Pebble Project

NORTHERN DYNASTY MINES INC.

DRAFT ENVIRONMENTAL BASELINE STUDIES

FIELD SAMPLING PLAN

CHAPTER 5. GROUND WATER
ROAD / PORT

NOVEMBER 2005

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ACRONYMS AND ABBREVIATIONS

ADEC	Alaska Department of Environmental Conservation
BEESC	Bristol Environmental & Engineering Services Corporation
C	Celsius
CAS	Columbia Analytical Services
COC	chain of custody
DI	deionized
DO	dissolved oxygen
EPA	U.S. Environmental Protection Agency
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
µg/L	micrograms per liter
µm	micrometer(s)
µS/cm	microSiemens per centimeter
mg/L	milligrams per liter
MS	matrix spike
MSD	matrix spike duplicate
NCA	North Creek Analytical
NDM	Northern Dynasty Mines, Inc.
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
TDS	total dissolved solids
TSS	total suspended solids

1.0 INTRODUCTION

An environmental monitoring program is being conducted to develop baseline environmental data for the Pebble Project. Information on the proposed development and an overview of the environmental program are described in the Pebble Project *Draft Environmental Baseline Studies, Proposed 2005 Study Plan* (NDM, in press).

The purpose of this Field Sampling Plan is to detail tasks and to establish field procedures for conducting a study of groundwater chemistry in the road and port areas. The field work for this study will involve collecting and analyzing groundwater samples from existing wells along the proposed road corridor. This Field Sampling Plan also provides the basis for appropriate quality assurance (QA) and quality control (QC) measures to be instituted and monitored during data-collection activities.

The groundwater studies field work for the road/port will be conducted by Bristol Environmental & Engineering Services Corporation (BEESC) under direct contract to Northern Dynasty Mines Inc. (NDM).

2.0 PROJECT SCOPE AND OBJECTIVES

2.1 OBJECTIVES

The objective of the groundwater-quality studies is to define the chemical characteristics of groundwater used for drinking water along the proposed road corridor between the Newhalen River and Cook Inlet. Establishment of this baseline and regular, ongoing monitoring will give local residents confidence that their health is being considered and protected. At the port site, where ore concentrates may be temporarily stored and handled, there is potential for environmental impact to groundwater. The objective at the port site is to establish background concentrations of naturally occurring constituents in groundwater.

2.2 SAMPLE LOCATION SUMMARY

Groundwater samples will be collected from existing water-supply wells along the road corridor. Upon selection of the port site, a program involving installation of groundwater monitoring wells may be required. This aspect of the program will be evaluated after the port site configuration is finalized.

The following four wells, shown on Figure 1, will be sampled on a quarterly basis in 2005:

- Nondalton City Well
- Newhalen Public Well #2
- Iliamna Weathered Inn
- Pedro Bay Tribal Council Well

The groundwater analysis methods are detailed in the *Draft Environmental Baseline Studies, 2005 Final Quality Assurance Project Plan* (QAPP; NDM, 2005).

3.0 GROUNDWATER ANALYTICAL SAMPLING

3.1 SAMPLE COLLECTION

The basic requirements for sampling groundwater from existing community drinking-water wells are designed to maximize sample quality and facilitate the permitting process. For each sample, water will be collected from a tap after running the water for several minutes. For the Nondalton and Newhalen wells, the water will be sampled from where it first leaves the wellhead, prior to chlorination. Water from the Iliamna and Pedro Bay wells is not treated. Groundwater will be tested for the same laboratory parameters and field parameters as for surface water (Table 1). QA/QC protocols will follow procedures outlined in Section 3.3 and in the QAPP (NDM, 2005).

Table 1. Groundwater Analytes for Laboratory Determination

Analyte	Method	Method Reporting Limit (µg/L)
Aluminum, total and dissolved	E200.8	1.0
Antimony, total and dissolved	E200.8	0.05
Arsenic, total and dissolved	E200.8	0.5
Barium, total and dissolved	E200.8	0.05
Beryllium, total and dissolved	E200.8	0.02
Bismuth	E200.8	0.1
Boron	E200.8	0.5
Cadmium, total and dissolved	E200.8	0.02
Calcium, total and dissolved	200.7	50
Chromium, total and dissolved	E200.8	0.2
Cobalt, total and dissolved	E200.8	0.02
Copper, total and dissolved	E200.8	0.1
Iron, total and dissolved	E200.7/200.8	20
Lead, total and dissolved	E200.8	0.02
Magnesium, total and dissolved	E200.7/200.8	20
Manganese, total and dissolved	E200.8	0.05
Mercury, total and dissolved	E245.1	0.2
Molybdenum, total and dissolved	E200.8	0.05
Nickel, total and dissolved	E200.8	0.2
Potassium, total and dissolved	E200.7/200.8	50

