

**Table 1-1
Comparison of Components of Proposed Action and Alternatives**

COMPONENT	PROPOSED ACTION Endicott SDI Expansion	OFFSHORE ISLAND FEIS Offshore Proposed Action plus Alternatives	ONSHORE ALTERNATIVE Pt. Brower	ONSHORE ALTERNATIVE Kadleroshilik
WELL PAD				
Location	Endicott SDI	Liberty Island	Pt. Brower	Kadleroshilik
Gravel Volume	860,000 yd ³	797,600 yd ³	490,000 yd ³	440,000 yd ³
Maximum Footprint Area	20 acres	22.4 acres	45 acres	40 acres
Working Surface	704 ft x 1,394 ft	345 ft x 680 ft	2,715 ft x 630 ft	2,000 ft x 630 ft
Slope Protection	Sheetpile N. & E. none W. & S.	Gravel bags/Sheetpile	Gravel bags	Gravel bags
Rock Riprap	6,000 yd ³	N/A	N/A	N/A
WELLS				
Oil Producer	1 to 4	14		
Water Injector	1 or 2	6	up to 6*	up to 6*
Gas Injector	N/A	2		
Disposal Well	N/A	1		
PROCESSING HOST				
Location	Endicott MPI	Liberty Island	Endicott MPI	Badami
Facility Upgrade at Host	None	Standalone facilities including: 65,000 bpd oil separation capacity, 120 million scfd gas compression capacity, 75,000 bpd seawater treatment capacity, and a full camp and utility system	Liberty slugcatcher at Endicott MPI	Expand oil separation from 38,000 to 55,000 bpd, expand gas compression and flare system capacity from 35 to 70 million scfd
POWER GENERATION				
Location	Endicott MPI	Liberty Island	Endicott	Badami
Power-line Installation	Buried in Causeway	N/A	Buried in Road	Buried in Road
LoSa™ FACILITIES				
Location	Endicott MPI	N/A	Pt. Brower Pad	Kadleroshilik Pad
NEW OIL PIPELINE**				
Type	N/A***	Sales Oil	3-Phase	3-Phase
Route	N/A	Liberty Island to Badami Pipeline	Pt. Brower Pad to Endicott	Kadleroshilik Pad to Badami
Design	N/A	Single-Wall Steel Pipe Buried Subsea	Single-Wall Steel Pipe on VSMS	Single-Wall Steel Pipe on VSMS
Onshore Length	N/A	1.5 mi	15.2 mi	11.5 mi
Offshore Length	N/A	6.1 mi	N/A	N/A
River Crossings - Number	N/A	N/A	3	2
River Crossings - Type	N/A	N/A	Road bridges	Road bridges
Leak Detection System	N/A	MBLPC, PPA, LEOS, or Equivalent	LEOS	LEOS
Construction Season	N/A	Winter	Winter	Winter

Table 1-1 (Cont'd)
Comparison of Components of Proposed Action and Alternatives

COMPONENT	PROPOSED ACTION Endicott SDI Expansion	OFFSHORE ISLAND FEIS Offshore Proposed Action plus Alternatives	ONSHORE ALTERNATIVE Pt. Brower	ONSHORE ALTERNATIVE Kadleroshilik
GRAVEL MINE SITE				
Location	Sag Delta	Kadleroshilik	Sag Delta	Sag & Kadleroshilik
Acres Disturbed	50	31	63	89
Number of Haul Days	90	45 to 60	90	90
Distance from Well Pad	10 mi	6 mi	6.3 mi	3.1 mi
ROAD				
Route	N/A	N/A	Pt. Brower Pad to Endicott Road (7.3 mi)	Kadleroshilik Pad to Endicott Road (15.2 mi)
Gravel Volume	N/A	N/A	550,000 yd ³	1,130,000 yd ³
Maximum Footprint	N/A	N/A	70 ft x 38,500 ft	70 ft x 80,256 ft
Maximum Footprint Area	N/A	N/A	62 acres	129 acres
Working Surface	N/A	N/A	30 acres	62.6 acres
Bridges (Number)	1 (upgrade West Sag Bridge)	N/A	3	7
Culverts (Number)	N/A	N/A	40±	80±
ICE ROAD				
Freshwater	22 million gal	N/A	44 million gal	88 million gal
LOGISTICS				
Barge Trips (approx.)	1	60/year	N/A	N/A
Road trips (approx.)	2,100/year	N/A	2,100/year	2,100/year
Helicopter trips (approx.)	N/A	760/year	N/A	N/A
Staging area (approx. number and size)	1 @ 5 acres	1 onshore 20 acres; 1 offshore 10 acres	1 @ 5 acres	1 @ 5 acres

* The number of wells required for the Pt. Brower and Kadleroshilik alternatives is the same as for the proposed action (Endicott SDI). Since the original offshore proposal, BP has concluded that the Liberty reservoir can be produced with considerably fewer wells (up to 6 total) than originally anticipated. In addition, for these alternative options, BPXA was considering drilling up to two water source wells to provide water for waterflood; these are not included in the well count above.

** The current capacity of the Endicott sales oil pipeline system is 100,000 bbl/day, and the current capacity of the Badami sales oil line system is 35,000 bbl/day.

*** The project will include new gas and water lines on the existing 3-mile-long Endicott causeway.

Table 2.1-1
Location and Elevation of the Stations Referenced in this Section
 Source: NCDC (2005)

Station	Latitude	Longitude	Elevation above Sea Level (m)
Barrow	71°17'N	156°46'W	9.5
Barter Island	70°08'N	143°38'W	11.9
Deadhorse	70°12'N	148°29'W	18.6
Kuparuk	70°19'N	149°35'W	19.5
Prudhoe Bay	70°15'N	148°20'W	22.9

Table 2.1-2
Temperature Summary for Barrow (1975-2004)
 Source: NCDC (2005)

Month	Average Temperatures (°C)			Extreme Temperatures (°C)			
	Average	Average High	Average Low	Record High	Date	Record Low	Date
Jan	-25.0	-21.8	-28.3	-0.6	1/24/91	-47.2	1/3/75
Feb	-26.0	-22.7	-29.4	2.2	2/4/82	-46.6	1/2/93
Mar	-24.6	-21.1	-28.2	1.1	3/21/98	-43.3	3/14/95
Apr	-17.5	-13.7	-21.3	3.3	4/30/95	-28.3	5/6/84
May	-6.4	-3.8	-9.0	8.3	5/23/96	-28.3	5/6/84
Jun	1.8	4.4	-0.8	22.2	6/18/96	-11.1	6/2/94
Jul	4.6	7.9	1.3	26.1	7/13/93	-3.9	7/27/92
Aug	3.7	6.3	0.9	23.3	8/5/99	-6.1	8/31/80
Sep	-0.4	1.6	-2.4	16.7	9/19/95	-17.2	9/28/75
Oct	-9.1	-6.8	-11.7	5.0	10/3/77	-32.7	10/27/96
Nov	-18.1	-14.9	-21.2	1.7	11/16/96	-38.9	11/22/92
Dec	-23.3	-20.1	-26.6	0.0	12/23/83	-45.0	12/24/94
Annual	-11.7	-8.7	-14.7	26.1	7/13/93	-47.2	1/3/75

Table 2.1-3
Mean Temperatures for North Slope Climatological Stations
 Source: NCDC (2005)

Station	Observation period	T(°C) Annual	T(°C) Warmest Month (July)	T(°C) Coldest Month (February)
Barrow	1975-2004	-11.7	4.6	-26.0
Deadhorse	1999-2003	-11.3	7.8	-27.4
Prudhoe Bay	1986-1999	-11.2	8.7	-27.8
Kuparuk	1983-2004	-11.5	8.6	-28.2
Barter Island	1949-1988	-12.2	4.5	-27.3

Table 2.1-4
Precipitation Statistics for North Slope Climatological Stations
 Source: NCDC (2005)

Station	Observation Period	P (cm) Mean	P (cm) Maximum	P (cm) Minimum
Barrow	1975-2004	10.9	18.5	4.4
Prudhoe Bay	1986-1999	10.8	18.8	7.4
Kuparuk	1983-2004	10.1	18.5	5.9
Barter Island	1949-1988	15.7	32.7	7.4

Table 2.1-5
Snowfall Statistics for North Slope Climatological Stations
 Source: NCDC (2005)

Station	Observation Period	Snowfall (cm) Mean	Snowfall (cm) Maximum	Snowfall (cm) Minimum
Barrow	1975-2004	79.5	130.6	36.1
Prudhoe Bay	1986-1999	84.1	133.4	21.1
Kuparuk	1983-2004	78.2	128.3	16.3
Barter Island	1949-1988	106.2	221.7	48.5

Table 2.1-6
Mean Monthly and Annual Wind Speed for Barrow, Barter Island, and Deadhorse
 Source: NCDC (2005)

Month	Wind Speed (kt)		
	Barrow	Barter Island	Deadhorse
Jan	9.5	12.5	10.4
Feb	9.1	11.3	9.9
Mar	8.7	10.3	10.6
Apr	9.0	9.1	10.9
May	9.6	10.0	11.1
Jun	8.9	9.3	10.3
Jul	9.2	8.9	10.5
Aug	9.6	9.0	10.2
Sep	10.0	10.0	9.2
Oct	10.2	12.0	9.8
Nov	9.7	11.4	9.7
Dec	9.6	10.9	10.0
Annual	9.4	10.4	10.2

Table 2.1-7
Days per Month with Wind Speed Greater Than 30 kt at Barrow (1987-2003)
 Source: NCDC (2005)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
12	16	5	4	1	0	1	6	11	16	16	13

Table 2.1-8
Summary of 2005 Ambient Air Quality Data for GPB A-Pad and CCP
 Source: NCDC (2005)

Location	Pollutant	Averaging Time	Ambient Standard (ppm)	Measured Concentration (ppm)	Percent of Standard
A-Pad	NO ₂	Annual	0.053	0.004	7.5
		SO ₂	Annual	0.031	0.001
		24-hour	0.14	0.003	2.1
		3-hour	0.5	0.005	1.0
	O ₃	1-hour	0.12	0.051	42.5
CCP	NO ₂	Annual	0.053	0.013	24.5
		SO ₂	Annual	0.031	0.000
		24-hour	0.14	0.007	5.0
		3-hour	0.5	0.009	1.8
	O ₃	1-hour	0.12	0.051	42.5
	PM ₁₀	Annual	50 µg/m ³	3.7 µg/m ³	7.4
	24-hour	150 µg/m ³	38.9 µg/m ³	25.9	

Table 2.3-1
Estimated Bluff Retreat Rates along the Alaskan Beaufort Sea Coast

Location	Estimated Bluff Retreat Rate	Investigator
Tigvariak Island to Point Thomson	2.1 m/yr	Hopkins and Hart (1978)
Brownlow Point	9.2 m/yr	Leffingwell (1919)
Flaxman Island	3.3 m/yr (1952-1982)	Miller and Gadd (1983)
Heald Point (Western Shoreline)	0.3 to 0.6 m/yr (entire study area) 1.2 to 1.5 m/yr (sector containing massive ice)	Leidersdorf et al. (1996)
Point Storkersen	0.8 m/yr (1949-1996) 1.2 m/yr (short-term)	Coastal Frontier Corp. (1996)

Table 2.3-2
Estimated Bluff Retreat Rates in Foggy Island Bay

Source: Coastal Frontiers (1997a, 2006)

Location	Maximum Short-Term Bluff Retreat Rate	Average Long-Term Bluff Retreat Rate
West Site	1.6 m/yr (1988-1995)	0.6 m/yr (1949-1995)
East Site	2.7 m/yr (1949-1955)	0.8 m/yr (1949-1995)
East Kadleroshilik Site	2.7 m/yr (1949-1955)	1.1 m/yr (1949-2003)
Pt. Brower Site	East Side – 9.6 m/yr (1949-1955)	East Side – 2.0 m/yr (1949-2003)
	West Side – 2.0 m/yr (1955-1968)	West Side – 0.2 m/yr (1993-2003)

Table 2.4-1
Tidal Characteristics at Prudhoe Bay – Station ID 9497645

Source: NOS (2006)

Datum	Elevation (above Mean Lower Low Water)
Mean Higher High Water	20.9 cm
Mean High Water	17.7 cm
Mean Sea Level	10.3 cm
Mean Low Water	2.3 cm
Mean Lower Low Water	0.0 cm

Table 2.4-2
Predicted Maximum Still Water Levels for Westerly Storms

Source: OCTI (1997), Resio and Coastal Frontiers (2007)

Return Period (years)	Still Water Level (m, MSL)			
	Original Island Site	East Shore Crossing	West Shore Crossing	Endicott SDI Pad Expansion
1	0.61	0.70	0.61	n/a
10	1.25	1.37	1.25	1.14
25	n/a	n/a	n/a	1.36
50	1.71	1.83	1.68	1.51
100	1.89	2.04	1.86	1.66
200	n/a	n/a	n/a	1.81

Table 2.4-3
Predicted Significant Wave Height (H_s) and Peak Periods (T_p) for Westerly Storms
 Source: OCTI (1997)

Return Period (years)	Original Island Site		East Shore Crossing		West Shore Crossing	
	H_s (m)	T_p (sec)	H_s (m)	T_p (sec)	H_s (m)	T_p (sec)
1	2.01	7.5	0.58	7.5	0.52	7.5
10	2.84	8.0	0.70	8.0	0.64	8.0
50	3.48	10.4	0.82	10.3	0.73	10.3
100	3.72	11.4	1.04	11.4	0.88	11.4

Table 2.4-4
Predicted Significant Wave Height (H_s) and Peak Periods (T_p) for Easterly Storms
 Source: OCTI (1997)

Return Period (years)	Original Island Site		East Shore Crossing		West Shore Crossing	
	H_s (m)	T_p (sec)	H_s (m)	T_p (sec)	H_s (m)	T_p (sec)
1	1.46	7.6	0.46	6.9	0.46	6.9
10	1.95	8.4	0.52	7.3	0.52	7.3
50	2.47	10.8	0.52	9.4	0.52	9.3
100	2.80	11.8	0.52	10.0	0.52	9.9

Table 2.4-5
Predicted Significant Wave Height (H_s) and Peak Periods (T_p) near the Endicott SDI Expansion for Westerly Storms
 Source: Resio and Coastal Frontiers (2007)

Site No. ⁽¹⁾	Return Period (years)									
	10		25		50		100		200	
	H_s (m)	T_p (sec)	H_s (m)	T_p (sec)	H_s (m)	T_p (sec)	H_s (m)	T_p (sec)	H_s (m)	T_p (sec)
7	1.80	8.9	2.01	10.2	2.13	11.1	2.29	11.9	2.41	12.8
8	1.80	8.9	2.01	10.1	2.16	11.0	2.29	11.8	2.44	12.7
9	1.77	8.9	1.95	10.1	2.10	11.0	2.23	11.8	2.38	12.7

(1) Sites 1 through 6 are omitted due to sheltering by the Endicott Causeway and SDI.

