology

The following discussion of impacts to geological resources is limited to lithified, inorganic materials and their associated petroleum resources. Impact to unconsolidated material is discussed in Sections 4B.2.1.3, Soils and Permafrost, and 4B.2.1.4, Sand and Gravel.

Alternative B – CPAI Development Plan Impacts on Geology

Construction Period

Direct Effects

The only surface bedrock identified in the ASDP Area outcrops at the bend in the lower Colville River upstream of Ocean Point (Mayfield et al. 1988). Alternative B does not propose excavation activities in this area and would therefore not directly affect surface bedrock.

Indirect Effects

No indirect effects are recognized for the construction period.

Operation Period

Direct Effects

Drilling oil production wells at the five pad locations would directly affect the target and overlying lithologies. Annular disposal or Class II reinjection of drilling wastes would directly affect the receiving lithologies. The volume of rock affected in conjunction with drilling and the disposal of drilling waste is insignificant compared to the volume of lithified resources present within the ASDP Area. For this reason, direct impacts to ASDP Area lithology are considered negligible.

The CPAI Development Plan would produce hydrocarbons from subsurface reservoirs, thereby depleting the *in situ* petroleum reserves. Although hydrocarbon production constitutes an unavoidable and permanent impact that would not recover to its pre-impact state within the scale of human longevity, the impact is confined to the geological environment and economic gains would likely outweigh adverse impact to petroleum resources.

Indirect Effects

No indirect effects are recognized for the operation period.

Alternative B – Full-Field Development Plan Impacts on Geology

Direct and indirect impacts incurred during construction and operation of Alternative B FFD would be similar to those presented in Section 4B.2.1.2.1, but would be experienced over greater spatial and temporal extents. The volume of rock affected in conjunction with drilling and disposal of drilling waste under FFD is also considered insignificant when compared to the volume of lithified resources present within the Plan Area. Surface bedrock is not expected to be affected under the FFD scenario. Full-field development would further deplete Plan Area petroleum reserves; however, the hypothetical nature of FFD precludes quantification of petroleum resource reduction.

Alternative B – Summary of Impacts (CPAI and FFD) on Geology

Reduction of petroleum resources in the ASDP Area is inevitable. Because these resources are essentially non-renewable, effects would be permanent and unresponsive to mitigation. Impacts to lithified resources in the ASDP Area under the Alternative B and FFD Alternative B would produce no measurable effect.

Alternative B – Potential Mitigation Measures (CPAI and FFD) for Geology

No measures have been identified to mitigate the effect on geologic resources under Alternative B or Alternative B FFD.

4B.2.1.2 Soils and Permafrost

Alternative B – CPAI Development Plan Impacts on Soils and Permafrost

Direct and indirect effects on soils and permafrost will be of the same type and caused by the same activities as under Alternative A. However, because of the different footprint and gravel requirements, the total amount of soils and permafrost disturbed or covered will be less. Development of new gravel mine sites would require excavation of overburden from approximately 37 acres of surface area. Fill material placed in conjunction with Alternative B would overlie approximately 195 acres of native soil. The total surface area of ice roads constructed over six seasons would overlie approximately 1,130 acres of native soil during the winter months. Approximately 3,031 VSMs would be embedded within the pipeline corridors delineated for Alternative B.

Alternative B – Full-Field Development Plan Impacts on Soils and Permafrost

The types of impacts and associated effects of FFD are similar to those presented in Section 4B.2.1.3, the CPAI Development Plan Alternative B, but would happen over greater spatial and temporal extents. Additional gravel mine sites would be developed to provide the volume of construction material necessary for FFD. Based upon the ratio of cubic yards of gravel per acre of gravel mine established from the 1999 to 2000 excavation at the ASRC mine, FFD would disturb surface soils and permafrost of approximately 287 acres.

Colville River Delta Facility Group

Fill material placed in conjunction with Alternative B FFD would overlie approximately 279 acres of native soil in the Colville River Delta area. The total surface area of ice roads constructed over 20 seasons would overlie approximately 639 acres of native soil during the winter months. Approximately 4,077 VSMs would be embedded, and six additional oil well clusters would be drilled in the Colville River Delta area.

Fish-Judy Creeks Facility Group

Fill material placed in conjunction with Alternative B FFD would overlie approximately 569 acres of native soil in the Fish and Judy creeks area. The total surface area of ice roads constructed over 20 seasons would overlie approximately 950 acres of native soil during the winter months. Approximately 8,153 VSMs would be embedded, and a minimum of 10 additional oil well clusters would be drilled in the Fish-Judy Creeks Facility Group.

Kalikpik-Kogru Rivers Facility Group

Fill material placed in conjunction with Alternative B FFD would overlie approximately 303 acres of native soil in the Kalikpik and Kogru rivers area. The total surface area of ice roads constructed over 20 seasons would overlie approximately 698 acres of native soil during the winter months. Approximately 4,077 VSMs would be embedded, and a minimum of three additional oil well clusters would be drilled in the Kalikpik-Kogru Rivers Facility Group.

