ATTACHMENT A

SCOPES OF WORK
FOR
TECHNICAL DESIGN EVALUATION REPORTS

NorthMet Project – Technical Design Evaluation Report – Scope of Work
October 24, 2005

Name: Reactive Residue and PolyMet Flotation Tailings Facility Design and Location

Due Date: 2/24/06

Timeline Reference: RS28 **Scoping Decision Reference:** 2.5

Objective:

Study and report on design options for the lined Reactive Residue Cell(s) and the lined PolyMet Flotation Tailings Cell(s) within Cell 2W of the existing tailings basin. Options for covering and capping of lined cells as well as management of water at cell closure will be evaluated. Conceptual sketches of the proposed optional designs will be provided.

Scope:

The study will evaluate the effectiveness, implementability and cost of:

1. Reactive residue cell construction including size (large vs. small, multiple vs. single), berm materials (amounts and sources), and the impact of removing existing LTVSMC tailings.
2. Initial five years of tailings storage cell construction including size and berm materials.
3. Alternate locations for lined cells on Cell 2W (specifically a location which is near to the processing plant but on top of the site where hornfels were disposed or another location within Cell 2W but not on top of the hornfels). This portion of the report will also evaluate placement of reactive residue cells on top of initial lined tailing basin in Cell 2W (after the cell is completed in five years).
4. Separate disposal containment cells for each type hydrometallurgical reactive residue compared with combined disposal containment cells. This evaluation will include an assessment of the potential benefits of disposal of residues in tailings basin Cells 1E, 2E, or 2W (e.g., iron/aluminum precipitate or gypsum)
5. Alternate liner systems (specifically single liner, double liner, and composite liner) as applied to containment of reactive residue and flotation tailings.
6. Alternate liner materials (specifically clay, geosynthetic clay, LTVSMC fine tailings, membranes (PVC, HDPE, etc.) and in combination with item 3) as applied to containment of reactive residue and flotation tailings.
7. Alternate cover materials (specifically clay, geosynthetic clay, LTVSMC fine tailings and membranes(PVC, HDPE, etc.)) as applied to containment of reactive residue and flotation tailings.
8. Leachate collection and treatment systems (operating and post closure) as applied to containment of reactive residue and flotation tailings.
9. Alternate means to transport reactive residue to the facility (specifically pumping as a slurry and trucking).
10. Alternate options for closure of the lined cells including cell configuration, drivers for placing a final cover system, procedures for cover and caps, subsidence of material, approaches to collection and controlled discharge of storm water runoff, the need to dewater and grade the residue and tailings in preparation for closure and long-term

maintenance. Detailed evaluation of a vegetative cover would be addressed in a (separate) reclamation plan.

The evaluation protocol will include:

- I. Technological feasibility
  - a. Ability to isolate reactive residue material and flotation tailings from the environment
  - b. Design limitations
    - i. Effects of interaction with disposed materials (between liners and reactive material as well as for residues considered for co-disposal with PolyMet tailings)
    - ii. Effects of temperature
  - c. Short term effectiveness including range of potential leakage and transport
  - a. Long term effectiveness (closure) including range of potential leakage and transport
- II. Economic implications
  - a. Capital costs
  - b. Operating and maintenance costs
  - c. Closure costs
- III. Implementability considerations

Designs for the reactive residue cells will, as a minimum, conform to MPCA standards for Mixed Solid Waste Landfills.

Existing/Provided Information:

Details on the proposed alternative and waste characteristics will be provided in the following reports or studies:

1. Waste Characterization for Residue, including residue generation rates
2. Process Design – Plant and Infrastructure Design
3. Tailings Basin Geotechnical
4. Hornfels monitoring well data and details on placement of hornfels
5. Water quality model of hydrometallurgical circuit water chemistry
6. Existing water quality of seepage from the LTVSMC tailings basin
7. Hydrological model of existing and proposed tailings basin

Deliverable:

A report will include design options for the lined Reactive Residue Cell(s) and the lined PolyMet Flotation Tailings Cell(s) (study details to be included as an appendix). The report will discuss location, size, liner and cover design, and water management (during operations, closure, and post closure) and will rank design options on effectiveness, implementability and cost. Highest effectiveness, easiest implementability, and lowest cost would be an optimum solution. Wherever possible, quantitative measures of effectiveness will be provided (e.g., leakage from or influx into cell in gallons/acre/day and percent capture or rejection efficiency). Cost will include construction, operation, closure, and post closure costs. Sketches of the proposed design will be included, consisting of plan location, alignment, and cross sections.