Table 2.4-6
Predicted Significant Wave Height (H_s) and Peak Periods (T_p) near the
Endicott SDI Expansion for Easterly Storms

Source: Resio and Coastal Frontiers (2007)

Site No.	Return Period (years)									
	10		25		50		100		200	
	H_s (m)	T_p (sec)	H_s (m)	T_p (sec)	H_s (m)	T_p (sec)	H_s (m)	T_p (sec)	H_s (m)	T_p (sec)
1	0.34	9.1	0.37	10.3	0.40	11.1	0.43	11.9	0.46	12.7
2	0.52	9.1	0.61	10.2	0.67	11.0	0.70	11.8	0.70	12.6
3	0.55	9.0	0.61	10.1	0.70	10.9	0.70	11.7	0.70	12.4
4	0.95	9.0	1.01	10.1	1.01	10.9	1.01	11.7	1.01	12.4
5	1.31	9.0	1.40	10.1	1.46	10.9	1.46	11.7	1.46	12.4
6	1.37	9.0	1.43	10.1	1.46	10.8	1.46	11.6	1.46	12.3
7	1.59	9.0	1.62	10.0	1.62	10.8	1.62	11.5	1.62	12.2
8	1.62	9.0	1.62	10.0	1.62	10.8	1.62	11.5	1.62	12.2
9	1.62	9.0	1.62	10.0	1.62	10.8	1.62	11.5	1.62	12.2

Table 2.4-7
Predicted Landfast Ice-Sheet Thickness in Foggy Island Bay

Source: Vaudry (2007)

Date	10-Yr Minimum Ice Thickness (cm)	Average Sheet Ice Thickness (cm)	100-Yr Maximum Ice Thickness (cm)
November 1	23	33	58
December 1	53	64	91
January 1	76	91	124
February 1	104	122	158
March 1	130	152	191
April 1	155	180	213
May 1	173	196	226
June 1	183	201	229

Table 2.4-8
Exceedence Probability Distribution of Ice Drift Speeds

Source: Colony (1979), Cornett and Kowalchuk (1985), St. Martin (1987), Thorndike and Cheung (1977a,b), Vaudrey (1987, 1989a)

Season	Per Cent > Net Daily Ice Movement Rate (kt)							Average Speed (kt)
	>0.2	>0.4	>0.6	>0.8	>1.0	>1.5	>2.0	
Freeze-Up	50.0	17.7	8.1	3.8	1.9	0.4	0.3	0.3
Breakup	34.0	14.4	6.2	2.8	0.8	0	0	0.2

Table 2.4-9
Ice Movement Summary for Stefansson Sound Near Point Brower

Source: OSI (1976, 1978a,b, 1980)

Year	Net Ice Movement by Month (cm)				Percent of Time Ice Moving <1 cm/hr
	January	February	March	April	
1975-76	61	61	30	0	99.3
1976-77	30	0	30	61	99.7
1977-78	183	91	61	0	100.0
	152	61	61	0	100.0

Table 2.5-1
TSS Measurements in the ANIMIDA Study Area During the Open-Water Season

Source: Rummel (1987), Dunton et. al (2005)

Year	n	TSS Mean \pm SD (mg/l)	TSS Maximum (mg/l)	TSS Minimum (mg/l)
1999	31	30 \pm 27	119	2.9
2000	51	8.2 \pm 4.8	26	1.7
2001	34	5.1 \pm 2.1	8.7	0.9
2002	32	2.1 \pm 1.3	4.4	0.2
2004	45	13 \pm 16	64	0.5

Table 2.5-2
TSS Measurements in Foggy Island Bay During the Open-Water Season

Source: Rummel (1987), Dunton et. al (2005)

Year	n	TSS Mean \pm SD (mg/l)	TSS Maximum (mg/l)	TSS Minimum (mg/l)
1999	7	14 \pm 3	19	10
2000	5	10 \pm 2	12	8
2001	6	6.5 \pm 1.1	9	6
2004	7	14 \pm 19	51	0.5

Table 2.5-3
TSS Measurements in the ANIMIDA Study Area as a Function of Runoff or Wind Conditions

Source: Trefry et al. (2004a)

Season	Runoff or Wind Conditions	Total Suspended Sediment
Under Ice	Pre-river runoff	TSS typically 0.1 to 0.5 mg/l
	During river runoff (top 2 m of water under ice)	TSS ranges from 1 to 50 mg/l
Open-water	Winds calm to 5 kt (calm to 2.5 m/sec)	TSS typically 1 to 4 mg/l
	Winds 5 to 10 kt (2.5-5 m/sec)	TSS typically 3 to 8 mg/l
	Winds 10 to 20 kt (5-10 m/sec)	TSS typically 5 to 15 mg/l
	Winds >20 kt (>10 m/sec)	TSS 50 to >100 mg/l

**Table 2.5-4
Concentrations of Trace Metals in Sediments from Foggy Island Bay and the Coastal Beaufort Sea**

Sample		Silver Ag (µg/g)	Aluminum Al (%)	Arsenic As (µg/g)	Barium Ba (µg/g)	Beryllium Be (µg/g)	Cadmium Cd (µg/g)	Cobalt Co (µg/g)	Chromium Cr (µg/g)	Copper Cu (µg/g)	Iron Fe (%)
Foggy Island Bay ¹ (1999-2002) (n = 26)	Mean	0.09	3.7	11	397	1.0	0.18	6.8	55	16.5	21.
	Range	<0.01- 0.26	1.6-6.3	7-18	233-674	0.5-2.0	0.08-0.37	3.8- 11.4	28-86	7-31	1.0- 3.5
Foggy Island Bay ² (2004-2005) (n = 14)	Mean	0.10	4.3	11.4	470	0.84	0.20	8.8	67	21	2.4
	Range	0.04- 0.22	2.2-6.3	5-20	220-700	0.35-1.7	0.05-0.38	5-12	32-96	8-41	1.3- 3.4
Coastal Beaufort Sea ³ (n = 192)	Mean	0.11	4.2	10.2	430	1.2	0.24	8.2	61	20	2.2
	Range	0.03- 0.44	1.1-7.3	4.2-28	155-753	0.3-2.3	0.03-0.82	2.2- 18.6	13-104	3.6-50	0.7- 3.9
Coastal Beaufort Sea ⁴	Range	0.01- 0.13	-	10-43	-	-	0.06-0.43	3-18	15-125	6-83	0.8- 4.8
Sagavanirktok River Suspended Sediment ⁵ (1999-2004, n = 54)	Mean	-	6.0	11.5	685	-	-	-	-	32	3.4
	Range	-	4.0-8.8	8-15	541- 1110	-	-	-	-	29-39	2.6- 4.7
World Average Coastal/Marine ⁶	-	-	8.4	5	460	3	0.17	13	60	56	4.1
Effects Range Median ⁷ (ERM)	-	3.7	-	70	-	-	9.6	-	-	-	-
Effects Range Low ⁷ (ERL)	-	1.0	-	8.2	-	-	1.2	-	-	-	-

¹Brown et al. (2004)

²Brown et al. (2006)

³Trefry et al. (2003)

⁴Sweeney and Naidu (1989); Valette-Silver et al. (1999)

⁵Rember and Trefry (2004); Trefry et al. (2004, 2006)

⁶Salomons and Förstner (1984)

⁷Long et al. (1995)

Table 2.5-4 (Cont'd)
Concentrations of Trace Metals in Sediments from Foggy Island Bay and the Coastal Beaufort Sea

Sample		Mercury	Manganese	Nickel	Lead	Antimony	Thallium	Vanadium	Zinc	Total Organic Carbon	Silt + Clay
		Hg (µg/g)	Mn (µg/g)	Ni (µg/g)	Pb (µg/g)	Sb (µg/g)	Tl (µg/g)	V (µg/g)	Zn (µg/g)	TOC (%)	(%)
Foggy Island Bay ¹ (1999-2002) (n = 26)	Mean	0.035	272	23	9.5	0.48	0.38	86	66	0.75	47
	Range	0.010-0.074	167-532	8-39	5-18	0.3-1.0	0.2-0.8	37-153	30-108	0.1-3.4	2-100
Foggy Island Bay ² (2004-2005) (n = 14)	Mean	0.053	340	28	11.4	0.43	0.36	98	83	0.86	63
	Range	0.023-0.097	170-520	13-44	4-20	0.19-0.71	0.22-0.53	46-149	41-136	0.25-2.4	7-93
Coastal Beaufort Sea ³ (n = 192)	Mean	0.046	306	28	10.0	0.56	0.44	96	81	1.0	60
	Range	0.003-0.20	62-898	6-48	3.2-22.3	0.15-1.1	0.12-0.92	27-173	15-157	0.01-4.4	1-99
Coastal Beaufort Sea ⁴ (n = 10-150)	Range	0.04-0.15	105-650	7-75	11-25	0.8-3.1	-	31-240	28-170	-	2-100
Sagavanirktok River Suspended Sediment ⁵ (n = 54)	Mean	-	590	61	14	-	-	-	133	1.4	-
	Range	-	519-614	50-76	4-23	-	-	-	115-214	0.7-2.7	-
World Average Coastal/Marine ⁶	-	0.19	850	35	12	1.2	-	145	95	-	-
Effects Range Median ⁷ (ERM)	-	0.71	-	-	218	-	-	-	410	-	-
Effects Range Low ⁷ (ERL)	-	0.15	-	-	46.7	-	-	-	150	-	-

¹Brown et al. (2004)

²Brown et al. (2006)

³Trefry et al. (2003)

⁴Sweeney and Naidu (1989); Valette-Silver et al. (1999)

⁵Rember and Trefry (2004); Trefry et al. (2004, 2006)

⁶Salomons and Förstner (1984)

⁷Long et al. (1995)

Table 2.5-5
Concentrations of Dissolved Trace Metals in Foggy Island Bay and the Coastal Beaufort Sea

Sample		Arsenic	Barium	Cadmium	Chromium	Copper	Mercury	Lead	Zinc	Dissolved Organic Carbon	Salinity
		As (µg/l)	Ba (µg/l)	Cd (ng/l)	Cr (µg/l)	Cu (µg/l)	Hg (ng/l)	Pb (ng/l)	Zn (µg/l)	DOC (mg/l)	
Foggy Island Bay ¹ (2000-2004) (n = 15)	Mean	0.5	24	24	0.09	0.5	0.8	12	0.21	1.5	-
	Range	0.3-1.2	19-28	20-28	0.08-0.14	0.4-0.7	0.5-1	3-27	0.2-0.3	0.9-2.5	15-32
Coastal Beaufort Sea ¹ (2000-2004) (n = 118)	Mean	0.6	24	22	0.08	0.5	0.8	7	0.16	1.7	-
	Range	0.2-1.2	10-40	15-39	0.05-0.15	0.3-0.8	0.3-1.5	3-27	0.12-0.42	0.9-3.8	15-32
World Average Coastal/Marine ²	-	1.5	15	-	0.18	0.1	1	20	0.3	1-2	20-35
Sagavanirktok River ³	Range	0.05-0.13	25-35	-	0.08-0.17	0.2-1	0.3-1	15-50	0.1-0.4	2-9	<0.3
Typical World River Water ⁴	-	1	-	20	0.5	1.5	10	30	0.6	-	<0.2

Table 2.6-1
Summary of Hydrologic Data for the Sagavanirktok River
 Source: PND (2006b)

Sagavanirktok River Location	Length (miles)	Drainage Area (mi ²)	Period of Record	Peak Discharge	
				Date	Flow (cfs)
River Mouth (whole river)	180	5,750		8/27/92	300,000 ^b
USGS Gauge 15908000 near PS3	80	1,860	1982-06	8/16/02	48,300
USGS Gauge 15910000 at Sagwon	85	2,208	1969-79	--	62,000 ^c
West Channel Bridge ^a	170	5,310 ^a	1970-06	8/27/92	135,000 ^b

Notes:

a. Drainage area at the Endicott Road and Badami Pipeline crossings is approximately 5,310 square miles, contributing to flows distributed between the West and East channels.

b. Estimate by Veldman and Ferrell (2002)

c. Maxir ¹Trefry et al. (2004, 2006)

²Donat and Bruland (1995)

³Rember and Trefry (2004); Trefry et al. (2004, 2006)

⁴Salomons and Förstner (1984); Donat and Bruland (1995)

Table 2.6-2
Summary of Annual Breakup vs. Rainfall Floods at the
Sagavanirktok River West Channel Bridge

Source: PND (2006b)

Year	Breakup Flood Peaks				Rainfall Flood Peaks			
	Date	Stage (ft)	Flow (cfs)	Ref.	Date	Stage (ft)	Flow (cfs)	Ref.
1970			20,000	a				
1971			25,000	a				
1972			23,000	a				
1980	May 23	17.0	10,500	b				
1981	May 23	16.5	16,500	b				
1982	June 7	14.6	62,000	b	Aug 4	8.7	3,700	c
1983	June 1	16.1	39,000	b	July 4	9.1	4,800	d
1984	May 23	14.7	10,800	b	Aug 4	10.7	9,600	d
1985		12.0		b	July 3	10.5	8,900	e
1986	June 8	12.5	15,500	b, e	Aug 1	10.4	9,100	e
1987	May 27	17.5	15,300	b, e	Aug 11	9.8	11,800	e
1988	June 4	10.5	13,500	f	Aug 14	9.1	7,200	f
1989	June 1	15.1	87,500	b	June 25	10.3	12,500	f
1990	May 19	12.1	28,500	b, f	June 18	9.2	7,600	f
1992					Aug 27		135,000	h
1993	May 29	13.6		g				
1995	May 16	14.8		g				
1997	June 1	12.5		g				
1998	May 22	13.5		g				
1999	May 26	11.6		g				
2000	June 8	14.2		g				
2001	June 10	13.3		g				
2002	May 22	14.0		g				
2003	June 4	13.4		g, j				
2004	May 19	14.8		g				
2005	May 15	13.4		g				
2006	May 28	12.0	17,200	g, j				

All elevations are ARCO MLLW datum.

