Paula Goodman Maccabee, Esq.
Just Change Law Offices
1961 Selby Ave., St. Paul, Minnesota 55104, pmaccabee@justchangelaw.com
Ph: 651-646-8890, Fax: 651-646-5754, Cell 651-775-7128
http://justchangelaw.com

MEMORANDUM

TO: PolyMet NorthMet Environmental Review Lead and Cooperating Agencies
FROM: Paula Maccabee, Counsel/Advocacy Director for WaterLegacy
RE: Water Resources Impacts Assessment (*The Emperor Has No Clothes)*
DATE: February 6, 2012

PolyMet's February 1, 2012 press release suggests that preliminary agency review of the supplemental draft environmental impact statement (SDEIS) for its NorthMet project will begin in summer of 2012, with public review and comment starting in fall 2012. Anticipating this release, WaterLegacy has reviewed a number of documents pertaining to the PolyMet NorthMet Water Resources and Wetlands Impact Assessment Planning (IAP). Our review suggests that the assumptions in IAP and other recent documents may bias or even predetermine the outcome of modeling in the upcoming SDEIS.

Many of the modeling assumptions appear to be tautological. For example, once it has been assumed at both the mine and the tailings basin that there will be no leakage to bedrock and that all seepage can be collected, the chemical composition of drainage, pit water and tailings would no longer result in predictions of significant impacts. Without demonstration in either hydrological testing or operational experience at other mines that these assumptions are valid, many potential impacts on water quality would be precluded by modeling. Other model parameters use statistics to avoid inputs based on the conditions of the site and to limit analysis of critical water quality issues. The use of an "analogue" from the Canisteo Pit to limit projections of the impacts of water drawdown on Partridge and Embarrass River wetlands seems to be a contrivance to preclude detailed knowledge of the NorthMet site and actual projections of indirect wetlands impacts of the project.

Other questionable assumptions and assertions pertaining to water resources are found in PolyMet documents, but not reflected in IAP decisions so may not reflect current thinking of lead agencies. Some areas of particular concern pertain to concentration caps, assumptions about subaqueous disposal and methylmercury. They are also discussed in this memo.

If the SDEIS is based on the assumptions reviewed below, WaterLegacy's perception is that it will be a sham analysis. In order to accurately predict the potential water resources impacts of the PolyMet NorthMet project, actual data from site hydrology and actual data from other mine projects demonstrating the efficacy or inefficacy of seepage collection, liners, leakage and water quality must be used. Water quality risks cannot be assumed away, relegated to the sidelines by limiting analysis or minimized through spurious or incomplete models.

I. IAP Assumptions Limiting Water Resources Impacts

Throughout the IAP documents, assumptions are made that effectively limit the potential impacts of leakage, seepage and drainage from both the Mine Site and the tailings basin.

No Seepage from Pits: "During operations, groundwater will flow into the pits with little or no seepage out of the pits. After the pits flood, the model will predict groundwater seepage from the pits." (Water Resources/Groundwater Impact Assessment Planning Summary Memo

NorthMet Project EIS, June 30, 2011, "Water Res./Groundwater IAP Summary," p. 2). No data confirms the assumption that mine pits will have no bedrock fractures that would result in seepage prior to and in addition to the overflow of the mine pits. Detailed investigations at the Former Finland Air Force Station demonstrate that contaminants can migrate through fractured rock and exit the groundwater system far from their point of origin.

An additional concern about propagation of contaminants through bedrock fractures is that the mining process itself may create fractures that impact the Biwabik Iron Formation, upon which many communities in Northern Minnesota depend for drinking water. Figures 4.1-2 and 4.1-3 of the PolyMet NorthMet draft EIS document the proximity of final east and west pit depths to the Biwabik Iron Formation. In order to assess impacts, not only must site-specific information on bedrock be obtained, but data from other mine pits or shafts after filling is needed to predict contaminant stratification at the bottom of the NorthMet pits.

