Barr Engineering Company
4700 West 77th Street • Minneapolis, MN 55435-4803
Phone: 952-832-2600 • Fax: 952-832-2601 • www.barr.com *An EEO Employer*

Minneapolis, MN • Hibbing, MN • Duluth, MN • Ann Arbor, MI • Jefferson City, MO

June 24, 2005

Mr. Jon Ahlness
Corps of Engineers
Department of the Army
190 East Fifth Street
St. Paul, MN 55101-1638

Mr. Steve Dewar
Minnesota Department of Natural Resources
Division of Lands and Minerals
1525 East Third Street
Hibbing, MN 55746

Re: Wetland Hydrology Study Plan - PolyMet

Dear Messrs. Dewar and Ahlness:

The purpose of this letter is to present a revised wetland hydrology study plan to address questions and comments raised by the U.S. Army Corps of Engineers in the correspondence dated May 20, 2005. It should be noted that the proposed wetland hydrology study plan refers to shallow monitoring wells. These wells will not meet the definition of a "monitoring well" defined in Minnesota Statutes, section 103I.005, subdivision 14 as administered by the Department of Health. The wells used in this study will only be used to monitor ground water elevations; no water samples will be collected. There is a specific distinction between the terms "well" and "piezometer" in reference to this wetland hydrology study. A "well" is defined in this study to be screened throughout the length of the well. A "piezometer" is defined as being perforated only at the bottom of the pipe, thereby measuring the water pressure within the perforated zone. Wells that are part of the hydrogeologic investigation described below will meet the definition of a "monitoring well" in accordance with Minnesota Statutes.

Background

PolyMet and other companies have conducted numerous exploratory borings at the project site to define the mining area. The borings were completed primarily to characterize the content of metals; however, the approximate elevation of bedrock was also noted.

PolyMet is conducting a hydrogeologic investigation that will utilize the current exploration borings as well as completing additional soil borings and monitoring wells (Attachment A). The primary goal of the hydrogeologic investigation is to aid in the characterization of the Duluth Complex and the surficial deposits at the site by conducting aquifer performance tests and collecting groundwater samples. This information will be critical for the mine permitting process, design of the water system, and design of plant operations. While the hydrogeologic investigation will provide some useful information to understanding wetland hydrology within project site, it will not provide all of the information necessary to evaluate potential wetland impacts.

One additional hydrogeologic study will be implemented in the future to collect background groundwater quality and flow data to assist in rock waste management. This study plan has not been developed or implemented at this time.

The Corps has suggested the following work:

1. Defining whether specific wetlands and wetland complexes are recharging the surficial deposits aquifer or are discharging to surface waters,
2. Defining whether specific wetlands and wetland complexes have perched water tables or are in direct hydrologic connection with the surficial deposits aquifer, and
3. Using shallow monitoring wells (~2 ft in depth) and piezometers to assist in providing wetland hydrology data.

Existing Wetland Hydrology

The PolyMet site is bordered on three sides by the Partridge River. The mine and stockpile site areas lie on the north side of the Dunka Road. There is a drainage divide oriented generally from southwest to northeast near the northern border of the project (Figure 1). A 2-foot topography map of the site is provided on Figure 2. The majority of the project site (80 percent) drains south through culverts and on to the Partridge River through extensive wetland complexes. The remaining 20 percent of the project site drains north to the Hundred Mile Swamp and the Partridge River or northeast to the Partridge River (Figure 2). Approximately 1.25 miles of the north mine pit rim will lie adjacent to wetlands without an intervening stockpile or upland area. The exploratory borings generally indicate that the bedrock surface slopes down from north to south between the Dunka Road and the north side of the proposed mine pit (Figure 3). There is limited bedrock surface elevation data for the area located north of the mine, but two county well index records located approximately 2 miles north of the site have bedrock elevations of 1715 and 1735 indicating a general rising trend in bedrock to the north.

The soils on the site have formed in the coarse-textured till, and a much denser till lies about 40 inches below the surface according to the U.S. Forest Service Ecological Land Type classifications for the site. Because of the dense underlying till, most of the mineral soils in the landscape experience perched water tables during late spring and very early summer at a depth of 1 to 3 feet. The majority of the extensive wetland complexes on and adjacent to the site are mapped as *ELT 6--LPN-Lowland Organic Acid to Neutral* which is equivalent to the Rifle mucky peat and Greenwood peat mapping units in the Natural Resources Conservation Service soil survey system. These soils are typically characterized by having fibric peat in the upper horizons underlain by mucky peat to a depth of up to 5 feet or more.