Alternative B – Summary of Impacts (CPAI and FFD) on Soils and Permafrost

Most impacts to soil and permafrost under Alternative B and FFD Alternative B would be sustained during construction. Impacts to the environments are unavoidable and semi-permanent but affect less than 1 percent of the total soil and permafrost system surface area within the Plan Area. Soil and permafrost systems could recover to their pre-impact state but not without appropriate mitigation.

Alternative B – Potential Mitigation Measures (CPAI and FFD) for Soils and Permafrost

Potential mitigation measures would be the same as those identified for Alternative A (Section 4A.2.1.3).

4B.2.1.3 Sand and Gravel

Once used, sand and gravel resources for construction of roads, pads, or airstrips may only be available for reuse upon abandonment.

Alternative B – CPAI Development Plan Impacts on Sand and Gravel

Alternative B would produce impacts similar to those discussed in Alternative A (Section 4A.2.1.4); however, the estimated sand and gravel quantities and mine site areas would be different, as discussed in the following sections.

Construction Period

The estimated gravel volume for Alternative B (Figure 2.4.2.1-1) from Table 2.4.2-1 is 1.85 million cubic yards. Using the same relationship between volumes and surface area detailed in Section 4A.2.1.4, Alternative B would affect approximately 37 acres of the surface and subsurface materials to extract gravel. This is about 0.004 percent of the total Plan Area.

Operation Period

During the operation period, relatively small amounts of gravel are expected to be extracted from existing permitted mine sites for repair of road or pad embankments.

Alternative B – Full-Field Development Plan Impacts on Sand and Gravel

The Alternative B FFD Plan would use and build off the same road network that would be constructed under the CPAI Development Plan Alternative B. The Alternative B FFD scenario, depicted in Figure 2.4.2.2-1, is

estimated to need 11.9 million cubic yards (Table 2.4.2-1). Other than the Clover Potential Gravel Source, the source of this gravel has not yet been determined. Using the same relationship between volumes and surface area detailed in Section 4A.2.1.4, construction of Alternative B FFD would affect approximately 254 acres of the surface to extract subsurface gravel materials. This is about 0.028 percent of the total Plan Area.

Alternative B – Summary of Impacts (CPAI and FFD) on Sand and Gravel

Once used, sand and gravel resources for construction of roads, pads, or airstrips may only be available for reuse upon abandonment. Removal of gravel fill is not currently a scheduled phase of abandonment.

Alternative B – Potential Mitigation Measures (CPAI and FFD) for Sand and Gravel

No measures have been identified to mitigate impact to sand and gravel resources under Alternative B or Alternative B FFD.

4B.2.1.4 Paleontological Resources

Alternative B – CPAI Development Plan Impacts on Paleontological Resources

Under Alternative B, the impacts to paleontological resources are generally the same as under Alternative A, except the intensity of the actions would decrease because of the elimination of road segments from CD-2 to CD-5 and CD-5 to CD-6. Excavation of sand and gravel material at the ASRC mine site and the Clover Potential Gravel Source could affect paleontological resources within approximately 37 acres of subsurface area. As in Alternative A, drilling, placement of gravel pads and VSMS, and bridge construction are very unlikely to impact paleontological resources.

Under Alternative B, power lines would be buried in or under roads (in areas with roads) and in the tundra adjacent to the pipelines between pads in roadless areas. Because the occurrence of paleontological materials on the surface is isolated and rare, the likelihood of impacts to paleontological resources during shallow trenching for power lines is low.

Compared with Alternative A, Alternative B would require seven fewer vehicle bridges. The only bridge construction would be associated with a 40-foot vehicle bridge on the road segment between CD-6 and CD-7 and a 1,200-foot pipeline bridge across the Nigliq Channel. The only impact resulting from bridge construction would be associated with placement of sheet piling at bridge abutments and with foundation piles at abutments and possibly in-stream locations. Depending on the depth at which the pilings are set, it is possible—though highly unlikely—that paleontological resources would be affected.

Alternative B – Full-Field Development Plan Impacts on Paleontological Resources

Under the hypothetical FFD scenario for Alternative B, the mechanisms associated with impacts to paleontological resources would remain the same as those described under Alternative B for the ASDP, except the intensity of the actions would increase as a result of the greater extent of the development. The primary potential cause of impacts would be excavation of gravel on approximately 287 acres. Approximately three gravel mine sites would be developed to provide the volume of construction material necessary for FFD. The location of the gravel mine sites for FFD is yet unknown, but could be in locations that would affect paleontological resources. It is likely that the additional sand and gravel mine sites would be situated in the vicinity of the Fish-Judy Creeks facility group and/or the Kalikpik-Kogru Rivers facility group. In addition, approximately 1,150 acres could be covered by gravel in the construction of pads, roads, and airstrips.

Alternative B – Summary of Impacts (CPAI and FFD) on Paleontological Resources

Surface activities such as construction of pad, road, and airfield embankments is not likely to affect paleontological resources. Impacts could result from those activities involving subsurface disturbance such as production well drilling, sand and gravel mining, and installation of VSMs and bridge piles. Excavation of sand and gravel under approximately 37 acres for CPAI's project and 287 acres for FFD constitute the greatest risk to paleontological resources.

Alternative B – Potential Mitigation Measures (CPAI and FFD) for Paleontological Resources

No measures have been identified to mitigate impacts to paleontological resources under Alternative B or Alternative B FFD.

