

NAD of 106114/506/ROJ

Hydrometrics, Inc.

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MEMORANDUM

July 31, 1991

TO: Dan McLaughlin, Noranda Minerals Corp.

FROM: Raymond Lazuk, Hydrogeologist

RE: Hydrologic Work for Alternative Tailing Impoundment Sites, Noranda New World Project

This memo describes the approach Hydrometrics will take to assess the hydrology of alternative tailing impoundment sites SB-1, SB-4 West and SB-4 East for the New World project. Our understanding is that you wish to proceed initially with a reconnaissance assessment of hydrologic conditions (Phase I) and, if necessary, follow up with a more detailed investigation (Phase II). Phase I reconnaissance work would essentially entail an aerial photo/map interpretive study of surface water features that would be followed by a field investigation to confirm the presence of streams, springs and seeps. There also would be limited collection and analysis of water samples from selected sites. A letter-report and map will be prepared which describes results of the work. If needed, a Phase II investigation would establish a number of surface water and spring monitoring sites, and also would involve construction of two to three groundwater monitoring wells. The Phase II study would be designed to provide the types of baseline data necessary for a more detailed evaluation of the area for inclusion in a hardrock permit application.

Phase I Hydrologic Reconnaissance

In 1989 and 1990, Hydrometrics inventoried and collected samples from a number of streams, springs and seeps in the area of the identified alternative tailing impoundment sites SB-1 and SB-4 West. In addition, a number of test pits were dug in SB-1 and in the western half of SB-4 West as part of data collection activities for the LAD investigation. This existing database allows us to reduce the amount of reconnaissance work that otherwise would be needed for these areas. As a result, our hydrologic reconnaissance will focus primarily on the west half of SB-4 West and all of SB-4 East.

Hydrometrics will obtain all available aerial photos and maps of sites SB-4 West and SB-4 East to locate streams, springs and seeps. This will be followed by an estimated two to three day field reconnaissance to confirm the locations of features observed from aerial photos and maps and to inventory the areas in greater detail. Flow measurements will be taken in selected streams and springs using a calibrated container and stopwatch, larger flows will be estimated by measuring the dimensions of the channel and timing the rate of flow. Approximately six surface water samples will be collected from

representative sites (streams and/or springs) within SB-4 East and the east half of SB-4 West and analyzed for the parameters listed on the attached table. Two of these samples will be from earlier established synoptic sites SBC-1 (Soda Butte Creek upstream of McLaren Mill tailings) and SBC-2 (Soda Butte Creek downstream of McLaren Mill tailings) which were previously included in the sampling area but were dropped from 1991 monitoring.

At the completion of this work, a letter report will be prepared which provides a map of the inventory area and presents the results of the analyses and other data collected during the reconnaissance. Data collected during 1989 and 1990 pertaining to SB-1 and SB-4 West will also be incorporated into the map and report such that all hydrologic knowledge of sites SB-1, SB-4 West and SB-4 East will be presented in one document.

Timetable

Phase I work can begin immediately with the photo and map interpretation. The field work would commence the week of August 12 and a report could be available by the end of August depending on laboratory turnaround time.

Estimated Costs

The estimated costs for Phase I would be:

Project Manager

0.25 days @ \$496/day	\$ 124
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Hydrogeologist II

5 - 7 days @ \$332/day	\$1,660 - \$2,324
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Secretary

.5 day @ \$156/day	\$ 78
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Data Management Technician

.5 day @ \$172/day	\$ 86
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Drafter II

.5 day @ \$200/day \$ 100

Per Diem

2 - 3 days @ \$60/day \$ 120 - \$ 180

Mileage

\$0.40/mile @ 500 miles \$ 200

4-Wheeler Rental (if needed)

2 - 3 days @ \$100/day \$ 200 - \$ 300

Laboratory

6 analyses @ \$180/analysis \$1,080

Miscellaneous \$ 75 - \$ 150

TOTAL \$3,723 - \$4,622

Description of Phase II Work

The purpose of Phase II work would be to conduct a baseline hydrologic investigation of one or more new areas considered for potential tailing impoundment sites. The expanded hydrologic investigation would document baseline surface water and groundwater conditions.

Based on the results of the Phase I reconnaissance, several new surface water monitoring stations would be established. Up to three new alluvium and/or bedrock wells could be constructed in each new study area to determine the general groundwater flow direction, quality of groundwater and hydraulic characteristics of the water-bearing units.

Supplemental baseline data collection activities and methods would be identical to those described in the June 1990 Environmental Baseline Study Plan submitted to the regulatory agencies. Surface water monitoring would consist of monthly streamflow measurements and collection of water samples for laboratory analyses. Samples would

be collected twice during the spring runoff period, once in the summer and once in the fall. Where appropriate, staff gages would be installed at stream monitoring sites. Of the three new groundwater monitoring wells constructed in each alternative tailing impoundment area, two of these are likely to be screened in bedrock and the third would probably be finished in alluvium. Fewer wells may be needed in the Alice E area due to the proximity of existing wells and the amount of data already collected for the site as part of the LAD investigation. All new information on surface water and groundwater would be added to the existing water resources database. As appropriate, changes would be made to existing potentiometric maps based on new groundwater level data.

The work items necessary to complete a Phase II investigation are listed in the following table. Potential costs and timeframes for completion of the work are given where appropriate to provide a more comprehensive description of this investigation. This estimated budget and timetable assumes only one alternate tailings impoundment area would be selected for detailed evaluation.

<u>Work Item</u>	<u>Timeframe to Complete</u>	<u>Potential Costs</u>
Obtain access/necessary permits from Forest Service	3 weeks - 6 months	Unknown - Noranda may submit.
Establish surface water stations, collect and analyze samples	1 year of baseline study	\$10,000 - \$15,000
Construct roads for access to monitoring well drilling locations	1 month	Unknown
Construct three groundwater wells (drilling and supervision)	10 days (subject to availability of driller, access, and seasonal and drilling conditions)	\$15,000 - \$25,000 (depends on access, depth of well and drilling apparatus used)
Conduct aquifer tests, measure water levels, and collect and analyze groundwater samples	1 year of baseline study (aquifer tests could be completed within 2 weeks)	\$4,000 - \$6,000
Prepare baseline report of study area, incorporate new data into existing reports for agency review (if needed), data management, drafting revisions to existing maps and figures, attend meetings and other project administration	60 days following completion of 1 year of baseline study	\$5,000 - \$10,000

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Phase II work expands baseline data collection/analysis for the mine permit application. It does not consider other design or permitting related work that is likely to be necessary should an alternative site be selected as the preferred site. Such work may include synoptic sampling/loading analyses or a groundwater flow net analysis (as currently proposed for the upper Fisher Creek site).

kab

Attachment