The Hundred Mile Swamp wetland is an extensive flat peatland with an average slope of about 0.2 percent from west to east (Figures 1 and 2). On average, wetlands make up 43 percent of the watershed areas within the main part of the project area. Within the detailed watersheds shown on Figure 2, wetlands make up 32 percent to 56 percent of the land area within each watershed. In the wetland areas located within and north of the proposed mine pit (where soil boring data is available), the surficial soils and quaternary deposits generally range from 1 to 25 feet thick. Many of the areas have clayey till underlying the organic soils in the wetlands and bedrock fairly close to the surface. However, the site is highly variable and sand to silty sand deposits are present in some areas, with bedrock at greater depths (Attachment A). It appears that the hydrology in the wetlands on the site is characterized by a waterlogged organic soil body perched over the dense till or a more localized sandy surficial aquifer. Lateral subsurface flow within peatland soils on extensive flat peatlands is typically very slow to negligible. Surface runoff from these flat peatlands is also generally negligible except during snowmelt due to the high water-holding capacity of the peat, the flat slopes, and the surface roughness. Surface runoff from the upland areas to the wetlands, however, is more prevalent. It appears that the wetlands are supported primarily by direct precipitation and surface runoff from the relatively small watershed areas with shallow local ground water flow making up a more variable component. This setting is fairly typical of northern Minnesota where evapotranspiration is considerably less than in warmer climates with longer growing seasons.

There are numerous examples on the Mesabi Iron Range of wetlands flourishing adjacent to mine pits due to the presence of dense, poorly drained soils. Near the PolyMet site there are numerous wetlands located on the south rim of Northshore Mining Company's mine pit that have sustained their characteristic hydrology for decades (Figure 4). Several wetlands including of shallow marshes and White Lake have remained viable along the north and south rims of Ispat Inland Mining Company's Laurentian Pit despite dewatering of the pit to nearly 300 feet below the wetlands (Figure 5). Numerous wetlands have also remained viable for years adjacent to the Mary Ellen, McKinley, and Canton mine pits near Biwabik (Figure 5). These wetlands have been sustained both during dewatering of those pits through the mid-1980's and since that time as water levels have risen and stabilized in the pits to levels 20-50 feet below the wetland elevations. There are several large wetland complexes located in the southwestern corner of Hibbing Taconite's property that have maintained their characteristic hydrology despite the presence of an adjacent mine pit on Keewatin Taconite's property.

Given the geologic conditions at the PolyMet site, we anticipate that the wetlands surrounding the project site will be sustained, despite the presence of the mine pit. Extensive alteration to the watersheds, could potentially affect some wetlands, but given the small watersheds feeding the wetlands, the effect may be subdued. However, study is needed before this general expectation can be regarded as confirmed. Monitoring is also needed to provide a baseline data set for detection and evaluation of any unexpected impacts.

Preliminary Wetland Hydrology Study

Objectives

This study has several objectives as described below:

1. Gain a better understanding of the wetland hydrology at the project site, i.e. defining whether specific wetlands are recharging the surficial deposits aquifer or are discharging to surface waters.
2. Collect baseline hydrology data that could be used to assess the effect of the project on wetland hydrology.
3. Review the data collected in the hydrogeologic study along with the wetland hydrology data to determine whether specific wetlands have perched water tables or are in direct hydrologic connection with the surficial deposits aquifer.
4. Determine the potential for indirect wetland impacts resulting from the project.

Wetland Hydrology Study Monitoring Plan

Data collected as part of the hydrogeologic investigation will be useful for finalizing the wetland hydrology study. A total of 9 piezometers have been installed around the site. The screens were typically installed within a variable distance above the bedrock (Table 1). Water elevations recorded in the piezometers will be compared to water elevations in the shallow wetland monitoring wells.

Instances where water levels in piezometers show a higher elevation than the shallow wells will typically indicate groundwater discharge to the wetland. Where the piezometer water level is lower than the shallow wells indicates recharge to groundwater from the wetland and likely a perched wetland system. The aquifer performance tests conducted as part of the hydrogeologic investigation will provide a measure of horizontal hydraulic conductivity within the surficial deposits. This information will help determine potential seepage rates of groundwater into or out of the wetlands.

