Pebble Project

NORTHERN DYNASTY MINES INC.

DRAFT ENVIRONMENTAL BASELINE STUDIES
2005 STUDY PLANS

CHAPTER 12. MARINE

NOVEMBER 2005

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LIST OF FIGURES (following document)

ACRONYMS

AASHTO	American Association of State and Highway Transportation Officials
ABA	acid base accounting
ACHP	Advisory Council on Historic Preservation
ACLS	alternative cleanup levels
ADEC	Alaska Department of Environmental Conservation
agl	above ground level
AHRS	Alaska Heritage Resource Survey
APE	area of potential effect
ARD/ML	acid rock leaching/metal leaching
ASCI	Alaska Stream Condition Index
BEESC	Bristol Environmental & Engineering Services Corporation
BMR	baseline monitoring report
CC	comprehensive stations with continuous stage monitoring
CH2M	CH2M HILL, Inc.
CIR	color infrared
CWOC	comprehensive stations without continuous stage monitoring
DECD	Alaska Department of Economic and Community Development
DNR	State of Alaska Department of Natural Resources
DO	dissolved oxygen
DOT&PF	State of Alaska Department of Transportation & Public Facilities
DQOs	data quality objectives
EC	environmental consequences
EIS	environmental impact statement
EPA	Environmental Protection Agency
EBD	environmental baseline document
FAA	Federal Aviation Administration
FHWA	Federal Highway Administration
FSP	field sampling plan
GIS	geographic information system
GPS	global positioning system
HGM	hydrogeomorphic
IM	initial monitoring station
mg/L	milligrams per liter
mm	millimeters

MRLs	method reporting limits
NDM	Northern Dynasty Mines Inc.
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NOAA	National Oceanic & Atmospheric Administration
NPS	National Park Service
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NWI	National Wetlands Inventory
ORP	oxidation reduction potential
PJD	preliminary jurisdictional determination
PSD	prevention of significant deterioration
QA	quality assurance
QAPP	quality assurance project plan
QC	quality control
SHPO	State Historic Preservation Officer
SOPs	standard operating procedures
SWANCC	Solid Waste Agency of Northern Cook County v. U.S. Army Corp of Engineers
SWE	snow-water equivalent
TPH	total petroleum hydrocarbons
USACE	United States Army Corp of Engineers
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WMP	water monitoring plan

12. MARINE

This section is relevant only to the proposed road/port and submarine power cable options of the Pebble Project. The marine work plan for the 2005 field season includes detailed marine-wildlife studies and reconnaissance-level surveys of marine fauna, flora, and their habitat. If required, additional marine study-plan components will be identified and planned at a later date. ABR will complete the marine-wildlife survey work for the port, and BEESC will complete the marine reconnaissance-level work.

12.1 Marine Wildlife — Port

12.1.1 Objectives

The objective of this study plan is the characterization of the seasonal distribution and abundance of marine-oriented wildlife in the potential port area(s), particularly those that could be affected by the construction of the port facility and the passage of ships through the area. Although all species will be examined, special emphasis will be placed on endangered species, such as Steller's Eiders, and on species that have been nominated for listing under the Endangered Species Act, such as Kittlitz's Murrelets.

12.1.2 Proposed Study Plan

12.1.2.1 Study Area/Scope

The study area will include the proposed port areas and nearby open coastline, weather permitting (Figure 12-1). At this time, until the preferred port site option is selected, the survey will include:

- The shoreline of Iniskin Bay.
- The shoreline of Iliamna Bay.
- The shoreline of the nearby outer coastline (east almost to Oil Bay and south to Ursus Head).
- Islands and islets near the mouth of Iniskin Bay (the Mushroom Islets and Scott, Vert, Iniskin, and Pomeroy islands).
- Islands and islets near the mouth of Iliamna Bay (White Gull Island, Turtle Reef, Black Reef).
- Deeper water in the centers of Iliamna and Iniskin bays and in the open bight to the southeast of their mouths.

