Appendix 15

Financial Assurance

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Appendix 15.1

Legacy Closure Plan

Legacy Closure Plan

for Ferrous LTVSMC Legacy Areas subject to Assignment from Cliffs Erie, L.L.C.

December 2017

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Acronyms, Abbreviations and Units

Acronym, Abbreviation or Unit	Stands For
ACM	asbestos-containing materials
AOC	Areas of Potential Concern
Arrowhead	Arrowhead Consulting and Testing Inc.
AST	aboveground storage tank
Barr	Barr Engineering Co.
Cliffs Erie	Cliffs Erie, L.L.C.
DNR	Minnesota Department of Natural Resources
ESA	Environmental Site Assessment
Lakehead	Lakehead Constructors Inc
LTVSMC	LTV Steel Mining Company
Mavo	Mavo Systems
MPCA	Minnesota Pollution Control Agency
NPV	Net Present Value
NTS	Northeast Technical Services
PCB	polychlorinated biphenyl
PolyMet	Poly Met Mining, Inc.
PTM	Permit to Mine
QAPP	Quality Assurance Project Plan
REC	Recognized Environmental Condition
SAP	Sampling and Analysis Plan
VIC	Voluntary Inspection and Cleanup

1.0 Introduction

This report presents an updated Legacy Closure Plan, which includes a Cost Estimate, for portions of the former LTV Steel Mining Company (LTVSMC) site which it is anticipated that Cliffs Erie, L.L.C. (Cliffs Erie) will convey fee title and associated permits to Poly Met Mining, Inc. or a related company (collectively, Permittee). These portions of the former LTVSMC site, all of which were used for taconite operations that halted in approximately 2001, are shown in Figure 1 attached to this report, and are referred to herein as the "LTVSMC Legacy Properties." The LTVSMC Legacy Properties include:

- All buildings, structures and associated infrastructure at the Plant Site, Area 1 Shops, Area 2 Shops, the Colby Lake Pumphouse and associated pipeline, the Main Gate, and the Administration Building (Figure 2)

- The Tailings Basin and Emergency Basin (Figure 3)

- Other lands surrounding the properties identified in the preceding bullets (Figure 1)

Cliffs Erie has been implementing its reclamation plan associated with its existing ferrous Permit to Mine (PTM) since 2001. Cliffs Erie's reclamation plan have been developed to meet the requirements of Minnesota Statutes, section 93.49 and the relevant rules of the Department of Natural Resources (DNR) relating to taconite operations such as those that were conducted on the LTVSMC Legacy Properties. Poly Met Mining, Inc. (PolyMet) has drafted an updated Legacy Closure Plan pursuant to these applicable requirements to replace the current Cliffs Erie Closure Plan.

1.1 Purpose and Overview

The purpose of this Legacy Closure Plan is to ensure that the continuing reclamation obligations under Minnesota Statutes, section 93.49 will be met with respect to the former ferrous LTVSMC taconite facilities if the NorthMet Project (Project) were not to commence operations for any reason. In general, the Legacy Closure Plan details the following reclamation activities: Areas of Potential Concern (AOCs) will be investigated and when necessary, remediated in accordance with the requirements of Minnesota Pollution Control Agency (MPCA)'s voluntary investigation and cleanup (VIC) program; and existing buildings will be demolished. The Legacy Closure Plan also provides for dewatering and other activities that may be necessary for reclamation of the ferrous LTVSMC tailings basin, if such circumstances were deemed necessary by DNR and MPCA. Both agencies have reviewed the elements of this Legacy Closure Plan, which includes erosion maintenance, water quality monitoring, and dam safety monitoring associated with the existing former ferrous LTVSMC tailings basin. The Legacy Closure Plan is intended to address the existing conditions associated with the ferrous LTVSMC Legacy Properties before Mine Year 1, and then only in the event that the Project waste water treatment system (WWTS) were not to become operational for any reason. MPCA has determined that in the event of such circumstances, water treatment would not be expected to be required for the existing tailings basin conditions, and accordingly, no treatment activities or costs are included in the Legacy Closure Plan.

The goals of this updated Legacy Closure Plan include preserving the LTVSMC Legacy Properties to the extent practical for future reuse and facilitating redevelopment of the brownfield properties subject to this Plan for a future mineral processing/industrial site. These goals are consistent with the requirements of Minnesota law. *See, e.g.,* Minn. Stat. § 93.003, subd. 1 (requiring a mine owner/operator to "maintain the mine or facilities in salable operating condition for at least two years after it discontinues operation in order to allow the state of Minnesota and other interested public and private bodies to seek a new owner and operator"); House Research Bill Summary, H.F. 47 (Jan. 30, 2001) (the statutorily-mandating holding period "allows the state or other parties time to find a new owner or a new use for the facility"); Minn. R. 6130.0200 and 6132.0200 (encouraging planning of future land utilization and promoting orderly development of mining). The state's policy since the 2001 LTVSMC bankruptcy has been to preserve the assets of the former LTVSMC operations to support future mining, including potential Cu/Ni developments as expressly recognized in the State Master Agreement that DNR, MPCA, and others executed with Cliffs Erie and Cleveland-Cliffs, Inc. (now Cliffs Natural Resources).

This updated Legacy Closure Plan is intended to reclaim subject properties to a safe, secure, and environmentally stable condition. In general, AOCs will be investigated and remediated, buildings will be demolished, and maintenance and dam safety monitoring associated with the existing former LTVSMC tailings basin will be performed. The Plan also provides for tailings basin dewatering, if necessary.

Assuming that the Project receives its permits, it is anticipated that this Legacy Closure Plan and associated financial assurance will be combined with the DNR-approved nonferrous contingency reclamation plan and associated nonferrous financial assurance under Minnesota Rules chapter 6132 for the Project. As part of that process, DNR is expected to approve the specific financial assurance instruments that will be applicable to both this Legacy Closure Plan and the nonferrous contingency reclamation plan for the Project. If any additional relevant regulatory details are developed during that DNR-approval process, this Legacy Closure Plan will be updated to incorporate any such necessary details.

There are portions of the former LTVSMC site that Cliffs Erie intends on retaining for the foreseeable future, including the Dunka Mine Area; Mine Areas 2, 2W, 3 and 5; and various lands associated with the railroad (including pellet stockpile, Knox station area, main line track and dock). Those areas will remain subject to Cliffs Erie's ferrous PTM for the former LTVSMC site, as well as subject to Cliffs Erie's existing Closure Plan, and accordingly, are outside of the scope of this report.

1.2 Outline

The outline of this report is:

Section 1.0	Introduction, objective and overview and general references
Section 2.0	Description of the activities associated with building demolition
Section 3.0	Description of the activities associated with remediation of relevant AOCs, and monitoring of two landfills

Section 4.0 Description of activities associated with dewatering the tailings basin, as well as monitoring and maintenance provisions

Section 5.0 Legacy Closure Cost Estimate, with basis for reclamation (short term) and long term activities; including supporting information

2.0 Building Demolition

All buildings and structures will be removed. Foundations above existing grade will be razed, and foundations and slabs at or below grade will be left in place. These will all be covered with a minimum of two feet of surface overburden and revegetated.

Demolition waste from structure removal will be disposed of in an off-site landfill. Concrete from demolition will be placed in building basements where possible including coarse crusher basement, fine crusher basement and concentrator basement and the Plant Reservoir.

Buildings that will be demolished are shown in Table 2-1. See Figure 2 for buildings at the Plant Site and the Colby Lake Pumphouse. Any asbestos containing materials (ACM) present in those buildings will be abated before demolition.

ACMs (hot water heating system insulation, lube system insulation, floor tile, etc.) from asbestos abatement will be removed, properly packaged, and disposed in appropriate existing off-site landfills. ACMs (i.e., pipe and electrical insulation) located in utility tunnels will also be removed and the tunnels cleaned.

Table 2-1 Buildings to be Demolished

Building	Site
Additive Building & Heating Plant	Plant Site
Sewage Treatment Plant	Plant Site
Area 1 Shops	Area 1
Area 2 Shops	Area 2
Booster Pump House #1	Plant Site
Coarse Crusher	Plant Site
Drive House #1	Plant Site
Drive House #2	Plant Site
Fine Crusher	Plant Site
Concentrator	Plant Site
General Shops	Plant Site
Rebuild Shop	Plant Site
Rubber Shop	Plant Site
Lube House	Plant Site
A-Lab	Plant Site
Water Tower	Plant Site

Building	Site
Warehouse Electrical	Plant Site
Warehouse #2	Plant Site
Warehouse 49	Plant Site
Miscellaneous Buildings (not listed separately)	Plant Site
Administration Building	Plant Site
Electrical and Service Tunnels	Plant Site
Colby Lake Pumphouse	Colby Lake

3.0 Areas of Potential Concern (AOCs) and Landfills

3.1 AOCs

Cliffs Erie commissioned a Phase I Environmental Site Assessment (ESA) after acquiring the former LTVSMC properties in the LTVSMC bankruptcy (Attachment A). The ESA identified 61 AOCs on the entire LTVSMC site. After the ESA, two additional AOCs were identified. As part of its 2001 Closure Plan, Cliffs Erie has implemented remediation activities for some of these AOCs under the supervision of the MPCA. Twenty-nine of the total of 63 AOCs are located on the LTVSMC Legacy Properties with respect to which it is expected that Permittee will acquire fee title in 2018. The locations of those 29 AOCs are shown on Figure 4. Of these 29 AOCs, one (Mill Rejects Area (AOC-12)) has already received a No Further Action letter from MPCA and is considered closed. Two other AOCs (AOC 8 and 36) are closed landfills. The monitoring provisions for these landfills are discussed in Section 5.1.