Contaminants from Tailings Basin do not Reach Bedrock: "No contaminant load from the tailings basin is assumed to reach bedrock." (Water Res./Groundwater IAP Summary, p. 4). No tracer well or geochemical data confirms that contaminants from the tailings basin are not currently migrating into bedrock or that there are no fractures or fissures that would transport tailings basin contamination.

All Tailings Basin Seepage Can be Captured: "Groundwater flow along the South flow path will not be modeled because under the Agency Draft Alternative essentially all seepage, including surface water and groundwater, from this flow path discharges via SD026 and will be captured and pumped back into the Tailings Pond." (Water Res./Groundwater IAP Summary, p. 4) "Given the anticipated small volume of uncaptured seepage leaving the tailings basin, modeling of hydrologic impacts to the main branch of the Embarrass River is not proposed." (Water Resources/Surface Water Impact Assessment Planning Summary Memo NorthMet Project EIS, June 30, 2011, "Water Res./Surface Water IAP Summary," p. 3).

Assuming capture of "essentially all" seepage minimizes water quality impacts. No data is provided to reflect actual pump back capture rates from Minnesota tailings basins from which an accurate prediction of impacts could be derived. In addition, given the design of the tailings basin in the 1950's to promote leakage and its location on the headwaters of both Spring Mine Creek (which flows to the Embarrass River) and Wyman Creek (which flows to the Partridge River), an assumption that no seepage will leak may not be reasonable. (See PolyMet NorthMet DEIS, Figures 4.1-1 and 4.1-9 illustrating streams beneath tailings basin). Spring Mine Creek has been listed as an impaired water due to aquatic life impairments.

Waste Rock Leakage is Like Landfills: The IAP assumes that liner leakage rates for landfills --the Hydrologic Evaluation of Landfill Performance or HELP model -- apply to waste rock piles. (Water Res./Groundwater IAP Summary, p. 4) Although the HELP model does not pertain or refer to waste rock piles or predict failure under hard rock mining conditions, no data is cited either in the IAP or Water Modeling Data Package to validate landfill liner leakage rates for hundreds of millions of tons of waste rock piles.

Hydromet Facility Will Not Leak: "Because the proposed Hydromet Facility will have a double liner with leak detection, it is expected that essentially no leakage will occur, or it will be detected and corrected. Therefore for modeling purposes, it will be assumed that the Hydromet Facility will have no leakage." (Water Res./Groundwater IAP Summary, p. 5). Although the models proposed are capable of estimating probabilities, this assumption suggests that no probability for failure of containment of hazardous Hydromet residues will be calculated. PolyMet's modeling work plan also assumes that neither the liners in the Rail

Transfer Hopper sump, the lined haul road process water ponds or the ponds and sumps of the wastewater treatment facility will leak and proposes to exclude from their model any probability of such leakage. (NorthMet Mine Site Water Modeling Work Plan, November 11, 2011, V. 4, pp. 5, 6)

No Impacts of Climate Change Will Be Considered: The Water Res./Surface Water IAP Summary concludes with respect to estimates of flows for the Partridge River, "No adjustment for potential climate change during PolyMet's 20 year life expectancy is planned." (p. 2) It appears that extreme weather events (drought and inundation) both during mine operation and over the hundreds of years after mine closure have been excluded from any analysis.

No Analysis of Concentrations of Aluminum, Iron and Manganese: Citing the argument that "concentrations are heavily influenced by processes not captured in the proposed model," the Co-lead Agencies would exclude aluminum, iron and manganese impacts from the tailings basin to drinking water from quantitative analysis. The only characterization required will be to identify whether PolyMet expects existing contamination from tailings basin groundwater seepage to increase or decrease. (Water Resources IAP Final Summary, p. 4, Water Res./Groundwater IAP Summary, p. 4). This exclusion avoids potential findings of project specific and cumulative impacts on drinking water and human health.

