Pebble Project

NORTHERN DYNASTY MINES INC.

DRAFT ENVIRONMENTAL BASELINE STUDIES
2006 STUDY PLANS

CHAPTER 12.
MARINE

JULY 2006

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12. MARINE

12.1 Marine Wildlife—Port

The 2006 field studies for marine wildlife are smaller in scope than those for 2004 and 2005. The study area for 2006 is the same as that described in Section 12.1.2.1 of the 2005 study plan. The sampling methods and taxa emphasized, however, have changed considerably (but not completely) in 2006, as discussed below. Data from all these surveys will be presented in the preliminary environmental baseline document.

Table 12.1-1 summarizes work conducted for the marine wildlife studies in 2004 through 2006. Figure 12.1-1 presents an overview of the study areas.

Boat-Based Surveys

In 2004 and 2005, a series of year-round boat-based surveys was conducted that provided high-resolution information on the distribution and abundance of marine-oriented birds and mammals, their age and sex ratios, and their activities and habitat locations. These surveys were conducted in early summer (June 2004, 2005), fall/early winter (December 2004, November 2005), late winter (March 2005), and spring (May 2005). In 2006, a second year of this cycle will be completed, with a late-winter cruise to be completed in March 2006 and a spring cruise to begin on May 1, 2006 (weather permitting). Data will be collected with the same methods used in 2004 and 2005, as outlined in Section 12.1 of the 2005 study plan.

Helicopter Surveys

Helicopter-based surveys were not conducted in 2004 or 2005. Surveys of the nearshore zone in the region of the proposed port (Figure 12.1-1) are scheduled for January through April 2006, weather permitting. (Because of severe weather, the January survey was cancelled; surveys were conducted in February, March, and April.) The focal taxa are Steller's Eiders and northern sea otters, although data on other species is being collected whenever possible. These surveys will provide some information on the timing of movements of these taxa out of the bays during the spring.

Harbor Seal Aerial Surveys

No surveys for harbor seals will be conducted in 2006. In 2005, a series of aerial-survey flights was done to photograph and count harbor seals in the study area and in Chinitna Bay from approximately May to December. Methods for these surveys are described in Chapter 9, Terrestrial Wildlife and Habitats, in the 2005 study plan. Researchers currently are finishing counting seals in these photographs.

12.2 Marine Nearshore Resources—Port

In 2006, additional field data will be collected on marine nearshore resources in the area of alternative port sites. Surveys were from April 25 through 28 and May 16 through 18, 2006. The 2006 studies

include three tasks that are continuations of tasks begun in 2004 and continued in 2005 (as described in the 2004 and 2005 study plans) and one new task, as described below. Methods for the surveys to be conducted in 2006, except the herring spawn surveys, are described in the 2005 field sampling plan for marine resources.

Tables 12.2-1 and 12.2-2 summarize work for the marine nearshore resources studies in 2004 through 2006. Figure 12.2-1 provides an overview of the study area and sampling locations.

Beach Seine Sampling

To document nearshore fish use, beach seining will be conducted—ice and sea state conditions permitting—at 13 stations sampled in previous work (Figure 12-1.1). Sampling will occur in late April to document early spring use of nearshore habitats, especially by juvenile salmonids. Sampling will also be conducted in mid-May in conjunction with the herring spawn surveys (see below). Selected fish will be retained for future stomach content analysis.

Trawl Sampling

Trawl sampling will be conducted at seven stations sampled in previous work (Figure 12.2-1). Sampling will occur in late April to document early spring use of shallow and deeper subtidal habitats in the vicinity of possible port sites. Sampling will also be conducted in mid-May in conjunction with the herring spawn surveys (see below).

Intertidal Rocky Habitat Assemblages

To take advantage of low tides during the April and to provide data on spring algal conditions that may provide a spawning substrate for herring, intertidal assemblage data will be collected at three rocky habitat stations (Figure 12.2-1). All sampling will occur during the April survey, except the lower elevation at Scott Island will be sampled in May. In addition to the previously sampled lower elevation transect at PS 1, transects will be set up, permanently marked, and sampled (in April) on middle and upper elevation rocky substrates in this area. Transects will be sampled as described in the 2005 field sampling plan, Section 4.2.