The 26 open AOCs shown in Figure 4 are included in this updated Legacy Closure Plan for the Permittee. These AOCs may require further investigation to determine whether or not they require any further action. For these AOCs, continued participation in the MPCA VIC program that Cliffs Erie started as part of its 2001 Closure Plan is anticipated. The AOCs will be investigated and remediated as necessary on a schedule and priority agreed to with the MPCA under the VIC program. These 26 open AOCs are summarized in Table 3-1.

Table 3-1 Areas of Potential Concern (AOC) for Remediation

AOC	Description	Activity	Contaminants of Potential Concern(1)	Status
1	Area 1 Shops and Reporting	Fueling equipment, rebuild and repair, steam cleaning, electrical shop	DRO, GRO, VOC, RCRA SVOC	Investigation at closure
6	Oily Waste Disposal Area	Oily waste from oil/water separator of the LTVSMC Plant Site Sewage Treatment Plant disposal	DRO, GRO, VOC, PAH, RCRA	Investigation pending
7	Bull Gear Disposal	One-time disposal of heavy lubricant	PAH, Pb	Investigation pending
9	RR Panel Yard	Railroad siding area, fabrication of rail panels, disposal of railroad ties, locomotive fueling	DRO, VOC, RCRA, PAH	Scrap and trash were disposed. Some items remain to be removed. Sampling and analysis plan was carried out and site report and further action plan is being generated.
10	Airport	Equipment salvage and tear-down area, materials storage	DRO, GRO, VOC, RCRA	Scrap sold and trash disposed. Some cleanup remains, and investigation pending.
11	Stoker Coal Ash Disposal	Coal ash industrial waste disposal	B, Sr	Investigation pending
13	2001 Storage Area	Equipment salvage, materials storage, transformer storage	DRO, GRO. VOC, PAH, PCB, RCRA Metals	Investigation pending
14	Large Equipment Paint Area	Sandblasting and painting	RCRA, VOC	Buildings sold. Scrap and trash to be removed. Investigation pending.
35	Dunka WTP Sludge	Stockpiling area for WTP sludge	RCRA Metals	Investigation pending

AOC	Description	Activity	Contaminants of Potential Concern(1)	Status
37	Line 9 Area 5 Petroleum Contaminated Soil	Petroleum contaminated soil landfarm	DRO	Landfarm released/closed by MPCA. Desktop study to close out AOC remains.
38	Area 2 Shops	Fueling equipment, rebuild and repair, paint shop, carpenter shop	DRO, GRO, VOC, RCRA SVOC	Site investigation complete - no solvents detected; will be handled as LUST-CAP approved(2)
40	Heavy Duty Garage	Equipment maintenance	DRO, GRO, VOC, PAH	Building removed. Investigation at closure
42	Bunker C Tank Farm	Large Aboveground Storage Tank (AST) storage of #4 to #6 fuel oil	DRO	PCA shows AOC42 as closed – this refers to the day tank work that has been completed, including some excavation and removal of surface stains, and pump house demolished. Petroleum impacted soils removed. However, further work necessary to remove tanks (AST) and some fuel lines.
43	Administration Building	Heating oil tank	DRO, BTEX	Demolition and investigation at closure
44	Main Gate Vehicle Fueling Area	Two 6,000 gallon AST	GRO/DRO/VOC	Demolition and investigation at closure
46	Plant Site Proper and General Shops	Crushing, concentrating and general maintenance facilities	DRO, GRO, VOC, PAH, PCB, RCRA	Investigation at closure; subsurface after buildings demoed

AOC	Description	Activity	Contaminants of Potential Concern[(1)]	Status
47	Tailings Basin Reporting	Lube station and fueling area	GRO, DRO	Closed MPCA LEAK site. Desktop study to close out AOC remains.
48	Transformers	Transformers associated with pumps located within the Tailings Basin	DRO, PCB	Investigation pending
49	Course Crusher	Course Crusher Petroleum Contaminated Soil	DRO	Investigation Pending
50	Emergency Basin	Drain outfall for stormwater and process water for the Plant Site	DRO, VOC, PAH, RCRA	Sampling and analysis plan was completed. Final report pending, recommending No Further Action to MPCA.
51	Salvage and Scrap Areas	Storage and salvaging various equipment. These are small areas scattered on the southwest side of the Tailings Basin.	DRO, PAH, PCB, RCRA Metals	Investigation pending
52	Cell 2W Salvage Area	Storage of materials and equipment	DRO, PAH, Pb	Investigation pending
53	Hornfels	Disposal of sulfide waste rock	RCRA, pH	Monitored via NPDES permit. Desktop study to close out AOC remains.
59	Colby Lake Pumping Station	Heating oil AST transformer	DRO, BTEX	Investigation at closure
63	General Shops Transformer	Transformer leak at General Shops	PCB	Clean up was completed. Final report pending, recommending No Further Action to PCA.

AOC	Description	Activity	Contaminants of Potential Concern[(1)]	Status
64 (note: referred to as AOC61 in NTS document)	Pellet Plant	Pelletizing facilities	DRO, GRO, VOC, PAH, PCB, RCRA	AOC 61 Pellet Plant – Ditch is closed. Pellet Plant facilities removed. Site investigation pending at Pellet Plant.

(1) Abbreviations include: B = boron; BTEX = benzene, toluene, ethylbenzene and xylenes; DRO = Diesel Range Organics; GRO = Gasoline Range Organics; PAH = Polycyclic aromatic hydrocarbons; Pb = lead, PCB = Polychlorinated biphenyls; RCRA = Resource Conservation and Recovery Act; RCRA SVOC = RCRA Semi-Volatile Organic Compounds; Sr = strontium; VOC = Volatile Organic Compounds

(2) LUST-CAP = leaking underground storage tank corrective action plan

MPCA will oversee any necessary remediation activities for these AOC sites. The VIC process for clearing and closing an AOC beyond the Phase I ESA is documented in the Quality Assurance Project Plan (QAPP) (Attachment B) that has been prepared and which is incorporated into this updated Legacy Closure Plan. Within the QAPP, a process for preparing a Sampling and Analysis Plan (SAP) is included. Record searches to confirm the presence or absence of a recognized environmental condition (REC) within applicable MPCA requirements will be completed during preparation of a SAP for each open AOC. If a REC is identified, a SAP will also be used to detail the scope of any required Phase II ESA investigation work that will help determine if a release to the environment has occurred. A Phase II ESA investigation is also intended to define the nature, magnitude, and extent of the release (if found). The results of the Phase II ESA will be used to perform an MPCA VIC Program Risk Based Site Evaluation based on intended land use, to determine if remediation is required under the applicable law to mitigate risk.

3.2 Legacy Landfills

3.2.1 Coal Ash Landfill

Coal ash from LTVSMC's Taconite Harbor facility was disposed at the Hoyt Lakes' Coal Ash Landfill located southeast of the Tailing Basin. As part of a Compliance Agreement with the MPCA, LTVSMC agreed to close the Coal Ash Landfill.

A Closure Plan and Postclosure Plan were subsequently submitted to the MPCA during May 2000. Those plans indicated that LTVSMC would stop accepting coal ash at the disposal area by approximately August 1, 2000. The Closure Plan prepared in accordance with Minnesota Rules, part 7035.2815, subpart 5, items D and E, subpart 6 and subpart 16, and it specified that closure activities be completed by September 2000.

The Postclosure Plan indicates that the postclosure care period will continue for 30 years from the final closure certification which certifies that the Coal Ash Landfill has been closed in accordance with approved plans and specifications as required by Minnesota Rules, part 7035.2610. Final closure occurred in approximately 2000.

Until 2030, inspections of the final cover system and surface water control system will be performed three times a year (spring, summer and fall), maintenance will be performed as necessary and an annual report describing the inspection(s), conditions observed, corrective actions, maintenance activities, and monitoring activities will be submitted to MPCA. PolyMet has included costs to perform these activities in this Legacy Closure Plan.

3.2.2 Industrial Landfill SW-619

Cliffs Erie's Industrial Landfill operates under MPCA Solid Waste Management Permit 619 (SW-619). A groundwater monitoring system and a methane ventilation system were already present at the closed LTVSMC industrial waste landfill and are currently used to monitor conditions at Industrial Landfill SW- 619. Groundwater and methane monitoring is performed annually during October each year. PolyMet has included costs to perform these activities in this Legacy Closure Plan.

The postclosure care period will continue for 30 years from the final closure certification, which certifies that the disposal area has been closed in accordance with approved plans and specifications as required by Minnesota Rules, part 7035.2610. Current plans are to close Industrial Landfill in 2018.

4.0 Dewatering, Maintenance and Monitoring of Tailings Basin

This Legacy Closure Plan incorporates the activities set forth below with respect to the former ferrous LTVSMC tailings basin. Additional details are provided in the memorandum from MPCA to DNR (Attachment O). Basin dewatering and closure under this Plan will not occur if the Project proceeds. This Legacy Closure Plan assumes that if the Project does not proceed, MPCA's determination as to whether the basin will be dewatered and closed will be made in 2027. However, MPCA has the option to begin the dewatering process sooner than 2027. Assuming dewatering is not accelerated, this Legacy Closure Plan includes the following items:

- The existing tailings basin seepage pump-back systems would continue to operate until commencement of tailings basin dewatering activities

- The tailings basin would be dewatered and closed under the existing NPDES/SDS permit and Consent Decree with MPCA supervision.

    - Water would be routed from the basin to Second Creek via SD026

- No water treatment would be required in connection with the basin dewatering and closure or any basin seepage.