References (see PND, 2006b):

- a. Earl and Wright (1980)
- b. McDonald (1981-85, 1990a, 1990b)
- c. Gallaway and Britch (1983). Flow from 1985 rating curve
- d. Flow estimated from USGS PS3 data and 1985 rating curve
- e. EnviroSphere (1987, 1990, 1991). Flow from rating curve
- f. SAIC (1991, 1993a, 1993b)
- g. Bell and Associates (1993, 1995-2006)
- h. Veldman and Ferrell (2002). Estimated from post-flood investigation
- j. PND (2003, 2006b)

Table 2.6-3
Breakup Flood Frequency and Magnitude at the
Sagavanirktok River West Channel Bridge

Source: PND (2006b)

Average Recurrence Interval (yrs)	Annual Exceedance Probability	Flood Magnitude (cubic feet per second, cfs)			
		Estimated Flow	Expected Probability	5% Confidence Limit (lower)	95% Confidence Limit (upper)
2	50%	22,000	22,000	16,000	29,000
10	10%	50,000	55,000	37,000	84,000
50	2%	87,000	110,000	58,000	182,000
100	1%	107,000	148,000	68,000	243,000
200	0.5%	130,000	198,000	79,000	319,000

Table 2.7-1
Abundance and Biomass of Epilithic Flora and Fauna from 0.05-m² Scrapes Collected off
Rocks in the Boulder Patch, 1979 and 1980

Source: Dunton and Schonberg (2000)

TAXA	Number/m ²	Standard Deviation	Grams/m ²	Standard Deviation
PROTOZOA				
Sarcodina				
Foraminifera				
<i>Cornuspira</i> sp.	16.67		0.030	
<i>Cornuspira foliacea</i>	6.67		0.059	0.058
<i>Cornuspira involvens</i>	6.67		0.014	0.015
<i>Dentalina</i> sp.	1.00		0.001	
<i>Elphidiella</i> sp.	16.61	15.72	0.009	0.006
<i>Elphidiella arctica</i>	56.67	32.99	0.009	0.007
<i>Guttulina</i> sp.	2.17	1.65	0.002	0.002
<i>Lagena</i> sp.	4.44		0.002	
Miliolidae	549.15	488.03	0.014	0.015
<i>Miliolinella</i> sp.	467.47	545.40	0.018	0.025
Nonionidae	8370.63	10082.80	0.470	0.361
<i>Triloculina</i> sp.	4408.00		0.212	
Unknown forms	1104.27	1716.46	0.061	0.100
BACILLARIOPHYTA				
<i>Amphipleura</i> sp.			2.378	5.291
Unknown diatoms			0.010	0.007
RHODOPHYTA				
<i>Lithothamnium</i> sp.			0.724	0.289
<i>Neodilsea integra</i>			30.627	23.018
<i>Odonthalia dentata</i>			2.994	4.894
<i>Phycodryis rubens</i>			43.129	45.228
<i>Phyllophora truncata</i>			29.538	13.764
<i>Rhodomela confervoides</i>			4.091	3.715
Unknown algae			0.311	0.473
PHAEOPHYTA				
<i>Laminaria</i> sp.			7.512	4.807
<i>Laminaria saccharina</i>			42.054	22.212
<i>Laminaria solidungula</i>			6.496	7.621
PORIFERA				
<i>Choanites lutkenii</i>			7.994	6.931
<i>Halichondria panicea</i>			1.436	2.299
<i>Haliclona rufescens</i>			2.500	3.452
<i>Leucandra</i> sp.			0.198	0.242
<i>Phakellia cribosa</i>			11.604	8.491
Unknown porifera			0.215	0.269
CNIDARIA				
Hydrozoa				
<i>Abietinaria</i> sp.			0.007	
<i>Calicella</i> sp.			0.003	

Table 2.7-1 (Cont'd)
Abundance and Biomass of Epilithic Flora and Fauna from 0.05 m² Scrapes Collected off
Rocks in the Boulder Patch, 1979 and 1980

Source: Dunton and Schonberg (2000)

TAXA	Number/m ²	Standard Deviation	Grams/m ²	Standard Deviation
<i>Calicella syringa</i>			0.058	0.113
<i>Campanulina quadrata</i>			0.087	
Campanulinidae			0.002	
<i>Corymorpha</i> sp.			0.002	
<i>Eudendrium</i> sp.			0.003	0.002
<i>Lafoeina maxima</i>			0.371	0.772
<i>Obelia</i> sp.			0.009	0.010
<i>Rathkea</i> sp.			0.017	
<i>Sertularia cupressoides</i>			7.526	3.915
<i>Sertularia</i> sp. cf. <i>albimaris</i>			1.718	2.369
Unknown hydrozoa			0.032	0.046
Anthozoa				
<i>Gersemia</i> sp.			0.003	0.000
<i>Gersemia fruticosa</i>			0.297	
<i>Gersemia rubiformis</i>			2.359	1.805
Unknown anenome	6.74	4.04	0.031	0.052
RHYNCOCOELA	46.02	27.86	0.048	0.041
NEMATODA	77.73	79.03	0.015	0.013
ANNELIDA				
Polychaeta				
<i>Allia</i> sp.	3.33		0.003	
<i>Ampharete</i> sp.	3.33		0.003	
<i>Ampharete acutifrons</i>	3.33		0.003	
Ampharetidae	3.33		0.003	
<i>Anaitides groenlandicus</i>	2.22		0.002	
<i>Antinoella sarsi</i>	3.33		0.010	0.009
<i>Autolytus</i> sp.	10.00		0.010	
<i>Brada villosa</i>	8.36	6.63	0.026	0.051
<i>Capitella capitata</i>	27.79	20.79	0.026	0.028
Capitellidae	3.33		0.003	
<i>Chaetozone setosa</i>	2.17	1.65	0.007	0.009
<i>Chone</i> sp.	10.56	0.79	0.003	0.001
Cirratulidae	6.67		0.009	
<i>Cirratulus cirratus</i>	121.32	51.41	2.538	1.686
<i>Eunoe nodosa</i>	161.11	224.70	2.601	3.631
<i>Exogone naidina</i>	445.75	262.50	0.046	0.031
<i>Exogone dispar</i>	17.22	8.64	0.006	0.002
<i>Flabelligera</i> sp.	4.07	2.31	0.006	0.004
<i>Flabelligera affinis</i>	3.54	2.38	0.029	0.054
<i>Harmothoe</i> sp.	3.33		0.383	0.537
<i>Harmothoe imbricata</i>	3.33		1.527	
Hesionidae	5.47	2.88	0.005	0.002

Table 2.7-1 (Cont'd)
Abundance and Biomass of Epilithic Flora and Fauna from 0.05 m² Scrapes Collected off
Rocks in the Boulder Patch, 1979 and 1980

Source: Dunton and Schonberg (2000)

TAXA	Number/m ²	Standard Deviation	Grams/m ²	Standard Deviation
<i>Lumbrineris fragilis</i>	9.30	4.52	0.010	0.005
<i>Nereimyra aphroditoides</i>	3.22	0.74	0.003	0.001
<i>Nereis</i> sp.	6.67	4.71	0.005	0.002
<i>Nereis zonata</i>	19.97	12.20	0.641	1.181
<i>Nicolea zostericola</i>	14.57	12.06	0.117	0.160
<i>Paramphitrite tetrabanchia</i>	3.33		0.480	
<i>Pholoe minuta</i>	4.22	2.60	0.011	0.008
<i>Pista cristata</i>	5.00	2.36	0.013	0.014
<i>Polycirrus</i> sp.	3.33		0.003	
<i>Polycirrus medusa</i>	20.56	24.36	0.239	0.237
<i>Polydora</i> sp.	1.00		0.001	
<i>Polydora caulleryi</i>	10.59	12.00	0.006	0.002
<i>Prionospio cirrifera</i>	3.33		0.003	0.000
<i>Pygospio elegans</i>	19.67	37.47	0.005	0.005
<i>Schistomeringos</i> sp.	5.67	3.30	0.008	0.006
<i>Sphaerodorum</i> sp.	3.33		0.003	
<i>Sphaerosyllis erinaceus</i>	2.96	0.64	0.003	0.001
<i>Spinther</i> sp.	6.67		0.003	
<i>Spinther miniaceus</i>	4.00		0.004	
<i>Spinther</i> sp. cf. <i>oniscoides</i>	3.33		0.040	
<i>Spio filicornis</i>	21.67	33.23	0.006	0.006
<i>Spirorbis</i> sp.	633.33	553.25	0.076	0.059
<i>Spirorbis granulatus</i>	140.46	146.73	0.148	0.206
<i>Spirorbis spirillum</i>	88.49	110.85	0.013	0.008
Syllidae	20.00		0.003	
Terebellidae	24.17	16.88	0.309	0.304
<i>Terebellides stroemi</i>	19.97	13.31	0.022	0.025
Unknown polychaetes			0.588	0.859
MOLLUSCA				
Gastropoda				
Aplacophora				
<i>Amphineura</i> sp.	3.83	4.01	0.002	0.002
Polyplacophora				
<i>Amicula</i> sp.	6.67		0.820	
<i>Amicula vestita</i>	16.84	14.74	11.776	12.268
Prosobranchia				
<i>Amauropsis purpurea</i>	3.33		0.003	
<i>Lacuna</i> sp.	3.33		0.007	
<i>Margarites</i> sp.	4.58	2.70	0.082	0.152
<i>Margarites costalis</i>	13.33		0.180	
<i>Oenopota</i> sp.	5.50	6.36	0.044	0.046
<i>Plicifusus</i> sp.	10.00		0.100	

Table 2.7-1 (Cont'd)
Abundance and Biomass of Epilithic Flora and Fauna from 0.05 m² Scrapes Collected off
Rocks in the Boulder Patch, 1979 and 1980

Source: Dunton and Schonberg (2000)

TAXA	Number/m ²	Standard Deviation	Grams/m ²	Standard Deviation
<i>Polinices</i> sp.	6.67		0.003	
<i>Solariella</i> sp.	5.78	1.54	0.010	0.011
<i>Solariella varicosa</i>	2.78	0.79	0.004	0.003
Unknown gastropod	16.81	10.93	0.068	0.033
Bivalvia				
<i>Astarte</i> sp.	6.67	4.71	0.028	0.035
<i>Boreacola vadosa</i>	4.44		0.002	
<i>Musculus</i> sp.	148.35	104.08	0.036	0.024
<i>Musculus discors</i>	223.89	47.93	5.858	7.926
<i>Macoma calcarea</i>	3.33		0.060	
<i>Portlandia arctica</i>	3.33		0.013	
Unknown bivalve	10.50	13.44	0.004	0.004
Opisthobranchia				
<i>Retusa obtusa</i>	10.00		0.003	
PRIAPULIDA				
<i>Priapulus caudatus</i>	3.33		0.543	
ARTHROPODA				
Halacaridae	50.69	50.03	0.012	0.006
Pycnogonidae				
<i>Nymphon brevitarse</i>	2.22		0.002	
CRUSTACEA				
Copepoda				
Cyclopoida	34.10	50.36	0.016	0.024
Harpacticoida	2.17	1.65	0.002	0.002
Cumacea				
<i>Brachydiastylis resima</i>	8.37	9.23	0.010	0.011
<i>Diastylis</i> sp.	3.33		0.003	
<i>Leucon</i> sp.	7.78	7.86	0.004	0.003
<i>Leucon nasicooides</i>	4.82	1.70	0.004	0.002
Ostracoda	5.96	3.79	0.004	0.002
Cirripedia				
<i>Balanus</i> sp.	4.00		0.004	
Unknown cirripedia	4.44		0.002	
Tanaidacea				
<i>Leptognathia gracilis</i>	5.00	2.36	0.003	0.000
Isopoda				
<i>Munna</i> sp.	10.54	7.54	0.005	0.002
<i>Pleurogonium</i> sp.	3.31	2.44	0.002	0.001
Unknown isopod	5.63	3.02	0.003	0.001
Amphipoda				
<i>Acanthonotozoma</i> sp. cf. <i>serratum</i>	8.11	7.93	0.037	0.019
<i>Anonyx nugax</i>	19.00	24.64	0.119	0.180

Table 2.7-1 (Cont'd)
Abundance and Biomass of Epilithic Flora and Fauna from 0.05 m² Scrapes Collected off
Rocks in the Boulder Patch, 1979 and 1980

Source: Dunton and Schonberg (2000)

TAXA	Number/m ²	Standard Deviation	Grams/m ²	Standard Deviation
<i>Apherusa</i> sp.	41.11	21.69	0.018	0.017
<i>Apherusa megalops</i>	69.28	142.54	0.037	0.071
<i>Atylus</i> sp.	3.33		0.003	
<i>Atylus carinatus</i>	3.67	0.47	0.006	0.003
<i>Boeckosimus plautus</i>	28.20	44.31	0.175	0.304
Calliopiidae	5.00		0.005	
<i>Dulichia</i> sp.	2.22		0.002	
<i>Dulichia spinosa</i>	6.67		0.004	
<i>Gammaracanthus loricatus</i>	3.67	0.47	2.244	0.600
<i>Gammarus setosa</i>	2.22		0.007	
<i>Halirages</i> sp.	130.46	236.77	0.056	0.058
<i>Halirages nilssoni</i>	5.30	2.44	0.032	0.027
<i>Hyperoche medusarum</i>	4.44	3.14	0.021	0.004
<i>Metopa boeckii</i>	6.67		0.003	
<i>Metopella carinata</i>	8.02	5.93	0.004	0.003
<i>Monoculodes</i> sp.	14.33	10.99	0.011	0.012
<i>Monoculodes kroyeri</i>	15.19	12.88	0.006	0.004
<i>Monoculodes longirostris</i>	9.44	8.64	0.032	0.016
<i>Monoculodes packardii</i>	6.58	2.93	0.004	0.001
<i>Monoculodes schneideri</i>	16.67		0.003	
<i>Monoculodes tuberculatus</i>	60.26	104.92	0.049	0.063
Oedicerotidae	3.31	2.44	0.002	0.001
<i>Onisimus litoralis</i>	4.00		0.076	
<i>Orchomene minuta</i>	2.78	0.79	0.018	0.022
<i>Paroediceros propinquus</i>	6.67	4.71	0.008	0.007
<i>Pleusymtes</i> sp.	39.67	5.19	0.081	0.013
<i>Pleusymtes karianus</i>	39.93	48.97	0.041	0.032
<i>Pontoporeia femorata</i>	3.33		0.017	
<i>Rhachotropis</i> sp.	3.67	0.47	0.004	0.000
<i>Rhachotropis inflata</i>	10.00		0.013	
<i>Stenula</i> sp.	14.42	23.70	0.006	0.008
Stenothoidae	3.17	0.24	0.002	0.002
<i>Weyprechtia pinguis</i>	7.17	5.40	0.022	0.019
Unknown amphipod	12.47	11.22	0.006	0.003
BRYOZOA				
<i>Alcyonidium</i> sp.			0.789	0.737
<i>Callopora lineata</i>			1.882	1.164
<i>Crisia</i> sp.			0.006	0.004
Cyclostomata			0.105	0.215
<i>Dendrobeania</i> sp.			0.733	1.252
<i>Eucratea loricata</i>			3.284	3.304
<i>Flustra</i> sp.			0.020	

Table 2.7-1 (Cont'd)
Abundance and Biomass of Epilithic Flora and Fauna from 0.05 m² Scrapes Collected off
Rocks in the Boulder Patch, 1979 and 1980

Source: Dunton and Schonberg (2000)