Herring Spawn Surveys (new task in 2006)

Skiff-based surveys will be conducted during spring low tides (late April and mid May) to search for herring spawn deposition in areas that may be impacted by port development. The survey team will cruise the shoreline around Scott Island and the Mushroom Islets (areas of historic herring spawning), around Knoll Head, and along Black Reef. The team will be particularly sensitive to areas where high bird or marine mammal activity is observed. They will document the condition of intertidal and shallow subtidal algal assemblages (especially kelp) and the presence or absence of herring spawn. GPS coordinates will be taken at all areas visited. Where herring spawn is detected, the following data will be recorded:

- Spawn density (scattered; near continuous; multilayered, including thickness).
- Substrata used (algae, eelgrass, rock).

- Elevation relative to mean lower low water.
- GPS coordinates of boundaries of spawn area.

In addition, photos will be taken of spawn deposition.

Table 12.1-1
Pebble Project Environmental Studies
Study Summary for Marine Wildlife, 2004-2006
Consultant: ABR, Inc.

Discipline	2004 Data Collected or Tasks	2005 Data Collected or Tasks	2006 Tasks to be Completed
Marine Wildlife		**Port/Cook Inlet**	
	Information Gathering / Literature Search	Information Gathering / Literature Search & Review	Information Gathering / Literature Search & Review
	Scope, Schedule, Field Sampling Plan	Scope, Schedule, Field Sampling Plan	Scope, Schedule, Field Sampling Plan
	2004 Study Plan	2005 Study Plan	2006 Study Plan Summary
	Marine Wildlife Surveys by Ship (June, November)	Marine Wildlife Surveys by Ship (March, May, June, November)	Marine Wildlife Surveys by Ship (March, May)
		Aerial Photography Surveys for Harbor Seals (May to December)	
			Marine Surveys by Helicopter for Steller's Eiders and Sea Otters (February, March, April)
	Data Entry and Analysis	Data Entry and Analysis	Data Entry and Analysis
	Communication and Data Management	Communication and Data Management	Communication and Data Management
	Coordination with NDM, Agency Meetings	Coordination with NDM, Agency Meetings, and Monthly Reporting	Coordination with NDM, Agency Meetings, and Monthly Reporting
		2004 Progress Report	Draft Environmental Baseline Document

Table 12.2-1
Pebble Project Environmental Studies
Study Summary for Marine Nearshore Resources, 2004-2006
Consultant: Pentec Environmental/Hart Crowser, Inc.