    - MPCA would consider whether to implement a site-specific water quality standard or use attainability analysis (or when applicable, a use and value demonstration (UVD) as an alternative to a UAA - for purposes of this Plan a UVD will be included in the term "use attainability analysis" even though the requirements for establishing a UVD may lower); under applicable MPCA requirements, any of these approaches for establishing revised water quality standards for streams near the tailings basin could be used in the future to address any seepage from the basin or any dewatering results depending on the outcome of the agency's anticipated revision of Class 3 & 4 water quality standards.

- In advance of the MCPA determination of whether to require basin dewatering and closure, water quality monitoring in the vicinity of the basin, dam safety monitoring, and maintenance of the basin would continue under the current Consent Decree and other applicable permitting requirements.

4.1 Tailings Basin Dewatering

Dewatering the tailings basin would involve pumping water from Cell 2E to Cell 1E, then from Cell 1E to Second Creek via SD026. The existing pump-back systems would be shut down once dewatering commences. The water’s pH will be adjusted, if necessary prior to discharge with carbon dioxide addition. Following completion of dewatering, dam breaches and stormwater flow channels would be constructed at sufficient depth to maintain Cells 1E and 2E in an effectively dry condition. Existing pump-back systems also would be removed after dewatering is completed.

4.2 Tailings Basin Reclamation Maintenance

Maintenance (including erosion repairs) of the tailings basin will continue on an annual basis.

4.3 Tailings Basin Dam Safety Monitoring

Inspection, monitoring and reporting with respect to the existing tailings basin dams will continue as under the existing Cliffs Erie Closure Plan.

4.4 Tailings Basin Water Quality Monitoring

Water quality sampling locations, frequency, and analytes tested that are currently required under the existing Cliffs Erie NPDES/SDS permits and Consent Decree will continue. This monitoring will continue until MPCA or DNR, as applicable, issues a release to Permittee.

4.5 Toxicity Monitoring

Biological monitoring will be conducted in support of the information needed for MPCA's implementation of a site-specific water quality standard or use attainability analysis, if MPCA elects to proceed with this process.

4.6 Wild Rice Monitoring

Wild rice monitoring will be conducted in support of the information needed for MPCA's implementation of a site-specific water quality standard or use attainability analysis, if MPCA elects to proceed with this process.

5.0 Legacy Closure Cost Estimate

The following sections describe how the Legacy Closure Cost Estimate was developed for purposes of this Legacy Closure Plan. Section 5.1 describes the organization of the estimate, Section 5.2 describes the basis for reclamation activities and Section 5.3 describes the basis for long term activities. The Legacy Closure Cost Estimate is attached as Appendix A.

The remainder of this section provides information about the firms that developed costs used in the estimate:

Barr Engineering Co. (Barr)

Barr is very familiar with the site and Project and, working with PolyMet engineers, developed scopes of work and estimates for Project reclamation including dewatering, dam breaching, and facility footprint grading and reseeding for the existing tailings basin.

Barr has provided dam safety geotechnical services for the tailings basin while LTVSMC was in operation, ongoing services since its closure, and designed the FTB dams for the Project. Barr provided estimates for dam safety geotechnical services as well as project staff during reclamation for this Legacy Closure Plan.

Northeast Technical Services (NTS)

NTS is very familiar with the former LTVSMC site and has been working on AOCs, monitoring and reporting on geotechnical instrumentation, monitoring, maintenance, and reporting since the LTVSMC bankruptcy in 2001. NTS provided estimates for these activities, as well as rate information for site manager and vehicles, in connection with the Legacy Closure Plan.

Lakehead Constructors Inc. (Lakehead)

Lakehead is a major local construction contractor and has worked with PolyMet engineers to develop estimates for building demolition, infrastructure removal, and footprint restoration for legacy facilities. Lakehead personnel have been on site to inspect the buildings included in the Legacy Closure Plan, and provided the cost estimates for demolition and removal included the Plan.

Mavo Systems (Mavo)

Mavo is a Minnesota-based specialist contractor providing environmental services and has worked with PolyMet engineers to develop estimates for asbestos, lead paint and mold abatement for legacy facilities. Mavo provided the cost estimates for these activities in the Legacy Closure Plan based on the on-site inspections conducted by their personnel.

Arrowhead Consulting & Testing Inc (Arrowhead)

Arrowhead is a Minnesota-based specialist consultant providing environmental inspection and testing services and has worked with PolyMet engineers to develop inventories of ACMs for legacy facilities and estimates for additional tests where required. Arrowhead personnel have been on site to inspect legacy buildings, and provided the ACM-inventory information for the Legacy Closure Plan.

Ames Construction (Ames)

Ames is national contractor with experience in mine construction and reclamation. Ames is very familiar with the site and Project and, working with PolyMet and Barr engineers, developed estimates for Project construction. Ames provided unit cost information used for earthmoving and related reclamation activities included in the Legacy Closure Plan.

D & T Landscaping, Inc. (D&T)

D&T is very familiar with the former LTVSMC site and has been providing reclamation seeding, fertilizing and mulching services since the LTVSMC bankruptcy in 2001. D&T provided estimates for these ongoing activities included in the Legacy Closure Plan.

5.1 Legacy Cost Estimate Organization

The cost estimates for the Legacy Closure Plan were developed in a standard Excel spreadsheet with no macros or user programming. All financial assurance estimates associated with the Project PTM Application were also developed using this spreadsheet.

<u>Legacy Reclamation Cost Estimate for Short Term Activities</u>

The Legacy Reclamation Estimate for short term activities is attached as Appendix A-1. There are 4 tabs or worksheets used in the estimate, which are described in the Table 5-1:

Table 5-1 Legacy Reclamation Estimate Tabs

Tab/worksheet Name	Tab/worksheet Contents	Source of Contents
Legacy Reclamation Tab	Estimate and summary for reclamation activities	See “Note” column in tab
AOC Tab	Summary of engineering estimates for remediation of AOCs	NTS
Demo Tab	Estimates for abatement, demolition, waste disposal and restoration for building, pipelines, power lines, roads and railroads	Lakehead, Mavo, Arrowhead
AST Tab	Estimates for abatement, demolition, waste disposal and restoration ASTs	Lakehead

Legacy Long Term Cost Estimate

The Legacy Long Term Estimate is attached as Appendix A-2. There are five tabs or worksheets used for the estimate, which are described in Table 5-2 below:

Table 5-2 Legacy Long Term Estimate Tabs

Tab/worksheet Name	Tab/worksheet Contents	Source of Contents
Legacy Long Term Tab	Estimate and summary for long term activities	See “Note” column in tab
Unit $ Long Term Tab	Unit costs	See “Comments” column in tab
Basin Closure	Engineering estimate for closing ferrous tailings basin, including pumpback systems, dewatering, dam breaching and regrading	Barr
Dewatering UC Development	Dewatering, pumping and treatment details used in Basin Closure tab	Barr
Dam Breach Calcs	Dam breach excavation volume estimates, used in Basin Closure tab	Barr

5.2 Reclamation Basis

This section describes the sources of information used for the cost estimates for the Legacy Closure Plan. The estimates assume that the first year after closure is required for the LTVSMC Legacy Properties, assuming the Project does not become operational, will be a holding year with no closure activities. After the holding year, reclamation (short-term) activities, described in the Legacy Reclamation Estimate below, will occur over a three-year period.

Table 5-3 lists the sources used for the Legacy Reclamation Estimate.

Table 5-3 Summary of Sources Used in Legacy Reclamation Estimate

Referenced As	Description	Used For
Attachment C	PolyMet specifications (C1) Mavo estimates (C2 and C3)	Legacy building asbestos abatement costs
Attachment D	PolyMet specifications Arrrowhead estimates (D1 and D2)	Legacy building asbestos inspection costs
Attachments E&F	PolyMet specification (E1 and F1) and Lakehead estimates (E2 and F2)	Building and AST demolition, road, railroad, pipeline and power line removal and site restoration costs
Attachment G	NTS estimates for AOC remediation	AOC remediation costs

5.2.1 Asbestos Abatement, Building Demolition and Infrastructure Removal

PolyMet developed a specification for the ACM abatement needs for legacy buildings, except the Main Plant Buildings (Attachment C1). Mavo submitted a proposal (Attachment C2) to implement that ACM abatement scope of work. Mavo submitted a second proposal (Attachment C3) for ACM abatement in the Main Plant Buildings. Arrowhead submitted estimates for the inspections and sampling of the ACM) (Attachments D1 and D2).

For the demolition of buildings, PolyMet developed two separate specifications. The first specification was for demolition of the Additive Building and Heating Plant, and reclamation of the associated site footprint (Attachment E1). Lakehead submitted a proposal for the costs under this specification (Attachment E2).

The second specification was for demolition of all remaining buildings (other than the Additive Building and Heating Plant), and reclamation of the associated sites footprints (Attachment F1). Lakehead submitted a proposal to cover this specification (Attachment F2).

The cost estimates for building demolition on the above proposals included mobilization, contractor overhead, contractor profit, and contractor supervision. These estimates are listed in the estimate on the Demo Tab, and are linked to the Legacy Reclamation Tab under line item “Plant Site – Demo and Abatement”.

The cost estimates for above ground storage tank (AST) removal (Attachment F2) on the above proposals included mobilization, contractor overhead, contractor profit, and contractor supervision. These estimates are listed in the estimate on the AST Tab, and are linked to the Legacy Reclamation Tab under the line item “Plant Site – Other”.

5.2.2 Areas of Potential Concern (AOCs)

NTS provided cost estimates for investigating and/or remediating 24 of the 26 open AOCs (Attachment G). The two AOCs that do not have cost estimates associated with them, AOC50 and AOC63, are open, but do not have any associated costs as the only action needed is a final report (Table 3-1).

NTS did the original ESA for the LTVSMC Legacy Properties in 2001 and has worked on all AOC site sampling and remediation that has occurred to date. NTS anticipates that some AOC sites may be closed based on desk-top analysis while others may require sampling, and based on the results of the sampling, some may require remediation.