The taxonomic scope of the surveys will include all marine-oriented wildlife that have a marine orientation during at least one stage of the annual cycle. Bird species of particular interest include:

- Waterfowl (geese, swans, and ducks).
- Loons.
- Grebes.

- Tubenoses (fulmars and storm-petrels).
- Cormorants.
- Herons.
- Raptors.
- Cranes.
- Shorebirds.
- Larids (jaegers, gulls, and terns).
- Alcids.
- Kingfishers.
- Corvids.

Mammal species of particular interest include:

- Mustelids (otters).
- Pinnipeds (seals and sea lions).
- Ursids (bears).
- Cetaceans (whales and porpoises).

12.1.2.2 Methods and Approach

Four boat-based surveys for marine-oriented wildlife will be conducted in Iniskin and Iliamna bays and nearby areas: late winter/early spring 2005 (March), spring 2005 (May), early summer 2005 (June), and fall 2005 (November). During each survey, the distribution and abundance of marine-oriented wildlife seen on nearshore surveys will be plotted, as will the general locations of marine-oriented wildlife seen on offshore survey segments. Each segment will be surveyed at least one time/cruise, weather permitting; if time permits, replicate samples will be taken.

Nearshore and offshore survey methods are standardized sampling techniques used by the U.S. Fish and Wildlife Service and other researchers. Specifically, to conduct nearshore surveys, we will:

- Sample from a skiff (e.g., Achilles raft, aluminum skiff).
- Follow the shoreline ~100 m from shore.
- Identify, count, and map locations of all marine-oriented wildlife seen in the nearshore zone (within 200 m from shore) or on the shoreline or nearshore areas (within 100 m from the coastline; primarily for raptors and corvids) or flying over these areas (Figure 12-1); however, flying birds will not be mapped.
- Describe locations (habitats) and activities (e.g., resting, feeding) of each wildlife sighting.
- Record environmental characteristics associated with each nearshore survey segment.
- Use GIS measurements to determine the area sampled in each nearshore segment.

- Use the GIS information to convert counts to estimates of birds/mi² or mammals/mi² of area surveyed in each segment.
- Digitize locations of all marine wildlife except flying birds.

To conduct offshore surveys, we will:

- Sample a series of strip-transect segments in the offshore zone (central portion) of each bay and in the open bight.
- Follow a fixed trackline (Figure 12-1).
- Record ship speed, time, and beginning and ending coordinates for each segment.
- Count all marine-oriented wildlife seen within 150 m on either side of the boat.
- Describe locations (habitats) and activities (e.g., resting, feeding) of each wildlife sighting.
- Record environmental characteristics associated with each offshore survey segment.
- Use GIS measurements to determine the area sampled in each offshore segment.
- Use the GIS information to convert counts to estimates of birds/km² or mammals/km² of area surveyed in each segment.
- Use waypoints in each sampling transect to map approximate locations of each sighting.

12.1.2.3 Major Activities

Major activities will include counting and determining the distribution of marine birds and mammals in the study area at various times of the year. Locations of birds and mammals on the water or shoreline will be mapped.

The major activities in this program are to:

- Survey the distribution and abundance of marine-oriented wildlife in the potential port areas with standardized boat-based surveys during four seasons (late winter/early spring, spring, summer, fall).
- Describe the seasonal species-composition of the marine-oriented wildlife community.
- Determine and describe the use of the potential port areas by Steller's Eiders and Kittlitz's Murrelets so that, if either species occurs there, strategies can be developed to minimize impacts.

Reconnaissance overflights of the landfall area and adjacent marine habitats at Seal Spit in Chinitna Bay (the potential northern submarine power-cable route) will be conducted as part of the marine mammal surveys described in Chapter 9. Surveys of marine habitats at the landfall area of the southern submarine power-cable route will be covered by the marine wildlife surveys at the proposed port site (described above).

12.2 Marine Reconnaissance — Port

12.2.1 Objectives of Study

The objective of this work is to characterize the marine fauna, flora, and related habitat conditions in the area(s) that could be potentially affected by a port and related shipping activities.