No Impact Except Railroad Car Spillage: The Water Res./Surface Water IAP states, after a discussion of water quality monitoring and direct impacts on the Wetlegs Creek watershed, "This further supports the conclusion that railroad car spillage is the only source of any potentially significant impact." (p. 6). If read at face value, this statement appears to reflect the conclusion of Co-lead Agencies, before any models have been run, that the only potential for significant impact on water quality at the mine site is spillage from railroad cars.

II. Contrived "Analogue" for Wetlands Indirect Hydrologic Effects

The IAP Summary assumes that there will be no hydrologic impacts on wetlands more than 3,200 feet from the mine pit claiming that there is an "analogy" between the Duluth Complex mine site and the Canisteo Pit. (Water Res./Groundwater IAP Summary, p. 2). No data confirms that the groundwater hydrology at the NorthMet Mine Pit during mining operations would be comparable to a study done in a dissimilar rock formation with a pit depth approximately one-eighth the depth proposed for the PolyMet mine. Pump tests sufficient to validate (or disprove) the analogy would also be sufficient to directly model impacts at the PolyMet NorthMet mine site.

The EIS record includes actual data from a single pump test from which drawdown could be determined for the NorthMet mine site. In Appendix B to RS22 prepared by Barr Engineering for the PolyMet Company using the MODFLOW model, the range of observed heads or hydraulic gradients was 17 meters (RS22 Draft-03, Appendix B, p. 13). The report notes that there are "high predictions of drawdown in the surficial aquifer" (*Id*., p. 18). Rather than requiring additional pump testing to verify or disprove predictions and to calculate the total number of wetland acres likely to be affected, the Co-lead Agencies have rejected actual site evaluation to determine potential drawdown impacts on wetland desiccation.

III. Use of Probabilistic Assumptions Rather than Data

The Water Res./Groundwater IAP Summary states that probabilistic assumptions, rather than deterministic inputs, will be used for parameters that effectively describe site conditions, rather than requiring additional monitoring and investigation:

- Baseline bedrock water quality at the Mine Site;

- Baseline surficial water quality at the Mine Site;
- Hydraulic conductivity of the surficial aquifer at the Mine Site;
- Baseline surficial aquifer water quality at the tailings basin;
- Hydraulic conductivity of the surficial aquifer at the tailings basin.

(Water Res./Groundwater IAP Summary, p. 2)

For both bedrock and baseline water quality, the Co-lead Agencies state that there is not enough data to perform a "bootstrap analysis," a statistical method that requires multiple samples for accuracy of prediction. (*Id*., pp. 3, 4) The Co-lead Agencies "acknowledge that collecting additional data would increase confidence that average baseline groundwater concentrations are adequately presented." (*Id*., p. 3) However, they suggest, while additional monitoring is done of surficial groundwater quality, "In the meantime, the SDEIS will rely on the available datasets." (*Id*., p. 4).

The Co-lead Agencies do not propose to collect additional data as to bedrock flow paths or evaluations at either the tailings basin (*Id*., p. 4) or the mine site.

The U.S. EPA cautioned in a memorandum sent on September 1, 2011 that current sampling is insufficient to perform the proposed modeling:

> The results of the modeling are largely dependent upon estimates of summary statistics which may or may not be sufficiently accurate. . . Given the schedule for issuance of the Supplemental Draft Environmental Impact Statement (SDEIS), which we understand is currently estimated to be released for public comment around November 2011, EPA continues to believe that there will be an inadequate number of samples to establish baseline data for NorthMet site. Any modeling, either deterministic or probabilistic, using this inadequate number of samples would have results that are not scientifically defensible. . . The collection of additional baseline data is essential to providing relevant input to the modeling efforts on which the environmental review and future decisions will rely.

IV. Predicting Significance on a Single Solute Basis

The Water Resources IAP states that the NorthMet project "will be assumed to predict a significant effect on water quality if the 90th-percentile model concentration of a solute exceeds the State of Minnesota surface or ground water quality at an evaluation point." (Water Resources IAP Final Summary, p. 2)

This focus on exceedance of solute concentration at an evaluation point has the potential to exclude several of the most important water quality concerns for the NorthMet project – mercury mass loading impacting downstream waters of the Lake Superior Basin with a bioaccumulative toxin; mercury methylation resulting from discharges of mercury and sulfates, wetlands disruption and changes in water levels; and chronic aquatic toxicity resulting from multiple chemical contaminants.

