March 13, 2014

Lisa Fay
EIS Project Manager
Minnesota Department of Natural Resources
500 Lafayette Road, Box 25
Saint Paul, MN 55155-4025

Dear Ms. Fay,

Thank you for providing the Minnesota Department of Health (MDH) with the opportunity to comment on the Supplemental Draft Environmental Impact Statement (SDEIS) for the NorthMet Mining Project and Land Exchange.

Due to the scope and nature of the SDEIS, MDH staff were not able to complete exhaustive review of the entire document. However, the following provide some comments, both specific and general in nature related to the SDEIS and the project.

Hydrogeology
The SDEIS assigns very low hydraulic conductivity values to the Duluth Complex and minimizes the potential for groundwater transport via large-scale fractures and faults. This assumption is based on the work of Foose and Cooper (1979, 1980) which indicates that such features were formed early and at depth during emplacement of the Duluth Complex and that these features are largely filled with gouge, limiting their ability to act as groundwater conduits. However, Davidson reported a regional fracture pattern in the Duluth Complex in Lake and Cook counties which were "…interpreted as having resulted from regional stresses, possibly related to glacial unloading and uplift together with some tectonic readjustments resulting from erosion, basin formation, and isostatic rebalancing" (The Duluth Complex in the Perent Lake and Kawishiwi Lake Quadrangles, Lake and Cook Counties, Minnesota – A Discussion to Accompany Miscellaneous Map Series Maps M-7 & M-8, D.M. Davidson, Jr., Minnesota Geological Survey, 1969). The forces that created the fracture pattern in Lake and Cook counties would have also affected the Duluth Complex in St. Louis County, suggesting that local- to regional-scale fractures could be present and may act as possible conduits for higher rates of groundwater flow in the Precambrian bedrock. These fractures were not taken into account in the SDEIS. It would therefore be more conservative to assume higher flow rates when modeling groundwater and contaminant transport for this project.

Available static water level elevations for residential water supply wells near the Embarrass River indicate that water levels are generally higher in the surficial aquifer wells than in the Precambrian bedrock wells, suggesting a downward vertical gradient may exist throughout this area. While the SDEIS, citing PolyMet (2013) and Siegel and Ericson (1980), notes that the surficial and bedrock aquifers are hydraulically connected and recharge to the bedrock occurs, in part, from leakage from the overlying surficial aquifer (pages 4-24, 4-26, 4-54 of the SDEIS), the SDEIS later cites the same work by Siegel and Ericson to conclude "…the interaction between the surficial deposits and the bedrocks aquifers is assumed to be insignificant…" (page 4-149 in the SDEIS).

This conclusion appears to underpin later assumptions regarding the effectiveness of the various seepage containment systems to prevent contaminant migration in the bedrock aquifer, particularly at the Tailings Basin on the Plant Site. However, some seepage is predicted to escape the Tailings Basin and containment systems. Additionally, discharge via the Emergency Overflow Channel would circumvent the containment system entirely. Moreover, if there is downward migration of groundwater from the surficial aquifer to the bedrock as noted on pages 4-24, 4-26, 4-54 of the SDEIS, this may permit seepage to migrate beneath the slurry cut-off walls. The proposed groundwater monitoring network for the Embarrass River Watershed (SDEIS Table 5.2.2-54) includes only the existing monitoring wells installed around the Tailings Basin, which apparently are the wells shown in SDEIS Figure 4.2.2-13. Construction details for these wells are not included in the SDEIS and only two have records in the Minnesota County Well Index (CWI) (GW006, UN 625042; GW008, UN 625044). These are completed in the surficial aquifer at depths of 14 and 12 feet, respectively. MDH recommends that additional monitoring wells be installed within the bedrock aquifer to evaluate potential impacts to this aquifer.