TAXA	Number/m ²	Standard Deviation	Grams/m ²	Standard Deviation
<i>Flustrella</i> sp.			0.310	
<i>Hippothoa hyalina</i>			4.637	2.242
Unknown bryozoan			1.989	2.626
ECHINODERMATA				
Asteroidea	14.89	6.98	0.169	0.182
UROCHORDATA				
Ascidiacea				
<i>Chelyosoma macleayanum</i>	3.24	2.80	1.262	1.409
<i>Mogula</i> sp. cf. <i>siphonalis</i>	2.78	0.79	2.376	1.732
<i>Mogula griffithsiii</i>	2.17	1.65	0.136	0.152
Styelidae	3.33		0.060	
<i>Styela rustica</i>	2.22		0.016	
Unknown ascidean	3.33		0.626	0.870
CHAETOGNATHA				
<i>Sagitta elegans</i>	17.11	7.23	0.054	0.043
CHORDATA				
Osteichthyes				
<i>Liparis</i> sp.	2.22		0.231	
<i>Liparis herschelinus</i>	2.22		0.389	
<i>Myoxocephalus scorpioides</i>	3.33		23.837	
Stichaeidae	2.22		0.262	
TOTALS	158 Taxa	18,441	15,671	283
			283	210

Table 2.8-1
Fish Species Found in the Marine Coastal and Freshwater Coastal Regions of the Central Alaskan Beaufort Sea

Type	Common Name	Scientific Name	Inupiat Name
Anadromous	Arctic cisco	<i>Coregonus autumnalis</i>	Qaaktaq
	Bering cisco	<i>Coregonus laurettae</i>	Tiipuuq
	Rainbow smelt	<i>Osmerus mordax</i>	Ilhaugniq
	Chum salmon	<i>Oncorhynchus keta</i>	Iqalugruaq
	Pink Salmon	<i>Oncorhynchus gorbuscha</i>	Amaqtuuq
Amphidromous*	Broad whitefish	<i>Coregonus nasus</i>	Aanaakliq
	Least cisco	<i>Coregonus sardinella</i>	Iqalusaaq
	Humpback whitefish	<i>Coregonus pidschian</i>	Piuktuuq
	Dolly varden	<i>Salvelinus malma</i>	Iqalukpik
Freshwater	Arctic grayling	<i>Thymallus arcticus</i>	Sulukpaugaq
	Lake trout	<i>Salvelinus namaycush</i>	Iqaluaqpuk
	Round whitefish	<i>Prosopium cylindraceum</i>	Savigunnaq
	Northern pike	<i>Esox lucius</i>	Siulik
	Burbot	<i>Lota lota</i>	Tittaaliq
	Alaska blackfish	<i>Dallia pectoralis</i>	Iluuginiq
	Longnose sucker	<i>Catostomus catostomus</i>	Milugiaq
	Ninespine stickleback	<i>Pungitius pungitius</i>	Kaklalisauraq
	Arctic lamprey	<i>Lampetra Japonica</i>	Nimigiaq
	Threespine stickleback	<i>Gasterosteus aculatus</i>	
	Slimy sculpin	<i>Cottus cognatus</i>	
Nearshore Marine	Fourhorn Sculpin	<i>Myoxocephalus quadricornis</i>	Kanayuuq
	Arctic flounder	<i>liopsetta glacialis</i>	Puyyagiaq
	Arctic cod	<i>Boreogadus saida</i>	Iqalugaq
	Saffron cod	<i>Eleginus gracilis</i>	Uugaq
	Capelin	<i>Mallotus villosus</i>	Panmigriq
	Pacific herring	<i>Clupea harengus</i>	Uqsruqtuuq
	Pacific sandlance	<i>Ammodytes hexapterus</i>	
	Kelp Snailfish	<i>Liparis tunicatus</i>	

* Have some components of their populations that remain in freshwater year round

**Table 2.10-1
Common, Scientific and Inupiaq Names and Status of Bird Species
Occurring in the Liberty Area**

Common Name	Scientific Name ^a	Inupiaq Name ^b	Status ^c	Occurrence ^d
LOONS (MALGITCH) AND GREBES				
Red-throated loon	<i>Gavia stellata</i>	Quqsruaq		C/B
Pacific loon	<i>Gavia pacifica</i>	Malgi	--	C/B
Yellow-billed loon	<i>Gavia adamsii</i>	Tuutlik	BCC	U/B
WATERFOWL (TINMIAGRUICH) AND WATERBIRDS				
Greater white-fronted goose	<i>Anser albifrons</i>	Kigiyuk	--	C/B
Snow goose	<i>Chen caerulescens</i>	Iqsrugutitik	--	U/B, C/M
Canada goose	<i>Branta canadensis</i>	Iqsrugutilik	--	C/B
Brant	<i>Branta bernicla</i>	Niglignaq		C/B
Tundra swan	<i>Cygnus columbianus</i>	Qugruk	--	C/B
King eider	<i>Somateria spectabilis</i>	Qinalik		C/B
Common eider	<i>Somateria mollissima</i>	Amaulik	--	C/B
Long-tailed duck	<i>Clangula hyemalis</i>	Aahaaliq		C/B
Scoters	<i>Melanitta spp.</i>	Tuungaagruk		U/B, U/S
SHOREBIRDS				
Semipalmated sandpiper	<i>Calidris pusilla</i>	Livilivillakpak	--	C/B
Pectoral sandpiper	<i>Calidris melanotos</i>	Puviaqtuuq	--	C/B
Red-necked phalarope	<i>Phalaropus lobatus</i>	Qayyugun	--	C/B
Red phalarope	<i>Phalaropus fulicarius</i>	Quksruaq	--	C/B
Dunlin	<i>Calidris alpina</i>	Siyukpaligauraq	BCC	C/B
RAPTORS AND OWLS				
Peregrine falcon	<i>Falco peregrinus</i>	Kirgavik	BCC	U/M
Gyrfalcon	<i>Falco rusticolus</i>	Aatqarruaq	--	U/B
Rough-legged hawk	<i>Buteo lagopus</i>	Qilqik	--	U/B
Golden eagle	<i>Aquila chrysaetos</i>	Tinmiaqpak	--	U/B
Short-eared owl	<i>Asio flammeus</i>	Nipaituktaq	--	C/B
Snowy owl	<i>Bubo scandiacus</i>	Ukpik	--	C/B
SEABIRDS				
Jaegers	<i>Stercorarius spp.</i>	Migiaqsaayuk, isunnaq	--	C/B
Glaucous gull	<i>Larus hyperboreus</i>	Nauqavasrugruk	--	C/B
Sabine's gull	<i>Xema sabini</i>	Aqargiyiaq	--	U/B
Arctic tern	<i>Sterna paradisaea</i>	Mitqutaiiaq	BCC	C/B
PASSERINES				
Lapland longspur	<i>Calcarius lapponicus</i>	Qupatuk, putukiituk	--	C/B
Snow bunting	<i>Plectrophenax nivalis</i>	Amautligaq	--	U/B
Common raven	<i>Corvus corax</i>	Tulugaq	--	C/B

Notes:

^a Scientific names from the American Ornithologist Union Check-list Area (<http://www.aou.org/aou/birdlist.html>).

^b Inupiaq names in Birds of Central Beringia, a taxonomic List in English, Russian, Inupiaq, Siberian Yupik, and Latin (<http://www.nps.gov/akso/beringia/berinotesnov97.htm>).

^c BCC = USFWS Birds of Conservation Concern, US Fish and Wildlife Service Status Region 7 (Alaska Region) (US Fish and Wildlife Service, 2002).

^d Occurrence information: C = Common, U = Uncommon, B = Breeding, M = Migration, S = Summer

**Table 2.10-2
Occurrence, Estimated Numbers and Trends for Common Birds in the Liberty Area**

Common Name	Occurrence	Estimated Numbers			
		Arctic Coastal Plain 1986-2005 (mean and trend) ^{a,b,c,d}	Arctic Coastal Plain 2005 ^{a,b,c}	Beaufort Sea Coast (Colville to Canning Rivers) ^e	Liberty Area
LOONS AND WATERFOWL					
Red-throated loon	early June-late Sept.	3,145 ↑↓	3,038 ± 555	124	8 ^e
Pacific loon	late May-late Sept.	26,783 ↔	24,955 ± 1,541	278	8 ± 3 ^g (13 ^e)
Yellow-billed loon	mid May-mid Sept.	2,833 ↔	1,871 ± 493	15	2 ^e
Greater white-fronted goose	mid May-mid Sept.	124,465 ↑	129,403 ± 14,795	935	1,098 ^e
Snow goose	mid May-mid Sept.	3,124 ↑	14,695 ± 7,891	3,816 ^f	1,494 ^f
Canada goose	early June-late July	18,330 ↔	21,200 ± 6,041	491	1,038 ^e
Brant	late May-early Sept.	9,980 ↑	15,609 ± 9,123	982	251 ^e
Tundra swan	mid May-early Oct.	9,961 ↑	12,002 ± 1,664	20	103 ^e
Northern pintail	late May-mid Sept.	224,011 ↔	156,754 ± 24,051	123	220 ^e
King eider	late May-Oct.	13,084 ↑	14,934 ± 1,232	32	13 ± 11 ^g
Common eider	late May-Oct.	2,537	2,581	3,275	36 ± 7 ^g
Long-tailed duck	late May-Oct.	107,923 ↓	84,241 ± 13,529	48,433	236 ± 35 ^g (1,136 ^e)
Scoters	late May-early Sept.	10,437 ↑	7,733 ± 3,373	1,388	19 ± 10 ^g (20 ^e)
SHOREBIRDS					
Semipalmated sandpiper	late May- Oct.	-	-	<30,000 ↓	23.1 ^g km ²
Pectoral sandpiper	late May-Oct.	-	-	<30,000 ↔	26.9 ^g km ²
Red-necked phalarope	late May-Oct.	-	-	<30,000 ↓	12.3 ^g km ²
Red phalarope	late May-Oct.	-	-	<30,000 ↓	8.7 ^g km ²
Dunlin	late May-Oct.	-	-	<30,000 ↓	9.4 ^g km ²
Small shorebirds	late May-Oct.	43,236 ↓	26,653 ± 2,277		
SEABIRDS					
Jaegers	early May-mid Sept.	6,903 ↓	5,804 ± 555	6	-
Glaucous gull	early May-Nov.	17,112 ↔	18,955 ± 3,514	1,915	59 ± 13 ^g (604 ^e)
Sabine's gull	early May-early Sept.	11,576 ↔	11,657 ± 1,541	81	-
Arctic tern	early May-early Sept.	23,505 ↑	30,688 ± 2,774	100	5 ^e
RAPTORS AND OWLS					
Rough-legged hawk ^d	late April-early Oct.	-	-	-	2 ^e
Golden eagle	April-early Sept.	428	48	-	1 ^e
Short-eared owl	mid-May-mid Sept.	83 ↔	35 ± 26	-	-
Snowy owl	Year round	747 ↔	191 ± 76	-	4 ^e

Table 2.10-2 (Cont'd)
Occurrence, Estimated Numbers and Trends for Common Birds in the Liberty Area

Common Name	Occurrence	Estimated Numbers			Liberty Area
		Arctic Coastal Plain 1986-2005 (mean and trend) ^{a,b,c,d}	Arctic Coastal Plain 2005 ^{a,b,c}	Beaufort Sea Coast (Colville to Canning Rivers) ^e	
PASSERINES					
Lapland longspur					63.4 ^g km ²
Common raven	Year round	65 ↔	25 ± 21	-	2 ^e

Notes:

- dash indicates no population estimate or number of birds recorded was available.

^a Population numbers are minimal estimates, and annually variable with standard errors ranging from 5 percent to over 75 percent of the estimated population.

^b Population estimates for all nesting waterfowl and loons (except king eiders) with visibility correction factors applied to duck species are long-term averages from 1986-2005 from Mallek, Platte, and Stehn (2006). Population estimates for colonial nesting species, snow goose and brant, may not reflect true population size. Estimates for common eiders from Dau and Larned (2005)

^c Population estimates for pre-nesting king eiders, raptors and owls, and common raven are long-term averages from 1992-2004 from Larned et al. (2005). Visibility correction factors not applied, averages are minimum population estimates used to track population trend.

^d Population trend symbols: ↑ = increasing, ↓ = decreasing, ↔ = stable with 90% Confidence from Mallek et al. (2006) and Larned et al. (2005), Alaska Shorebird Group (2004).

^e Average on-transect counts from aerial coastal surveys during July and August 1999 to 2002 from the Colville River to the Canning River (Noel, ODoherty, and Johnson, 2003). Population estimates for shorebirds based on Colville River Delta and Simpson Lagoon estimates (Appendix 7; Alaska Shorebird Group, 2004).

^f Estimated based on July 2006 broodrearing survey (unpublished data, LGL Alaska Research Associates, Inc., 2006) and number of total nests (2 adults/nest) on Howe Island during 2006 (Rodrigues, McKendrick, and Reiser, 2006).

^g Maximum nearshore numbers Prudhoe Bay to Tigvariak Island (<10 m depth = within barrier islands) during June, July and August 1999 and 2000 (Fisher and Larned, 2004). Shorebird and Lapland Longspur density based on mean breeding season bird densities in 1994 at Prudhoe Bay, Kaleroshilik and Badami study sites (Troy Ecological Research Associates, 1995).