12.2.2 Study Area/Scope

The study area will include the proposed port area(s) and nearby coastlines, and will include a consideration of intertidal infaunal and epifaunal communities, and marine and anadromous fish.

12.2.3 Major Activities

The marine sampling program for 2005 will study the nature and usage of the nearshore and intertidal habitat in the project area. The intertidal studies will include:

- Mapping of intertidal habitat types.
- Beach seining.
- Quantitative survey of intertidal epibenthic assemblages.
- Intertidal infaunal and sediment sampling in soft-bottom habitats.
- Offshore trawling with a "try-net."

A detailed discussion of each task is listed below.

12.2.3.1 Mapping of Intertidal Habitat Types

Intertidal habitat types present around portions of the Iliamna/Iniskin estuary (IIE) that may be directly impacted by port development will be mapped. The area of study will include Iliamna Bay, the lower reaches of Iniskin Bay, and the headlands between the two bays. Intertidal habitat mapping will be conducted building on base information from the Cook Inlet Regional Citizen's Advisory Council (CIRCAC) and other observations. Where field observations differ significantly from existing mapping, dominant substrate types observed in the upper, middle, and lower intertidal zones will be recorded separately. Habitat mapping will include recording locations using global positioning systems (GPS) for later incorporation into the project GIS base map.

12.2.3.2 Beach Seining

Beach seining will study the use of the littoral zone by juvenile salmonids, forage fish, and invertebrates. Seining will be performed biweekly from early May through early July with more intensive surveys in late May and early June to study salmonid out-migration through the estuary. Less frequent sampling will extend into September. Proposed beach seining locations include several beaches near proposed port site locations, as well as potential causeway and shoreline roads (Figure 12-A).

BEESC will rely on herring spawn surveys conducted by the Alaska Department of Fish and Game (ADF&G) in the IIE and adjacent bays. ADF&G currently surveys the study area by air on

a weekly basis, weather permitting, with at least one on-water survey annually. Using ADF&G personnel will ensure that the survey methods are consistent with ongoing surveys in the area and defensible. ADF&G has already provided data to our team on surveys conducted between 1978 and 2002.

Spotted greenling will be collected to provide tissue samples of resident fish species. The spotted greenling was selected due to its limited migratory range and its potential for human consumption. Tissue samples from collected specimens will be analyzed for trace metals, hydrocarbons, or other inorganic chemistry by the project laboratories in accordance with the project field sampling plan (BEESC, 2005) and project-specific Quality Assurance Project Plan (NDM, 2005).

12.2.3.3 Offshore Trawling

Offshore trawling with a "try-net" will be conducted concurrent with beach seining activities between May (or ice out) and September. Extending the trawling program over the entire summer will allow evaluation of both resident and migratory species and event-related species interaction such as herring spawning. A food web study will analyze stomach contents of key fish species collected from seine and trawl programs to document prey and feeding patterns.

12.2.3.4 Intertidal Epibenthic Assemblages

Intertidal epibenthic assemblages will be quantified in fixed quadrats on fixed transects. The sampling program will revisit some sites established in 1978, 1996, and 2004, as well as establishing several new sites along Iliamna Bay to evaluate potential impact from construction of the port access road. Key historic sampling locations will be revisited to ensure that monuments are well established for future reference, as well as to evaluate long-term trends observed in algae and barnacle cover on these beaches. Proposed sampling locations are shown on Figure 12-B.

12.2.3.5 Intertidal Infaunal and Sediment Sampling

Intertidal infaunal and sediment sampling in soft-bottom habitats will be conducted as in 2004 to establish the type and distribution of infaunal species in the soft intertidal areas. Larger intertidal infaunal samples (0.25-m^2) will be excavated and sieved to collect larger organisms, including bivalves for contaminant analyses.

Sediment and tissue samples will be analyzed for trace metals, hydrocarbons, or other inorganic chemistry by the project laboratories in accordance with the project field sampling plan (BEESC, 2005) and project-specific quality assurance project plan (NDM, 2005). Infauna samples collected from the intertidal and subtidal IIE will be analyzed by the University of Alaska Fairbanks (UAF) Institute of Marine Science laboratory. Analyses will include calculation of coefficients of variation for subsequent incorporation into a power analysis.