Calculating probability based on a single solute, from a statistical perspective, is likely to substantially under predict the potential that the NorthMet project will violate water quality standards. There are multiple standards for water quality contaminants. The probability that the NorthMet project will violate standards should require multiplication of the probabilities of violation of each standard, along with some adjustment for the dependence or independence of violations. The Water Resources IAP Final Summary also does not explain how analysis of probability of violation over time will be addressed. In particular, the probability of violation over time will be misleading if projections are not based on data on increased chemical reactivity over periods of years.

V. Additional Problematic Water Resources Assumptions

The preceding concerns are based on IAP documents, apparently reflecting agreement by the Co-Lead Agencies to accept the proposed methodology. Additional problematic assumptions pertaining to water resources are reflected in various documents prepared for PolyMet. It is hoped that Co-Lead Agencies will reject these assumptions as well as reconsider the proposed IAP provisions described above. Some areas of particular concern are discussed below.

Concentration caps for Category 1 Waste Rock Stockpiles: PolyMet's consultants have argued that levels of sulfide in Category 1 waste rock stockpiles -- which comprise 70 percent of the waste rock at the mine and will be permanently stored without liners -- are low enough that it should be assumed that leachate will not be acidic. Based on this assumption and relatively short-term (less than 4 years) experiments with lab scale rock piles, PolyMet seeks to use concentration caps to limit effluent concentrations from stockpiles and pit porewater concentrations. No field data is used to support either concentration limit. (Hinck, Technical Memorandum Unresolved Geochemistry Modeling Issues, November 9, 2011, "Barr Geochemistry Tech Memo").

In fact, the MDNR comparison of PolyMet's lab-to-field scaling factor to actual experience at the Dunka stockpiles showed an order of magnitude discrepancy -- the average MDNR bulk scaling factor was 0.19 as compared to Barr's average of 0.02 (Barr Geochemistry Tech Memo, p. 8). Since that discovery, Barr has contrived a new argument to assume away higher acidity from real waste rock piles over time by asserting that PolyMet's "misclassification" of hundreds of millions of tons of waste rock will be "less than 1%" and assuming with a conceptual random distribution that "the effect on the overall pH of the stockpile drainage will be negligible." (*Id*., pp. 10-11). No field data supports these dismissive assumptions. Research suggests that compositing of samples for environmental characterization has the potential to understate variability and mask the potential for acid drainage and other potential environmental problems.[1]

In addition, concentration caps for waste rock stockpiles may understate the potential that leachate will violate standards for aquatic toxicity in conditions with pH in a circumneutral range. It has been documented for decades that toxic metal release of copper, nickel, cobalt and zinc has occurred at the Amax test site and the Dunka Mine stockpiles at circumneutral as well as acidic pH conditions.[2]

Assumption that Subaqueous Disposal Will Remove Risk to Water Quality:
Various PolyMet documents suggest that subaqueous disposal will prevent impacts to water quality from the mine pits and tailings basin. The Project Description states, "By placing Category 2, 3 and 4 waste rock into the East and Central Pits it would be stored in a subaqueous environment, thereby reducing the environmental impact associated with further oxidation and decomposition of sulfide minerals." (NorthMet Project Description, V. 3, September 13, 2011). PolyMet's Waste Characterization Data Package states that "the modeling methodology for the pit lakes assumes that oxidation of sulfide minerals and the accompanying release of constituents is negligible when waste rock or pit walls are submerged under water." (NorthMet Project Waste Characterization Data Package, V. 6, November 11, 2011, p. 99).

---

[1] See, A. Maest & J. Kuipers, *Predicting Mine Water Quality at Hardrock Mines*, 2005, p. 36 and citations therein.