Discipline	2004 Data Collected or Tasks	2005 Data Collected or Tasks	2006 Tasks to be Completed
		Cook Inlet/Port	
Nearshore Fish and Demersal Invertebrates	Information Gathering/Literature Synthesis	Information Gathering/Literature Synthesis	
	Scope, Schedule, Field Sampling Plan	Scope, Schedule, Field Sampling Plan	Scope, Schedule, Field Sampling Plan
	2004 Study Plan	2005 Study Plan	2006 Study Plan Summary
	On-site Reconaissance and Station/Transect Selection	On-site Expansion of Stations/Transects Reflecting Current Design Alternatives	
	Year 1 Initial Nearshore Beach Seining at Proposed Port Sites	Year 2 Spring/Summer Nearshore Beach Seining at Proposed Port Sites (May through August)	Year 3 Early Spring Nearshore Beach Seining at Proposed Port Sites
	Year 1 Initial Otter Trawling Offshore Demersal Areas in Iniskin and Iliamna Bays	Year 2 Spring/Summer Otter Trawling Offshore Demersal Areas in Iniskin and Iliamna Bays (May through August)	Year 3 Early Spring Otter Trawling Offshore Demersal Areas in Iniskin and Iliamna Bays
	Fish Tissue Collection for Baseline Chemical Analysis	Fish Tissue Collection for Baseline Chemical Analysis	
			Iniskin/Iliamna Bay Herring Spawn Survey
			ADFG Herring Data Analysis
		Fish Collection for Stomach Content Analysis	Fish Collection for Stomach Content Analysis
	Year 1 Data Management and QA/QC	Year 2 Data Management and QA/QC	Year 3 Data Management and QA/QC
	Year 1 Data Analysis	Year 2 Data Analysis	Year 3 Data Analysis and Synthesis
	Coordination with NDM & Agencies	Coordination with NDM & Agencies	Coordination with NDM & Agencies
		2004 Progress Report on Marine Studies	Preparation of Draft Environmental Baseline Document
Marine Benthos/Habitat	Information Gathering/Literature Synthesis	Information Gathering/Literature Synthesis	
	Scope, Schedule, Field Sampling Plan	Scope, Schedule, Field Sampling Plan	Scope, Schedule, Field Sampling Plan
	2004 Study Plan	2005 Study Plan	2006 Study Plan Summary
	On-site Reconaissance and Station/Transect Selection	On-site Expansion of Stations/Transects Reflecting Current Design Alternatives	
	Year 1 Intertidal sampling of epibenthos on rocky habitats (late summer)	Year 2 Intertidal sampling of epibenthos on rocky habitats (mid summer)	Year 3 Intertidal sampling of epibenthos on selected rocky habitats (early spring)
	Year 1 Intertidal sampling for sediment chemistry on sand/mud habitats (late summer)	Year 2 Intertidal sampling for sediment chemistry on sand/mud habitats (mid summer)	
	Year 1 Subtidal sampling for sediment chemistry on sand/mud habitats (late summer)		
	Year 1 Intertidal sampling of infauna on sand/mud habitats (late summer)	Year 2 Intertidal sampling of infauna on sand/mud habitats (mid summer)	
	Year 1 Subtidal sampling of infauna on sand/mud habitats (late summer)		
	Year 1 Diver subtidal ebibenthos surveys		
	Year 1 Marine water quality sampling for trace metals		
	Invertebrate Tissue Collection for Baseline Chemical Analysis (late summer)	Invertebrate Tissue Collection for Baseline Chemical Analysis (mid summer)	
	Shoreline habitat verification	Shoreline habitat detailed survey	Shoreline habitat map generation
	Year 1 Data Management and QA/QC	Year 2 Data Management and QA/QC	Year 3 Data Management and QA/QC
	Year 1 Data Analysis	Year 2 Data Analysis	Year 3 Data Analysis and Synthesis
	Coordination with NDM & Agencies	Coordination with NDM & Agencies	Coordination with NDM & Agencies
		2004 Progress Report on Marine Studies	Preparation of Draft Environmental Baseline Document

Table 12.2-2
Pebble Project
Sample Site Period-of-Record Index
Port Area Marine Nearshore Resources

Monitoring Site	Year	Period Of Record By Discipline												Notes
		Water Quality (Contaminants)*												
	Month	J	F	M	A	M	J	J	A	S	O	N	D	
MBB (Blackie Bch.)	2004													Blackie Beach
	2005													
	2006													
MPS 1	2004								X					Port Site 1 - Knoll Head
	2005													
	2006													
MPS 1A**	2004													Knoll Head West
	2005													Also sampled in 1978 and 1996
	2006													
MPS 1B	2004													Weather Station South
	2005													
	2006													
MPS 1C	2004													Weather Station North
	2005													
	2006													
MPS 1T	2004													
	2005													
	2006													
MPS 2	2004								X					Port Site 2
	2005													
	2006													
MPS 2T	2004													
	2005													
	2006													
MPS 2TA	2004													
	2005													
	2006													
MPS 2TB	2004													
	2005													
	2006													
MPS 3	2004								X					Port Site 3 - Diamond Head
	2005													
	2006													
MPS 4	2004								X					Port Site 4 - North Head
	2005													
	2006													
MBS 1	2004													Southeast Iliamna Bay
	2005													
	2006													
MBS A1	2004													AC Point
	2005													
	2006													
MBS 3	2004													East central Iliamna Bay
	2005													
	2006													
MBS 4	2004													Williamsport
	2005													
	2006													
MPSE	2004									X				Port Site Existing (South of Williamsport)
	2005													
	2006													
MPSE1	2004													West central Iliamna Bay
	2005													
	2006													
MSI** (Scott Is.)	2004													Scott Island
	2005													Also sampled in 1978 and 1996
	2006													
MTR 1	2004													
	2005													
	2006													
MTR 2	2004													
	2005													
	2006													
MTR 3	2004													
	2005													
	2006													
MOPP 1	2004									X				Offshore reference site
	2005													
	2006													
White Gull Island	2004													
	2005													Also sampled in 1978 and 1996
	2006													