4B.2.2 Aquatic Environment

4B.2.2.1 Water Resources

Alternative B – CPAI Development Plan Impacts on Water Resources

Alternative B would affect the same water resources (i.e., subsurface waters, lakes, creeks, rivers, and the near-shore environment) and to a similar extent as Alternative A except Alternative B would alter the proposed project to conform completely to Northeast NPR-A IAP/EIS development stipulations. Stipulation No. 39 specifically minimizes impacts to water resources owing to setback requirements of permanent oil and gas facilities from water bodies. Tables 4B.2.2-1 and 4B.2.2-2 provide summaries of potential construction and operation impacts to water resources under Alternative B.

The potential impacts between the alternatives differ primarily because of the presence of additional airstrips at CD-5 and CD-6 under Alternative B. In addition to air access to these production pads during the construction and drilling phases, this alternative would require ice roads and an ice bridge to be built across the Nigliq Channel during the winter. Further, under Alternative B, gravel roads would be eliminated between CD-2, CD-5, and CD-6, which minimizes (when compared to Alternative A) the potential impacts to water resources along these segments. CD-6 would be relocated just outside the 3-mile setback for Fish and Judy Creeks. Pipeline segments and gravel road segments between CD-5 and CD-6, and CD-6 and CD-7 would be positioned differently than under Alternative A but result in similar impacts to water resources in the specific geographic locations.

Alternative B – Full-Field Development Plan Impacts on Water Resources

The FFD scenario for Alternative B is similar to Alternative A FFD, but one hypothetical processing facility (APF-2) would be eliminated from the Fish-Judy Creeks drainage and relocated to one of the hypothetical production pad locations (CD-9). Table 4B.2.2-3 provides a summary of potential construction and operation impacts to water resources under Alternative B FFD.

Stipulation No. 31 would set aside the Teshekpuk Lake Surface Protection Area; conformance would eliminate CD-29. This stipulation eliminates impacts to water resources to the Kogru River and other associated water bodies in the area of CD-29. In addition, under the FFD for Alternative B, several production pads would be relocated just outside the 3-mile setback on Fish and Judy Creeks (CD-6, 8, 23, and 24) in conformance with Stipulation No. 39. Stipulation No. 48 requires that no roads connect with road systems outside the NE NPR-A planning area, which, among other things, causes this alternative not to have a vehicle bridge over the Nigliq Channel.

Ice road construction for the FFD scenario would require up to approximately 400 acre-feet of water to be withdrawn from lakes. The lengths of ice roads to be constructed would be higher for this alternative compared with Alternative A, in part because no gravel road would be built across Fish Creek.

TABLE 4B.2.2-1 POTENTIAL CONSTRUCTION IMPACTS TO WATER RESOURCES

Alternative B – CPAI Development Plan												
	GROUNDWATER		LAKES			MAJOR & MINOR STREAM CROSSINGS					ESTUARIES & NEARSHORE ENVIRONMENT	
	Shallow Groundwater	Deep Groundwater	Small Shallow Lakes and Ponds	Large Deep Lakes	Uiamngiaq Channel	Tamayaglaaq Channel	Sakonang Channel	Colville River	Minor Streams	Colville River Delta	Harrison Bay	
CD-3												
Gravel Road Segment: CD-3 to Airstrip	8	NI	NI	5	NI	NI	NI	NI	NI	7	NI	
Ice Roads	NI	NI	NI	5	NI	NI	NI	NI	NI	6	NI	
Airstrip	8	NI	NI	8	2,3	2,3	2,3	2,3	2,3	6	NI	
Pipeline Segment: CD-1 - CD-3	NI	NI	NI	8	3,4,5,6,7	3,4,5,6,7	3,4,5,6,7	NI	3,4,5,6,7	6	NI	
Production Pad	8	NI	NI	8	2,3	2,3	2,3	2,3	2,3	6	NI	
Chemical/Petroleum Tank Storage	9	NI	9	9	NI	NI	NI	NI	NI	9	9	
Surfacewater extraction for potable and construction use	NI	NI	10	10	NI	NI	NI	NI	NI	NI	NI	
CD-4												
	Shallow Groundwater	Deep Groundwater	Small Shallow Lakes and Ponds	Large Deep Lakes	Niglig Channel			Minor Streams			Harrison Bay	
Gravel Road Seg. CD-1 to CD-4	8	NI	NI	NI	NI			2,3,4,5,6			NI	
Pipeline Segment: CD-1 - CD-4	NI	NI	NI	NI	NI			2,3,4,5,6			NI	
Production Pad	8	NI	8	NI	NI			2,3,4,5,6			NI	
Chemical/Petroleum Tank Storage	9	NI	9	NI	9			9			9	
Surfacewater extraction for potable and construction use	NI	NI	10	10	NI			NI			NI	

TABLE 4B.2.2-1 POTENTIAL CONSTRUCTION IMPACTS TO WATER RESOURCES (cont'd)