The NTS cost estimates for the AOC proposal included mobilization, contractor overhead, and contractor supervision. These estimates are listed in the FAE on the AoC Tab, and are linked to the Legacy Tab under the line item "Plant Site – Other".

The NTS cost estimates assume the AOC work will be completed over a three-year period. This timing is consistent with the work to-date under the MPCA VIC process.

5.2.3 Indirects

Indirect costs are included in the Legacy Reclamation Estimate on the Legacy Reclamation Tab.

<u>Contingency</u>

A contingency of 10% was applied to the total direct cost included in the Legacy Reclamation Estimate.

<u>Prime Contractor Markup</u>

A prime contractor markup of 2.5% was applied to the total direct cost.

5.3 Long Term Cost Estimate Basis

The long-term portion of the Legacy Closure Plan includes ongoing activities. Some long-term activities are projected to change once reclamation is complete and the site is safe and stable. Based on the activities described above, a 30-year cash flow with financial assurance put into place in 2018 and expenses starting in 2019 was developed for the Legacy Long Term Estimate. An NPV was calculated using an effective discount rate of 2.9%. Table 5-4 lists the sources used for the Legacy Long Term Estimate.

Table 5-4 Summary of Sources Used in Legacy Long Term Cost Estimate

Referenced As	Description	Used For
Attachment H2	Ames email with update item Unit $ Long Term Tab (Ames 2017)	Rate for road grader
Attachment I3	NTS letter	Rates for dam safety instrumentation services, landfill SW-619 monitoring, Site Manager, and pickup truck
Attachment K2	Barr letter	Rates for dam safety geotechnical services
Attachment M	PolyMet historical snow Plowing	Snow plowing cost

Tailings Basin Dewatering

Estimated costs for dewatering of the existing former LTVSMC tailings basin and related closure activities are based on the following assumptions approved by MPCA and DNR

- Seepage pumpback continues for 9 years
- 12 years to dewater Cell 1E and 2E to SD026
- 50,000 cubic yards of grading work in Cell 1E for proper drainage and to promote vegetation
- Breach dams and construct channels from the Cell 1E and 2E ponds to the northern wetlands to direct future runoff off site to maintain dry cells in Cells 1E and 2E
- Install riprap channels along the dam breaches where needed
- Seeding Cells 1E and 2E
- Removal of pump-back systems

These are summarized in the estimate on the Legacy Long Term Tab under line item "Water Tailings Basin Option" as "Tailings Basin Seepage" and "Tailings Basin Dewatering."

Biological Testing

This estimate includes costs for biological surveys at Bear (reference creek), Unnamed, Trimble, Mud, and Second Creeks as part of the closure of the tailings basin. This monitoring will include measuring stream flow, evaluating limited stream characteristics, and sampling for macroinvertebrates. This work is estimated at $10,000 annually, and will be conducted two times (in Years 8 and 9). This amount is based on previous, similar sampling events that

PolyMet has conducted.

The estimated cost estimate for this work is included in the Legacy Long Term Tab under line item “Monitoring/Application for Site Specific Standards”.

Wild Rice Monitoring

This cost estimate includes sediment sampling near wild rice stands in waters downstream of the tailings basin in Years 8 and 9 of the reclamation phase for the basin. This sampling involves collecting sediments from area waters and analyzing them for extractable iron (eFe), total iron (tFe), total organic carbon (TOC), and organic matter (LOI). Surface water samples will also be collected and analyzed for sulfate. The annual wild rice sampling costs are estimated at $36,400 based on similar sampling in 2015 and 2016.

The estimated cost for this work is included in the estimate on the Legacy Long Term Tab under line item “Monitoring/Application for Site Specific Standards”.

Develop Site-Specific Standard

A one-time cost is included to update, as necessary, the site-specific standard request submitted to MPCA by Cliffs Erie in 2014 for the existing former LTVSMC tailings basin. This funding alternatively could be used to support a use attainability analysis if MPCA determined that was a preferred course of action in connection with closure of the basin.

The estimated cost for this work is included in the estimate on the Legacy Long Term Tab under line item “Monitoring/Application for Site Specific Standards”.

Water Quality Monitoring

The estimated cost for water quality monitoring is based on PolyMet FY2018 budget and is included in the estimate on the Legacy Long Term Tab under line item “Water Quality Monitoring”. The cost estimate assumes a decrease to 15% after 5 years due to reductions in sampling frequency and constituents analyzed.

5.3.1 Site Administration and Maintenance

Cost estimates for staff, vehicles, and services that support long term activities are included in the estimate on the Legacy Long Term Tab under line item “Site Administration and Maintenance”.

Site Manager

Estimates for annual salary with benefits from an hourly rate based on the NTS rate for mid-level professional (Attachment I3). The estimated annual cost is based on assumption of 0.5 FTE. The rate is included on the Unit $ Long Term Tab (NTS 2016).

DNR Oversight

The annual estimated cost is based on an assumption of 0.5 FTE during reclamation, and 0.25 FTE in the long term. Costs provided by DNR as a flat rate (that includes overhead and expenses) for all FTEs. The rate is included on the Unit $ Long Term Tab (DNR).

Dam Safety Monitoring

In 2016 NTS prepared estimates (Attachment I3) for biannual inspection and data collection of tailings basin instrumentation and preparation of an instrumentation report. In 2016, Barr prepared estimates (Attachment K2) for inspection and preparation of an annual geotechnical report. Dam safety monitoring will occur two times per year.

The annual estimated cost for dam safety monitoring is based on estimated annual costs from the Unit $ Long Term Tab (NTS 2016 and Barr 2016) and is included in the estimate on the Legacy Long Term Tab under line item "Dam Safety Monitoring".

Legacy Landfill Monitoring

Landfill SW-619

Landfill SW-619 is planned to be closed in 2018. In 2016 NTS prepared estimates (Attachment I3) for annual inspection, monitoring, and reporting associated with the landfill.

The annual cost for Landfill SW-619 monitoring is based on annual costs from the Unit $ Long Term Tab (NTS 2016) and is included in the estimate on the Legacy Long Term Tab under line an item "Landfill Maintenance and Monitoring SW619".

Coal Ash Landfill

The current MPCA-approved Closure Plan for the closed Coal Ash Landfill includes various activities through 2030. The annual cost estimates for its inspection, monitoring and reporting is based on PolyMet's FY2018 budget. The annual cost estimate for Coal Ash Landfill monitoring from the Unit $ Long Term Tab and is included in the estimate on the Legacy Long Term Tab under line item "Landfill Maintenance and Monitoring Coal Ash".

Tailings Basin Maintenance

The annual cost estimates for tailings basin erosion maintenance is based on PolyMet's experience with vegetation maintenance and erosion control at this facility. The estimates are from the Unit $ Long Term Tab and is included in the estimate on the Legacy Long Term Tab under line item "Tailings Basin Maintenance".

Snow Plowing and Road Maintenance

The annual cost estimate for snow plowing is based on historical PolyMet costs (Attachment M) for the site from the Unit $ Long Term Tab (PolyMet 2016) and is included in the estimate on the Legacy Long Term Tab under line item "Snow Plowing/Road Maintenance".

The annual cost estimates for road maintenance is based on an estimate for a grader on an as needed basis from the Unit $ Long Term Tab (Ames 2017) and is included in the estimate on the Legacy Long Term Tab under line item “Snow Plowing/Road Maintenance”.

Vehicles

The estimated mileage rate is NTS charge for a pick up (Attachment I3). The annual cost estimate is based on assumption of 25,000 miles. The rate is from the Unit $ Long Term Tab (NTS 2016).

5.3.2 Indirects

Indirect costs for the Legacy Closure Long Term Estimate are included in the estimate on the Legacy Long Term Tab.

Contingency

A contingency of 15% was applied to the total direct cost of the Legacy Long Term Estimate.

Adaptive Management

A cost estimate for adaptive management of 2% was applied to the total direct cost less Site Administration and Maintenance.

Engineering Redesign

A cost estimate for engineering redesign of 2% was applied to the total direct cost less Site Administration and Maintenance.

Contractor Supplies Markup

A cost estimate for contractor supplies markup of 2.5% was applied to contractor supplies.