Table 1: Soil boring log and well summary

Boring ID	Boring Depth (ft)	Bedrock Depth (ft)	Well Screen Interval (ft)	Surficial Deposit Textures
MW-05-02	18	6.5	~5-6.5	Sandy clay
MW-05-08	28.5	>28.5	7-17.5	Sand and silty sand
MW-05-09	13	12.5	6.5-13	Sand and silty sand
SB-05-01	19	15	10-15	Silty clay
SB-05-03	20.5	17	7.5-12.5	Sandy clay
SB-05-04	20	15	14.5-20	Clayey silt and silty sand
SB-05-05	18	8	None	Clayey to silty sand
SB-05-06	16	14.5	11.5-15.5	Clay and silty sand
SB-05-07	17	13	8-13	Silty sand to clayey sand
SB-05-10	14.5	4	None	Peat and silty sand
SB-05-10A	6	~6	2-6	Peat and silty sand

Well Construction and Placement

Shallow water table monitoring wells will be installed in approximately 19 locations within and surrounding the PolyMet site as shown on Figure 1. The majority of the wells will be installed in areas in which mining activities are not planned so that monitoring can continue during the operation of the mine. However, 4 wells are proposed to be installed between the mine pits and stockpiles, including 2 of the additional locations suggested by the Corps. It is expected that the areas between the stockpiles and mine pit may be significantly altered during the operation of the project. Due to the lack of a detailed mine plan at the present time, it is assumed that wetlands within these areas will be impacted by the project. However, should opportunities exist to avoid impacts to these wetlands during more detailed mine planning, efforts will be made to preserve them.

The wells will be installed to a depth of 1.5 to 3.0 feet with approximately a 1 to 2 foot length of 1.25-inch diameter, 0.01-inch slot PVC commercial well screen with a drain hole drilled in the bottom cap. Where a confining soil layer is encountered at a shallower depth, the wells will be installed down to the confining layer with the screened portion extending to within 6 inches of the ground surface. Wells installed in organic soils will be fitted with filter fabric or a filter sock to prevent clogging of the screen. Wells placed in organic soils will be backfilled with native soils to the surface. A sand pack will be installed around each well placed in mineral soils to within 4 to 6 inches of the surface to allow water to enter the well through the entire length of the well. For wells placed in mineral soils, the upper 4 to 6 inches will be sealed with bentonite to prevent the infiltration of surface water. A loose fitting slip cap will cover each well and a breather hole will be drilled near the top of the well casing to equalize pressure and to ensure accurate readings. The wells will be surge tested to ensure that they are functional and operating as required. Remote Data Systems electronic monitoring wells may also be used in conjunction with the standard wells to verify hydrologic conditions between monitoring events. If feasible, electronic wells will be installed in well locations 1, 4, 7, and 12 as shown on Figure 1. The position of each well will be located with GPS and eventually surveyed using traditional surveying techniques. The elevation of the ground and top of riser at each well will be surveyed annually using traditional surveying techniques.

Monitoring Schedule

The wells will be installed as soon as possible after final approval of this plan. Ground water monitoring will start within a few days of installation, after water levels have had time to equilibrate. Water levels will be monitored approximately once every week during the early growing season (May-August) and less frequently for the remainder of the growing season (once every two weeks from September to November. Electronic well readings will be taken every 4 hours throughout the monitoring period. The electronic well data will be downloaded during each monitoring event. Water levels in the electronic wells will be measured manually to verify the accuracy of the electronic data. The monitoring data will be evaluated as it is collected to determine if any changes to the plan are warranted.

The data from the first three months of monitoring will be compiled, graphed and analyzed in a short report to be delivered to the Corps of Engineers and the Department of Natural Resources by early November, 2005. This will allow the data to be used in the preparation of the draft Environmental Impact Statement.

We hope this work plan meets the needs of your respective agencies and look forward to discussing it with you. If you have any questions regarding this matter, please call me at (952)832-2764.