The results of this study may identify constraints on the removal of taconite tailings from Cell 2W (if required) and the design of new tailings disposal systems in Cells 1E, 2E, and 2W because those activities may impact the geotechnical stability or hydrology (surface water management) in the vicinity of the lined cells.

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Name: Tailings Basin Geotechnical **Due Date:** 02/02/06

Timeline Reference: RS40 **Scoping Decision Reference:** 2.5

Objective:

Evaluate tailings basin dam stability and the suitability and benefits of various tailings basin dam designs, basin operations, and provide conceptual sketches and details of the proposed design

Scope:

The study will include a description of past construction and operations at the existing tailings basin including: starter dams, deposition history, tailings dam construction, water management, instrumentation and monitoring, seepage history and historical subsurface and laboratory testing.

Samples of PolyMet flotation tailings collected during the pilot plant processing of the bulk sample and samples of the LTVSMC fine tailings collected from the tailings basin will be analyzed to determine geotechnical design parameters such as strength characteristics, permeability, and compressibility. The attached table summarizes the laboratory testing planned for the PolyMet flotation tailings and LTVSMC tailings (Table RS40-1).

This information will be used to evaluate the suitability of PolyMet flotation tailings for dam construction, and construction of lined cell(s) on Cell 2W for placement of PolyMet flotation tailing cells. Geotechnical stability related to placement of liner systems for the reactive residue cells and the five-year deposition of PolyMet flotation tailings on Cells 2W will be evaluated. Consideration of other engineering aspects related to the reactive residue cells and PolyMet flotation tailings cells are evaluated in Reactive Residue and PolyMet Flotation Tailings Facility Design and Location.

The assembled historical information and laboratory data will be used to evaluate three different methods for future tailings basin dam construction in Cells 1E and 2E: upstream dam construction, downstream dam construction and centerline dam construction or a combination of these methods. Additionally construction of lined cell(s) in the existing Cell 2W for deposition of up to five years of PolyMet flotation tailings will be evaluated. These evaluations will include consideration of dam location, setback of the lined cell(s) from the existing perimeter dams, and an evaluation of the mass and source of material needed for dam construction (including coarse tailings from Cell 2W) for the various dam construction options. Sketches of these options will be prepared, including plans that define the general footprint and alignments, and representative cross sections. This evaluation will consider PolyMet flotation tailings and existing taconite tailings and will consider dam construction stage-volume needs, as well as stability of Cell 2W dams and tailings if coarse tailings are used for new dam construction.

Existing/Provided Information:

1. Process Design – Plant Water Balance

2. Index Testing, Strength Characterization, Compressibility, Seepage and other Physical and Hydraulic Characteristics of Tailings
3. Historical tailing basin reports
4. East Range Hydrology Study

Note: Based on the current schedule, any field testing required would have only one field season available for data/sample collection.

Deliverable:

A report summarizing the methods for tailings dam design (study details to be included as an appendix), geotechnical consideration of the lined cell(s), and ranking the tailings dam design methods on effectiveness, implementability and cost is required. Highest effectiveness, easiest implementability and lowest cost (construction and operation) would be an optimum solution. Reasonable quantitative measures (i.e. dam staged construction, dam raise frequency, seepage rate (gallons/hour or million gallons per day from the basin), total volume (gallons), dam stability factors, dam crest elevation (feet), freeboard (feet), plan area of water (acres), volume of water (acre-feet), depth of water (feet), and area of beach (acre)) will be provided. Cost estimates will include construction, operation, closure, and post closure. Sketches of proposed dam construction will be included, consisting of plan location, alignment, and cross sections.