**Table 2.11-1
Terrestrial Mammal Species Known or Suspected to Occur in the Liberty Area**

Common Name	Scientific Name	Inupiaq Name	Abundance
LARGE MAMMALS			
Lynx	<i>Lynx canadensis</i>	Niutuiyiq	rare
Caribou	<i>Rangifer tarandus</i>	Tuttu	abundant
Muskox	<i>Ovibos moschatus</i>	Umifmak	common
Moose	<i>Alces alces</i>	Tuttuvak	uncommon
Grizzly (brown) bear	<i>Ursus arctos</i>	Akjaq	common
Gray wolf	<i>Canis lupus</i>	Amabuq	rare
Wolverine	<i>Gulo gulo</i>	Qavvik	uncommon
Arctic fox	<i>Alopex lagopus</i>	Tibiganniaq	common
Red fox	<i>Vulpes vulpes</i>	Kayuqtuq	uncommon
SMALL MAMMALS			
Arctic ground squirrel	<i>Spermophilus parryii</i>	Siksrik, sigrik	abundant
Ermine (short-tailed weasel)	<i>Mustela erminea</i>	Itibiaq	common
Least weasel	<i>Mustela nivalis</i>	Naulayuq	uncommon
Tundra hare	<i>Lepus othus</i>	Ukallisugruk	rare
Snowshoe hare	<i>Lepus americanus</i>	Ukalliatchiaq	rare
Brown lemming	<i>Lemmus trimucronatus</i>	Aviffapiaq	uncommon
Collared lemming	<i>Dicrostonyx groenlandicus</i>	Qixafmiutaq	common
Northern red-backed vole	<i>Clethrionomys rutilus</i>	Aviffaq	rare?
Tundra vole	<i>Microtus oeconomus</i>	Aviffaq	uncommon
Singing vole	<i>Microtus miurus</i>	Aviffaq	common
Barrenground shrew	<i>Sorex ugyunak</i>	Ugrugnaq	common?
Tundra shrew	<i>Sorex tundrensis</i>	Ugrugnaq	uncommon?
OTHER MAMMALS			
Mink	<i>Mustela vison</i>	Itibiaqpak	rare
River otter	<i>Lontra canadensis</i>	Pamiuqtuuq	rare
Porcupine	<i>Erethizon dorsatum</i>	Qifabluk	rare
Coyote	<i>Canis latrans</i>	Amabuuraq	rare

Source: Modified from Table 3.3.4-1 in USDOL, Bureau of Land Management (2004)

Notes: ? indicates that occurrence in the Liberty area is uncertain; and species designated as rare are at the limit of their range

**Table 2.15-1
Demographic and General Resource Information for North Slope Borough Villages**

Attribute	Barrow	Anaktuvuk Pass	Atkasuk	Kaktovik	Nuiqsut	Point Hope	Point Lay	Wainwright
Land area (sq. miles)	18.4	4.6	4.8	0.8	9.2	6.3	30.5	17.6
Water area (sq. miles)	2.9	0.1	0.1	0.2	0.0	0.1	4.0	24.9
Total population	4,581	282	228	293	433	757	247	546
Percent American Indian and Alaska Native	64.0	88.3	94.3	84.0	89.1	90.6	88.3	90.3
Percent male	51.7	51.8	53.4	52.6	59.6	55.1	57.5	53.3
Percent female	48.3	48.2	46.9	47.4	40.4	44.9	42.5	46.7
Median age (years)	28.8	25.7	26.3	32.1	23.8	21.8	20.8	24.5
Percent 65 years and over	3.4	5	5.7	7.5	4.4	5.2	2.8	6.8
Median 1999 household income (dollars)	\$67,097	\$52,500	\$66,607	\$55,625	\$48,036	\$63,125	\$68,750	\$54,722
Percent Families below poverty level 1999	7.7	3.2	25	9.9	3.2	13.9	11.4	8.5
Year incorporated	1959	1959	1982	1971	1975	1966	Unincorporated	1962
Housing units (total)	1,620	106	59	90	100	213	68	179
Percent lacking complete plumbing facilities	11.1	17.6	80.4	67	85.1	56.3	82.8	51.7
Percent lacking complete kitchen facilities	9.3	17.6	0	14.8	18.4	28.4	46.9	19.5
Percent without telephone service	3.7	0	25.5	18.2	17.5	23	31.3	18.1

Table 2.15-1 (Cont'd)
Demographic and General Resource Information for North Slope Borough Villages

Attribute	Barrow	Anaktuvuk Pass	Atqasuk	Kaktovik	Nuiqsut	Point Hope	Point Lay	Wainwright
Health Services (Primary and Alternate)	Samuel Simmonds Memorial Hospital; Borough Volunteer Fire Dept./EMS/Search & Rescue/Medevac	Anaktuvuk Pass Health Clinic; Anaktuvuk Pass Volunteer Fire Dept.	Atqasuk Health Clinic; Atqasuk Volunteer Fire Dept.	Kaktovik Health clinic; Kaktovik Volunteer Fire Dept.	Nuiqsut health clinic; Nuiqsut Volunteer Fire Dept.	Point Hope Health Clinic; Point Hope Volunteer Fire Dept.	Point Lay Clinic; Point Lay Volunteer Fire Dept.	Wainwright Health Clinic; Wainwright Volunteer Fire Dept.
Transportation	Air service; seasonal marine service	Air service; no roads, Cat-trains haul cargo from TAPS haul road in winter.	Air service; seasonal land access, cat-trains haul cargo from Barrow in winter	Air service; seasonal marine access	Air service and access to Dalton Highway 4 months/yr.	Air service; seasonal marine and land access,	Air service; seasonal marine and land access	Air service; seasonal marine and land access
Schools	Separate elementary, middle, and high schools, and Ilisagvik College	Nunamiut School: pre-school through grade 12, vocational and adult education	Meade River School: pre-school through grade 12, and adult education	Harold Kaveolook School: pre-school through grade 12, and adult education	The Trapper School: pre-school through grade 12, and adult education	The Tikigaq School: pre-school through grade 12, and adult education	The Cully School: pre-school through grade 12, and adult education	The Alak School: pre-school through grade 12, and adult education
Communications	phones, mail, cable TV and Internet, 3 TV and 3 radio stations	phone, mail, public radio, and cable television	Phone, mail, public radio, and cable television	phone, mail, public radio, cable TV and Internet	phone, mail, public radio, cable TV and Internet	phone, mail, public radio, cable TV and DSL internet services	phone, mail public radio and cable TV	phone, mail, public radio and cable TV
Alcohol	Sale banned, but importation or possession permitted	Sale and possession banned	Sale and possession banned	Sale and possession banned	Sale and possession banned	Sale and possession banned	Sale and possession banned	Sale and possession banned

Alaska Community Database, available electronically at: http://www.dced.state.ak.us/dca/commdb/CF_COMDB.htm;
The North Slope Borough Website, available electronically at: <http://www.north-slope.org/nsb/HomeruleBrochure/BrwInfo.htm>;
Various local Alaskan websites:
<http://www.kingeider.net/king55.html> ;
<http://www.welcometoalaska.com/Communities/anaktuvukpass.htm>;
<http://explorenorth.com/library/communities/alaska/bl-commindex.htm> ;
<http://www.kaktovik.com/>
<http://www.nbsbd.org/> (NSB school information)
<http://www.prudhoebay.com/>
http://www.prudhoebay.com/communities_Nuiqsut.htm

**Table 2.15-2
Annual Cycle of Subsistence Activities for Nuiqsut**

	Winter					Spring		Summer			Fall	
	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
Fish	High	High	Low	Low	Low	Low	High	High	High	High	High	High
Birds/Eggs	High	High	High	High	High	High	High	High	High	High	High	High
Berries	High	High	High	High	High	High	High	High	High	High	High	High
Moose	High	High	High	High	High	High	High	High	High	High	High	High
Caribou	High	High	High	High	High	High	High	High	High	High	High	High
Furbearers	High	High	High	High	High	High	High	High	High	High	High	High
Polar Bear	High	High	High	High	High	High	High	High	High	High	High	High
Seals	High	High	High	High	High	High	High	High	High	High	High	High
Whales	High	High	High	High	High	High	High	High	High	High	High	High

	No to Very Low Levels of Subsistence Activity
	Low to Medium Levels of Subsistence Activity
	High Levels of Subsistence Activity

Sources: IAI (1990), RFSUNY (1984)
As interpreted by Stephen R. Braund & Associates

**Table 2.15-3
Nuiqsut Subsistence Harvests and Subsistence Activities for 1985, 1992, and 1993**

Study Year	Resource	Percentage of Households					Estimated Harvest				
		Use	Try to Harvest	Harvest	Receive	Give	Total Number	Total Pounds	Mean HH Pounds	Per Capita Pounds	% of Total Harvest
1985	All Resources	100	98	98	100	95		160,036	160,035	399	100.0%
	Fish	100	93	93	78	83	68,153	68,153	70,609	176	44.1%
	Salmon	60	43	40	23	23	441	441	1,366	3	0.9%
	Non-Salmon	100	93	93	75	83	67,712	67,712	69,243	173	43.3%
	Land Mammals	100	95	93	70	85	1,224	1,224	67,866	169	42.4%
	Large Land	98	90	90	70	80	536	536	67,621	169	42.3%
	Small Land	65	63	58	13	23	688	688	245	1	0.2%
	Marine Mammals	100	48	23	100	30	59	59	13,355	33	8.3%
	Birds & Eggs	98	95	95	60	80	3,952	3,952	8,035	20	5.0%
	Vegetation	38	50	18	20	10		169	169	0	0.1%
1992	All Resources							150,196	1,430	359	100.0%
	Fish							51,955	495	124	35.0%
	Land Mammals							41,503	395	99	28.0%
	Marine Mammals							52,749	502	126	35.0%
	Birds and Eggs							3,924	37	9	3.0%
	Vegetation							65	1	0	0.0%
1993	All Resources	100	94	90	98	92		267,818	267,818	742	100.0%
	Fish	100	81	81	94	90	71,897	71,897	90,490	251	33.8%
	Salmon	71	45	36	47	39	272	272	1,009	3	0.4%
	Non-Salmon	97	79	79	90	87	71,626	71,626	89,481	248	33.4%
	Land Mammals	98	77	76	94	82	1,290	1,290	87,390	242	32.6%
	Large Land	98	76	74	92	82	691	691	87,306	242	32.6%
	Small Land	53	45	42	18	27	599	599	84	0	0.0%
	Marine Mammals	97	58	37	97	79	113	113	85,216	236	31.8%
	Birds & Eggs	90	77	76	69	73	3,558	3,558	4,325	12	1.6%
	Vegetation	79	71	71	40	27		396	396	1	0.1%
1994-95	All Resources										100.0%
	Fish						14,650				30.0%
	Land Mammals						254				63.0%
	Marine Mammals						24				2.0%
	Birds & Eggs						605				5.0%
	Vegetation										<1%

Source: ADF&G, Division of Subsistence CPBD, Version 3.12, July 2001 (for 1985 and 1993).
Fuller and George, 1999 (for 1992).
Brower and Opie, 1997 (for 1994-1995).

As interpreted by Stephen R. Braund & Associates

**Table 2.15-4
Selected Nuiqsut Subsistence Harvests for 1985, 1992, 1993, and 1994-1995**

Study Year	Resource	Estimated Harvest				
		Total Number	Total Pounds	Mean HH Pounds	Per Capita Pounds	% of Total Harvest
1985	Caribou	513	513	60,021	150	37.5%
	Cisco	46,478	46,478	29,354	73	18.3%
	Broad Whitefish	7,900	7,900	26,861	67	16.8%
	Bowhead	0	0	7,458	19	4.7%
	Moose	13	13	6,650	17	4.2%
	Geese	1,345	1,345	6,045	15	3.8%
	Grayling	4,055	4,055	3,650	9	2.3%
	Humpback Whitefish	4,345	4,345	3,476	9	2.2%
	Arctic Char	1,060	1,060	2,969	7	1.9%
	Burbot	669	669	2,675	7	1.7%
1992	Bowhead	2	48,715	464	117	32.0%
	Caribou	278	32,551	310	78	22.0%
	Arctic cisco	22,391	22,391	213	54	15.0%
	Broad Whitefish	6,248	15,621	149	37	10.0%
	Moose	18	8,835	84	21	6.0%
1993	Caribou	672	672	82,169	228	30.7%
	Bowhead	3	3	76,906	213	28.7%
	Broad Whitefish	12,193	12,193	41,455	115	15.5%
	Cisco	51,791	51,791	34,943	97	13.0%
	Ringed Seal	98	98	7,277	20	2.7%
	Burbot	1,416	1,416	5,949	16	2.2%
	Moose	9	9	4,403	12	1.6%
	Grayling	4,515	4,515	4,063	11	1.5%
	Geese	1,459	1,459	2,314	6	0.9%
	Arctic Char	603	603	1,689	5	0.6%
1994-95	Caribou	258				
	Whitefish	14,532				
	Seals	24				
	Grayling	462				
	Moose	5				
	Burbot	91				
	Char	8				
	Wolf	19				
	Geese	457				
	Berries	14				

Source: ADF&G, Division of Subsistence CPBD, Version 3.12, July 2001 (for 1985 and 1993).
Fuller and George, 1999 (for 1992).
Brower and Opie, 1997 (for 1994-1995).
As interpreted by Stephen R. Braund & Associates

**Table 2.15-5
Recent Harvest of Bowhead Whales near Cross Island**

Year	Whales			Notes
	Quota	Landed	Struck and Lost	
1973	NA	1	0	First "Nuiqsut" whale, no quota in effect
1982	1	1	0	
1986		1	0	
1987		1	0	
1989		2	2	Oil industry vessel disturbance noted
1990		0	1	Oil industry disturbance, also rough seas
1991	3	1	2	Poor weather, bad ice conditions
1992	3	2	1	
1993	3	3	0	Very favorable conditions
1995	4	4	0	
1996	4	2	0	
1997	4	3	1	
1998	4	4	1	
1999	4	3	0	
2000	4	4	0	Very favorable conditions
2001	4	3	0	Saw few whales, relatively far from Cross Island
2002	4	4	1	Saw more whales closer in than in 2001
2003	4	4	0	Poor weather for whaling
2004	4	3	0	Poor weather for whaling

Notes: Years of no harvest and no "struck and lost" are not listed. This does not imply that no whaling effort was made that year. "Quota" was not applicable in 1973.

Source: Compiled from AWC and NSB Wildlife Management records

**Table 2.15-6
Selected Characteristics of Nuiqsut Whaling Seasons, 2001-2004**

Year	Crews	Boats	Season Dates	Season Days	Scouting Days	Whales Taken	Struck and Lost
2001	4	7	9/03-9/26	24	11	3	0
2002	3	9	8/30-9/20	23	11	4	1
2003	4	9 ¹	8/23-9/10 ²	19	7	4	0
2004	4	7 ¹	8/15-9/19 ²	36	12	3	0

Notes:

1. Plus two boats used primarily for support and logistics

2. One crew went out earlier than all other crews – see text

Source: Galginaitis and Funk (2003a,b, 2004, 2005) Galginaitis (2005b)

**Table 3.1-1
 Predicted Travel Distance for Suspended Sediment to Settle to Seafloor**

Particle Size (microns)	ASTM Soil Classification	Travel Distance (meters)
1	Clay (lower range)	142,400
5	Clay (upper range) / Silt (lower range)	5,700
15	Silt	630
25	Silt	230
50	Silt	60
75	Silt (upper range) / Fine Sand (lower range)	25
100	Fine Sand	14

Table 3.5-1

*** (See Note Below) - Effects of Liberty Development Alternatives on Boulder Patch and Benthic Communities**

Project Component		Alternatives			
		Point Brower	Kadleroshilik River	Liberty Island	SDI Expansion
Development Pads	Description	New pad 45 acres, onshore	New pad 40 acres, onshore	New island 22.4 acres, offshore	Pad expansion 20 acres, nearshore
	Effect	None	None	Insignificant loss of Boulder Patch and marine benthic habitat, minor and insignificant effect of small refined-oil spills and activity disturbances	Insignificant loss of nearshore benthic habitat, minor and insignificant effect of small refined-oil spills and activity disturbances (marine access)
Access Roads	Description	New 7.3 miles (62 acres), 3 bridges	New 15.2 miles (129 acres), 7 bridges	None	None
	Effect	None	None	None	None
Pipelines	Description	New 15.2 miles onshore, 3 bridges	New 11.5 miles onshore, 2 bridges	New 1.5 miles onshore, 6.1 miles offshore	No new oil pipeline; new gas and water lines on existing 3-mile-long Endicott causeway
	Effect	None	None	Oil spills, temporary and minor alteration of marine habitat from turbidity during construction, insignificant effect of small refined-oil spills	None
Gravel Placement	Description	1,040,000 yd ³	1,570,000 yd ³	797,600 yd ³	860,000 yd ³
	Effect	None	None	None	None
Operations	Description	Production	Production	Production	Production
	Effect	Large oil spill not a major threat to Boulder Patch, marine and nearshore benthic habitat	Large oil spill not a major threat to Boulder Patch, marine and nearshore benthic habitat	Large oil spill not a major threat to Boulder Patch, marine and nearshore benthic habitat	Large oil spill not a major threat to Boulder Patch, marine and nearshore benthic habitat

* Note: Reviewers of both the Environmental Impact Analysis (EIA) submitted with the DPP and this EA will note that “significant” findings discussed in the EIA have been modified to reflect: (1) MMS analysis of potential impact; (2) MMS significance thresholds; and (3) additional mitigation measures identified subsequent to submittal of the DPP, which have been incorporated in the proposed action or become requirements for the proposed action.