[2] See, for example, Paul Eger & Kim Lapakko, *Environmental Leaching of Duluth Gabbro under Laboratory and Field Conditions: Oxidative Dissolution of Metal Sulfide and Silicate Minerals*, Minnesota Department of Natural Resources Division of Minerals, 1980, p. 110.

Although a calculation is offered as a test of this assumption, no field data confirms that, over time, subaqueous disposal will prevent oxidation and levels of metallic contaminants exceeding water quality standards. PolyMet admits that without more information on pit inflows during dewatering, the cone of depression around mine pits and oxygen transport through surficial material, it is not possible to quantify the impact to water quality from *in situ* oxidation. (*Id*., pp. 101-102). Field data on subaqueous concentrations of contaminants in mine pits and shafts should be compared with assumptions, and information on hydrology at the mine site should be developed to quantify water quality impacts.

Predicting High Sulfide Tailings will be Neutralized in LTVSMC Tailings Basin:
The prediction that high-sulfide material will be neutralized by disposal at the LTVSMC tailings basin is inconsistent with historic experience where disposal of a modest quantity of (sulfide-bearing) hornfels at the LTVSMC resulted in elevated sulfate levels in seepage from the tailings.[3] In addition, although it is predicted that a wide and shallow (8 feet or less) pond at the tailing basin will minimize oxidation and chemical reaction, PolyMet acknowledges that tailings basins with shallow ponds can re-suspend tailings, increasing oxidation and the release of sulfates and metals. (NorthMet Project Waste Characterization Data Package, V. 6, November 11, 2011, pp. 131, 133, 135). Some groundwater at the edge of the LTVSMC tailings basin currently has high oxygen levels, rather than anoxic conditions.[4]

Denial that Sulfide Discharge will Increase Methylmercury in Food Chain:
Although acknowledging the MPCA's concern about methylmercury in the Embarrass River watershed, PolyMet's consultants have argued based on limited water column sampling that elevated sulfate concentrations do not result in increased methylmercury ("MeHg") and that, since the tailings basin has discharged sulfates for over 40 years, "it is unlikely that continued discharge from the tailings basin will have an effect on the sulfate and MeHg dynamics in the Embarrass River watershed." (NPDES Field Studies Plan – Tailings Basin, Prepared for Cliffs Erie L.L.C. and PolyMet Mining Inc., May 6, 2010 – revised submittal based on MPCA comments, pp. 13-14). Thus, no additional methylmercury sampling is planned. (*Id*., p. 14).

A conclusion that no additional sampling is necessary, with the implication that mercury methylation can be disregarded, contradicts the peer-reviewed literature as well data from the St. Louis River after a significant precipitation event (See Slide #6 from MDNR presentation in January 2011). Sampling of methylmercury in aquatic food webs is needed to assess impacts of sulfates and increased acidity on bioaccumulation of methylmercury. (*See e.g*. J. Chetelat et al, *Habitat-specific bioaccumulation of methylmercury in invertebrates of small mid-latitude lakes in North America*, Environmental Pollution 159 (2011), pp.10-17).

Conduct a More Candid Analysis of Water Resources

WaterLegacy's review of recent water resources documents as well as the previous draft EIS suggests that PolyMet NorthMet environmental review assumptions are being designed to avoid predictions of adverse impacts on water resources irrespective of facts. The limited scope of field testing, the complexity of GoldSim modeling and the assumptions discussed above that cap or otherwise constrain predicted impacts seem to be designed to conceal the likelihood of adverse impacts on water resources, rather than to provide an objective "hard look" at the likely effects of the NorthMet sulfide mine, plant and tailings basin.

---

[3] MDNR, *Environmental Mine Waste Management: Strategies for the Prevention, Control, and Treatment of Problematic Drainages Volume 1 of 2; Advances in Mine Waste Management Project Final Report to the Minerals Coordinating Committee,* June 30, 2001, pp. 25 & 26.