Table RS40-1
Geotechnical Parameters for Tailings Basin Geotechnical TDER

Introduction: The following is a listing of the information that will be developed as a result of the geotechnical testing to be performed on samples of the PolyMet flotation tailing samples obtained from the Pilot Plant testing and samples of the LTVSMC fine tailings (slimes) obtained from the tailings basin. The tailings testing program will determine the geotechnical design parameters for the range of tailings anticipated (i.e. slimes, fines, and coarse). This information will be used to complete the work described in TDER **Tailings Basin Geotechnical and Reactive Residue and PolyMet Flotation Tailings Design and Location.**

Testing Summary

1. Index Property Testing (PolyMet flotation tailings and LTVSMC Fine Tailings)
   Atterberg Limits
   Grain Size Distribution
   Specific Gravity

2. Strength Characterization (PolyMet flotation tailings)
   Triaxial testing to determine void ratio vs. steady state undrained shear strength. Triaxial tests will be consolidated undrained with pore pressure and deformation measurements.

3. Compressibility Characterization (PolyMet flotation tailings)
   Determined in triaxial testing.
   Consolidation testing of LTVSMC and PolyMet Fine Tailings

4. Permeability Testing (PolyMet flotation tailings)
   Performed on triaxial samples.

Example: Stability Evaluation. Stability of the tailings basin dams will include an evaluation of the rate of consolidation, seepage, deformation, and shear stability. The geotechnical parameters will be varied to obtain sensitivity analyses to ascertain the stability of the tailings basin dams for a range of anticipated conditions (i.e. maximum, minimum, and strength at compatible strains will be evaluated as part of the sensitivity analyses).

Stability Input Parameters would include:

a. Permeability (coarse tailings (LTVSMC historical information), fine tailings (PolyMet flotation tailings and LTVSMC fine tailings). Will evaluate constant head permeability testing of LTVSMC coarse tailings.
b. Undrained Shear Strength, fine tailings (PolyMet flotation tailings), fine tailings (LTVSMC historical information)
c. Friction Angle (coarse tailings, LTVSMC historical information)

Other parameters as reported in previous geotechnical reports from LTVSMC.

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Name: Wastewater Treatment Technology **Due Date:** 4/4/06

Timeline Reference: RS29 **Scoping Decision Reference:** 2.5

Objective:

Study and report on wastewater treatment technologies for mine site reactive runoff water and plant site process water and provide conceptual sketches of the proposed design.

Scope:

Phase 1 of the study will develop anticipated water quality effluent discharge limits for permitted discharges at the mine site and plant site. The specific parameters to be studied are:

a. pH
b. Metals
c. Mercury
d. Sulfate
e. 'Salinity' (chloride, alkalinity, specific conductance, hardness, TDS)
f. Nutrients
g. Organics, GRO, DRO

Phase 2 of the study will collect information on the potential treatment (removal) efficiency for the parameters listed in Phase 1, using the following wastewater treatment technologies:

a. Precipitation (neutralization, Bauxaul, sulfide, etc.)
b. Reverse osmosis
c. Ion exchange
d. Constructed Wetland
e. Membrane technology

Phase 3 of the study will address wastewater minimization by developing a matrix of potential wastewater quantity and quality values associated with various capping and segregation scenarios for the sources of wastewater including:

a. Mine pit dewatering
b. Stockpile run-off
    i. Reactive Waste Rock
    ii. Lean Ore
    iii. Ore
c. Process water discharged from the tailings basin

Phase 4 of the study will evaluate the effectiveness, implementability and cost of the studied technologies (including practical combinations - pretreatment, staged and series) for wastewater minimization and treatment of mine site reactive runoff (Mine Pit Dewatering and Reactive Waste Rock/Ore/Lean Ore Stockpile Seepage).

Phase 5 of the study will evaluate the effectiveness, implementability and cost of the studied technologies (including practical combinations – pretreatment, staged and series) for plant site process water (Tailings Basin).