On page 5-6, the SDEIS estimates that over 90% of seepage from the Category 1 Stockpile will be captured by the groundwater containment system with the remaining 10% following the groundwater flow to the West Pit where the water will be cycled through the Waste Water Treatment Facility (WWTF). However, the west end of the stockpile is located on a groundwater "high" (Fig. 4.2.2-5 in the SDEIS) from which some of the flow may be to the north and northeast and could discharge to Yelp Creek and then the Partridge River. This needs to be accounted for in the evaluation of potential migration of contaminants to groundwater and surface water and planning of the Mine Site groundwater monitoring network.

Groundwater Evaluation Criteria

On page 5-10 the SDEIS notes that the national primary drinking water standards for copper and lead are treatment-based, "at-the-tap" values for public water supplies and not "in situ" groundwater values. Therefore, the SDEIS proposes that the secondary Maximum Contaminant Level (sMCL) of 1,000 µg/L for copper be used as the groundwater evaluation criterion. This value is protective only for acute health effects resulting from short-term, high level exposures and is not considered protective for infants, children, or other sensitive individuals. MDH is currently evaluating its advice for copper in drinking water. In the interim, MDH recommends that 300 µg/L be used as the groundwater evaluation criterion for the NorthMet project, as this appears to be protective for infants, children, and other sensitive individuals (Public Health Goals for Chemicals in Drinking Water: Copper, California Office of Environmental Health Hazard Assessment, February 2008).

Regarding lead, MDH recommends well owners take action to remove all lead from their drinking water if detected. Given the presence of domestic water supply wells near the site, MDH recommends the national primary drinking water standard of 15 µg/L be used as a groundwater evaluation criterion in monitoring near the site.

On pages 5-11 and 5-12, Table 5.2.2-2 of the SDEIS lists the applicable groundwater evaluation criteria for the project. In most cases, either the federal MCL or the Minnesota Health Risk Limit (HRL) is selected, but higher SDEIS evaluation criteria were chosen for beryllium, manganese and thallium "…based on background water quality". Although manganese exceeded the federal MCL of 50 µg/L in most samples, Table 4.2.2-6 in the SDEIS indicates most of the groundwater samples collected near the proposed Mine Site were near or below the state Risk Assessment Advice (RAA) levels of 100 µg/L for infants and 300 µg/L for children and adults. MDH recommends the RAA values be used as the groundwater evaluation criterion for manganese. Table 4.2.2-24 of the SDEIS indicates higher manganese concentrations downgradient of the existing LTV Steel Mining Company Tailings Basin, but this simply suggests contamination of the surficial and bedrock aquifers from previous activities at this site that need to be considered in evaluating impacts to groundwater, not background concentrations for the aquifers. This is important as the maximum 90^{th} percentile probability (P90) concentrations predicted in the 500-year model simulation suggests manganese concentrations in the groundwater in all of the flow paths from the Plant Site will exceed the MDH RAAs, including areas where domestic wells are present (Table 5.2.2-38 in the SDEIS).

Similarly, the detections of beryllium near the proposed Mine Site indicate background concentrations in the aquifers are generally below the federal MCL of 0.4 µg/L and only slightly above the MDH HRL of 0.08 µg/L. MDH recommends the HRL be used as the groundwater evaluation criterion, as beryllium concentrations in the Plant Site flow paths are also predicted to exceed the HRL in areas where domestic wells are present.

In contrast, naturally occurring levels of thallium do appear to exceed the state and federal drinking water criteria, so using a slightly higher value for evaluation purposes makes sense. Moreover, the SDEIS modeling indicates that thallium levels are unlikely to exceed the state and federal criteria.

Water Quality

Groundwater discharge from the Mine Site to the Partridge River could impact the Hoyt Lake drinking water supply (via Colby Lake) and alter geochemical conditions that affect mercury availability to fish, creating another potential human exposure pathway. Therefore, conservative modeling of potential impacts to the river that incorporate all possible contaminant sources is critical.