Monitoring Site	Year	Period Of Record By Discipline												Notes
		Intertidal Sediments/infauna												
	Month	J	F	M	A	M	J	J	A	S	O	N	D	
MBB (Blackie Bch.)	2004								X					Blackie Beach
	2005							X						
	2006													
MPS 1	2004													Port Site 1 - Knoll Head
	2005													
	2006													
MPS 1A**	2004								X					Knoll Head West
	2005							X						Also sampled in 1978 and 1996
	2006													
MPS 1B	2004													Weather Station South
	2005													
	2006													
MPS 1C	2004													Weather Station North
	2005													
	2006													
MPS 1T	2004													
	2005													
	2006													
MPS 2	2004								X					Port Site 2
	2005							X						
	2006													
MPS 2T	2004													
	2005													
	2006													
MPS 2TA	2004													
	2005													
	2006													
MPS 2TB	2004													
	2005													
	2006													
MPS 3	2004								X					Port Site 3 - Diamond Head
	2005							X						
	2006													
MPS 4	2004								X					Port Site 4 - North Head
	2005							X						
	2006													
MBS 1	2004													Southeast Iliamna Bay
	2005													
	2006													
MBS A1	2004													AC Point
	2005							X						
	2006													
MBS 3	2004													East central Iliamna Bay
	2005													
	2006													
MBS 4	2004													Williamsport
	2005													
	2006													
MPSE	2004								X					Port Site Existing (South of Williamsport)
	2005							X						
	2006													
MPSE1	2004													West central Iliamna Bay
	2005													
	2006													
MSI** (Scott Is.)	2004													Scott Island
	2005													Also sampled in 1978 and 1996
	2006													
MTR 1	2004													
	2005													
	2006													
MTR 2	2004													
	2005													
	2006													
MTR 3	2004													
	2005													
	2006													
MOPP 1	2004								X					Offshore reference site
	2005													
	2006													
White Gull Island	2004													
	2005													Also sampled in 1978 and 1996
	2006													

Monitoring Site	Year	Period Of Record By Discipline												Notes
		Intertidal Epibenthos												
	Month	J	F	M	A	M	J	J	A	S	O	N	D	
MBB (Blackie Bch.)	2004													Blackie Beach
	2005													
	2006													
MPS 1	2004								X					Port Site 1 - Knoll Head
	2005							X						
	2006				X									
MPS 1A**	2004								X					Knoll Head West
	2005							X						Also sampled in 1978 and 1996
	2006				X									
MPS 1B	2004													Weather Station South
	2005													
	2006													
MPS 1C	2004													Weather Station North
	2005													
	2006													
MPS 1T	2004													
	2005													
	2006													
MPS 2	2004								X					Port Site 2
	2005							X						
	2006													
MPS 2T	2004													
	2005													
	2006													
MPS 2TA	2004													
	2005													
	2006													
MPS 2TB	2004													
	2005													
	2006													
MPS 3	2004								X					Port Site 3 - Diamond Head
	2005							X						
	2006													
MPS 4	2004								X					Port Site 4 - North Head
	2005							X						
	2006													
MBS 1	2004													Southeast Iliamna Bay
	2005													
	2006													
MBS A1	2004													AC Point
	2005							X						
	2006													
MBS 3	2004													East central Iliamna Bay
	2005													
	2006													
MBS 4	2004													Williamsport
	2005													
	2006													
MPSE	2004													Port Site Existing (South of Williamsport)
	2005													
	2006													
MPSE1	2004													West central Iliamna Bay
	2005													
	2006													
MSI** (Scott Is.)	2004								X					Scott Island
	2005							X						Also sampled in 1978 and 1996
	2006				X									
MTR 1	2004													
	2005													
	2006													
MTR 2	2004													
	2005													
	2006													
MTR 3	2004													
	2005													
	2006													
MOPP 1	2004													Offshore reference site
	2005													
	2006													
White Gull Island	2004													
	2005													Also sampled in 1978 and 1996
	2006													