For Phases 4 and 5 of the evaluation protocol will include

I. Technological feasibility
   a. Ability to meet effluent limits
   b. Design limitations
      i. Hydraulic and chemical capacity
      ii. Effects of temperature
   c. Short term effectiveness
   d. Long term effectiveness (closure)
   e. Metal recovery (recycling for further processing) from wastewater or sludge

II. Economic implications
   a. Capital costs
   b. Operating and maintenance costs
   c. Closure costs

III. Implementability considerations

Existing/Provided Information:

Details on predicted pre discharge water quality and discharge water quantity will be provided in the following reports or studies:

1. Hydrology – Mine Water Model and Balance
2. Process Design – Tailings Basin Water Balance
3. Mine Pit Water Quality Model
4. Wastewater Modeling - Waste Rock and Lean Ore
5. Wastewater Modeling – Tailings
6. Mine Wastewater Management Systems
7. Reactive Waste Segregation

Deliverable:

A report summarizing the wastewater management (including combinations of wastewater minimization and treatment) scenarios for mine site and plant site (study details to be included as an appendix) and ranking them on effectiveness, implementability and cost is required. Highest effectiveness, easiest implementability and lowest cost would be an optimum solution. However, it is likely that trade-offs between effectiveness, implementability, and cost will need to be considered. Wherever possible, quantitative estimates of effectiveness will be provided (e.g., concentration and mass of pollutants in effluent and pollutant removal efficiency). Cost will include construction, operation and post closure costs. Sketches of the proposed design will be included, consisting of plan location, alignment and cross sections.

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Name: Air Emission – Cross Media **Due Date:** 3/31/06

Timeline Reference: RS04 **Scoping Decision Reference:** 2.5 and 3.3.5

Objective:

Determine the impact on other media (water, solid waste) from options for air emissions control.

Scope:

For the crushing and grinding operations, a dry fabric filter system and a wet scrubbing system (water only) will be evaluated. Pollutants in scrubber water or collected solids from crushing and grinding will report to the flotation tailings basin

The flotation process and processes downstream of flotation are wet processes. The major pollutants downstream of flotation are acid mist and gases. Dry fabric filters will not provide effective control for these processes. Therefore, only wet scrubbing systems (water and the addition of caustic or lime to control potential acid gas emissions) will be evaluated for these processes. Pollutants collected from processes downstream of flotation will be recycled back into the process stream or will report to the Reactive Residue Facility.

Collected solids from dry systems will be reintroduced to the process as a very small fraction of the total process stream. Thus, direct impacts from a dry system on the water treatment and solid waste systems are expected to be minimal and no solid waste will be generated directly. The amount (by weight) of reintroduced solids generated from the dry air emissions control system will be estimated from published literature or vendor estimates. The potential amount of increased solid waste from water treatment operations (e.g. sludges) due to treatment of the reintroduced solids from dry air emission processes will also be estimated from published literature and vendor estimates.

The quantity (volume) and quality (concentration of metals and pH) of the scrubber water will be estimated from published literature or vendor estimates. The potential impacts of the wet scrubber flows on proposed water treatment systems will be discussed, along with the potential need to modify water treatment systems to accommodate the volume and changes in quality of scrubber water. Impact will focus on the primary design constituents: flow, solids, pH, and COD as well as critical discharge constituents including: mercury, copper, nickel, cobalt, zinc, sulfates, chlorides and fibers. Estimates of potential changes in the quality of the water discharge will include all water quality parameters. The potential amount of increased waste from water treatment operations (e.g. sludges) due to treatment of the scrubber water will be estimated from published literature and vendor estimates.

Existing Information:

The scoping EAW shall be used to determine sizes of air emission control equipment and water treatment schemes. AP-42, published literature and vendor estimates shall be used to determine quantities and qualities of water and solid waste emanating from air emission control equipment.

Deliverable:

A report summarizing the impact on other media (including an evaluation of impacts on solid waste generation, water treatment complexity and water discharge) for air emission control options (study details to be included as an appendix) and ranking them on effectiveness, implementability and cost is required. Highest effectiveness, easiest implementability and lowest cost would be an optimum solution. Wherever possible, quantitative measures of effectiveness (e.g., pounds/year increase of solid waste and gallons/minute increase of water discharge) will be provided. Cost will include construction, operation and post closure costs.

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Name: Wetlands Mitigation Plan **Due Date:** 12/06/05

Timeline Reference: RS20 **Scoping Decision Reference:** 2.5 and 3.3.1

Objective:

Study various wetland mitigation opportunities and identify feasible mitigation projects that will provide compensation for unavoidable wetland impacts resulting from the project.