Seepage from the Category 2/3 and 4 waste rock stockpiles and Ore Surge Piles primarily will be captured by leachate collection systems and treated, but some will reach the groundwater along with seepage from the mine pits, WWTF equalization basins and Overburden Storage and Laydown Area and eventually discharge to the Partridge River (Table 5.2.2-26 of the SDEIS). Table 5.2.2-22 of the SDEIS suggests that this will result in little, if any, change in groundwater quality compared to the continued existing conditions and that none of the groundwater evaluation criteria will be exceeded, based on modeling predictions regarding constituent release under oxidizing conditions and considering likely attenuation factors for arsenic, antimony, copper and nickel. This seems inconsistent with field leaching test results on locally sourced Duluth Complex Gabbro (1978 DNR/AMAX Field Leaching and Reclamation Program – Progress Report on the Leaching Study, DNR, Jan. 29, 1979; and Environmental Leaching of Duluth Gabbro Under Laboratory and Field Conditions: Oxidative Dissolution of Metal Sulfide and Silicate Minerals, DNR, 1980). That rock had copper, nickel, and sulfate percentages lower than those projected for the Category 4 waste rock and similar to those projected for the Category 2/3 waste rock, yet generated runoff containing 620 – 2,400 µg/L sulfate and 120 – 70,000 µg/L nickel (copper was generally <50 µg/L in these tests, except one pile that leached approximately 10,000 µg/L).

Several untreated wastewater streams from the Plant Site appear to be directed to the Mine Site during the early phases of reclamation. These include untreated seepage from the Tailings Basin, blended with seepage that has passed through the Waste Water Treatment Plant (WWTP), which is to be discharged to the West Pit to accelerate its flooding (p. 3-135, "Water Management") and WWTP reject concentrate will be transported to the West Equalization Basin of the WWTF at the Mine Site (p. 5-81, Plant Site). No information is provided regarding likely contaminant concentrations in these wastewater streams, so it is not clear how their possible contribution to groundwater contamination was evaluated.

It is also unclear how constituent leaching was accounted for during the period while the pits are being flooded during the reclamation phase. Table 5.2.2-19 of the SDEIS seems to suggest the oxidation will occur before flooding, but according to Younger (The longevity of minewater pollution: a basis for decision-making. Sci. Tot. Env., vol. 194/195, pp. 457-466, 1997), fluctuating water levels result in conditions more conducive to acid mine drainage and metal leaching than full exposure to oxygen. The flooding of each pit will take approximately 20 years during which time it is likely water levels will fluctuate within the pits. Also, it is not clear whether the waste rock from the stockpiles will simply be deposited in the East Pit in year 11 and remain partly exposed for 20 years while the water rises around it, or if the placement of the waste rock will occur in stages to ensure the rock is either still on the stockpile liner (and leachate is collected and treated) or entirely submerged within the pit to minimize acid production and metal leaching.

On p. 5-104, the SDEIS indicates that once flooded, groundwater inflow to the pits will limit the exposure of the wall rock to oxygen. However, no dissolved oxygen data was presented in Section 4 of the report. Has it been measured?

Local Well Inventory and Chemical Monitoring

The SDEIS does not adequately address possible impacts of groundwater contamination on local domestic wells. A thorough inventory and baseline water quality assessment of existing wells should be conducted prior to the initiation of any mining activities so that any future degradation of drinking water quality related to mining activities can be identified and remediated.

Figures 5.2.2-4 and 5.5.2-6 in the SDEIS outline the groundwater flowpaths along which contamination from the NorthMet mine and plant sites is projected to flow toward the Partridge and Embarrass Rivers. MDH staff conducted a preliminary comparison of these two areas with a search of well locations from the CWI database to assess the impacts that this proposed mining action could have on local domestic wells that are either within the delineated flowpath zones or are between the flowpath zones and the Partridge or Embarrass River. The area between the flowpath zones and the rivers was incorporated into the analysis to address uncertainty in discharge points along tributary streams between the plant and the Embarrass River.