Monitoring Site	Year	Period Of Record By Discipline												Notes
		Subtidal Benthos/Sediments/Dive Tran												
	Month	J	F	M	A	M	J	J	A	S	O	N	D	
MBB (Blackie Bch.)	2004													Blackie Beach
	2005													
	2006													
MPS 1	2004								X					Port Site 1 - Knoll Head
	2005													
	2006													
MPS 1A**	2004													Knoll Head West
	2005													Also sampled in 1978 and 1996
	2006													
MPS 1B	2004													Weather Station South
	2005													
	2006													
MPS 1C	2004													Weather Station North
	2005													
	2006													
MPS 1T	2004													
	2005													
	2006													
MPS 2	2004								X					Port Site 2
	2005													
	2006													
MPS 2T	2004													
	2005													
	2006													
MPS 2TA	2004													
	2005													
	2006													
MPS 2TB	2004													
	2005													
	2006													
MPS 3	2004								X					Port Site 3 - Diamond Head
	2005													
	2006													
MPS 4	2004								X					Port Site 4 - North Head
	2005													
	2006													
MBS 1	2004													Southeast Iliamna Bay
	2005													
	2006													
MBS A1	2004													AC Point
	2005													
	2006													
MBS 3	2004													East central Iliamna Bay
	2005													
	2006													
MBS 4	2004													Williamsport
	2005													
	2006													
MPSE	2004													Port Site Existing (South of Williamsport)
	2005													
	2006													
MPSE1	2004													West central Iliamna Bay
	2005													
	2006													
MSI** (Scott Is.)	2004													Scott Island
	2005													Also sampled in 1978 and 1996
	2006													
MTR 1	2004													
	2005													
	2006													
MTR 2	2004													
	2005													
	2006													
MTR 3	2004													
	2005													
	2006													
MOPP 1	2004									X				Offshore reference site
	2005													
	2006													
White Gull Island	2004									X				
	2005													Also sampled in 1978 and 1996
	2006													