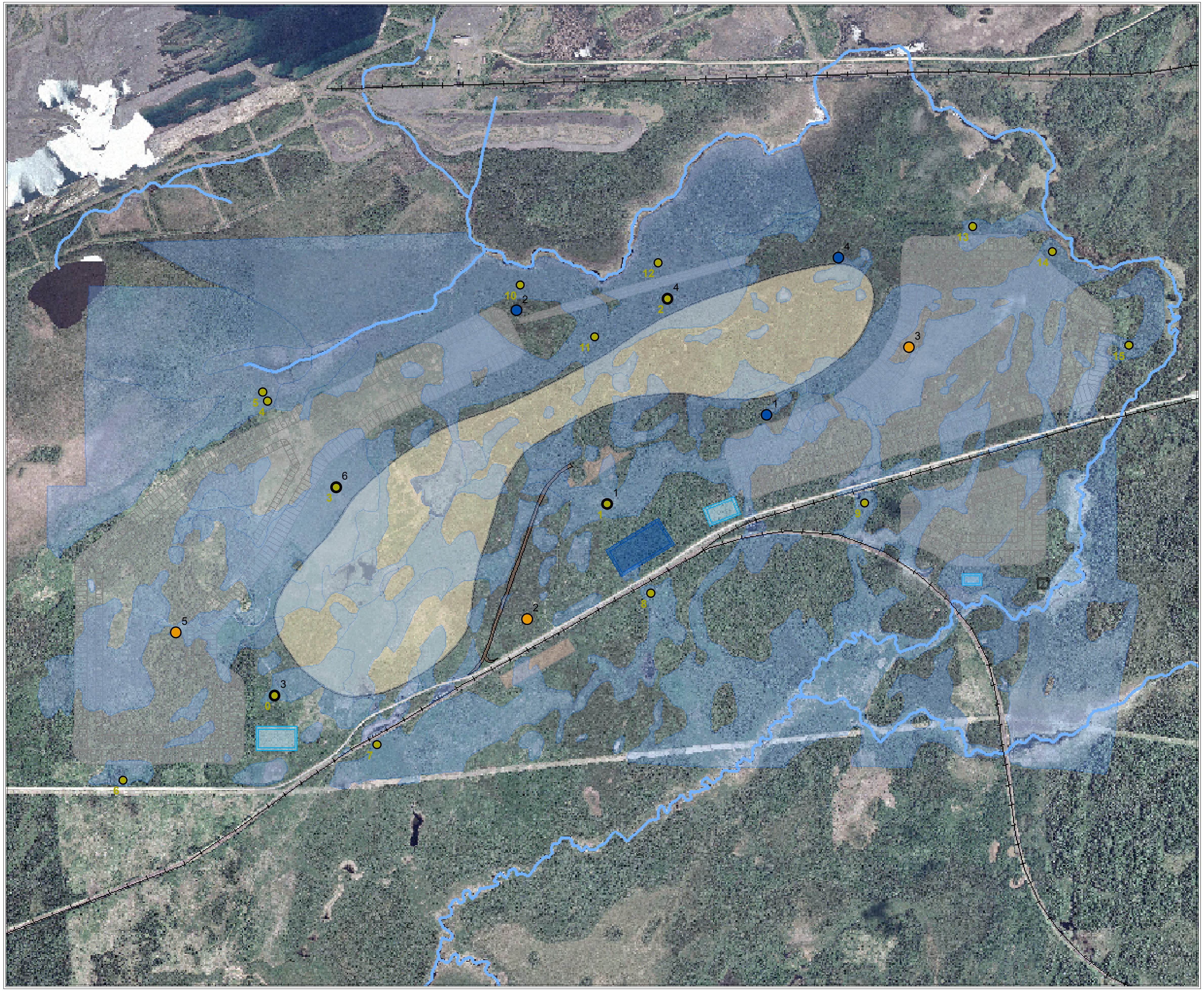
Sincerely,

Mark A Jacobson

Mark Jacobson
Environmental Scientist

c: John Borovsky
Nels Nelson

Enclosure



Wetland Monitoring

Proposed Boring

Proposed Monitoring Well

Potential Future Mine Features

Stockpiles

Mine Pit

Road

Non-Reactive Pond

Reactive Pond

Infrastructure; Sideslope

Wetlands

0 1,250 2,500 5,000 Feet

Allen, Babbitt, Babbitt SW, and Isaac Lake
7.5 Minute USGS Quadrangles

Figure 1
Proposed Wetland
Monitoring Well
Locations