Two sets of well data were assessed: located wells (wells that either have locations verified and recorded using GPS or that have been field-verified to six quarter-sections) and unlocated wells (wells whose locations are estimated based on information provided by well contractors at the time of well construction). Our assessment shows that there were no well records in CWI between the mine site and the Partridge River. However, Figure 1 (attached) shows that 19 located and eight unlocated wells with records currently within CWI met our search criteria for the area between the Plant Site and the Embarrass River, and by inference could be impacted by this mining activity. It should be noted that these numbers likely represent minimum values, as there may be unlocated wells in the area that pre-date the Minnesota state Well Code in either of the modeled zones. These wells that pre-date the code would need to be inventoried, located and input into CWI. Any unused and unsealed wells found during the inventory could be conduits through which a contaminant plume could more quickly propagate, and therefore would need to be sealed as per current Well Code by the parcel owner, possibly with PolyMet Mining, Inc.'s assistance. Also, PolyMet Mining, Inc. should take every opportunity to collect baseline samples for any new wells that might be drilled in the area.

Sample analytes and frequency of resampling are two aspects for which MDH would like to be consulted if permitting for the project moves forward. MDH is also interested in accessing the baseline data results archive and would ask to be included in those discussions as well.

Water Supply Contingency Planning

The city of Hoyt Lakes relies upon Colby Lake as its drinking water source, and modeling results presented within the SDEIS indicate that the lake water will remain safe for consumption. However, the uncertainty associated with all modeling studies points to the need for a monitoring and contingency strategy that will ensure a safe water supply for Hoyt Lakes in the event of unanticipated water quality degradation of Colby Lake related to the proposed mining activities.

In order to ensure a continued safe drinking water source for Hoyt Lakes, PolyMet Mining, Inc., as the owner and operator of the NorthMet mine, should assist with water supply contingency planning for the city. This contingency plan should address ongoing water quality and quantity monitoring and set up protocols for gradually changing conditions and emergencies, should they occur. There are existing contingency plans in place in other areas of the Iron Range, and those plans could be used as a template for any Hoyt Lakes plan.

Air Quality

Air quality modeling for crystalline silica in the SDEIS is based on predicted PM_{10} and $PM_{2.5}$ emissions. However, when discussing the toxicity of crystalline silica, the real concern is with respirable crystalline silica particles with a diameter of 4 micrometers (4 µm or 4 microns) or smaller, also referred to as PM_4. Particles of crystalline silica in this size range are of greatest concern. PM_{10} (particulate matter 10 microns or smaller) is inhalable, but the fraction of PM_{10} that is larger than 4 microns only reaches upper levels of the respiratory system. Particles 4 microns or smaller can travel much deeper in the lungs and reach the lower respiratory surfaces (alveoli) where the changes that produce silicosis take place. Disease risk is related to both the levels and duration of silica exposure and the onset of disease may occur long after the exposure has ceased. $PM_{2.5}$ measurements may underestimate health risks from crystalline silica exposures. MDH has established a chronic Health Based Value (HBV) of 3 $\mu g/m^3$ for respirable PM_4 crystalline silica and recommends using this as a screening value for assessing potential health risks associated with respirable crystalline silica.

Climate Change

Table 5.2.7-8 in the SDEIS indicates that the NorthMet project will result in 196,341 metric tons per year (mtpy) direct and 511,000 mtpy indirect greenhouse gas (GHG) emissions, or a total increase in GHG emissions of 707,342 mtpy. This would make the NorthMet project a significant contributor to the total annual state GHG emissions. MDH recommends that all projects in Minnesota evaluate options for reducing GHG emissions, through energy conservation and use of renewable energy sources, to limit contributions to climate change and help achieve Minnesota's GHG emissions reduction targets of 15% by 2015 and 30% by 2025.

Health Impact Assessment

A Health Impact Assessment (HIA) is a research and community engagement process that can be used to help ensure that people's health and concerns are being considered when decisions on infrastructure and land use projects are being made. The National Research Council defines HIA as "a structured process that uses scientific data, professional expertise, and stakeholder input to identify and evaluate public-health consequences of proposals and suggests actions that could be taken to minimize adverse health impacts and optimize beneficial ones." HIAs have been used to provide important health information to decision makers on a wide range of projects outside the typical health arena, including comprehensive plans, brownfield redevelopment, transportation projects, energy policies, and housing projects. Over 100 HIAs have been performed in the US to help improve public health. Ten HIAs have been completed in Minnesota, mostly on comprehensive plans and transportation projects.