12.2.4 Logistics

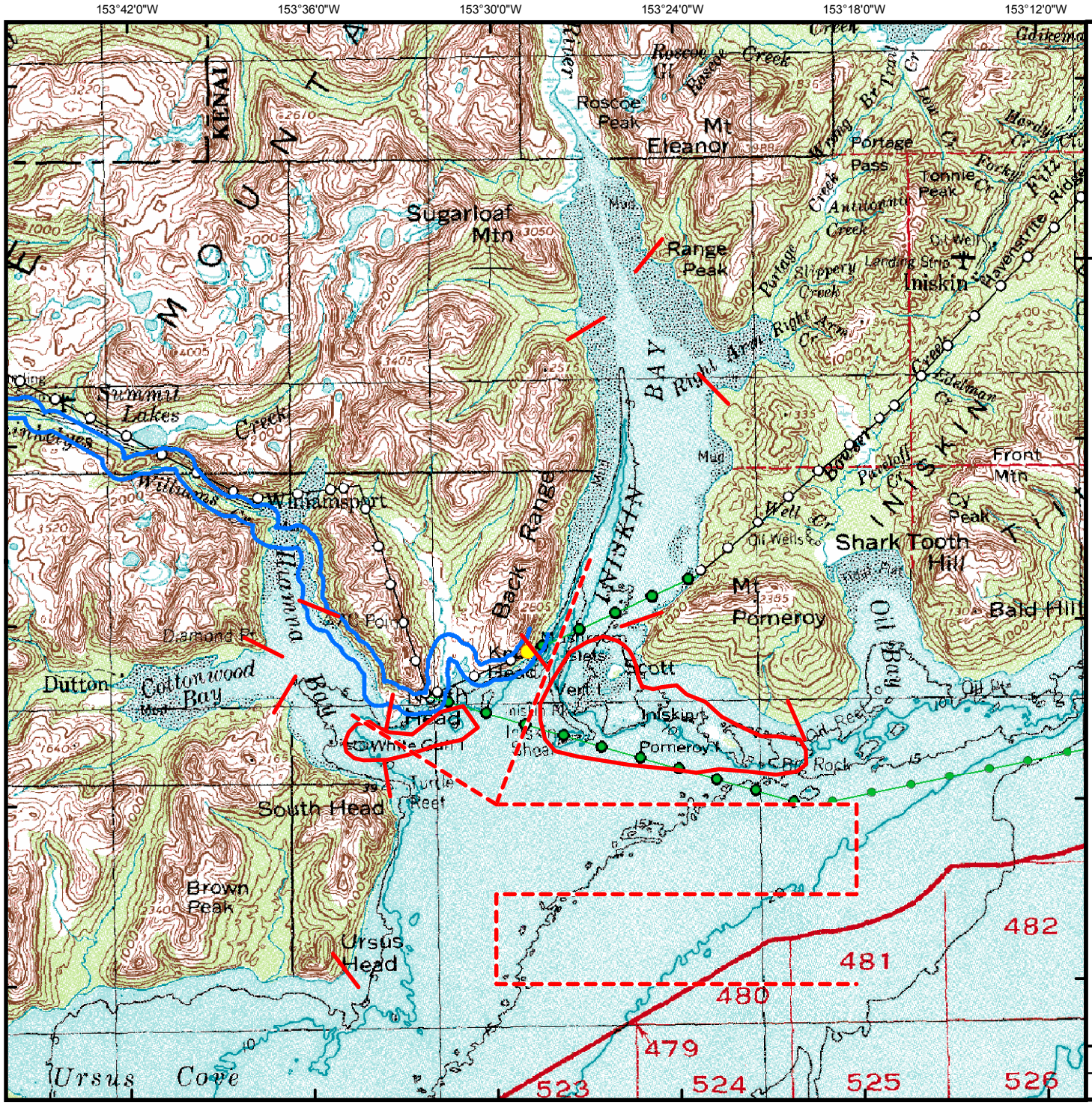
The 2004 sampling event was designed as a one-time event intended to collect a snapshot of marine conditions. Because of the timing of that event, efforts were focused to maximize the amount of data collected in a very limited time period. To obtain the highest quality data in 2005, field tasks will be scheduled during the most beneficial seasonal and tidal cycles for each study task. All work will be conducted from marine vessels chartered from Homer.