Scope:

The study will cover technical and regulatory evaluation of the wetland mitigation strategies listed below and identification of specific sites for wetland mitigation. The scope will not include specific designs, rather, a study of the technical, regulatory, and legal feasibility (including land ownership issues) of mitigation strategies. It may be that a combination of the following will provide a replacement plan.

- Restoration of Drained and Partially Drained Wetlands – two to three sites will be evaluated. Upstream and downstream impacts will be determined including flooding of roads, railroads, bridges, and culverts. Issues relating to ditch abandonment, jurisdictional ditches, beaver control, ditch management, and ditching effectiveness will be identified.
- On-site Mitigation – potential short- and long-term (i.e. at closure) on-site mitigation opportunities will be evaluated. These could include creating areas less than six feet deep in flooded mine pits, closing unneeded settling ponds in a way that creates wetlands, and creating wetlands upstream in drainage areas impacted by construction of stockpiles and roads.
- Off-site Mitigation (creation or restoration of off-site wetlands)
- Wetland Preservation (Permanent protection of high quality wetland communities that would otherwise be at risk of destruction or degradation. This option must involve a component of hydrologic or vegetative restoration.) – two to three sites will be evaluated.
- Purchase of wetland credits from an established bank

Existing/Provided Information:

Existing information that will be used in this study includes:

- Soil survey data
- Geologic and hydrogeologic mapping data
- Peat inventory studies
- National Wetland Inventory maps
- Property ownership data
- Digital elevation models
- Aerial photography
- Stream and ditch inventory data
- Forest/vegetation inventory data
- Site history - ditching, land use (wildlife, recreation, timber harvesting)

- Natural Heritage Information System – locations of threatened, endangered or rare species, high quality native plant communities, and aggregation sites such as colonial waterbird nesting colonies

Deliverable:

A report summarizing the strategies and related sites and ranking them on effectiveness, implementability and cost is required. Highest effectiveness, easiest implementability and lowest cost would be an optimum solution.

The report will include for each strategy and site a description of the level of study employed, a description of the site and mitigation strategy, an evaluation of the technical feasibility, the projected mitigation credits that may result, application of the state and federal regulatory requirements, potential risks and unknowns, and any regulatory guidance received regarding the site. The report will also include a map of each site and other data collected regarding the site.

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Name: Reactive Waste Rock, Lean Ore, and Deferred Ore Segregation **Due Date:** 4/20/06

Timeline Reference: RS23 **Scoping Decision Reference:** 2.5

Objective:

Study and report on segregating reactive mine waste rock, lean ore (no current economic value), and deferred ore (intended to be blended with other ore in subsequent years) by degree of reactivity and having different stockpile designs based on degree of reactivity for each these three products. The evaluation will include a review of literature on the effectiveness of applications at existing operations. It will also provide conceptual schematic drawings of the proposed design and other viable options, including liner, cover , and the collection system.

Scope:

Phase 1 of the study will evaluate the effectiveness, implementability and cost of having one (proposed) or up to three classes of each of reactive mine waste rock, lean ore, and deferred ore and placing each class in a separate location for each reactive mine material type. Separate stockpiles or separate areas within a single stockpile, with separate collection areas for reactivity class, will be considered. The three classes would be acid generating (pH < about 4), acid generating (pH > about 4), and non-acid generating but producing drainage that does not meet water quality effluent limitations.
Phase 2 of the study will evaluate the effectiveness, implementability and cost of:

1. Alternate liner systems (specifically single liner, double liner, and composite liner)
2. Alternate liner materials (specifically clay, geosynthetic clay, membranes [e.g. PVC, LDPE, HDPE, etc.) in combination with item 3)
3. Alternate cover materials (specifically standard mineland reclamation, clay, geotextile, synthetics,(e.g. PVC, LDPE, HDPE, etc.)
4. Aternate cover systems (e.g. use of non-reactive rock around reactive rock, allowing covers to be placed over the entire footprint of the reactive rock.
5. Leachate collection systems

Phase 3 of the study will be further evaluation of three to five combinations of the liner systems, liner materials, and cover materials investigated. The predicted water quality and quantity will be determined for each of the combinations.