Alternative B – CPAI Development Plan									
	GROUNDWATER		LAKES			MAJOR & MINOR STREAM CROSSINGS		ESTUARIES & NEARSHORE ENVIRONMENT	
	Shallow Groundwater	Deep Groundwater	Small Shallow Lakes and Ponds	Large Deep Lakes	Niglig Channel	Minor Streams			
CD-5									
Gravel Segment: CD-5 to Airstrip	8	NI	5	NI	NI	NI	NI	NI	Harrison Bay
Airstrip	8	NI	NI	NI	NI	2,4,5,6	NI	NI	
Pipeline Segment: CD-2 - CD-5	NI	NI	NI	NI	NI	6	NI	NI	
Production Pad	8	NI	8	NI	NI	NI	NI	NI	
Underground injection	NI	9	NI	NI	NI	NI	NI	NI	
Chemical/Petroleum Tank Storage	9	NI	9	NI	NI	9	9	9	
Surfacewater extraction for potable and construction use	NI	NI	10	10	NI	NI	NI	NI	
CD-6									
	Shallow Groundwater	Deep Groundwater	Small Shallow Lakes and Ponds	Large Deep Lakes	Fish-Judy Creek Basin	Ublutuoch River Basin	Minor Streams		Harrison Bay
Gravel Road Segment: CD-6 - Airstrip	8	NI	NI	NI	NI	NI	2,3,4,5,6,7	NI	
Airstrip	8	NI	NI	NI	NI	NI	2,4,5,6	NI	
Pipeline Segment: CD-5 - CD-6	NI	NI	NI	NI	NI	2,3,4,5,6,7	2,3,4,5,6,7	NI	
Production Pad	8	NI	8	NI	NI	NI	NI	NI	
Chemical/Petroleum Tank Storage	9	NI	9	NI	9	9	9	9	
Surfacewater extraction for potable and construction use	NI	NI	10	10	NI	NI	NI	NI	

TABLE 4B.2.2-1 POTENTIAL CONSTRUCTION IMPACTS TO WATER RESOURCES (cont'd)

Alternative B – CPAI Development Plan									
	GROUNDWATER		LAKES			MAJOR & MINOR STREAM CROSSINGS		ESTUARIES & NEARSHORE ENVIRONMENT	
	Shallow Groundwater	Deep Groundwater	Small Shallow Lakes and Ponds	Large Deep Lakes	Fish-Judy Creek Basin	Minor Streams			
CD-7									
Gravel Road Segment: CD-6 - CD-7	8	NI	NI	NI	2,3,4,5,6,7	2,3,4,5,6,7	NI		
Pipeline Segment: CD-6 - CD-7	NI	NI	NI	NI	2,3,4,5,6,7	2,3,4,5,6,7	NI		
Production Pad	8	NI	8	NI	NI	NI	NI		
Chemical/Petroleum Tank Storage	9	NI	9	NI	9	NI	9		
Surfacewater extraction for potable and construction use	NI	NI	10	10	NI	NI	NI		

Notes:

IMPACTS

- 1 = Shoreline Disturbance & Thermokarsting
- 2 = Blockage of Natural Channel Drainage
- 3 = Increased stages & velocities of floodwater
- 4 = Increased channel scour
- 5 = Increased Bank Erosion
- 6 = Increased Sedimentation
- 7 = Increased potential for over banking (due to inundation or wind-generated wave run-up)
- 8 = Removal of surface soils/gravel and changes in recharge potential
- 9 = Chemical & Petroleum Spills & Cleanup
- 10 = Water Supply Demand
- NI = No Impact

TABLE 4B.2.2-2 POTENTIAL OPERATIONS IMPACTS TO WATER RESOURCES

Alternative B – CPAI Development Plan												
	GROUNDWATER		LAKES		MAJOR & MINOR STREAM CROSSINGS					ESTUARIES & NEARSHORE ENVIRONMENT		
	Shallow Groundwater	Deep Groundwater	Small Shallow Lakes and Ponds	Large Deep Lakes	Uamngiaq Channel	Tamayagtaaq Channel	Sakoanang Channel	Colville River	Minor Streams	Colville River Delta	Harrison Bay	
CD-3												
Gravel Road Segment: CD-3 to Airstrip	8	NI	NI	NI	NI	NI	NI	NI	NI	7	NI	
Ice Roads	NI	NI	10	10	3?	NI	NI	NI	3?	3	NI	
Airstrip	8	NI	NI	NI	2,3,4,5	NI	NI	NI	NI	6	NI	
Pipeline Segment: CD-1 - CD-3	NI	NI	NI	NI	3,4,5,6,7	3,4,5,6,7	3,4,5,6,7	NI	3,4,5,6,7	6	NI	
Production Pad	8	NI	NI	8	2,3	2,3	2,3	NI	2,3	6	NI	
Underground injection	NI	9	NI	NI	NI	NI	NI	NI	NI	NI	NI	
Chemical/Petroleum Tank Storage	9	NI	9	9	9	NI	NI	NI	9	9	9	
Surfacewater extraction for potable and construction use	NI	NI	10	10	NI	NI	NI	NI	NI	NI	NI	
CD-4 Area												
	Shallow Groundwater	Deep Groundwater	Small Shallow Lakes and Ponds	Large Deep Lakes	Niglliq Channel			Minor Streams			Harrison Bay	
Gravel Road Seg. CD-1 to CD-4	8	NI	NI	NI	NI	NI	2,3,4,5,6			NI	NI	
Pipeline Segment: CD-1 - CD-4	NI	NI	NI	NI	NI	NI	2,3,4,5,6			NI	NI	
Production Pad	8	NI	8	NI	NI	NI	2,3,4,5,6			NI	NI	
Underground injection	NI	9	NI	NI	NI	NI	NI			NI	NI	
Chemical/Petroleum Tank Storage	9	NI	9	NI	9	9	9			9	9	