The International Council on Metals and Mining (ICMM) prepared the Good Practice Guidance on Health Impact Assessment to ensure their member's operations contribute positively to community health and wellbeing. ICMM notes that mining projects can impact infectious and chronic disease rates and mental health and wellbeing. ICMM recommends conducting HIAs to proactively maximize community health and wellbeing and reduce potential health impacts.

HIAs have been used to inform decision makers about health effects in projects such as oil and gas leasing, coal mine proposals, and copper, zinc and gold mining. These HIAs may review health issues that are typically included in an EIS, such as water and air quality, but they also review additional health effects that are related to the specific site and community. Some health effects considered in these HIAs include reviewing the health effects of newly built infrastructure and traffic to support mining, the influx of migrant workers, and the disturbance of food sources relied upon by subsistence cultures.

An HIA on the project could provide additional health information for policy makers in determining how to balance health and citizens' concerns with economic benefits of the project. An HIA could be scaled according to available resources and still answer some of the health questions posed by the community. An HIA could provide recommendations to policy makers to support possible positive health outcomes and to mitigate or prevent possible negative health outcomes to improve the public's health and to inform zoning, permitting, monitoring, and reclamation policies.

Summary

- Assume higher flow rates for groundwater and contaminant transport modeling to account for local- to regional-scale fractures within the Duluth Complex.
- Install additional monitoring wells within the bedrock aquifer to evaluate potential impacts to this aquifer.
- Account for the groundwater "high" in the evaluation of potential migration of contaminants to groundwater and surface water and in planning of the Mine Site groundwater monitoring network.
- Use 300 µg/L as the groundwater evaluation criterion for copper.
- Use 15 µg/L as the groundwater evaluation criterion for lead. Well owners should take action to remove all lead from their drinking water if detected.
- Use 100 µg/L for infants and 300 µg/L for children and adults as the groundwater evaluation criterion for manganese.
- Use 0.08 µg/L as the groundwater evaluation criterion for beryllium.
- Conservatively model all potential impacts to the river, incorporating all possible contaminant sources.
- Clarify inconsistencies between field leaching test results and modeling predictions that indicate no change in groundwater quality compared to existing conditions with no exceedances of groundwater evaluation criteria.
- Provide contaminant concentrations from untreated wastewater streams and clarify how their contribution to groundwater contamination was assessed.
- Clarify how constituent leaching was accounted for during reclamation flooding.
- Provide dissolved oxygen data if available or complete measurement.
- Conduct a thorough inventory and baseline water quality assessment of existing wells prior to the initiation of any mining activities so that any future degradation of drinking water quality related to mining activities can be identified and remediated. This inventory and assessment should include located and unlocated wells.
- Properly seal any unused and unsealed wells found during the inventory.

- Collect baseline water samples when new wells are drilled in the area.
- Consult with MDH staff regarding sample analytes and frequency of resampling.
- Consult with MDH staff regarding the baseline data results archive.
- Prepare a water supply contingency plan for the city of Hoyt Lakes that addresses ongoing water quality and quantity monitoring and sets up protocols for gradually changing conditions as well as emergencies, should they occur.
- Use 3 $\mu g/m^3$ as a screening value for assessing potential health risks from respirable PM_4 crystalline silica.
- Evaluate options for reducing GHG emissions, through energy conservation and use of renewable energy sources.
- Consider preparation of a Health Impact Assessment.

Health starts where we live, learn, work, and play. To create and maintain healthy Minnesota communities, we have to think in terms of health in all policies. Thank you again for the opportunity to provide comments on this SDEIS for the NorthMet project. Please feel free to contact Michele Ross at (651) 201-4927 or michele.ross@state.mn.us if you have any questions regarding this letter.