Table 3.5-2
 * (See Note Below) - **Effects of Liberty Development Alternatives on Fish and Fish Habitat**

Project Component		Alternatives			
		Point Brower	Kadleroshilik River	Liberty Island	SDI Expansion
Development Pads	Description	New pad 45 acres	New pad 40 acres	New island 22.4 acres	Pad expansion 20 acres
	Effect	Insignificant loss of freshwater habitat, insignificant effect of small refined-oil spills and activity disturbances	Insignificant loss of freshwater habitat, insignificant effect of small refined-oil spills and activity disturbances	Insignificant loss of marine habitat, insignificant effect of small refined-oil spills and activity disturbances	Insignificant loss of nearshore brackish habitat, insignificant effect of small refined-oil spills and activity disturbances
Access Roads	Description	New 7.3 miles (62 acres), 3 bridges	New 15.2 miles (129 acres), 7 bridges	None	None
	Effect	Pond and stream fish habitat loss, altered drainage (movement routes), possible disturbance to overwintering sites at river crossings during construction, insignificant effect of small refined-oil spills	Pond and stream fish habitat loss, altered drainage (movement routes), possible disturbance to overwintering sites at river crossings during construction, insignificant effect of small refined-oil spills	None	None
Pipelines	Description	New 15.2 miles onshore, 3 bridges	New 11.5 miles onshore, 2 bridges	New 1.5 miles onshore, 6.1 miles offshore	No new oil pipeline; new gas and water lines on existing 3-mile-long Endicott causeway
	Effect	Oil spills, possible disturbance to overwintering sites at river crossings during construction, insignificant effect of small refined-oil spills	Oil spills, possible disturbance to overwintering sites at river crossings during construction, insignificant effect of small refined-oil spills	Oil spills, temporary and minor alteration of marine habitat from turbidity during construction, insignificant effect of small refined-oil spills	Oil spills from existing lines, possible disturbance to overwintering site on lagoon side of causeway, insignificant effect of small refined-oil spills
Gravel Placement	Description	1,040,000 yd ³	1,570,000 yd ³	797,600 yd ³	860,000 yd ³
	Effect	Insignificant loss of freshwater habitat, insignificant effect of small refined-oil spills, reclamation enhance summer and winter habitat	Insignificant loss of freshwater habitat, insignificant effect of small refined-oil spills, reclamation enhance summer and winter habitat	Insignificant loss of freshwater habitat, insignificant effect of small refined-oil spills, reclamation enhance summer and winter habitat	Insignificant loss of freshwater habitat, insignificant effect of small refined-oil spills, reclamation enhance summer and winter habitat
Operations	Description	Production	Production	Production	Production
	Effect	Large oil spill threat to anadromous fish nearshore migratory corridor, selected feeding grounds. Major threat to critical fish habitat in the Sag Delta.	Large oil spill threat to anadromous fish nearshore migratory corridor, selected feeding grounds. Moderate threat to critical fish habitat in the Sag Delta.	Minor, unless in the unlikely event of a large oil spill then threat to anadromous fish nearshore migratory corridor, selected feeding grounds. Moderate threat to critical fish habitat in the Sag Delta	Minor, unless in the unlikely event of a large oil spill then threat to anadromous fish nearshore migratory corridor, selected feeding grounds. Major threat to critical fish habitat in the Sag Delta.

* Note: Reviewers of both the Environmental Impact Analysis (EIA) submitted with the DPP and this EA will note that “significant” findings discussed in the EIA have been modified to reflect: (1) MMS analysis of potential impact; (2) MMS significance thresholds; and (3) additional mitigation measures identified subsequent to submittal of the DPP, which have been incorporated in the proposed action or become requirements for the proposed action.

Table 3.5-3
 * (See Note Below) - **Effects of Liberty Development Alternatives on Marine Mammals**

Project Component		Alternatives			
		Point Brower	Kadleroshilik River	Liberty Island	SDI Expansion
Development Pads	Description	New pad 45 acres	New pad 40 acres	New island 22.4 acres	Pad expansion 20 acres
	Effect	Minor noise and activity disturbances	Minor noise and activity disturbances	Moderate noise and activity disturbances, insignificant loss of marine habit	Minor noise and activity disturbances, insignificant loss of marine habitat
Access Roads	Description	New 7.3 miles (62 acres), 3 bridges	New 15.2 miles (129 acres), 7 bridges	None	None
	Effect	None	None	None	None
Pipelines	Description	New 15.2 miles onshore, 3 bridges	New 11.5 miles onshore, 2 bridges	New 1.5 miles onshore, 6.1 miles offshore	No new oil pipeline; new gas and water lines on existing 3-mile-long Endicott causeway
	Effect	Minor unless large oil spill in marine environment	Minor unless large oil spill in marine environment	Large oil spill in marine environment, temporary and minor alteration of marine habitat from turbidity during construction, moderate noise and activity disturbances during construction	Oil spill in marine environment from existing lines, minor noise and activity disturbances during construction
Gravel Placement	Description	1,040,000 yd ³	1,570,000 yd ³	797,600 yd ³	860,000 yd ³
	Effect	None	None	None	None
Operations	Description	Production	Production	Production	Production
	Effect	Minor unless large oil spill in marine environment, minor noise and activity disturbances	Minor unless in the unlikely event a large oil spill reaches the marine environment, minor noise and activity disturbances	Minor unless in the unlikely event a large oil spill reaches the marine environment, moderate noise and activity disturbances including annual ice roads	Minor unless in the unlikely event a large oil spill reaches the marine environment, impacts would depend upon numerous factors, minor noise and activity disturbances

* Note: Reviewers of both the Environmental Impact Analysis (EIA) submitted with the DPP and this EA will note that “significant” findings discussed in the EIA have been modified to reflect: (1) MMS analysis of potential impact; (2) MMS significance thresholds; and (3) additional mitigation measures identified subsequent to submittal of the DPP, which have been incorporated in the proposed action or become requirements for the proposed action.

Table 3.5-4

*** (See Note Below) - Effects of Liberty Development Alternatives on Marine and Coastal Birds**

Project Component		Alternatives			
		Point Brower	Kadleroshilik River	Liberty Island	SDI Expansion
Development Pads	Description	New Pad 45 acres, onshore	New Pad 40 acres, onshore	New Island 22.4 acres, offshore	Pad expansion 20 acres, nearshore
	Effect	Minor coastal nesting, foraging, brood rearing, staging habitat loss (shorebirds, brant, tundra swan)	Minor coastal nesting, foraging, brood rearing, staging habitat loss (shorebirds, snow geese, brant)	Insignificant loss of marine seabird foraging habitat, insignificant addition of molting habitat (long-tailed ducks, loons, gulls)	Insignificant loss of marine seabird foraging and molting habitats (long-tailed ducks, loons, gulls)
Communication Towers	Description	New tower	New tower	New tower	Existing tower
	Effect	Minor collision mortality - coastal island (migrant seabirds, raven and gull perch)	Minor collision mortality - coastal shoreline (migrant seabirds and shorebirds, raven and gull perch)	Minor collision mortality - offshore (migrant seabirds - offshore location may lead to increased seabird mortality compared to coastal locations, raven and gull perch)	No additional mortality or perch habitat
Access	Description	New Road 7.3 miles (62 acres), 3 bridges	New Road 15.2 miles (129 acres), 7 bridges	Air and Boat Traffic	Existing road
	Effect	62 acres coastal, riparian tundra habitat loss in Sag Delta (snow goose and tundra swan brood rearing, tundra swan nesting, shorebird nesting and staging). Traffic disturbance to nesting and brood rearing birds, increased depredation.	129 acres coastal, riparian tundra habitat loss in Sag Delta and across Kadleroshilik (snow goose and tundra swan brood rearing, tundra swan nesting, shorebird nesting and foraging). Traffic disturbance to nesting and brood rearing birds, increased depredation.	Air traffic disturbance to nesting, brood rearing, molting, staging birds. Boat traffic disturbance to brood rearing, molting birds (snow geese, tundra swans, long-tailed ducks, common eiders, shorebirds)	Existing effects.
Power Lines	Description	Buried in road	Buried in road	None	Buried in road
	Effect	7.3 miles construction disturbance to nesting and brood rearing birds during summer installation.	15.2 miles construction disturbance to nesting and brood rearing birds during summer installation.	None	None

* Note: Reviewers of both the Environmental Impact Analysis (EIA) submitted with the DPP and this EA will note that “significant” findings discussed in the EIA have been modified to reflect: (1) MMS analysis of potential impact; (2) MMS significance thresholds; and (3) additional mitigation measures identified subsequent to submittal of the DPP, which have been incorporated in the proposed action or become requirements for the proposed action.

**Table 3.5-4 (Cont'd)
Effects of Liberty Development Alternatives on Marine and Coastal Birds**

Project Component		Alternatives			
		Point Brower	Kadleroshilik River	Liberty Island	SDI Expansion
Pipelines	Description	New 15.2 miles onshore, 3 bridges	New 11.5 miles onshore, 2 bridges	New 1.5 miles onshore, 6.1 miles offshore	No new oil pipeline; new gas and water lines on existing 3-mile-long Endicott causeway
	Effect	Oil spills - Sag Delta, Foggy Island; nesting, brood rearing, staging (snow geese, tundra swan, brant, sea ducks, loons, shorebirds), predator perches.	Oil spills - Kadleroshilik, Shaviovik; nesting, brood rearing, staging (snow geese, tundra swan, brant), predator perches	Oil spills - Foggy Island Bay, Sag Delta, Kadleroshilik Delta, Shaviovik Delta; molting, brood rearing, staging (snow geese, tundra swan, brant, sea ducks, loons, shorebirds), predator perches	Oil spills from existing lines - Sag Delta; nesting, molting, brood rearing, staging (snow geese, tundra swan, brant, sea ducks, loons, shorebirds), predator perches - existing pipelines
Construction	Description	Primary construction in winter - following summer grade and smooth road/pads	Primary construction in winter - following summer grade and smooth road/pads	Primary construction in winter - following summer grade and smooth island	Primary construction in winter - following summer grade and smooth island
	Effect	Summer smoothing/compaction - disturbance to tundra nesting birds, facilitation of predation	Summer smoothing/compaction - disturbance to tundra nesting birds, facilitation of predation	Summer smoothing/compaction disturbance to foraging, molting seabirds	Summer smoothing/compaction disturbance to foraging, molting seabirds
Gravel Source	Description	Sagavanirktok Pit - 1,040,000 yd ³ (63 acres)	Sagavanirktok and Kadleroshilik Pits - 1,570,000 yd ³ (89 acres)	Kadleroshilik Pit - 797,600 yd ³ (31 acres)	Sagavanirktok Pit - 860,000 yd ³ (50 acres)
	Effect	63-acre coastal tundra habitat loss or alteration - nesting, foraging, brood rearing, staging	89-acre coastal tundra and riparian habitat loss or alteration - nesting, foraging, brood rearing, staging	31-acre riparian habitat loss or alteration - nesting, foraging, brood rearing	50-acre coastal habitat loss or alteration - nesting, foraging, brood rearing, staging
Operations	Description	Production	Production	Production	Production
	Effect	Large oil spill threat to Sag Delta, nearshore waterfowl brood rearing, seabird foraging, shorebird staging habitats	Large oil spill threat to Kadleroshilik and Sagavanirktok river deltas, nearshore waterfowl brood rearing, seabird foraging, shorebird staging habitats	Large oil spill threat to Kadleroshilik and Sagavanirktok river deltas, nearshore waterfowl brood rearing, seabird foraging, sea duck molting, shorebird staging habitats	Minor, because of low likelihood of a large oil spill occurrence. However, would be major in the event that this occurred. Effects to Sag Delta, nearshore waterfowl brood rearing, seabird foraging, shorebird staging habitats

* Note: Reviewers of both the Environmental Impact Analysis (EIA) submitted with the DPP and this EA will note that “significant” findings discussed in the EIA have been modified to reflect: (1) MMS analysis of potential impact; (2) MMS significance thresholds; and (3) additional mitigation measures identified subsequent to submittal of the DPP, which have been incorporated in the proposed action or become requirements for the proposed action.

Table 3.5-5
 * (See Note Below) - **Effects of Liberty Development Alternatives on Terrestrial Mammals**

Project Component		Alternatives			
		Point Brower	Kadleroshilik River	Liberty Island	SDI Expansion
Development Pads	Description	New Pad 45 acres, onshore	New Pad 40 acres, onshore	New Island 22.4 acres, offshore	Pad expansion 20 acres, nearshore
	Effect	Minor coastal insect relief and foraging, habitat loss disturbance displacement (caribou, arctic fox, arctic ground squirrel)	Minor coastal insect relief and foraging, habitat loss disturbance displacement (caribou, arctic fox, arctic ground squirrel)	None	None
Access	Description	New Road 7.3 miles (62 acres), 3 bridges	New Road 15.2 miles (129 acres), 7 bridges	Air and Boat Traffic	Existing road
	Effect	62 acres coastal, riparian tundra habitat loss in Sag Delta, displacement from coastal mudflat and spit insect relief habitats, displacement from potential bear denning habitat (caribou, muskoxen, grizzly bear, arctic fox, arctic ground squirrel). Traffic disturbance and collision mortality.	129 acres coastal, riparian tundra habitat loss in Sag Delta and across Kadleroshilik, displacement from coastal and riparian insect relief habitats, displacement from potential bear denning habitat (caribou, muskoxen, grizzly bear, arctic fox, arctic ground squirrel). Traffic disturbance and collision mortality.	Air traffic disturbance from Deadhorse to Liberty Island to caribou calving and coastal and riparian insect relief habitats.	Existing effects
Power lines	Description	Buried in road	Buried in road	None	Buried in road
	Effect	7.3 miles construction disturbance during summer installation (caribou, muskoxen, grizzly bear, arctic fox).	15.2 miles construction disturbance during summer installation (caribou, muskoxen, grizzly bear, arctic fox).	None	None
Pipelines	Description	New 15.2 miles onshore, 3 bridges	New 11.5 miles onshore, 2 bridges	New 1.5 miles onshore, 6.1 miles offshore	No new oil pipeline; new gas and water lines on existing 3-mile-long Endicott causeway
	Effect	Oil spills - Sag Delta, Foggy Island; insect relief, foraging, denning habitats (caribou, muskoxen, grizzly bear, arctic fox, arctic ground squirrel)	Oil spills - Kadleroshilik, Shavirovik; insect relief, foraging, denning habitats (caribou, muskoxen, grizzly bear, arctic fox, arctic ground squirrel)	Oil spills - Foggy Island Bay, Sag Delta, Kadleroshilik Delta, Shavirovik Delta; insect relief, foraging habitats (caribou, muskoxen, grizzly bear, arctic fox, arctic ground squirrel)	Oil spills from existing lines - Sag Delta - existing pipeline; foraging, insect relief, denning habitats (caribou, muskoxen, grizzly bear, arctic fox, arctic ground squirrel)

* Note: Reviewers of both the Environmental Impact Analysis (EIA) submitted with the DPP and this EA will note that “significant” findings discussed in the EIA have been modified to reflect: (1) MMS analysis of potential impact; (2) MMS significance thresholds; and (3) additional mitigation measures identified subsequent to submittal of the DPP, which have been incorporated in the proposed action or become requirements for the proposed action.