12.3 References

Bristol Engineering and Environmental Services Corporation (BEESC). 2005. Draft Environmental Baseline Studies, Marine Studies, 2005 Field Sampling Plan. Prepared for Northern Dynasty Mines Inc.

Northern Dynasty Mines Inc. (NDM). 2005. Draft Environmental Baseline Studies, 2005 Final Quality Assurance Project Plan.

FIGURES



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Nearshore and Offshore Surveys for Marine Birds
Figure 12-1

Legend

- Nearshore Segment Breaks
- Offshore Survey Transects
- 2000-ft Road Corridor
- Proposed Port Site
- Proposed Transmission Lines
- Proposed Submarine Powerlines

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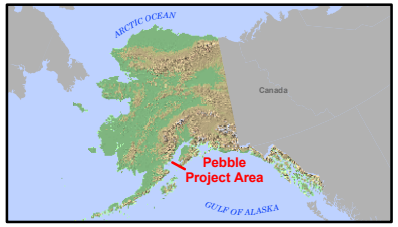

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Kilometers 0 1 2 3 4
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Scale 1:175,000

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

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Version: 2	Author: ABR-DD-AZC

1,700,000

1,750,000

2,050,000

Sand & Mud

Right Arm

Foul

Rk

Rks

Bids

M

Cl

Reef
(Cov 1 ft at MLLW)

INISKIN BAY

Summit Lakes

Williams Creek

Williamsport

Back Range

A.C. Point

Knoll Head

North Head

ILIAMNA BAY
(use inset)

COTTONWOOD BAY
(use inset)

Diamond Pt

Kelp

Vert

Iniskin Rk

Iniskin I

Iniskin Shoal

Black Reef

White Gull I
(70)

Turtle Reef
rky (15)

South Head

LOCAL MAGNETIC DISTURBANCE
(see note)

Pomeroy I

Big Rk
(9)

Mushroom
Islets

Scott I

The Toadstools

Mt Pomeroy

S Oz

S M

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Beach Seining Sites
Figure 12-A.

Legend

Beach Seine Site

Samples in 2004

New Site

Port Site 1

ADOT&PF Preferred Corridor

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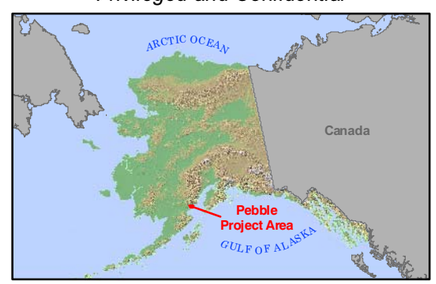

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0 0.6 1.2 1.8 2.4 Miles

0 0.8 1.6 2.4 3.2 Kilometers

Scale 1:70,000

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

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Version: 2	**Author: BEESC-ME**

1,700,000

1,750,000

2,050,000

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Intertidal Survey Sites
Figure 12-B.

Legend

- Rocky Beach
- Soft Beach
- Port Site 1
- ADOT&PF Preferred Corridor

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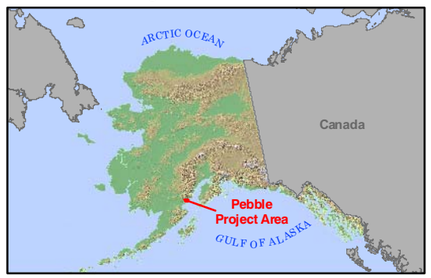

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0 0.8 1.6 2.4 3.2 Kilometers

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