[4] Some groundwater wells at the edge of the LTVSMC tailings basin, rather than having anoxic groundwater (<1 part per million) have dissolved oxygen as high as 4.6 parts per million. See *NPDES Field Studies Report - Tailing Basin*, prepared for Cliffs Erie L.L.C. and PolyMet by Barr. Eng. Sept. 11, 2011, Table 3-1 Ground Water Quality Data Summary.

The proposed Monte Carlo simulation has the further disadvantage of providing an appearance that uncertainty has been resolved. WaterLegacy is concerned that the complicated exercise in modeling reflected in the PolyMet draft EIS and subsequent documents may both prevent the prediction of significant adverse impacts and make it less likely that we will notice that this emperor has no clothes.

In order to meet legal requirements for an objective judgment of likely environmental impacts and to permit technical and factual analysis, WaterLegacy believes that additional field data must be provided regarding mine site wetlands and pump test hydrology, LTVSMC tailings basin leakage and contaminants, bedrock fractures at both the mine and tailings basin, hydrological pathways for contaminants at the mine site and tailings basin, and baseline groundwater concentrations of pollutants at the mine site and tailings basin.

Transparent, rigorous and peer-reviewed modeling must be based upon this additional field data at the NorthMet mine and LTVSMC tailings basin and upon appropriate scaling factors, field-tested data on toxic leachate from Duluth Complex stockpiles over time, field-tested data on contaminant concentrations in subaqueous disposal, efficacy of pump back rates at similar tailings basins, liner leakage rates, methylmercury concentrations in the aquatic food web and other directly pertinent data. As Minnesota's first proposed sulfide mine proceeds through the EIS process, responsible governmental units and cooperating agencies must insist upon a candid and fact-based analysis of its potential adverse impacts on wetlands and water quality.

SELECTED REFERENCES

Water Resources/Impact Criteria Impact Assessment Planning Final Summary Memo, NorthMet Project EIS (October 17, 2011)

Water Resources/Groundwater Impact Assessment Planning Summary Memo, NorthMet Project EIS (June 30, 2011)

Water Resources/Surface Water Impact Assessment Planning Summary Memo NorthMet Project EIS (June 30, 2011)

PolyMet NorthMet *EIS - Wetland Resources IAP Final Summary Memo* (July 1, 2011)

J. Adams (ERM) & M. Liljegren (DNR), *Analogue Information Relating to Mine Pit Cone of Depression Impacts on the Surficial Aquifer* (May 23, 2011)

NorthMet Project Water Modeling Data Package Volume 1 - Mine Site Version 9 (December 2, 2011)

Remedial Investigation Report Former Finland Air Force Station, Finland, Minnesota, prepared for U.S. Army Corps of Engineers (October 2006)

PolyMet NorthMet, *Draft Environmental Impact Statement* (October 2009)

U.S. EPA, *The Use of GoldSim in the PolyMet NorthMet Environmental Impact Statement* (September 1, 2011).

Peter Hinck (Barr), *Technical Memorandum, Unresolved Geochemistry Modeling Issues*, November 9, 2011.

NorthMet Mine Site Water Modeling Work Plan, November 11, 2011 – V. 4.

NPDES Field Studies Plan – Tailings Basin, Prepared for Cliffs Erie L.L.C. and PolyMet Mining Inc., May 6, 2010 – revised submittal based on MPCA comment.

NPDES Field Studies Report - Tailing Basin, prepared for Cliffs Erie L.L.C. and PolyMet by Barr. Eng. Sept. 11, 2011.

MDNR Slide, Major tributaries following 3 to 4 inch rain event in SLR basin (Jan. 2011).

J. Chetelat et al, *Habitat-specific bioaccumulation of methylmercury in invertebrates of small mid-latitude lakes in North America*, Environmental Pollution 159 (2011) 10-17.

NorthMet Project Waste Characterization Data Package, V. 6, November 11, 2011.

NorthMet Project Description, V. 3, September 13, 2011.