**Table 3.5-5 (Cont'd)
Effects of Liberty Development Alternatives on Terrestrial Mammals**

Project Component		Alternatives			
		Point Brower	Kadleroshilik River	Liberty Island	SDI Expansion
Construction	Description	Primary construction in winter - following summer grade and smooth road/pads	Primary construction in winter - following summer grade and smooth road/pads	Primary construction in winter - following summer grade and smooth island	Primary construction in winter - following summer grade and smooth island
	Effect	Winter - disturbance of bear dens; Summer smoothing/compaction - disturbance to insect relief, foraging habitats (caribou, muskoxen, grizzly bears, arctic foxes)	Winter - disturbance of bear dens; Summer smoothing/compaction - disturbance to insect relief, foraging habitats (caribou, muskoxen, grizzly bears, arctic foxes)	None	None
Gravel Source	Description	Sagavanirktok Pit - 1,040,000 yd ³ (63 acres)	Sagavanirktok and Kadleroshilik Pits - 1,570,000 yd ³ (89 acres)	Kadleroshilik Pit - 797,600 yd ³ (31 acres)	Sagavanirktok Pit - 860,000 yd ³ (50 acres)
	Effect	63-acre coastal tundra habitat loss or alteration - foraging, denning habitats (caribou, grizzly bear, arctic fox, arctic ground squirrel)	89-acre coastal tundra and riparian habitat loss or alteration - foraging, migration, denning (caribou, muskoxen, grizzly bear, arctic fox, arctic ground squirrel)	31-acre riparian habitat loss or alteration - foraging, insect relief, migration, denning (caribou, muskoxen, grizzly bear, arctic fox, arctic ground squirrel)	50-acre coastal habitat loss or alteration - foraging, denning habitats (caribou, grizzly bear, arctic fox, arctic ground squirrel)
Operations	Description	Production	Production	Production	Production
	Effect	Minor, because of low likelihood of a large oil spill occurrence. In the event of a large spill, areas for insect relief, and foraging in Sag Delta may be unavailable (caribou, muskoxen, grizzly bear, arctic fox)	Minor, because of low likelihood of a large oil spill occurrence. In the event of a large spill, areas for insect relief, and foraging in Kadleroshilik and Sagavanirktok river deltas may be unavailable (caribou, muskoxen, grizzly bear, arctic fox)	Minor, because of low likelihood of a large oil spill occurrence. In the event of a large spill, areas for insect relief, and foraging in Kadleroshilik and Sagavanirktok river deltas may be unavailable (caribou, muskoxen, grizzly bear, arctic fox)	Minor, because of low likelihood of a large oil spill occurrence. In the event of a large spill, areas for insect relief, and foraging in Sag Delta may be unavailable (caribou, muskoxen, grizzly bear, arctic fox)

* Note: Reviewers of both the Environmental Impact Analysis (EIA) submitted with the DPP and this EA will note that “significant” findings discussed in the EIA have been modified to reflect: (1) MMS analysis of potential impact; (2) MMS significance thresholds; and (3) additional mitigation measures identified subsequent to submittal of the DPP, which have been incorporated in the proposed action or become requirements for the proposed action.

Table 3.5-6
 * (See Note Below) - **Effects of Liberty Development Alternatives on Terrestrial and Wetland Vegetation**

Project Component		Alternatives			
		Point Brower	Kadleroshilik River	Liberty Island	SDI Expansion
Development Pads	Description	New pad 45 acres	New pad 40 acres	New island 22.4 acres	Pad expansion 20 acres
	Effect	Burial of vegetation, possible changes to drainage patterns altering community types and species composition of surrounding tundra	Burial of vegetation, possible changes to drainage patterns altering community types and species composition of surrounding tundra	None	None
Access Roads	Description	New 7.3 miles (62 acres), 3 bridges	New 15.2 miles (129 acres), 7 bridges	None	None
	Effect	Burial of vegetation, potential changes to drainage patterns altering community types and species composition of surrounding tundra, dust from road travel possibly thinning vegetation, altering species composition and soil properties	Burial of vegetation, potential changes to drainage patterns altering community types and species composition of surrounding tundra, dust from road travel possibly thinning vegetation, altering species composition and soil properties	None	None
Pipelines	Description	New 15.2 miles onshore, 3 bridges	New 11.5 miles onshore, 2 bridges	New 1.5 miles onshore, 6.1 miles offshore	No new oil pipeline; new gas and water lines on existing 3-mile-long Endicott causeway
	Effect	Oil spills, possible disturbance to organic mat during construction (ice roads), insignificant effect of small refined-oil spills	Oil spills, possible disturbance to organic mat during construction (ice roads), insignificant effect of small refined-oil spills	Oil spills, possible disturbance to organic mat during construction (ice roads), insignificant effect of small refined-oil spills	None
Gravel Placement	Description	1,040,000 yd ³	1,570,000 yd ³	797,600 yd ³	860,000 yd ³
	Effect	Loss of terrestrial and wetland vegetation at roads, pads and mine site	Loss of terrestrial and wetland vegetation at roads, pads and mine site	Loss of terrestrial and wetland vegetation at mine site only	Loss of terrestrial and wetland vegetation at mine site only
Operations	Description	Production	Production	Production	Production
	Effect	Large oil spill threat to terrestrial and wetland vegetation communities	Large oil spill threat to terrestrial and wetland vegetation communities	Large oil spill threat to coastal vegetation communities	Minor, unless in the unlikely event of a large oil spill then threat to coastal vegetation communities

* Note: Reviewers of both the Environmental Impact Analysis (EIA) submitted with the DPP and this EA will note that “significant” findings discussed in the EIA have been modified to reflect: (1) MMS analysis of potential impact; (2) MMS significance thresholds; and (3) additional mitigation measures identified subsequent to submittal of the DPP, which have been incorporated in the proposed action or become requirements for the proposed action.

Table 3.5-7
 * (See Note Below) - **Effects of Liberty Development Alternatives on Bowhead Whales**

Project Component		Alternatives			
		Point Brower	Kadleroshilik River	Liberty Island	SDI Expansion
Development Pads	Description	New pad 45 acres	New pad 40 acres	New island 22.4 acres	Pad expansion 20 acres
	Effect	Negligible noise and activity disturbances from construction during fall migration.	Negligible noise and activity disturbances from construction during fall migration	Moderate noise and activity disturbances from construction during fall migration, potential for offshore displacement during fall migration, insignificant loss of marine habitat	Negligible noise and activity disturbances from construction during fall migration
Access Roads	Description	New 7.3 miles (62 acres), 3 bridges	New 15.2 miles (129 acres), 7 bridges	None	None
	Effect	None	None	None	None
Pipelines	Description	New 15.2 miles onshore, 3 bridges	New 11.5 miles onshore, 2 bridges	New 1.5 miles onshore, 6.1 miles offshore	No new oil pipeline; new gas and water lines on existing 3-mile-long Endicott causeway
	Effect	Minor unless large oil spill in marine environment	Minor unless large oil spill in marine environment	Minor unless large oil spill in marine environment	Minor unless oil spills from existing lines
Gravel Placement	Description	1,040,000 yd ³	1,570,000 yd ³	797,600 yd ³	860,000 yd ³
	Effect	None	None	None	None
Operations	Description	Production	Production	Production	Production
	Effect	Reduced risk of large oil spill in marine environment	Reduced risk of large oil spill in marine environment	Minor, because of low likelihood of a large oil spill occurrence. Moderate noise and activity disturbances, potential for offshore displacement of fall migration	Minor, because of low likelihood of a large oil spill occurrence. Negligible noise and activity disturbances, unlikely potential for offshore displacement during fall migration

* Note: Reviewers of both the Environmental Impact Analysis (EIA) submitted with the DPP and this EA will note that “significant” findings discussed in the EIA have been modified to reflect: (1) MMS analysis of potential impact; (2) MMS significance thresholds; and (3) additional mitigation measures identified subsequent to submittal of the DPP, which have been incorporated in the proposed action or become requirements for the proposed action.

Table 3.5-8
 * (See Note Below) - **Effects of Liberty Development Alternatives on Spectacled and Steller's Eiders**

Project Component		Alternatives			
		Point Brower	Kadleroshilik River	Liberty Island	SDI Expansion
Communication Towers	Description	New tower	New tower	New tower	No new tower
	Effect	Minor of collision mortality, avian-predator perch sites	Minor of collision mortality, avian-predator perch sites	Elevated of collision mortality, avian-predator perch sites	None
Development Pads	Description	New pad 45 acres	New pad 40 acres	New island 22.4 acres	Pad expansion 20 acres
	Effect	Potential loss of tundra nesting habitat, moderate noise and activity disturbances during nesting season, low risk of collision mortality, potential for predator denning/nesting habitat	Potential loss of tundra nesting habitat, moderate noise and activity disturbances during nesting season, low risk of collision mortality, potential for predator denning/nesting habitat	Insignificant loss of marine habitat, negligible noise and activity disturbances during nesting season, elevated risk of collision mortality, minimal potential for predator denning/nesting habitat	Insignificant loss of marine habitat, negligible noise and activity disturbances during nesting season, elevated risk of collision mortality, potential for predator denning/nesting habitat
Access Roads	Description	New 7.3 miles (62 acres), 3 bridges	New 15.2 miles (129 acres), 7 bridges	None	None
	Effect	Potential loss or alteration of tundra nesting habitat, moderate noise and activity disturbances, risk of vehicular collision mortality	Potential loss or alteration of tundra nesting habitat, moderate noise and activity disturbances, risk of vehicular collision mortality	None	None
Pipelines	Description	New 15.2 miles onshore, 3 bridges	New 11.5 miles onshore, 2 bridges	New 1.5 miles onshore, 6.1 miles offshore	No new oil pipeline; new gas and water lines on existing 3-mile-long Endicott causeway
	Effect	Large oil spills, avian-predator perch sites	Large oil spills, avian-predator perch sites	Large oil spills, avian-predator perch sites	Large oil spills from existing lines, minimal noise and activity disturbances if constructed during open-water season, no new avian perch sites (new gas and water pipelines will parallel existing pipelines)
Gravel Placement	Description	1,040,000 yd ³	1,570,000 yd ³	797,600 yd ³	860,000 yd ³
	Effect	Potential loss or alteration of tundra nesting habitat	Potential loss or alteration of tundra nesting habitat	Potential loss or alteration of tundra nesting habitat	Potential loss or alteration of tundra nesting habitat

* Note: Reviewers of both the Environmental Impact Analysis (EIA) submitted with the DPP and this EA will note that “significant” findings discussed in the EIA have been modified to reflect: (1) MMS analysis of potential impact; (2) MMS significance thresholds; and (3) additional mitigation measures identified subsequent to submittal of the DPP, which have been incorporated in the proposed action or become requirements for the proposed action.

**Table 3.5-8 (Cont'd)
Effects of Liberty Development Alternatives on Spectacled and Steller's Eiders**

Project Component		Alternatives			
		Point Brower	Kadleroshilik River	Liberty Island	SDI Expansion
Operations	Description	Production	Production	Production	Production
	Effect	Minor, because of low likelihood of a large oil spill occurrence. Moderate noise and activity disturbances during nesting season	Minor, because of low likelihood of a large oil spill occurrence. Moderate noise and activity disturbances during nesting season	Minor, because of low likelihood of a large oil spill occurrence. Negligible noise and activity disturbances during nesting season	Minor, because of low likelihood of a large oil spill occurrence. Negligible noise and activity disturbances during nesting season

* Note: Reviewers of both the Environmental Impact Analysis (EIA) submitted with the DPP and this EA will note that “significant” findings discussed in the EIA have been modified to reflect: (1) MMS analysis of potential impact; (2) MMS significance thresholds; and (3) additional mitigation measures identified subsequent to submittal of the DPP, which have been incorporated in the proposed action or become requirements for the proposed action.

Table 3.5-9

*** (See Note Below) - Effects of Liberty Development Alternatives on Subsistence, Sociocultural, and Environmental Justice¹**

Project Component		Alternatives			
		Point Brower	Kadleroshilik River	Liberty Island	SDI Expansion
Development Pads	Description	New pad 45 acres, onshore	New pad 40 acres, onshore	New island 22.4 acres, offshore	Pad expansion 20 acres, nearshore
	Effect	Subsistence: Insignificant; negligible habitat loss, minor effects of small refined oil spills and activity disturbances.	Subsistence: Insignificant; negligible habitat loss, minor effects of small refined oil spills and activity disturbances.	Subsistence: Insignificant; negligible habitat loss, minor effects of small refined oil spills and activity disturbances.	Subsistence: Insignificant; negligible habitat loss, minor effects of small refined oil spills and activity disturbances.
		Sociocultural: Insignificant; no material impacts on subsistence; relatively few incremental FTEs.	Sociocultural: Insignificant; no material impacts on subsistence; relatively few incremental FTEs.	Sociocultural: Insignificant; no material impacts on subsistence; more, but still few FTEs, compared to other alternatives.	Sociocultural: Insignificant; no material impacts on subsistence; relatively few incremental FTEs.
Environmental Justice: Insignificant	Environmental Justice: Insignificant	Environmental Justice: Insignificant	Environmental Justice: Insignificant	Environmental Justice: Insignificant	
Access Roads	Description	New road 7.3 miles (62 acres), 3 bridges	New road 15.2 miles (110 acres), 2 bridges	No roads, but air and boat traffic	Existing road
	Effect	Subsistence: Insignificant; negligible habitat loss, minor effects of small refined oil spills and activity disturbances. No effects on bowhead whales.	Subsistence: Insignificant; negligible habitat loss, minor effects of small refined oil spills and activity disturbances. No effects on bowhead whales.	Subsistence: Insignificant; no habitat loss, air traffic disturbance from Deadhorse to Liberty Island to caribou calving and coastal and riparian insect relief habitats. No effects on bowhead whales.	Subsistence: Insignificant; no incremental habitat loss, minor effects of small refined oil spills and activity disturbances. No effects on bowhead whales.
		Sociocultural: Insignificant, no material impacts on subsistence; relatively few incremental FTEs.	Sociocultural: Insignificant, no material impacts on subsistence; relatively few incremental FTEs.	Sociocultural: Insignificant, no material impacts on subsistence; relatively few incremental FTEs.	Sociocultural: Insignificant, no material impacts on subsistence; relatively few incremental FTEs.
Environmental Justice: Insignificant	Environmental Justice: Insignificant	Environmental Justice: Insignificant	Environmental Justice: Insignificant	Environmental Justice: Insignificant	

¹ All alternatives have similar (and generally positive) economic impacts. Qualitative assessments of significance of impacts assume that mitigating measures identified in this document are implemented.