TABLE 4B.2.2-2 POTENTIAL OPERATIONS IMPACTS TO WATER RESOURCES (cont'd)

Alternative B – CPAI Development Plan											
	GROUNDWATER		LAKES			MAJOR & MINOR STREAM CROSSINGS			ESTUARIES & NEARSHORE ENVIRONMENT		
	Shallow Groundwater	Deep Groundwater	Small Shallow Lakes and Ponds	Large Deep Lakes	Niglig Channel	Minor Stream	Harrison Bay				
Surfacewater extraction for potable and construction use	NI	NI	10	10	NI	NI	NI	NI	NI		
	Shallow Groundwater	Deep Groundwater	Small Shallow Lakes and Ponds	Large Deep Lakes	Niglig Channel	Minor Stream	Harrison Bay				
CD-5											
Gravel Road Segment: CD-2 -CD-5	8	NI	NI	NI	2,3,4,5,6,7	2,4,5,6	NI	NI	NI		
Pipeline Segment: CD-2 -CD-5	NI	NI	NI	NI	2,3,4,5,6,7	6	NI	NI	NI		
Production Pad	8	NI	8	NI	NI	NI	NI	NI	NI		
Bridges/Culverts	NI	NI	NI	NI	2,3,4,5,6,7	2,3,4,5,6,7	NI	NI	NI		
Underground injection	NI	9	NI	NI	NI	NI	NI	NI	NI		
Chemical/Petroleum Tank Storage	9	NI	9	NI	NI	9	9	9	9		
Surfacewater extraction for potable and construction use	NI	NI	10	10	NI	NI	NI	NI	NI		
CD-6											
	Shallow Groundwater	Deep Groundwater	Small Shallow Lakes and Ponds	Large Deep Lakes	Fish-Judy Creek Basin	Ubtutuch River Basin	Minor Stream	Harrison Bay			
Gravel Road Segment: CD-6 - Air-strip Airstrip	8	NI	NI	NI	NI	NI	2,3,4,5,6,7	NI	NI		
Pipeline Segment: CD-5 - CD-6	NI	NI	NI	NI	NI	2,3,4,5,6,7	2,4,5,6	NI	NI		
Production Pad	8	NI	8	NI	NI	NI	NI	NI	NI		
Chemical/Petroleum Tank Storage	9	NI	9	NI	9	9	9	9	9		

TABLE 4B.2.2-2 POTENTIAL OPERATIONS IMPACTS TO WATER RESOURCES (cont'd)

Alternative B – CPAI Development Plan										
	GROUNDWATER		LAKES		MAJOR & MINOR STREAM CROSSINGS			ESTUARIES & NEARSHORE ENVIRONMENT		
	NI	NI	10	10	NI	NI	NI			
Surfacewater extraction for potable and construction use	NI	NI	10	10	NI	NI	NI	NI		
CD-7										
Gravel Road Segment: CD-6 - CD-7	8	NI	NI	NI	2,3,4,5,6,7	2,3,4,5,6,7	2,3,4,5,6,7	NI		
Pipeline Segment: CD-6 - CD-7	NI	NI	NI	NI	2,3,4,5,6,7	2,3,4,5,6,7	2,3,4,5,6,7	NI		
Production Pad	8		8	NI	NI	NI	NI	NI		
Chemical/Petroleum Tank Storage	9	NI	9	NI	9	NI	NI	9		
Surfacewater extraction for potable and construction use	NI	NI	10	10	NI	NI	NI	NI		

Notes:

IMPACTS

- 1 = Shoreline Disturbance & Thermokarsting
- 2 = Blockage of Natural Channel Drainage
- 3 = Increased stages & velocities of floodwater
- 4 = Increased channel scour
- 5 = Increased Bank Erosion
- 6 = Increased Sedimentation
- 7 = Increased potential for over banking (due to inundation or wind-generated wave run-up)
- 8 = Removal of surface soils/gravel and changes in recharge potential
- 9 = Chemical & Petroleum Spills & Cleanup
- 10 = Water Supply Demand
- NI = No Impact