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List of Attachments

Attachment A ESA Cliffs Erie 2003

Attachment B QAPP Cliffs Erie 2003

Attachment C1, C2, C3 ACM Specification and Estimate

Attachment D1, D2 Arrowhead ACM Survey Estimate

Attachment E1, E2 Lakehead Additive Building and Heating Plant Estimate

Attachment F1, F2 Lakehead Other Than Additive Building and Heating Plant Estimate

Attachment G NTS AOC Estimates

Attachment H2 Ames Email

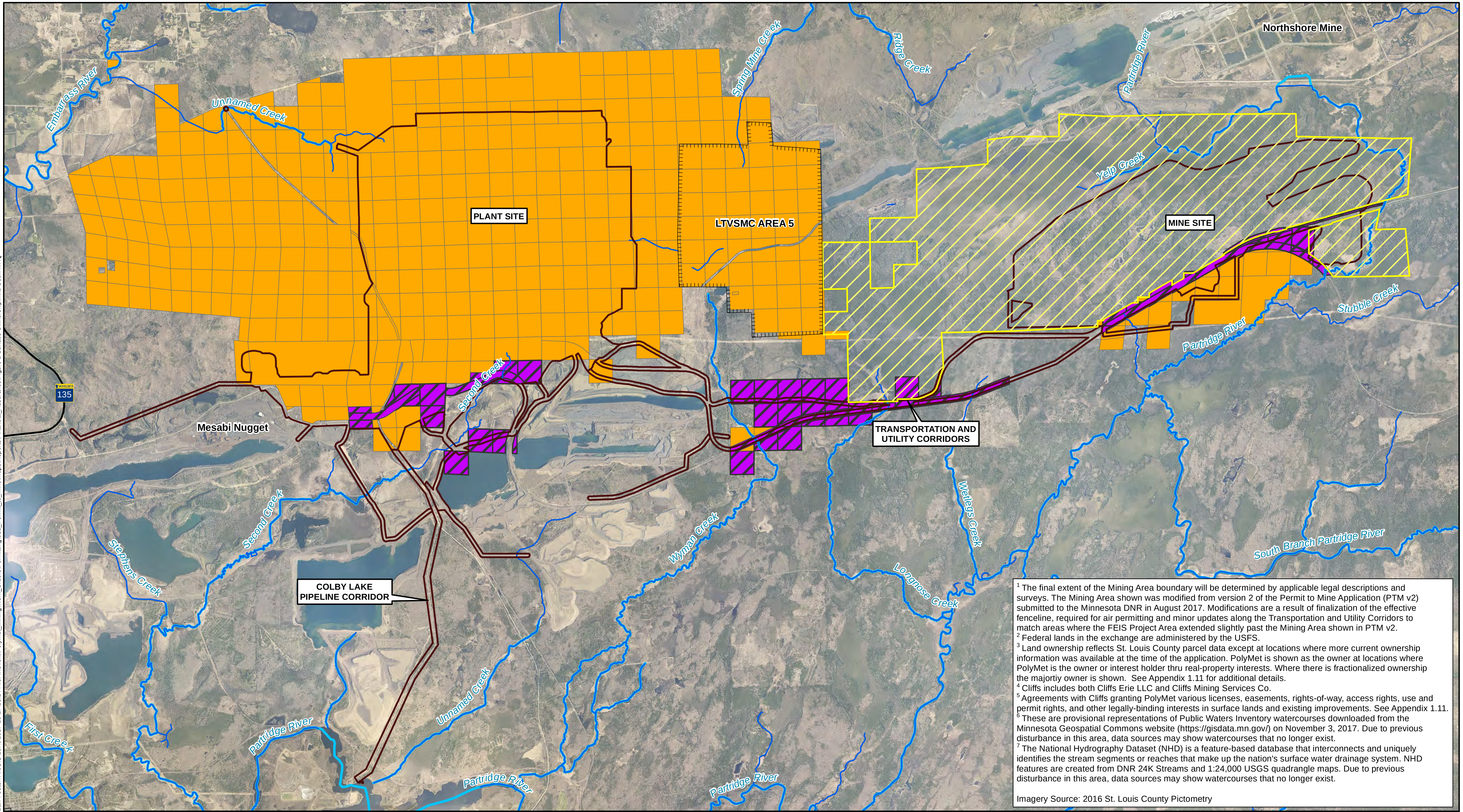
Attachment I3 NTS Rate Letter

Attachment K2 Barr Geotechnical Letter

Attachment M PolyMet Snow Plowing Historical Cost

Attachment O Memorandum from MPCA to DNR on Legacy

Figures



[1] The final extent of the Mining Area boundary will be determined by applicable legal descriptions and surveys. The Mining Area shown was modified from version 2 of the Permit to Mine Application (PTM v2) submitted to the Minnesota DNR in August 2017. Modifications are a result of finalization of the effective fenceline, required for air permitting and minor updates along the Transportation and Utility Corridors to match areas where the FEIS Project Area extended slightly past the Mining Area shown in PTM v2.
[2] Federal lands in the exchange are administered by the USFS.
[3] Land ownership reflects St. Louis County parcel data except at locations where more current ownership information was available at the time of the application. PolyMet is shown as the owner at locations where PolyMet is the owner or interest holder thru real-property interests. Where there is fractionalized ownership the majortiy owner is shown. See Appendix 1.11 for additional details.
[4] Cliffs includes both Cliffs Erie LLC and Cliffs Mining Services Co.
[5] Agreements with Cliffs granting PolyMet various licenses, easements, rights-of-way, access rights, use and permit rights, and other legally-binding interests in surface lands and existing improvements. See Appendix 1.11.
[6] These are provisional representations of Public Waters Inventory watercourses downloaded from the Minnesota Geospatial Commons website (https://gisdata.mn.gov/) on November 3, 2017. Due to previous disturbance in this area, data sources may show watercourses that no longer exist.
[7] The National Hydrography Dataset (NHD) is a feature-based database that interconnects and uniquely identifies the stream segments or reaches that make up the nation's surface water drainage system. NHD features are created from DNR 24K Streams and 1:24,000 USGS quadrangle maps. Due to previous disturbance in this area, data sources may show watercourses that no longer exist.

Imagery Source: 2016 St. Louis County Pictometry

NorthMet Project Mining Area[1]
LTVSMC Area 5 Boundary
Federal Land Exchange Parcels[2]
St. Louis County Parcels by Owner or Interest Holder[3]
PolyMet - Contract for Deed
PolyMet - Ancillary Agreements with Cliffs[4,5]

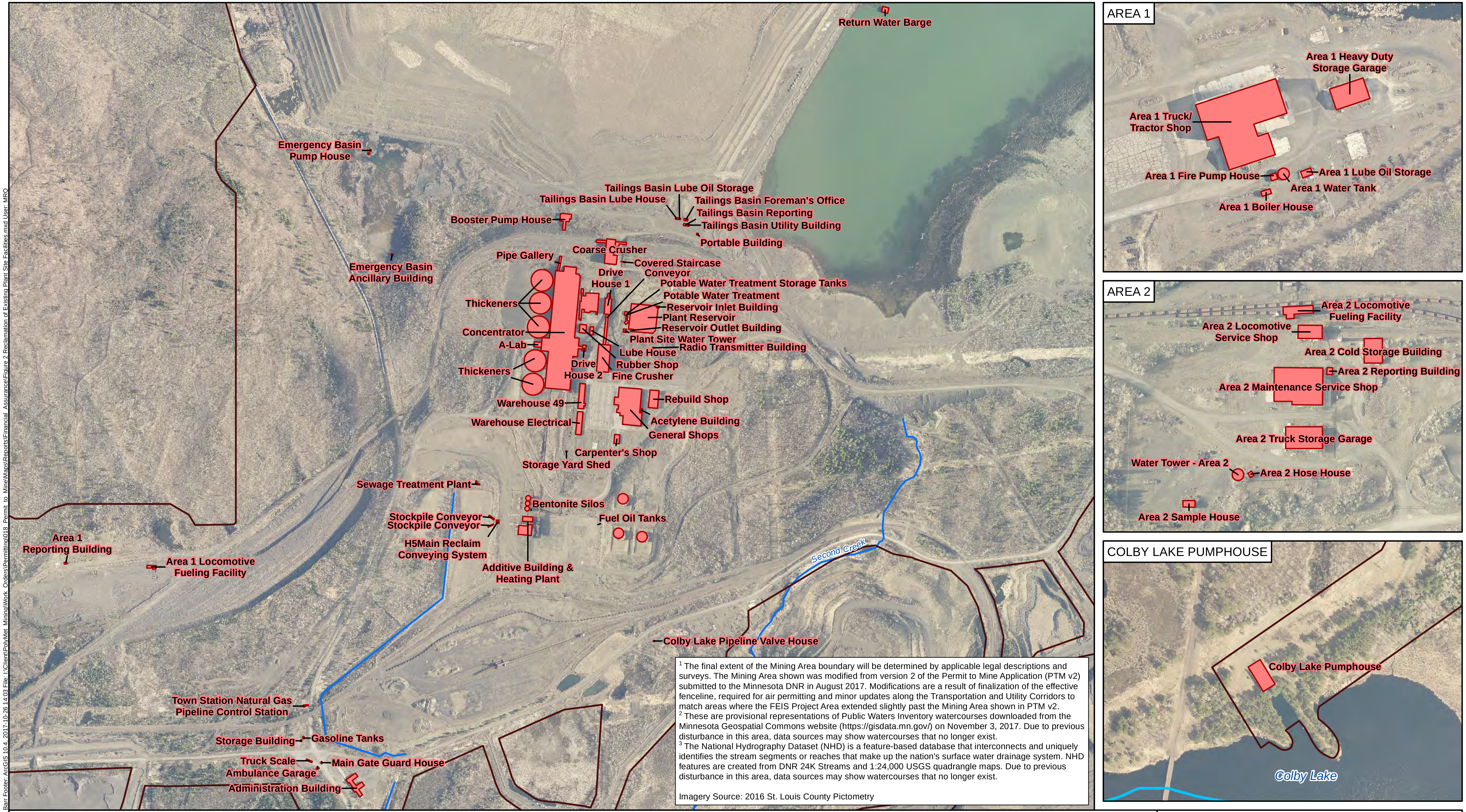
Public Waters Inventory (PWI) Watercourses[6]
National Hydrography Dataset (NHD) Rivers & Streams[7]

N

0 0.5 1 2
Miles

SURFACE OWNERSHIP
NorthMet Project
Poly Met Mining, Inc.

Figure 1
Ferrous Reclamation Plan



[1] The final extent of the Mining Area boundary will be determined by applicable legal descriptions and surveys. The Mining Area shown was modified from version 2 of the Permit to Mine Application (PTM v2) submitted to the Minnesota DNR in August 2017. Modifications are a result of finalization of the effective fenceline, required for air permitting and minor updates along the Transportation and Utility Corridors to match areas where the FEIS Project Area extended slightly past the Mining Area shown in PTM v2.
[2] These are provisional representations of Public Waters Inventory watercourses downloaded from the Minnesota Geospatial Commons website (https://gisdata.mn.gov/) on November 3, 2017. Due to previous disturbance in this area, data sources may show watercourses that no longer exist.
[3] The National Hydrography Dataset (NHD) is a feature-based database that interconnects and uniquely identifies the stream segments or reaches that make up the nation's surface water drainage system. NHD features are created from DNR 24K Streams and 1:24,000 USGS quadrangle maps. Due to previous disturbance in this area, data sources may show watercourses that no longer exist.