For Phases 2 and 3 the evaluation protocol will include

I. Technological feasibility
   a. Ability to isolate stockpile material from water and air (liner and cover)
   b. Ability to collect water passing through the stockpile (liner and leachate collection)
   c. Ability to remove water collected from the top of the stockpile
   d. Design limitations
      i. Effects of precipitation
      ii. Effects of temperature
      iii. Effects of freeze-thaw cycles

   e. Systems to monitor effectiveness
   f. Effectiveness (water quality and water quantity)
      i. Short term
      ii. Long term (post operation)

   a.

II. Economic implications
   a. Capital costs
   b. Operating and maintenance costs,
   c. Closure costs, including long-term maintenance
III. Implementability considerations

This study will also be useful for the possibility of segregating reactive waste rock, lean ore, or deferred ore in disposal methods other than that proposed at the mine site (e.g., in-pit, off-site, etc.)

Existing/Provided Information:

Details on the proposed design will be provided in the following reports or studies:
1. Mine Design and Schedule
2. Mine Waste Management Plan
3. Mine Production Schedule Final
4. Stockpile Design

Deliverable:

A report summarizing the studies (study details to be included as an appendix) and ranking them on effectiveness, implementability and cost is required. Highest effectiveness, easiest implementability and lowest cost would be an optimum solution. Wherever possible, quantitative measures of effectiveness will be provided (e.g., gallons/acre/day leakage from the stockpile, influx to the stockpile and percent capture or rejection efficiency, and water quality). Cost will include construction, operation, and post closure costs. Schematic drawings of proposed design will be included, consisting of plan location, alignment, and cross sections.

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Name: Tailings Basin Modifications **Due Date:** 3/1/06

Timeline Reference: RS55 **Scoping Decision Reference:** 2.5, 2.7 and 3.3.4

Objective:

Study and report on modifications to the existing tailings basin that would minimize water release via seepage from the tailings basin through seepage collection and recovery, and seepage prevention.

Scope:

Phase 1 of the study will develop conceptual plans for minimizing water release via seepage from the tailings basin. The development of alternatives will be divided into two fundamental approaches: seepage collection and recovery, and seepage prevention. Recommended solutions are likely to represent combinations of these approaches applied in different locations. An important consideration will be preventing or minimizing groundwater drawdown from surrounding wetlands.

Seepage collection will focus on:
1. Collecting water from existing drain pipes (including refurbishment of drain pipes) on the southern and western side of Cell 2W and northern side of Cells 2E and 2W
2. Modifying seepage collection to include additional horizontal or vertical drains
3. Adding a collection system for the uncollected seepage at the south side of Cell 1E
4. Extending the ditching system at the toes of the Cells 2E and 2W dams.
5. Avoidance and minimization of wetland impacts for any seepage collection approach that would draw down wetlands groundwater levels.

Seepage prevention will focus on options for reducing seepage from the basin by adding a liner system. Liner options will include:
1. Lining the more porous perimeter embankments of one or more of the existing cells
2. Entirely lining one or more of the existing cells
3. Adding clay to tailings to reduce permeability

Phase 2 of the study will evaluate the effectiveness, implementability and cost of the options developed in Phase 1, both separately and in combination. Combinations will be developed based on nature of seepage, embankment, and foundation conditions, and are likely to vary along different segments of the perimeter embankments. Trafficability for construction work will be considered based on phreatic surface within the basin, existing elevations and other geotechnical issues being developed as part of the Tailings Basin Geotechnical study. Available information on the tailings basin water level and flow paths as well as hydraulic characteristics of underlining material below the collection ditch or the basin (foundation materials) will be utilized.

Existing/Provided Information:

Details will be provided in the following reports or studies:

1. Process Design – Tailings Basin Water Balance
2. Process Design – Tailings Basin
3. Tailings Basin Geotechnical
4. Map and data for existing seeps
5. East Range Hydrology Study
6. Physical characteristics of existing LTVSMC tailings

Deliverable:

A report summarizing the options for seepage reduction and seepage recovery improvement (study details to be included as an appendix) and ranking them on effectiveness, implementability and cost is required. Highest effectiveness, easiest implementability and lowest cost would be an optimum solution. Wherever possible quantitative measures (ie gals/minute or mgd for seepage) of effectiveness will be provided. Cost will include construction, operation and post closure costs.