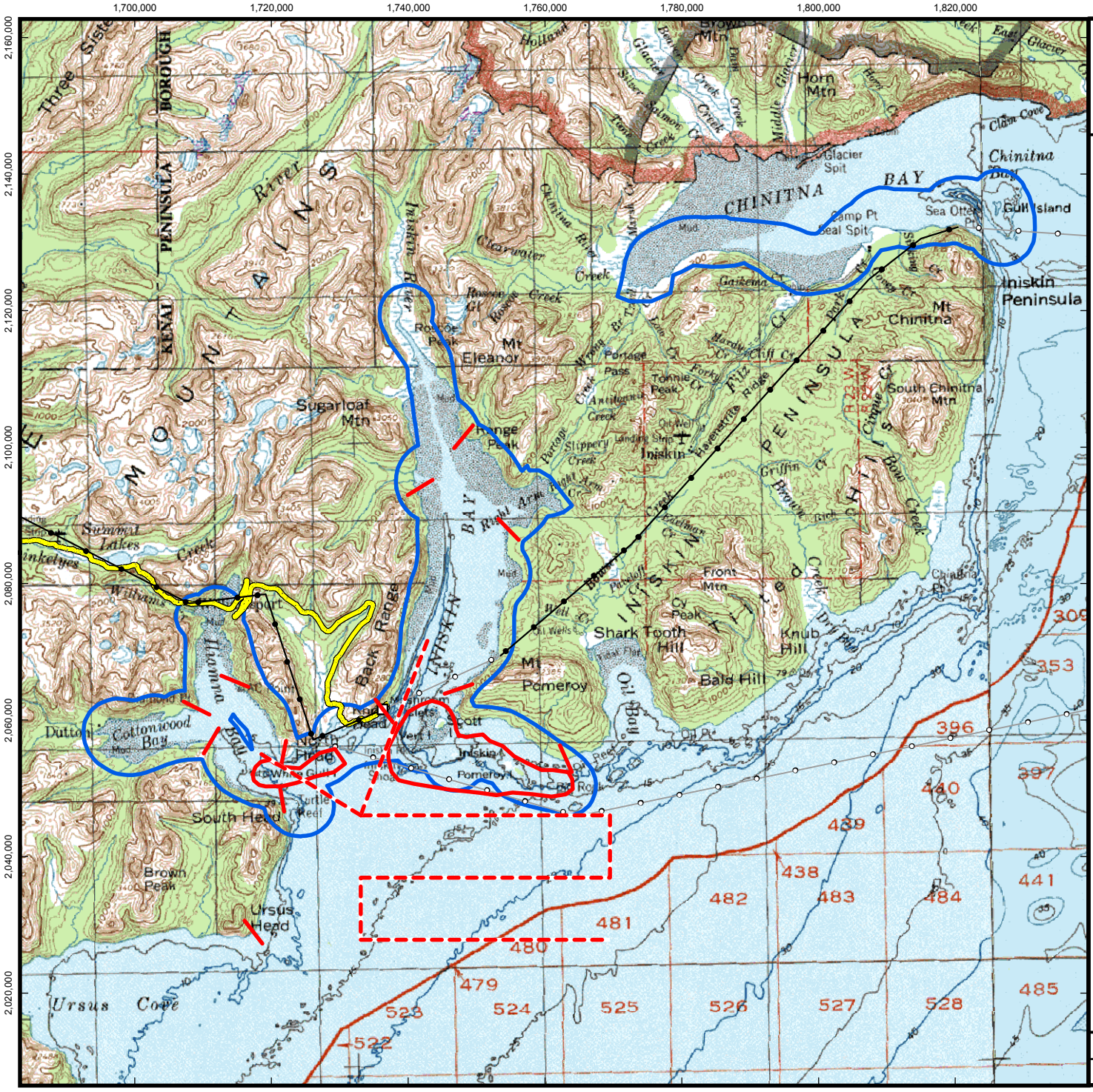
Monitoring Site	Year	Period Of Record By Discipline												Notes
		Beach Seines												
	Month	J	F	M	A	M	J	J	A	S	O	N	D	
MBB (Blackie Bch.)	2004													Blackie Beach
	2005													
	2006													
MPS 1	2004													Port Site 1 - Knoll Head
	2005													
	2006													
MPS 1A**	2004													Knoll Head West
	2005													Also sampled in 1978 and 1996
	2006													
MPS 1B	2004													Weather Station South
	2005													
	2006													
MPS 1C	2004													Weather Station North
	2005													
	2006													
MPS 1T	2004													
	2005													
	2006													
MPS 2	2004													Port Site 2
	2005													
	2006													
MPS 2T	2004													
	2005													
	2006													
MPS 2TA	2004													
	2005													
	2006													
MPS 2TB	2004													
	2005													
	2006													
MPS 3	2004													Port Site 3 - Diamond Head
	2005													
	2006													
MPS 4	2004													Port Site 4 - North Head
	2005													
	2006													
MBS 1	2004													Southeast Iliamna Bay
	2005													
	2006													
MBS A1	2004													AC Point
	2005													
	2006													
MBS 3	2004													East central Iliamna Bay
	2005													
	2006													
MBS 4	2004													Williamsport
	2005													
	2006													
MPSE	2004													Port Site Existing (South of Williamsport)
	2005													
	2006													
MPSE1	2004													West central Iliamna Bay
	2005													
	2006													
MSI** (Scott Is.)	2004													Scott Island
	2005													Also sampled in 1978 and 1996
	2006													
MTR 1	2004													
	2005													
	2006													
MTR 2	2004													
	2005													
	2006													
MTR 3	2004													
	2005													
	2006													
MOPP 1	2004													Offshore reference site
	2005													
	2006													
White Gull Island	2004													
	2005													Also sampled in 1978 and 1996
	2006													