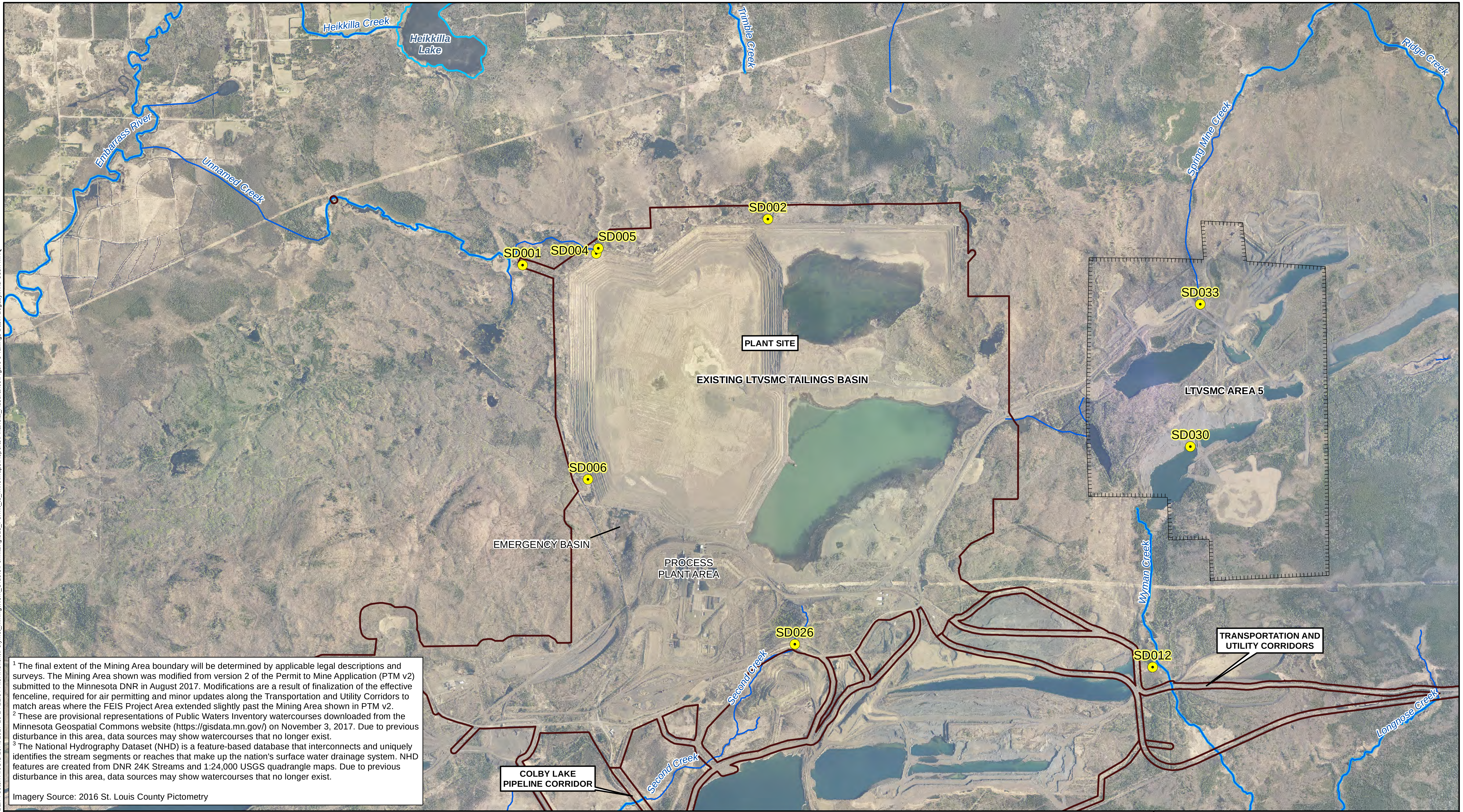
Imagery Source: 2016 St. Louis County Pictometry

NorthMet Project Mining Area[1]
Buildings
Public Waters Inventory Watercourse[2]
National Hydrography Dataset (NHD) Rivers & Streams[3]

0 1,000 2,000
Feet

EXISTING PLANT SITE FACILITIES
NorthMet Project
Poly Met Mining, Inc.

Figure 2
Ferrous Reclamation Plan



[1] The final extent of the Mining Area boundary will be determined by applicable legal descriptions and surveys. The Mining Area shown was modified from version 2 of the Permit to Mine Application (PTM v2) submitted to the Minnesota DNR in August 2017. Modifications are a result of finalization of the effective fenceline, required for air permitting and minor updates along the Transportation and Utility Corridors to match areas where the FEIS Project Area extended slightly past the Mining Area shown in PTM v2.
[2] These are provisional representations of Public Waters Inventory watercourses downloaded from the Minnesota Geospatial Commons website (https://gisdata.mn.gov/) on November 3, 2017. Due to previous disturbance in this area, data sources may show watercourses that no longer exist.
[3] The National Hydrography Dataset (NHD) is a feature-based database that interconnects and uniquely identifies the stream segments or reaches that make up the nation's surface water drainage system. NHD features are created from DNR 24K Streams and 1:24,000 USGS quadrangle maps. Due to previous disturbance in this area, data sources may show watercourses that no longer exist.

Imagery Source: 2016 St. Louis County Pictometry

Existing Surface Discharges - Concent Decree
NorthMet Project Mining Area[1]
LTVSMC Area 5 Boundary
Public Waters Inventory (PWI) Watercourses[2]
National Hydrography Dataset (NHD) Rivers & Streams[3]

0 3,000 6,000
Feet

TAILINGS BASIN AREA
NorthMet Project
Poly Met Mining, Inc.

Figure 3
Ferrous Reclamation Plan

[1] The final extent of the Mining Area boundary will be determined by applicable legal descriptions and surveys. The Mining Area shown was modified from version 2 of the Permit to Mine Application (PTM v2) submitted to the Minnesota DNR in August 2017. Modifications are a result of finalization of the effective fenceline, required for air permitting and minor updates along the Transportation and Utility Corridors to match areas where the FEIS Project Area extended slightly past the Mining Area shown in PTM v2.
[2] These are provisional representations of Public Waters Inventory watercourses downloaded from the Minnesota Geospatial Commons website (https://gisdata.mn.gov/) on November 3, 2017. Due to previous disturbance in this area, data sources may show watercourses that no longer exist.
[3] The National Hydrography Dataset (NHD) is a feature-based database that interconnects and uniquely identifies the stream segments or reaches that make up the nation's surface water drainage system. NHD features are created from DNR 24K Streams and 1:24,000 USGS quadrangle maps. Due to previous disturbance in this area, data sources may show watercourses that no longer exist.

Imagery Source: 2016 St. Louis County Pictometry

NorthMet Project Mining Area[1]

Plant Site Areas of Concern

Resolved

Managed During Operations, Reclamation, Closure, and/or Postclosure Maintenance

Public Waters Inventory (PWI) Watercourses[2]

National Hydrography Dataset (NHD) Rivers & Streams[3]

0 2,000 4,000

Feet

AREAS OF CONCERN (AOCs)
NorthMet Project
Poly Met Mining, Inc.

Figure 4
Ferrous Reclamation Plan

Appendix A

Cost Estimate

	LEGACY			
	Reclamation (Appendix A-1)		Long Term (Appendix A-2)	
Discount Rate (Cash Flow starts year before expenses start and expenses occur mid year)	0.0%			2.9%
PolyMet Estimate	$45,143,496			$13,269,809
TOTAL LEGACY	**58,413,304**			

Appendix A-1

Legacy Reclamation Estimate

Appendix A-1 Legacy Reclamation Cost Estimate **12/7/2017**

Includes Demo of Legacy Buildings with Abatement and AOCs

							Start	Bankruptcy			
						2.9%	01/01/18	07/01/18	07/01/19	07/01/20	07/01/21
	support tabs	**Cash $**	**NPV $**	**Note**	**30 Yr Tot**	**NPV**	1		2	3	4
Legacy Ferrous Total with Indirects		**$45,143,496**	**$41,848,774**				**Oper**	**Hold**			
Contingency	**10.0%**	**$4,103,954**	**$3,804,434**			Calandar Year	2018		2019	2020	2021
Adaptive Management	**2.0%**	**$0**	**$0**								
Engineering Redesign	**2.0%**	**$0**	**$0**								
Prime Contractor Markup	**2.5%**	**$1,025,989**	**$951,108**								
Mobilization	**4.0%**	**$0**	**$0**	included in pricing							
Legacy Ferrous Total (no Indirects)		**$41,039,542**	**$38,044,340**		41,039,542	38,044,340					
Plant Site		$41,039,542	$38,044,340								
Demo and Abatement		$33,897,717	$31,386,895								
Legacy Structure Removal											
Area 1 Shop Buildings	Demo	$448,916	$430,123		448,916	430,123	0	0	448,916	0	0
Area 2 Shop Buildings	Demo	$556,827	$533,517		556,827	533,517	0	0	556,827	0	0
Main Plant Area - Demoed in Construction	Demo	$1,655,350	$1,541,233		1,655,350	1,541,233	0	0	0	1,655,350	0
Main Plant Area	Demo	$19,888,937	$18,521,989		19,888,937	18,521,989	0	0	4,972,234	9,944,469	4,972,234
Main Gate Colby PH Ad Bldg	Demo	$243,170	$220,026		243,170	220,026	0	0	0	0	243,170
Roads	Demo	$660,000	$597,183		660,000	597,183	0	0	0	0	660,000
Railroads	Demo	$380,000	$343,832		380,000	343,832	0	0	0	0	380,000
Power System	Demo	$97,810	$88,501		97,810	88,501	0	0	0	0	97,810
Piping System	Demo	$2,879,000	$2,604,983		2,879,000	2,604,983	0	0	0	0	2,879,000
Legacy Asbestos Abatement											
Area 1 Shop Buildings	Demo	$98,350	$94,233		98,350	94,233	0	0	98,350	0	0
Area 2 Shop Buildings	Demo	$167,350	$160,344		167,350	160,344	0	0	167,350	0	0
Main Plant Area	Demo	$5,962,607	$5,473,327		5,962,607	5,473,327	0	0	0	2,981,304	2,981,304
Main Gate Colby PH Ad Bldg	Demo	$859,400	$777,604		859,400	777,604	0	0	0	0	859,400
Other		$7,141,825	$6,657,444								
AST Removal	AST	$223,625	$214,264		223,625	214,264	0	0	223,625	0	0
AOCs	AOC	$6,918,200	$6,443,181		6,918,200	6,443,181	0	0	2,283,006	2,352,188	2,283,006