TABLE 4B.2.2-3 POTENTIAL CONSTRUCTION AND OPERATIONAL IMPACTS TO WATER RESOURCES

ALTERNATIVE B - FULL FIELD DEVELOPMENT														
	GROUNDWATER		LAKES		MAJOR & MINOR STREAM CROSSINGS							ESTUARIES & NEARSHORE ENVIRONMENT		
	Shallow Groundwater	Deep Ground-water	Small Shallow Lakes and Ponds	Large Deep Lakes	Niglig Channel	Sakoanang Channel	Tamayagiaraq Channel	Ulamiglaq Channel	Elaktoveach Channel	Kupigruak Channel	Colville River	Minor Streams	Colville River Delta	Harrison Bay
Proposed production pads CD-3 and CD-4 & hypothetical production pads CD-11, 12, 14, 15, 19, 20, and 21.														
COLVILLE RIVER FACILITY GROUP	8	NI	NI	NI	1,2,3,4,5,6,7	1,2,3,4,5,6,7	1,2,3,4,5,6,7	1,2,3,4,5,6,7	1,2,3,4,5,6,7	1,2,3,4,5,6,7	1,2,3,4,5,6,7	1,2,3,4,5,6,7	1,2,3,4,5,6,7	NI
	NI	NI	10	10	NI	NI	3	3	3	3	3	3	1,2,3,4,5,6,7	NI
	NI	NI	NI	NI	3,4,5,6,7	3,4,5,6,7	3,4,5,6,7	3,4,5,6,7	3,4,5,6,7	3,4,5,6,7	3,4,5,6,7	3,4,5,6,7	3,4,5,6,7	NI
	8	NI	8	8	2,3	2,3	2,3	2,3	2,3	2,3	NI	2,3	2,3	NI
														NI
	NI	9	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
	9	NI	9	9	9	9	9	9	9	9	9	9	9	9
	NI	NI	10	10	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
	Production Pads: All Proposed and Hypothetical Satellite Locations Airstrips: CD-3, 14, 19, 20, and 21 Underground Injection Chemical/Petroleum Tank Storage Surfacewater extraction for potable and construction use													

TABLE 4B.2.2-3 POTENTIAL CONSTRUCTION AND OPERATIONAL IMPACTS TO WATER RESOURCES (CONT'D)

ALTERNATIVE B - FULL FIELD DEVELOPMENT												
	GROUNDWATER			LAKES		MAJOR & MINOR STREAM CROSSINGS					ESTUARIES & NEARSHORE ENVIRONMENT	
	Shallow groundwater	Deep groundwater	Groundwater	Small Shallow Lakes and Ponds	Large Deep Lakes	Fish Creek Basin	Inigok Creek Basin	Judy Creek Basin	Ublutuoch River Basin	Minor Streams		
Fish and Judy Creek Subgroup												Harrison Bay
Proposed CD-5, 6, and 7 production pads, hypothetical processing facility APF-2, and hypothetical production pads CD-8, 9, 10, 13, 16, 17, 18, 22, 23, 24, and 26.												
Gravel Road Segments: CD-5 to CD-6; CD-6 to CD-7; CD-8 to CD-6/5; CD-7 to CD-9; CD-10 to CD-6/5; CD-13 to CD-5/6 ; CD-13 to CD-16; CD-17 to CD-7/9 ; CD-16 to CD-18; CD-6 to CD-22; APF-2 to CD23; CD-23 to CD-24; CD-24 to CD-26	8	NI		3,5,6,7	3,5,6,7	2,3,4,5,6,7	2,3,4,5,6,7	2,3,4,5,6,7	2,3,4,5,6,7	2,3,4,5,6,7	2,3,4,5,6,7	NI
Pipeline Segment: CD-6 to CD-5; CD-7 to CD-6; CD-8 to CD-6/5 ; CD-7 to CD-9; CD-10 to CD-6/5; CD-13 to CD-5/6 ; CD-13 to CD-16; CD-17 to CD-7/9 ; CD-16 to CD-18; CD-6 to CD-22; APF-2 to CD23; CD-23 to CD-24; CD-24 to CD-26	NI	NI		3,5,6,7	3,5,6,7	2,3,4,5,6,7	2,3,4,5,6,7	2,3,4,5,6,7	2,3,4,5,6,7	2,3,4,5,6,7	2,3,4,5,6,7	NI
Production Pads: All Proposed and Hypothetical Satellite Locations and Hypothetical Processing Facility	8	NI	8		NI	2,3	2,3	2,3	2,3	2,3	2,3	NI
Underground Injection	NI	9	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
Processing Facility: APF-2	8	NI	NI	NI	NI	NI	NI	2,3,4,5,6	NI	NI	NI	NI
Chemical/Petroleum Tank Storage	9	NI	9	9	9	9	9	9	9	9	9	9
Surfacewater extraction for potable and construction use	NI	NI	10	10	10	NI	NI	NI	NI	NI	NI	NI

TABLE 4B.2.2-3 POTENTIAL CONSTRUCTION AND OPERATIONAL IMPACTS TO WATER RESOURCES (CONT'D)

ALTERNATIVE B - FULL FIELD DEVELOPMENT										
	GROUNDWATER		LAKES		MAJOR & MINOR STREAM CROSSINGS			ESTUARIES & NEARSHORE ENVIRONMENT		
	Shallow Groundwater	Deep Groundwater	Small Shallow Lakes & Ponds	Large Deep Lakes	Kalikpik River Drainage	Kogru River	Minor Streams			
Kogru-Kalikpik Subgroup								Harrison Bay		
Hypothetical processing facility APF-3 and hypothetical production pads CD-25, 27, 28, and 29										
Gravel Road Segments: CD-25 to APF-2; CD-27 to APF-3; CD-25 road; CD-28 to APF-3; APF3 to CD-25; APF-3 road to airstrip	8	NI	3,5,6	3,5,6	2,3,4,5,6	NI	2,3,4,5,6	NI		
Pipeline Segment: CD-25 to APF-2; CD-27 to APF-3; CD-25 road; CD-28 to APF-3; APF-3 to CD-25	NI	NI	NI	NI	2,3,4,5,6	NI	2,3,4,5,6	NI		
Production Pads: All hypothetical Satellite Locations and hypothetical processing facility	8	NI	NI	NI	2,3,4,5,6	NI	2,3,4,5,6	NI		
Airstrips: APF-3	8	NI	NI	NI	3,4,5,6	NI	3,4,5,6,7	NI		
Underground Injection	NI	9	NI	NI	NI	NI	NI	NI		
Processing Facility: APF-3	8	NI	NI	NI	3,4,5,6	NI	NI	NI		
Chemical/Petroleum Tank Storage	9	NI	9	NI	9	NI	9	9		
Surfacewater extraction for potable and construction use	NI	NI	10	10	NI	NI	NI	NI		