Monitoring Site	Year	Period Of Record By Discipline												Notes
		Trawls												
	Month	J	F	M	A	M	J	J	A	S	O	N	D	
MBB (Blackie Bch.)	2004													Blackie Beach
	2005													
	2006													
MPS 1	2004													Port Site 1 - Knoll Head
	2005													
	2006													
MPS 1A**	2004													Knoll Head West
	2005													Also sampled in 1978 and 1996
	2006													
MPS 1B	2004													Weather Station South
	2005													
	2006													
MPS 1C	2004													Weather Station North
	2005													
	2006													
MPS 1T	2004								X					
	2005					X	X		X					
	2006				X	X								
MPS 2	2004													Port Site 2
	2005													
	2006													
MPS 2T	2004													
	2005					X	X	X	X					
	2006				X									
MPS 2TA	2004								X					
	2005						X	X	X					
	2006				X									
MPS 2TB	2004													
	2005						X	X	X	X				
	2006				X									
MPS 3	2004													Port Site 3 - Diamond Head
	2005													
	2006													
MPS 4	2004													Port Site 4 - North Head
	2005													
	2006													
MBS 1	2004													Southeast Iliamna Bay
	2005													
	2006													
MBS A1	2004													AC Point
	2005													
	2006													
MBS 3	2004													East central Iliamna Bay
	2005													
	2006													
MBS 4	2004													Williamsport
	2005													
	2006													
MPSE	2004													Port Site Existing (South of Williamsport)
	2005													
	2006													
MPSE1	2004													West central Iliamna Bay
	2005													
	2006													
MSI** (Scott Is.)	2004													Scott Island
	2005													Also sampled in 1978 and 1996
	2006													
MTR 1	2004													
	2005					X	X	X	X					
	2006				X	X								
MTR 2	2004													
	2005					X	X	X	X					
	2006				X	X								
MTR 3	2004													
	2005					X	X	X	X					
	2006					X								
MOPP 1	2004													Offshore reference site
	2005													
	2006													
White Gull Island	2004													
	2005													Also sampled in 1978 and 1996
	2006													

NOTES:

* In addition to contaminant water quality, temperature and salinity were taken with most beach seine and trawl events.

** In addition to the 2004 - 2006 data, quantitative data on intertidal epibenthos are available for these sites from 1978 and 1996.



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NORTHERN DYNASTY MINES INC.

Figure 12.1-1.
2004, 2005 and 2006 Surveys for Marine Wildlife in the Transportation Corridor

DRAFT

Marine Wildlife Survey Areas

- 2004, 2005 and 2006 Nearshore Segment Boundaries for Boat Surveys and 2006 Helicopter Surveys for Sea Otters and Steller's Eiders
- 2004, 2005 and 2006 Offshore Boat Survey Transects
- 2005 Coastal Seal Survey

- Proposed Road Alignment
- Proposed Transmission Line
- Proposed Submarine Powerline
- Proposed Port Site

Miles 0 1 2 3 4 5 6

Kilometers 0 2 4 6 8 10

N

Scale 1:250,000

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

File: Marine_Wildlife_StudyPlan06_06-170-1.mxd	Date: June 7, 2006
Version: 1	Author: ABR-AZC

Pebble Project

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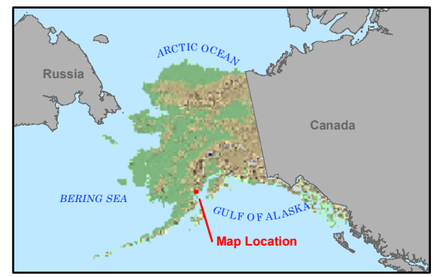
Sampling Plan 2006
Marine Benthos and Nearshore
Fish Sampling Locations
Figure 12.2-1
DRAFT

Legend

Marine Benthos and Nearshore Fish Sampling Locations

- Beach Seine
- Intertidal
- Trawl
- J. Collings Route (10/2005)
- ADOT&PF Road Study Corridor (11/2005)
- Port Site

Note: Shoreline may be inaccurate base on tidal variation.



Miles
0 1 2 3

Kilometers
0 0.7 1.4 2.1 2.8 3.5

Scale 1:70,000

N

Contour Interval 100 ft
Alaska State Plane Zone 5 (units feet)
1983 North American Datum

File: RDI_Pen_MarineSampLocs_11X17L_1of1_D04.mxd	Date: May 31, 2006
Version: 4 - Pentec Job #12644-01	Author: RDI-LS