Sincerely,

Edward P. Ehlinger, M.D., M.S.P.H.
Commissioner
P.O. Box 64975
St. Paul, MN 55164-0975

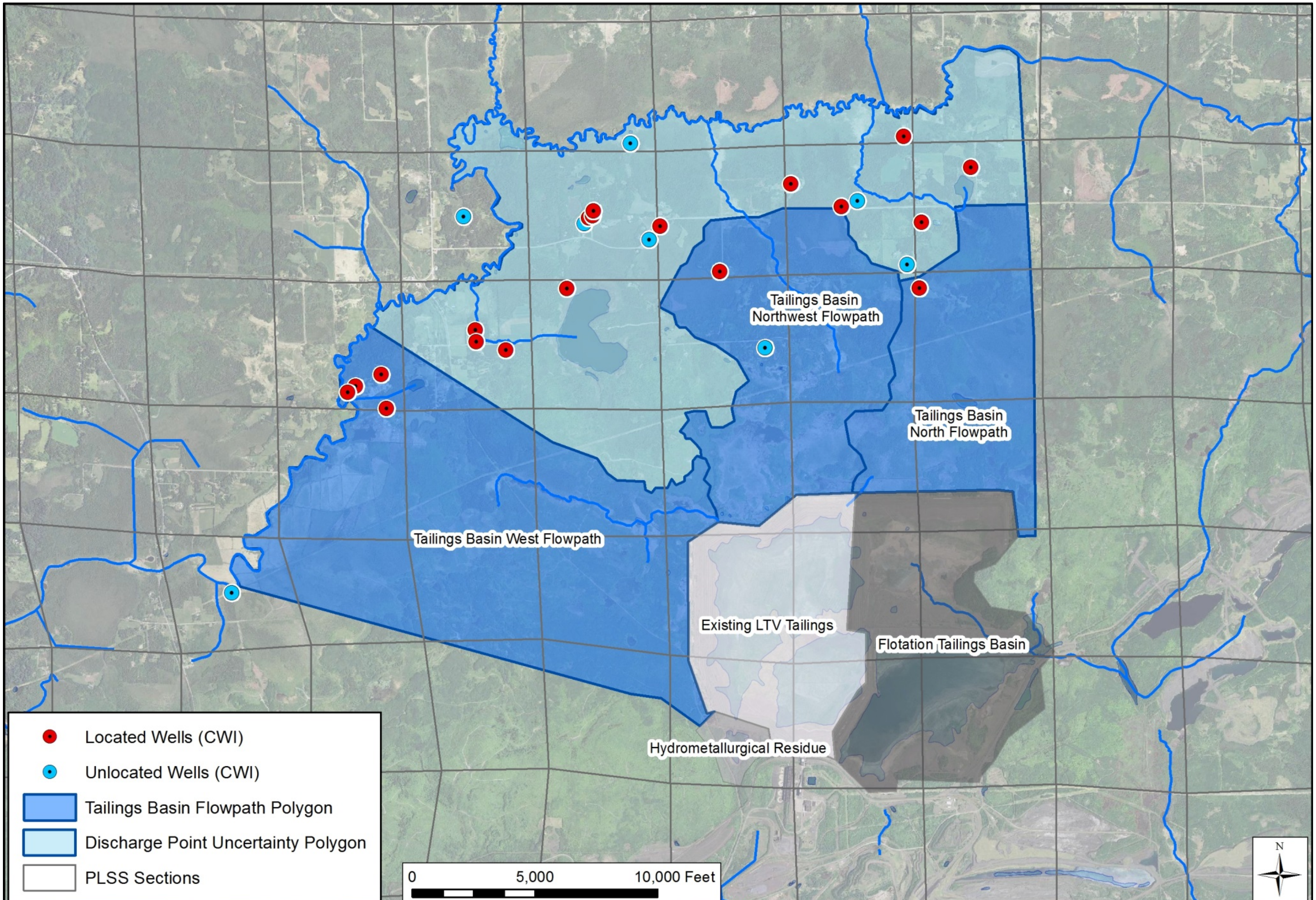

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Figure 1
Known and Estimated Well Locations in Relation to NorthMet Plant Site Surface and Groundwater Flowpaths