* Note: Reviewers of both the Environmental Impact Analysis (EIA) submitted with the DPP and this EA will note that “significant” findings discussed in the EIA have been modified to reflect: (1) MMS analysis of potential impact; (2) MMS significance thresholds; and (3) additional mitigation measures identified subsequent to submittal of the DPP, which have been incorporated in the proposed action or become requirements for the proposed action.

**Table 3.5-9 (Cont'd)
Effects of Liberty Development Alternatives on Subsistence, Sociocultural, and Environmental Justice**

Project Component		Alternatives			
		Point Brower	Kadleroshilik River	Liberty Island	SDI Expansion
Pipelines	Description	New 15.2 miles onshore, 3 bridges	New 11.5 miles onshore, 2 bridges	New 1.5 miles onshore, 6.1 miles offshore	No new oil pipeline; new gas and water lines on existing 3-mile-long Endicott causeway
	Effect ²	Subsistence: Insignificant; possible disturbance to fish overwintering sites at river crossings during construction, insignificant effect of small refined-oil spills. Sociocultural: Insignificant Environmental Justice: Insignificant	Subsistence: Insignificant; possible disturbance to fish overwintering sites at river crossings during construction, insignificant effect of small refined-oil spills. Sociocultural: Insignificant Environmental Justice: Insignificant	Subsistence: Insignificant; oil spills, temporary and minor alteration of marine habitat from turbidity during construction, insignificant effect of small refined-oil spills Sociocultural: Insignificant Environmental Justice: Insignificant	Subsistence: Insignificant; maximizes utilization of existing infrastructure, possible disturbance to fish overwintering site on lagoon side of causeway, insignificant effect of small refined-oil spills. Sociocultural: Insignificant Environmental Justice: Insignificant
Gravel Source	Description	Sagavanirktok Pit - 1,040,000 yd ³ (63 acres)	Sagavanirktok and Kadleroshilik Pits - 1,570,000 yd ³ (89 acres)	Kadleroshilik Pit - 797,600 yd ³ (31 acres)	Sagavanirktok Pit - 860,000 yd ³ (35 acres)
	Effect	Subsistence: Insignificant. No risk to bowhead whales. 63 acre coastal tundra habitat loss or alteration - foraging, denning habitats (caribou, grizzly bear, arctic fox, arctic ground squirrel). Sociocultural: Insignificant; effects on cultural resources mitigated by survey and consultation process. Environmental Justice: Insignificant	Subsistence: Insignificant. No risk to bowhead whales. 89 acre coastal tundra and riparian habitat loss or alteration - foraging, migration, denning (caribou, muskoxen, grizzly bear, arctic fox, arctic ground squirrel). Sociocultural: Insignificant; effects on cultural resources mitigated by survey and consultation process. Environmental Justice: Insignificant	Subsistence: Insignificant. No risk to bowhead whales. 31 acre riparian habitat loss or alteration - foraging, insect relief, migration, denning (caribou, muskoxen, grizzly bear, arctic fox, arctic ground squirrel). Sociocultural: Insignificant; effects on cultural resources mitigated by survey and consultation process. Environmental Justice: Insignificant	Subsistence: Insignificant. No risk to bowhead whales. alteration - foraging, denning habitats (caribou, grizzly bear, arctic fox, arctic ground squirrel). Sociocultural: Insignificant; effects on cultural resources mitigated by survey and consultation process. Environmental Justice: Insignificant

² Infrastructure effects discussed in this table, such as pipelines, refer to effects during construction. Impacts during operation of these facilities are included under the heading of "operations." Thus, for example, impacts of oil spills from pipelines are included under "operations."

* Note: Reviewers of both the Environmental Impact Analysis (EIA) submitted with the DPP and this EA will note that "significant" findings discussed in the EIA have been modified to reflect: (1) MMS analysis of potential impact; (2) MMS significance thresholds; and (3) additional mitigation measures identified subsequent to submittal of the DPP, which have been incorporated in the proposed action or become requirements for the proposed action.

**Table 3.5-9 (Cont'd)
Effects of Liberty Development Alternatives on Subsistence, Sociocultural, and Environmental Justice**

Project Component		Alternatives			
		Point Brower	Kadleroshilik River	Liberty Island	SDI Expansion
Operations	Description	Production	Production	Production	Production
	Effect	<p>Subsistence: Minor, because of low likelihood of a large oil spill that would impact subsistence resources. Negligible noise and activity disturbances, unlikely potential for offshore displacement during fall bowhead migration. Oil spill threat to Sagavanirktok Delta; insect relief, foraging (caribou, muskoxen, grizzly bear, arctic fox).</p> <p>Sociocultural: Probably minor unless subsistence resource impacts resulted from large oil spill.</p> <p>Environmental Justice: Probably minor unless subsistence resource impacts resulted from large oil spill.</p>	<p>Subsistence: Minor, because of low likelihood of a large oil spill that would impact subsistence resources. Negligible noise and activity disturbances, unlikely potential for offshore displacement during fall bowhead migration. Oil spill threat to Kadleroshilik and Sagavanirktok river deltas; insect relief, foraging (caribou, muskoxen, grizzly bear, arctic fox).</p> <p>Sociocultural: Probably minor unless subsistence resource impacts resulted from large oil spill.</p> <p>Environmental Justice: Probably minor unless subsistence resource impacts resulted from large oil spill.</p>	<p>Subsistence: Minor, because of low likelihood of a large oil spill that would impact subsistence resources. Likelihood of an offshore spill impacting bowhead whales, although low, is probably greater than any of the other alternatives considered. Moderate noise and activity disturbances, potential for offshore displacement of fall bowhead migration. Oil spill threat to Kadleroshilik and Sagavanirktok river deltas; insect relief, foraging (caribou, muskoxen, grizzly bear, arctic fox).</p> <p>Sociocultural: Probably minor unless subsistence resource impacts resulted from large oil spill.</p> <p>Environmental Justice: Probably minor unless subsistence resource impacts resulted from large oil spill.</p>	<p>Subsistence: Minor, because of low likelihood of a large oil spill that would impact subsistence resources. Negligible noise and activity disturbances, unlikely potential for offshore displacement during fall bowhead migration. Oil spill threat to Sagavanirktok Delta; insect relief, foraging (caribou, muskoxen, grizzly bear, arctic fox).</p> <p>Sociocultural: Probably minor unless subsistence resource impacts resulted from large oil spill.</p> <p>Environmental Justice: Probably minor unless subsistence resource impacts resulted from large oil spill.</p>

* Note: Reviewers of both the Environmental Impact Analysis (EIA) submitted with the DPP and this EA will note that “significant” findings discussed in the EIA have been modified to reflect: (1) MMS analysis of potential impact; (2) MMS significance thresholds; and (3) additional mitigation measures identified subsequent to submittal of the DPP, which have been incorporated in the proposed action or become requirements for the proposed action.

**Table 3.6-1
Some Perspectives on Possible Cumulative Effects**

<p>Expected oil and gas activities are likely to have fewer impacts on the environment than those activities conducted in the early years of the region's development. More rigorous environmental standards and more environmentally prudent industry practices now exist, which include smaller facility "footprints," fewer roads, directional drilling from onshore, elimination of most discharges into the water, practices that avoid damage to the tundra, and better working relations with the local residents.</p>
<p>Current industry practices and the environmental state of the North Slope/Beaufort Sea region frequently are observed and assessed, and much of this information is available to the public. This information and the ongoing dialogue about environmental issues among Federal, State, and local government agencies; Iñupiat regional and village corporations; industry; interest groups; and the public should continue to increase environmental awareness and encourage environmentally sound practices that, in turn, should help reduce the potential for environmental damage.</p>
<p>A key element of the transportation system for development of North Slope/Beaufort Sea oil is the Trans-Alaska Pipeline System pipeline. The pipeline is 800 miles long, stretching from Pump Station 1 at Prudhoe Bay to the Valdez Marine Terminal and, if we choose a corridor width of about 100 feet, it represents an area of about 16 square miles. This pipeline is expected to continue to serve as existing infrastructure for all foreseeable future oil production, eliminating the need for the construction of new oil pipelines other than feeder pipelines.</p>
<p>Following the Exxon Valdez oil spill, substantive improvements have been made in tanker safety to reduce the potential for oil spills from tanker accidents. These include a mandatory phase-in of double-hulled tankers, better navigational systems, and tanker escorts. In addition, oil-spill response capabilities for tanker-related oil spills in Prince William Sound have been increased substantially through additional equipment, personnel, training, and exercises. These initiatives were developed specifically to reduce the potential for future tanker accidents and to lessen effects, should spills occur.</p>
<p>If a major spill occurred, there likely would be a great slowdown in new development during which additional safeguards certainly would be put in place and new ideas of pipeline placement and design would be researched. Just as the additional safeguards resulting from the Exxon Valdez oil spill, the likelihood of an additional oil spill from the same causative factors and to the same resources would be reduced. This emphasis on preventing a similar incident further would ensure the full recovery of those resources from the initial spill.</p>
<p>The actual size and location of future oil and gas developments on the North Slope and in the Beaufort Sea are uncertain. The actual effects on natural resources and the human environment that may result from such developments also are uncertain. Nevertheless, we have developed our best estimate of what those activities and effects might be. However, it is likely that projected actions or effects may not happen in a way that fits neatly into the scenarios we have established for this EIS.</p>
<p>The recommended alternative in the original EIS has been changed. The new proposal involves the use of ultra-extended reach drilling (uERD) from an onshore location. This design eliminates the offshore impacts of island and pipeline construction and significantly mitigated the potential offshore environmental impacts related to the Boulder Patch, marine mammals, and concerns of the North Slope Iñupiat communities related to the bowhead whale and subsistence whaling.</p>

Source: The first six points are included in the Liberty FEIS (USDOI, MMS, 2002).

**Table 4-1
Avoidance and Minimization of Environmental Impact during Design**

Action	Benefit
Developed the oil reservoir from an existing oil and gas facility.	Avoid potential impacts in marine environment. Eliminates need for offshore pipeline with related concerns about spills and construction near Boulder Patch. Minimize the project footprint – no new roads or pads in undeveloped areas of the Sagavanirktok River delta and adjacent to Foggy Island Bay. Minimize air emissions (versus standalone facility with full processing). Provides year-round access to the drilling site and eliminates the need for a new road. Endicott facility has been studied extensively over the past 20 years with respect to fish and wildlife, water quality and other issues. This has benefited the design, environmental mitigation and assessment of potential impacts.
Site gravel mine outside active river floodplain. Mine gravel during winter according to approved mining plan. Use ice roads for gravel haul.	Minimize impacts to fish overwintering areas; Minimize bird impacts, including eiders; reduce or eliminate impacts due to increased dust from mining and gravel haul.
Designed facility for zero surface discharge of drilling wastes; no reserve pits.	Reduce drilling pad size and impacts to benthos; eliminate potential for contaminant release from reserve pits.
Use sheetpile for slope protection.	Reduces the seabed footprint (versus other slope protection systems). Reduces TSS concentrations in the water column from erosion of side slopes.
Meet with Federal, State, and local agencies early and frequently in project development to reaffirm critical issues and develop familiarity with project.	Verify critical issues early in project design; establish agency involvement in design and environmental mitigation early in process.
Reviewed and summarized existing data on oceanographic conditions and potential alterations due to expansion of Endicott SDI.	Identify potential project and cumulative impacts; minimize impacts within project design and operational constraints.
Reviewed and summarized existing data on use of Sagavanirktok Delta by anadromous and freshwater fish, marine mammals and birds.	Identify potential project and cumulative impacts; minimize impacts within project design and operational constraints.
Drilling rig to be powered by natural gas.	Reduce air emissions as a result of cleaner burning fuel.
Drilling engineers to meet with USFWS to discuss rig design and mitigation of raven reproduction.	Reduce potential increase in bird-predator populations.
Drilling engineers to meet with USFWS to discuss rig design and mitigation of light attraction by birds to newly constructed facilities.	Minimize bird strikes, including threatened eiders.
Conduct archeological survey of construction areas (mine site, etc.).	Avoid or minimize impacts to archeological and cultural resources.

**Table 4-2
Avoidance and Minimization of Environmental Impact during Construction and Operation**

Action	Benefit
Use ice roads to construct Liberty Project and access temporary water sources; construct during winter.	Minimize impacts to tundra and disturbance to wildlife from permanent roads; minimize generation of dust.
House construction and drilling workers in existing facilities to the extent feasible.	Reduce temporary facilities on site; eliminate impacts of placement of new camps. Reduce potential for wildlife disturbance or attraction. Allow use of existing sewage treatment and other sanitation facilities.
Enforce speed limits along Endicott Road and other project areas.	Reduce wildlife impacts; reduce potential for accidents and spills both on road surface and onto tundra and sea ice; reduce generation of dust.
Coordinate with Alaska Department of Fish and Game. Identify and avoid grizzly bear den locations and avoid fish overwintering areas.	Avoid impacting bear dens and important fish resources in project area.
Coordinate with U.S. Fish and Wildlife Service on locations of polar bear den sites; perform surveys using FLIR/dogs along ice road route.	Avoid actions that would disturb denning polar bears.
Store food and dispose of solid wastes in wildlife-resistant facilities.	Minimize waste storage at project sites; reduce potential for wildlife population increase; avoid negative wildlife encounters.
Zero surface discharge of drilling wastes (disposal through grind and in injection well).	Avoid water quality impacts.
Drilling rig powered by natural gas.	Reduce air emissions and risks of fuel spills.
Route vessel traffic inshore and time sealift to occur outside of whaling season.	Minimize disturbance to marine mammals and subsistence whaling activities.
Maintain continual on-site environmental presence during construction and operation to ensure compliance with permit requirements.	Assure compliance with permits and environmental regulations and high level of environmental performance.
Remove bird-predator nests on facility structures; remove new fox dens constructed in facility structures.	Reduce the potential for increasing the abundance and distribution of bird predators.
Monitor for bird mortality from collision with facilities and vehicles.	Determine level of incidental take of protected species; assess potential effectiveness of mitigation measures.
Consult with Alaska Eskimo Whaling Commission on any marine activities (e.g., sealift). Develop Conflict Avoidance Agreement or similar mechanism with AEWC and local whalers, if necessary.	Minimize disturbance to migrating bowhead whales and conflicts with subsistence whaling activities.
If public access is restricted, prohibit hunting and fishing by project personnel within or via controlled access areas..	Provide equal access to fish and wildlife resources.
Train personnel in interactions with wildlife. Establish an environmental awareness program.	Increase awareness of risks and means to reduce impacts on wildlife.
Train personnel to recognize and avoid cultural resources.	Ensure that cultural resources are protected.