Legacy Remediation - Areas of Concern (AOC) - costs from detailed spreadsheets by NTS [2016] (see Attachment G)

Heavy Border with Bold Amounts are used in Reclamation Estimates

		Cost Per Phase/Task (see separate sheet for details and assumptions)					
AoC No.	**WBS No.**	**Site Name**	**Phase I ESA/ SAP**	**Implement SAP**	**Complete Phase II**	**Remediation**	**Total Cost**
01	731-1	Area 1 Shops	$7,500	$208,615	$235,615	$380,000	$831,730
06	731-2	Oily Waste Disposal Area	$7,500	$53,190	$100,450	$73,270	$234,410
07	731-3	Bull Gear Disposal	$7,500	$35,600	$0	$0	$43,100
09	731-4	Railroad Panel Yard	$0	$0	$23,010	$1,352,397	$1,375,407
10	731-5	Airport	$7,500	$29,180	$57,580	$60,240	$154,500
11	731-6	Stoker Coal Ash Disposal	$7,500	$30,180	$38,868	$245,120	$321,668
13	731-7	2001 Storage Area	$7,500	$29,180	$57,580	$0	$94,260
14	731-8	Sandblasting and large Equipment Painitng Area	$7,500	$57,796	$29,460	$43,570	$138,326
35	731-9	Dunka Water Treatment Plant Sludge	$4,000	$20,800	$37,800	$0	$62,600
37	731-10	Line 9 Area 5 Petroleum Contaminated Soil	$7,500	$0	$0	$0	$7,500
38	731-11	Area 2 Shops	$0	$0	$242,110	$179,796	$421,906
40	731-12	Heavy Duty Garage	$7,500	$21,000	$40,000	$0	$68,500
42	731-13	Bunker C Tank Farm (inc asbestos abatement)	$0	$0	$0	$915,000	$915,000
43	731-14	Administration Building	$7,500	$20,600	$0	$0	$28,100
44	731-15	Main Gate Vehicle Fueling Area	$7,500	$17,000	$34,900	$24,200	$83,600
46	731-16	Plant Site and General Shops	$7,500	$59,344	$189,760	$644,690	$901,294
47	731-17	Tailings Basin Reporting	$7,500	$0	$0	$0	$7,500
48	731-18	Booster Pump House with Transformer	$7,500	$20,900	$38,700	$0	$67,100
49	731-19	Coarse Crusher Petroleum Contaminated Soil	$7,500	$16,700	$35,100	$0	$59,300
51	731-20	Tailings Basin Salvage and Scrap Areas	$7,500	$83,308	$22,450	$408,244	$521,502
52	731-21	Cell 2W Salvage Area	$7,500	$21,000	$0	$0	$28,500
53	731-22	Hornfels Burial	$7,500	$0	$0	$0	$7,500
59	731-23	Colby Lake Pumping Station	$7,500	$21,000	$0	$0	$28,500
61	731-24	Pellet Plant	$7,500	$98,926	$58,425	$258,546	$423,397
	Totals		$154,000	$844,319	$1,241,808	$4,585,073	$6,825,200
		MPCA Coordination Trans 1			$4,024,183	1.5%	$62,000
		MPCA Coordination Trans 2			$2,801,017	1.1%	$31,000
							$6,918,200

Demo Estimate from Lakehead/Rachel, Mavo and Arrowhead Consulting & Testing	Lakehead / Rachel 2016 (Attachments E and F)						Mavo 2016 (Attachment C)	Arrowhead Consulting & Testing 2016 (Attachment D)		
Scope of Work Description	**Universal Waste Collection**	**Galbestos Removal**	**Demolition**	**Total Demo**	**Site Restoration**	**Recovery (not used - see Summary Scrap Value tab))**	**Asbestos Lead Paint Mold**	**Pre Demo Insp**	**Demo To Rollup**	**Abatement To Rollup**
Pre-Demolition Services										
Legacy with construction				$1,650,850	$4,500	$1,125	$20,500	$4,800	$1,655,350	$25,300
Additive Building & Heating Plant				$1,593,300			Included in Lakehead's total demo			in Main Plant Area below
Bentonite silos				inc in above			n/a			
Area 2 Water Tower (price separate from Heating & Additives buildings)			$30,000	$30,000	$2,500	$1,125	n/a			
Legacy Tailings Basin Buildings - Demoed as part of construction										
Foreman's Office (Bldg. 718)			$9,350	$9,350	$400		$6,500	$1,100		
Reporting Building (Bldg. 719)			$9,900	$9,900	$400		$6,500	$1,100		
Lube House (Bldg. 720)			$2,500	$2,500	$400		$2,500	$850		
Reporting Building (Bldg. 724)			$3,300	$3,300	$400		$2,500	$900		
Lube Oil Building (Bldg. 725)			$2,500	$2,500	$400		$2,500	$850		
Legacy Area 1				$351,597	$97,319	$41,000	$97,500	$850	$448,916	$98,350
Area 1 Shop and Truck Storage (Bldg. 220)	$2,900	$106,900	$103,332	$213,132	$74,669	$37,000	$82,500			
Area 1 Cold Storage (Bldg. 221)	$400	$48,970	$10,860	$60,230	$13,400	$2,800	$5,000			
Area 1 Reporting Building (Bldg. 231)			$9,900	$9,900			$5,000	$850		
Area 1 Boiler House (Bldg. 226)	$200	$13,500	$9,875	$23,575	$3,000	$200	$2,500			
Area 1 Fire Pump House & Water Tank (Bldg. 228)	$410		$11,250	$11,660			$2,500			
Area 1 Locomotive Fueling	$500	$22,500	$10,100	$33,100	$6,250	$1,000				
Legacy Area 2				$474,042	$82,785	$18,315	$164,700	$2,650	$556,827	$167,350
Area 2 Service Shop (Bldg. 201)	$2,200	$160,900	$38,990	$202,090	$37,334	$10,940	$93,050			
Area 2 Truck Storage (Bldg. 202)	$2,000	$63,190	$9,175	$74,365	$13,988	$3,075	$3,000			
Area 2 Cold Storage (204)	$697	$42,560	$13,080	$56,337	$14,100	$1,700	$3,000			
Area 2 Shop Locomotive Service Shop (Bldg. 203)	$3,400	$20,500	$12,300	$36,200	$11,113	$1,625	$52,150			
Area 2 Locomotive Fueling	$2,000	$20,900	$11,800	$34,700	$6,250	$975	$2,500			
Hose House (Bldg. 209) Not to be used in project		$3,000	$9,150	$12,150			$2,500	$850		
Sample House (Bldg. 208) Not to be used in project		$25,400	$20,300	$45,700			$5,000	$950	main plan areas inc tunnels	
Reporting Building (Bldg. 425) Not to be used in project		$3,300	$9,200	$12,500			$3,500	$850	$19,888,937	$5,962,607