Alternative B – Summary of Impacts (CPAI and FFD) on Water Resources

Impacts to water resources would be similar to Alternative A. Reduction in the linear miles of roads would reduce potential impacts between CD-2 and CD-5. For FFD, the use of ice roads would be greater than Alternative A, requiring more use of surface water resources.

Alternative B – Potential Mitigation Measures (CPAI and FFD) for Water Resources

No measures have been identified to mitigate impacts to water resources under Alternative B or Alternative B FFD.

4B.2.2.2 Surface Water Quality

Alternative B – CPAI Development Plan Impacts on Surface Water Quality

Construction Period

Water withdrawal volumes required for ice road construction would be approximately the same for the applicant's proposed action because ice roads would be built to the same locations, with very slight differences in length due to the movement of the CD-6 pad. The lengths of ice roads to be constructed would be higher for this alternative compared with Alternative A because no gravel road would be built across Fish Creek. The chance would be increased that ice roads would be routed across lakes, potentially causing increased incidences of reductions in dissolved oxygen concentrations (as described for Alternative A), which in turn could affect fish over-wintering habitats. However, the likelihood of this impact occurring is very low. Lakes less than 7 feet deep typically freeze solid during the winter, so there would be no concern about oxygen concentrations. Additionally, owing to safety considerations, industry does not typically route ice roads over deeper lakes for fear of unfrozen water and the possibility of cracking the road while transporting heavy equipment.

This alternative would involve the elimination of the gravel road between CD-6 and CD-5 for the Applicant's proposed project. The reduction in total gravel placed in the planning area would reduce the potential impacts to water quality from increased turbidity caused by erosion and sedimentation compared to Alternative A. Alternative B would have approximately 195 acres covered with gravel for the proposed project. This represents a 28 percent decrease in the gravel coverage estimated for Alternative B compared to Alternative A. The area of tundra potentially affected by thermokarst erosion would be equivalent to twice the area directly covered by gravel or approximately 390 acres for the development assumptions made in this alternative.

An additional source of thermokarst erosion for Alternative B would be the trenching required for burial of power lines. The power lines would parallel the route of the pipelines and would cover a distance of approximately 34 miles. Assuming a maximum trench width of 18 inches, the width of possible thermokarst erosion resulting from trenching would be approximately 3 feet. This would represent a potential area of disturbance of 4 acres.

Operation Period

Dust fallout from roads would be expected to be lower for this alternative compared to Alternative A for two reasons. First, this alternative restricts access to roads to industry. This would reduce the total number of vehicles traveling on the roads, although probably not by a measurable percentage. Second, this alternative would include construction of 11 miles of gravel roads for the applicant's proposed action, which represents a reduction from Alternative A of 56 percent. This reduction in the miles of gravel road constructed would be the only factor controlling the potential for impacts from upslope impoundments because roads would be constructed in the same general areas (in terms of surface water flow) and would be constructed with the same design specifications (in terms of number and type of culverts).

Alternative B – Full-Field Development Plan Impacts on Surface Water Quality

Ice road construction for the FFD scenario would require up to approximately 400 acre-feet of water to be withdrawn from lakes. The lengths of ice roads to be constructed would be higher for this alternative compared with Alternative A because no gravel road would be built across Fish Creek. Because the miles of ice roads constructed in this alternative for the FFD scenario would be approximately 35 percent higher, the chance would be increased that ice roads would be routed across lakes, potentially causing increased incidences of reductions in dissolved oxygen concentrations (as described for Alternative A), which in turn could affect fish over-wintering habitats. However, the likelihood of this impact occurring is very low. Lakes less than 7 feet deep typically freeze solid during the winter, so there would be no concern about oxygen concentrations. Additionally, owing to safety considerations, industry does not typically route ice roads over deeper lakes for fear of unfrozen water and the possibility of cracking the road while transporting heavy equipment.

This alternative would involve the elimination of several pads and roads for the FFD scenario. The reduction in total gravel placed in the planning area would reduce the potential impacts to water quality from increased turbidity caused by erosion and sedimentation. Alternative B would have approximately 1,150 acres covered with gravel for the FFD scenario. This represents an 18 percent decrease from the gravel coverage estimated for Alternative A. The area of tundra potentially affected by thermokarst erosion would be equivalent to twice the area directly covered by gravel or approximately 2,300 acres for the development assumptions made for the FFD scenario.

Burial of the power line also could cause thermokarst erosion. Based upon the calculations cited above for power line burial impacts from the CPAI project, the FFD could prompt thermokarst erosion of 18 acres in an area about 3 feet wide over a length of 150 miles.

Dust fallout from roads would be expected to be lower for this alternative compared to Alternative A for the same two reasons as cited in describing the impacts of CPAI's proposal—limiting road use to industry and the construction of few miles of road. This alternative would include construction of 90 miles of gravel roads for the FFD scenario, which represents a reduction from Alternative A of 26 percent. This reduction in the miles of gravel road constructed would be the only factor controlling the potential for impacts from upslope impoundments because roads would be constructed in the same general areas (in terms of surface water flow) and would be constructed with the same design specifications (in terms of number and type of culverts).

Alternative B – Summary of Impacts (CPAI and FFD) on Surface Water Quality

Alternative B proposes conducting all activities and siting all facilities in complete accordance with Northeast NPR-A IAP/EIS development stipulations. In comparison with Alternative A, this alternative would have fewer sources of potential impacts to surface water quality. This is mainly due to the movement of several production facilities outside sensitive resource areas and reduction in total miles of roads to be constructed. Impacts would include:

- Increased area potentially affected by thermokarst erosion compared to Alternative A, leading to increased impacts to water quality from increased turbidity caused by erosion and sedimentation
- Further distance from water bodies compared to Alternative A, reducing the chance of accidental releases migrating into a nearby water body
- Reduced potential for dust fallout and upslope impoundments compared to Alternative A, causing lower level impacts to turbidity.

Alternative B – Potential Mitigation Measures (CPAI and FFD) for Surface Water Quality

No mitigation measures have been identified for Alternative B and Alternative B FFD.

4B.2.3 Atmospheric Environment

4B.2.3.1 Climate and Meteorology

Alternative B – CPAI Development Plan Impacts on Climate and Meteorology

Construction Period

The impacts to climate and meteorology from construction of Alternative B would be similar to those discussed for Alternative A.

Operational Period

Impacts from GHG would be similar to those stated for Alternative A in Section 4A.2.3. Additional aircraft flights would occur from operation of the additional airstrips, but would not change the overall impact from GHG.

Alternative B – Full-Field Development Plan Impacts on Climate and Meteorology

The impacts to climate and meteorology are similar to those discussed for the FFD of Alternate A. Additional airstrips would change the emission source of GHG from Alternative A. The overall impact, however, would be minimal to the global GHG emissions budget.

Alternative B – Summary of Impacts (CPAI and FFD) on Climate and Meteorology

The impacts are the same as for Alternate A.

Alternative B – Potential Mitigation Measures (CPAI and FFD) for Climate and Meteorology

No mitigation measures have been identified.

4B.2.3.2 Air Quality

Alternative B – CPAI Development Plan Impacts on Air Quality

Construction Period

Air quality impacts would be similar to those for Alternative A, with the exception of a potential decrease in fugitive dust and particulates from construction of less acreage of gravel roads.

Operation Period

Air emissions from the operational period of Alternative B would be the same as for Alternative A, except for minor short-term changes to air quality that may occur from differences in aircraft flights per month.

Alternative B – Full-Field Development Plan Impacts on Air Quality

The impacts to the airshed would not likely be significantly different from Alternative A, except for a slight reduction in emissions as a result of elimination of drillsite heaters and emergency generators from pads that are not constructed under Alternative B. Impacts would be determined by air quality impacts analysis under the Prevention of Significant Deterioration (PSD) preconstruction review process.

Operation of the airstrips would change the nature of mobile source emissions from daily aircraft takeoffs and landings, instead of vehicular ground travel. However, air emissions from the use of aviation fuel are consid

erably less than from diesel fuel-powered mobile sources and would not add to deterioration in the overall air quality of the region.

Alternative B – Summary of Impacts (CPAI and FFD) on Air Quality

The impacts would be roughly the same as for Alternative A.

Alternative B – Potential Mitigation Measures (CPAI and FFD) for Air Quality

Air quality impacts from Alternative B would be limited through the permitting process, which ensures that no significant new air pollution sources contribute to deterioration of the ambient air quality. No additional measures have been identified.

4B.2.3.3 Noise

Alternative B – CPAI Development Plan Impacts on Air Quality

Construction Period

Noise impacts during the construction period of Alternative B would be similar to those for Alternative A. Although two additional airstrips would be constructed, fewer roads would be constructed, and similar noise impacts would be spread out over the construction period.

Operation Period

The noise quality environmental consequences would be similar to those for Alternative A for the operational period except for the short-term noise impacts of additional aircraft flights at the two additional airstrips.

Alternative B – Full-Field Development Plan Impacts on Air Quality

The noise impacts would be similar to those described for the FFD Plan under Alternative A as discussed in Section 4A.2.3. There would be a reduction in drilling noise because there would be fewer production pads than under Alternative A.

Alternative B – Summary of Impacts (CPAI and FFD) on Air Quality

The impacts from CPAI and FFD would be similar to the impacts described under Alternative A.

Alternative B – Potential Mitigation Measures (CPAI and FFD) for Air Quality

No potential mitigation measures have been identified for Alternative B or Alternative B FFD.