Analyte	Method	Method Reporting Limit (µg/L)
Selenium, total and dissolved	E200.8	1
Silver, total and dissolved	E200.8	0.02
Sodium, total and dissolved	E200.7/200.8	100
Thallium, total and dissolved	E200.8	0.01
Tin, total and dissolved	E200.8	1
Vanadium, total and dissolved	E200.8	0.2
Zinc, total and dissolved	E200.8	0.5
pH	E150.1	N/A
Specific Conductance	SM20 2510B	2 (µS/cm)
Alkalinity	SM20 2320B	10 (mg/L)
Acidity	E305.2	10 (mg/L)
Ammonia	SM20 4500NH3 G	0.1 (mg/L)
Chloride	E300.0	0.2 (mg/L)
Cyanide-total	SM20 4500	0.01 (mg/L)
Cyanide-WAD	SM20 4500	0.01 (mg/L)
Fluoride	E300.0	0.1 (mg/L)
Nitrate + Nitrite	E300.0	0.1 (mg/L)
Phosphorus-total	E365.2	0.1 (mg/L)
Sulfate	E300.0	0.01 (mg/L)
TDS	E160.1	10 (mg/L)
TSS	E160.2	5 (mg/L)
Thiocyanate	Lab SOP	1 (mg/L)
Hardness	SM20 2340 B	N/A

Notes:

µg/L = micrograms per liter

µS/cm = microSiemens per centimeter

mg/L = milligrams per liter

E – Methods for Chemical Analysis of Inorganic Substances in Environmental Samples, EPA/600/R-93-100, August 1993, and Methods for the Determination of Metals in Environmental Samples, EPA/600/4-91-010, June 1991.

SM – Standard Methods for the Examination of Water and Wastewater, 20th Edition.

Before a water sample is collected, the following field parameters will be measured and recorded in the field logbook:

- Dissolved oxygen.
- Conductivity.

- Temperature.
- pH.
- Turbidity.

Groundwater samples will be collected for analysis in the following order:

1. Total metals.
2. Dissolved metals.
3. Total suspended solids (TSS), Total dissolved solids (TDS), etc.
4. Cyanide.
5. Miscellaneous parameters (e.g., ammonia, phosphorus).

Samples collected for dissolved metals analyses will be filtered using disposable 0.45 micrometer, inline filters. Sample preservatives will be added to sample bottles by the laboratory prior to field sampling. Water collected in the field will be placed in bottles already containing the preservative.

At each sampling location, all bottles designated for a particular analysis will be filled sequentially before bottles designated for the next analysis are filled. If a duplicate sample is to be collected at a location, all bottles designated for a particular analysis for both duplicates will be filled sequentially before bottles for another analysis are filled.

Because the water samples will be collected directly from the tap at each well, no non-disposable sampling equipment will be used; therefore, no decontamination procedures are required.

3.2 SAMPLE HANDLING

Samples will be packed to prevent breakage and will be kept chilled during field operations by packing the samples with frozen gel ice.

3.2.1 Sample Containers

Sample-container requirements are described in the QAPP (NDM, 2005). The field-team leader will review the bottle order received from the laboratory against the QAPP prior to departing for Iliamna to verify that the requirements for sample containers, container types, and preservation have been met.

3.2.2 Sample Identification

Each sample container will have a waterproof label large enough to contain the information needed to easily identify each sample. The information to be included on each label will include the project name, date, time, preservative (if added), sample identification, analysis, and sampler's initials. Sample identification will be formatted to indicate sample date (month

and year), location, matrix, and number. Each sampling location will be identified by the sampler on the field form. An example of a sample identification is as follows:

0105ILIWIWG001

Where:

- 0105 is the date as month/year
- ILIWI is the location ID
- WG is the matrix code for groundwater
- 001 is a sequential sample number

For field duplicates, the sequential sample number will be 201, and triplicates will be 301.

3.2.3 Sample Custody

Chain-of-custody (COC) forms will be used for all samples and will be prepared by the field sample-handling person at Iliamna. Once collected, samples will remain within sight of the sampler or will be secured until the samples are turned over to the sample-handling person at Iliamna for transport to Anchorage. The field sample-handling person will be responsible for shipping and laboratory notification.

3.3 FIELD QUALITY CONTROL SAMPLES

To aid in evaluating the accuracy and precision of the analytical data, QC (duplicate) samples, and QA (triplicate) samples will be collected and subjected to the same analyses as identified for task samples. Equipment (also known as field) blanks will not be collected during this program because groundwater samples are being collected directly from the wells and sample-collection equipment is not used. The field QA/QC samples to be collected are summarized in the QAPP (NDM, 2005).

4.0 MEASUREMENT OF FIELD PARAMETERS

4.1 COLLECTION OF MEASUREMENTS

Portable instruments will be used for the in situ measurement of pH, temperature, dissolved oxygen, conductivity, and turbidity. The field measurements of water levels, pH, temperature, dissolved oxygen, conductivity, and turbidity will be recorded in the field logbook or on field sampling sheets, as appropriate.

4.2 EQUIPMENT CALIBRATION AND QUALITY CONTROL

Field equipment used for collection, measurement, and testing will be subject to a strict program of control, calibration, adjustment, and maintenance. Recorded measurements will not be taken until field readings stabilize. These values will then be recorded. Calibrations will be performed before each day's sampling and will be checked before sampling at each

station with reference to standard calibration solution. The standards of calibration are in accordance with the equipment manufacturer's handbook of specifications. All calibration activities will be documented on appropriate field-calibration forms.

The field-crew leader will review data measured in the field, and senior personnel will perform final validation by checking procedures used in the field and comparing the data with previous results.

Data that cannot be validated will be documented and corrective action may be required. Field-sampling corrective actions include procedures to be followed when field data results are not within the acceptable error-tolerance range. These procedures include the following:

- Comparing data readings being measured with readings previously recorded.
- Recalibrating equipment (e.g., pH meters).
- Replacing or repairing faulty equipment.
- Resampling, when feasible.

The field-team leader is responsible for ordering appropriate corrective actions when deemed necessary. All corrective actions will be recorded in the field book.

Equipment will be maintained in good operating condition.

5.0 RECORD KEEPING

Field observations, field equipment-calibration information, field measurements, and sample documentation—including sample identification, sample duplicates and triplicates, and date and time of sample collection—will be the responsibility of the entire sampling team. Record keeping will be accomplished with field logbooks, as described below. No general rules can specify the extent of information that must be entered on the field records; however, they will contain sufficient information so that all field activity can be reconstructed without relying on the memory of the field crew.

5.1 FIELD LOGBOOKS

A field logbook will be maintained on a daily basis to document all field activities, including the collection of every sample. The field logbook will be bound, with consecutively numbered pages. All field notes will be entered in indelible ink. At a minimum, field logbooks will contain the following information:

- Date and time that work commenced.
- Name and location of site.
- Description of work area.
- Date and times of sample collection or event.
- Name of the leader of the field team; names of all field personnel; and the names,

addresses, and telephone numbers of all pertinent project contacts.

- Summary of equipment preparation procedures.
- Field observations (weather conditions, field instrument readings).
- Number and type of samples collected and sample identification numbers.
- Sample location.
- Explanations of any deviations from this Field Sampling Plan, with rationale for deviation.
- Problems encountered and their resolution.

Field activities, site conditions, and sampling locations will be documented with photographs. Calibration logbooks will be maintained for each field-parameter meter used for the entire sampling season. The data in the calibration logbooks will include the name of the person doing the calibration, date and time, calibration solution and expiration date, and reading versus calibration value.

5.2 CORRECTIONS TO DOCUMENTATION

Unless weather conditions prevent it, all original data will be recorded using waterproof ink. No records will be destroyed or thrown away, even if they are illegible or contain inaccuracies that require a replacement document. If an error is made on a record assigned to one person, that person must make corrections by drawing a line through the error, initialing and dating the lined-out item, and entering the correct information. The erroneous information is not to be obliterated, but is to remain legible. Any subsequent error discovered on a document will be corrected by the person who made the entry. All such subsequent corrections will be initialed and dated.

6.0 REFERENCES

Northern Dynasty Mines (NDM). In press. Draft Environmental Baseline Studies, Proposed 2005 Study Plan.

———. 2005. Draft Environmental Baseline Studies, 2005 Final Quality Assurance Project Plan.

FIGURE

1,400,000 1,450,000 1,500,000 1,550,000 1,600,000 1,650,000 1,700,000 1,750,000

2,250,000 2,200,000 2,150,000 2,100,000 2,050,000 2,000,000

Nondalton

Iliamna

Newhalen

Pedro Bay

Northern Dynasty Mines Inc.

Pebble Project

Groundwater Well Sample Locations

Figure 1.

Legend

- Groundwater Well Sample Location
- Port Site 1
- ADOT&PF Preferred Road Corridor

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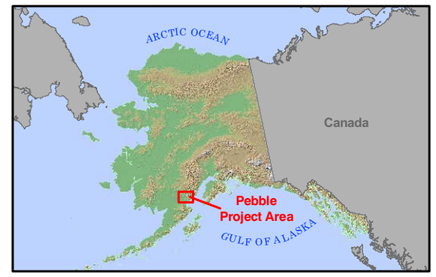

0 16,000 32,000 48,000 64,000 Feet

0 4,700 9,400 14,100 18,800 Meters

Scale 1:361,929

N

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

File: WaterGrnd_V02.mxd	Date: Sept. 2, 2005
Version: 2	Author: BEESC-ME