Demo Estimate from Lakehead/Rachel, Mavo and Arrowhead Consulting & Testing

	Lakehead / Rachel 2016 (Attachments E and F)						Mavo 2016 (Attachment C)	Arrowhead Consulting & Testing 2016 (Attachment D)		
Scope of Work Description	**Universal Waste Collection**	**Galbestos Removal**	**Demolition**	**Total Demo**	**Site Restoration**	**Recovery (not used - see Summary Scrap Value tab))**	**Asbestos Lead Paint Mold**	**Pre Demo Insp**	**Demo To Rollup**	**Abatement To Rollup**
Legacy Plant Area				$13,305,631	$3,223,306	$2,890,406	$3,807,340	$2,200	$16,528,937	$3,809,540
Rebuild Shop (Bldg 602)	$3,000	$70,200	$125,600	$198,800	$27,560	$13,940	$85,000			
General Shop (Bldg. 601) Includes Acetylene Building (Bldg.604)	$15,000	$199,190	$353,600	$567,790	$182,300	$113,796	$480,800			
Carpenter Shop (Bldg. 603)	$2,000	$10,200	$13,250	$25,450	$3,300	$100	$2,500			
Coarse Crusher	$10,000	$313,345	$1,551,800	$1,875,145	$593,890	$199,325	$1,070,618			
Drive House 1 conv and housings	$7,500	$165,569	$141,540	$314,609	$46,900	$41,050	incl. in above			
Drive House 2 inc conv and housings		inc in above	inc in above	inc in above	inc in above	inc in above	incl. in Fines Crusher			
Fine Crusher	$45,000	$302,430	$1,373,460	$1,720,890	$203,400	$205,250	$439,686			
Warehouse 49 (Bldg. 920)	$6,500	$27,586	$82,800	$116,886	$15,947	$5,350	$49,000			
Warehouse 45 (Bldg. 921, Electrical)	$2,500	$35,159	$72,700	$110,359	$15,947	$3,590	$13,500			
Lube House (Bldg. 926)	$578	$17,000	$20,550	$38,128	$7,385	$1,600	$52,000			
Rubber Shop (Bldg. 605)	$1,000	$30,464	$36,550	$68,014	$11,269	$5,150	$24,000			
Concentrator Building and Thickeners	$100,000	$1,248,260	$5,895,850	$7,244,110	$1,145,998	$2,141,430	$1,535,236			
A-Lab	$500	$9,400	$14,560	$24,460	$2,940	$2,450	ncluded in Concentrator			
Hinsdale Bridge	$0	$16,700	$616,300	$633,000	$15,200	$148,500	n/a			
Water Reservoir	$5,000		$98,100	$103,100	$914,400	$7,750	n/a			
Plant Site Water Tower			$30,000	$30,000	$2,500	$1,125	n/a			
Water Treatment Plant & Storage Tanks	$1,000	$20,000	$72,600	$93,600	$2,250		$45,000			
Colby Pump House (potential deduct depends on variance request)		$41,000	$8,260	$49,260	$1,500		$2,500	$1,000	$50,760	$3,500
Ad Building inc UST	$3,900		$157,935	$161,835	$18,200		$850,000		$180,035	$850,000
Main Gate	$100		$11,400	$11,500	$875		$5,000	$900	$12,375	$5,900
Booster Pump House #1	$300		$23,500	$23,800	$9,200		included in Concentrator		$243,170	$859,400
Sewage Treatment Plant	$0		$62,700	$62,700	$19,520		$5,000	$900		
Portable Pump Houses	$0		$9,890	$9,890	$3,400		n/a			
Return Water Barge	$0		$44,900	$44,900			$5,000	$1,300		
General Infrastructure (railroads, tunnels, roadways, etc)					$1,504,000	$237,500			$1,504,000	
Legacy Railroads	$0		$380,000	$380,000					$380,000	
Legacy Tunnels	$0		$1,856,000	$1,856,000			$2,127,767		$1,856,000	$2,127,767
Galleries							included in Concentrator			
Sanitary Systems and Wells			$17,500	included in associated areas						
Pipelines					$591,000				$2,879,000	
Colby Lake Pipeline (potential deduct depends on variance request)			$900,000	$900,000	$98,000					
Inter-Pit Pipeline from Reservoir to Areas 1 & 2			$562,000	$562,000						
Natural Gas Pipeline Removal			$150,000	$150,000						
Legacy PipeLines Tailings management above ground			$378,000	$378,000						
Legacy PipeLines Tailings management below ground			$200,000	$200,000						
Legacy Power Lines	$0		$97,810	$97,810					$97,810	
Legacy Roads/Parking Lots	$0		$465,000	$465,000	$195,000				$660,000	

Demo Estimate from Lakehead/Rachel, Mavo and Arrowhead Consulting & Testing

Demo Estimate from Lakehead/Rachel, Mavo and Arrowhead Consulting & Testing	Lakehead / Rachel 2016 (Attachments E and F)						Mavo 2016 (Attachment C)	Arrowhead Consulting & Testing 2016 (Attachment D)		
Scope of Work Description	**Universal Waste Collection**	**Galbestos Removal**	**Demolition**	**Total Demo**	**Site Restoration**	**Recovery (not used - see Summary Scrap Value tab))**	**Asbestos Lead Paint Mold**	**Pre Demo Insp**	**Demo To Rollup**	**Abatement To Rollup**
New - Phase 1 - Plant Site				$2,190,000	$689,000					
Flotation Plant and Reagent Building	$75,000		$621,800	$696,800	$147,600	$242,500			$844,400	
Concentrate Storage and Loadout Facility	$12,000		$273,760	$285,760	$48,100	$37,500			$333,860	
Plant Site Sewage Treatment Plant	$1,000		$118,000	$118,000	$30,000				$148,000	
Railroads	$0		$185,000	$185,000	$111,000				$296,000	
Pipelines	$0		$1,555,000	$1,555,000	$375,000				$1,930,000	
Power Lines	$0			$0	$0				$0	
Roads and Parking Lots	$0			$0	$0				$0	
Plant Site Wastewater Treatment Plant (WWTP) Ponds not included	$0		$245,000	$245,000					$245,000	used long term
New - Phase 1 - Mine Site										
Maintenance Service and Fueling Facility	$1,100		$19,210	$20,310	$7,300	$1,200			$27,610	
Rail Transfer Hopper	$1,100		$40,000	$41,100	$45,000	$1,200			$86,100	
Rail Transfer Hopper Control Bldg	$100		$18,600	$18,700					$18,700	
Rail Transfer Hopper Platform			$60,000	$60,000					$60,000	
Central Pumping Station	$500		$14,000	$14,500	$1,200				$15,700	
Railroads	$0		$45,000	$45,000	$33,750				$78,750	
Pipelines	$0		$580,133	$580,133	$217,000				$797,133	
Power Lines	$0		$83,900	$83,900	$0	$7,175			$83,900	
Roads and Parking Lots	$0		$392,000	$392,000	$132,000				$524,000	
Mine Site Wastewater Treatment Facility (WWTF)	$0		$498,000	$498,000	$14,000				$512,000	
New - Phase 2				$10,735,100	$97,375					
Reagent Building	$15,000		$820,000	$835,000	$4,100	$22,500				
Oxygen Plant	$65,000		$4,238,600	$4,303,600	$16,600	$72,500				
Limestone Preparation	$7,500		$345,000	$352,500	$1,750	$12,500				
Hydrometallurgical Plant	$49,000		$4,365,000	$4,414,000	$13,500	$62,500				
Hydrometallurgical Reagents	$15,000		$815,000	$830,000	$2,200	$17,500				
Railroads	$0									
Pipelines	$0		$1,450,000							
Power Lines	$0									
Roads and Parking Lots	$0		$156,000		$59,225					

	Lakehead	Mavo
Totals	$31,155,813	$7,087,707
Mine Site	$2,203,893	$0
less Mine Site	$28,951,920	$7,087,707

Demo Estimate for Above Ground Storage Tanks from Lakehead Rachel

Heavy Border with Bold Amounts are used in Reclamation Estimates						Lakehead / Rachel 2016 (Attachments E and F)				
Name	**Tank #**	**Fluid**	**Gallons**	**Location**	**Fluid Removal/ Disposal**	**Demolition/ Removal**	**Site Restoration**	**Asbestos Lead Paint**	**Assets Recovery**	**Notes**
Legacy - Area 1 Shop					$0	$24,100	$3,000	$0		
Portable tank on skids (silver)	048	Fuel Oil	1,800	E of Area 1 Shop		$600				Out of Service - Disconnected, Labeled lube oil, Silver tank
Storage Tank	080		20,000	Area 1 - South of Rail Road Grade		$1,000				BASIS: Costs based on conceptual plan, site experience and historical knowledge.
Storage Tank	358	Used Anti-freeze		N. Side Area 1 Shop		$0				Included as part of Area 1 Shop demo
Storage Tank	420	Used Anti-freeze		N. Side Area 1 Shop		$0				Included as part of Area 1 Shop demo
Black Tank	n/a		20,000	N of Area 1 Shop		$7,500	$1,000.00		$1,500.00	
Black Tank	n/a		20,000	N of Area 1 Shop		$7,500	$1,000.00		$1,500.00	
3 Blue			20,000	N of Area 1 Shop		$7,500	$1,000.00		$1,500.00	Out of Service. Disconnected, Labeled "save for conc."
Locomotive Fueling		# 1,2 Fuel Oil		West end of Panel Yard		-				This tank is no longer on site.
Legacy - Area 2 Shop					$0	$0	$0	$0		
Locomotive Fueling		# 1,2 Fuel Oil								
Legacy - Plant Area					$0	$199,525	$25,700	$0		
Storage Tank	015	# 1,2 Fuel Oil	12,000	E. Side Concentrator		$600				
Storage Tank	032	# 2, 6 Fuel Oil	3,384,000	Tank Farm		$62,000	$8,100.00		$40,000.00	
Storage Tank	033	# 6 Fuel Oil	3,384,000	Tank Farm		$62,000	$8,100.00		$40,000.00	
Storage Tank	034	# 6 Fuel Oil	3,384,000	Tank Farm		$62,000	$8,100.00		$40,000.00	
Storage Tank	304	Mineral Oil	12,000	E. Side Concentrator		$600				
Storage Tank	305	Mineral Oil	12,000	E. Side Concentrator		$600				
Storage Tank	306	Mineral Oil	12,000	E. Side Concentrator		$600				
Storage Tank	408	Lube oil	20,000	SW of Tailings Basin Reporting Area		$0				Out of Service, but piping still in place and no signs are posted
Storage Tank	421	Alcohol	10,000	E side Concentrator		$500				
Storage Tank	506	Fuel Oil	500	Heating Plant		$25				
WTP Backwash (green)			16,000	NE of Drivehouse 1		$5,000	$700.00		$1,000.00	
Tank (white)			14,000	SE of Tailings Basin Reporting Area		$5,000	$700.00		$1,000.00	Out of Service. Disconnected, no visible labels
Dispensing Tanks at Main Gate	121	Gasoline	6,000	See gas station dwg's for reference		$600				
Dispensing Tanks at Main Gate	122	Gasoline	6,000	See gas station dwg's for reference		$600				
New - Phase 1 - