

## ENVIRONMENTAL BASELINE STUDIES

### PRELIMINARY SUMMARY STUDIES PERFORMED BY HDR ALASKA, INC. SURFACE WATER STUDIES, MINE STUDY AREA

#### 1. SURFACE WATER QUALITY

This study provides water-quality information for surface water systems in the vicinity of the proposed mine, mill, and tailings-disposal facilities. The study is characterizing baseline (existing) water quality to support the permitting, engineering, and future monitoring of the Pebble Project.

Objectives of the baseline study for surface water quality include data collection for the following:

- Characterization of surface water resources with particular focus on site-specific water chemistry.
- Design of facilities, including water-management and water-supply structures.
- Support for assessments of aquatic and fish resources and wetlands habitat.

The surface water-sampling program is documenting the water chemistry under a range of different hydrologic conditions throughout the year. The sampling program is conducted during breakup and six times in the summer when there is the greatest potential variation in water chemistry. As hydrologic conditions change (for example, variation of flows because of breakup and storm events), there is greater potential for varying water chemistry. During winter, flows gradually decrease as winter progresses. Therefore, winter sampling also is being conducted in order to understand these critical low flow conditions.

The study area, including the mineralized area and potential mine, mill, and tailings disposal facilities, is drained by the North Fork and South Fork of the Koktuli River, Upper Talarik Creek, and tributaries of these waterbodies. Data are being collected from 32 stations located in these watersheds.

Sampling has been occurring routinely since the spring of 2004 when the sample sites were first selected. The sites were based on their proximity to the ore body and the need to understand the water chemistry for several potential conceptual layouts for the mine site, milling facilities, and associated waste-

management facilities. Sample sites were selected both upstream and downstream of the ore body and all potential mine development concepts. A subset of these sampling locations will be maintained for operations and closure monitoring. The Kaskanak Creek watershed in the southwest portion of the study area was sampled to understand the nature and extent of potential interbasin transfer from the South Fork of the Kaktuli River. Sample locations for are presented on Figure HDR-1.

Additional water quality samples are being collected from lakes, ponds, and seeps. Water samples are being submitted to three laboratories and analyzed for major ions, dissolved solids, nutrients, total and dissolved metals, and organics. More than 40 different compounds, both total and dissolved, are being tested with each sample. The table below provides a complete list of the analytes being tested for. In all, more than 70,000 individual results will have been collected, analyzed, validated, and organized into a database by the close of the 2006 field season.

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**Surface Water Analytes for Laboratory Determination**

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Aluminum, total and dissolved	Silver, total and dissolved
Antimony, total and dissolved	Sodium, total and dissolved
Arsenic, total and dissolved	Thallium, total and dissolved
Barium, total and dissolved	Tin, total and dissolved
Beryllium, total and dissolved	Vanadium, total and dissolved
Bismuth, total and dissolved	Zinc, total and dissolved
Boron, total and dissolved	pH
Cadmium, total and dissolved	Specific Conductance
Calcium, total and dissolved	Alkalinity
Chromium, total and dissolved	Acidity
Cobalt, total and dissolved	Ammonia
Copper, total and dissolved	Chloride
Iron, total and dissolved	Cyanide-total
Lead, total and dissolved	Cyanide-WAD
Magnesium, total and dissolved	Fluoride
Manganese, total and dissolved	Nitrate + nitrite
Mercury, total	Phosphorus-total
Molybdenum, total and dissolved	Sulfate
Nickel, total and dissolved	Total dissolved solids
Potassium, total and dissolved	Total suspended solids
Selenium, total and dissolved	Thiocyanate
Silicon, dissolved	

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## 2. SURFACE WATER HYDROLOGY

The baseline study for surface water hydrology provides physical flow information for surface water systems in the vicinity of the proposed mine, mill, and tailings-disposal facilities. The surface hydrology study is interfacing with a concurrent baseline study of groundwater hydrology to provide a complete assessment of the interactions between groundwater and surface water throughout the study area. Surface water-flow data are also used by the surface water-quality program to calculate existing mineral loadings in surface water that originate from the mineralized area and flow naturally to downstream surface water systems. Surface water-flow data will also be used in the water balance model being developed for project engineering purposes. This information will provide a description of current conditions.

The mine study area for surface water hydrology (Figure HDR-1), which includes the ore body and potential mine, mill, and tailings-disposal facilities, is drained by the North Fork Koktuli River, South Fork Koktuli River, Upper Talarik Creek, and tributaries of these waterbodies. The Kaskanak Creek watershed is southwest of the ore body and is being monitored to understand the nature and extent of potential interbasin transfer from the South Fork of Koktuli River. Kaskanak Creek drains to the Kvichak River below Iliamna Lake. These streams are part of the Nushagak or Kvichak river watersheds. The watersheds in the vicinity of the project encompass approximately 360 square miles.

The research and field work for the surface hydrology study have been ongoing since spring 2004. The program includes the following data collection efforts:

- Installation of pressure transducers and dataloggers at 13 stations on the Koktuli River, north and south forks of Koktuli River, Upper Talarik Creek, and Kaskanak Creek.
- Coordination with the U.S. Geological Service on installation of three continuously recorded stations: one each on the North Fork Koktuli River, South Fork Koktuli River, and Upper Talarik Creek.
- Measurement of instantaneous discharge at 32 stations (including the 16 continuously monitored stations) during monthly field visits between April and October.
- Measurement of instantaneous discharge at 32 stations during iced conditions during the winter months.
- Measurement of stream discharge during critical low flow conditions during late winter and early spring at up to 39 locations.

Stage-discharge relationships at each continuous station are being developed to calculate a continuous-discharge record. Mean daily and mean monthly discharge, mean monthly runoff, and minimum mean daily discharge per unit area at each continuous station were calculated to demonstrate the different characteristics and potential interaction of the watersheds.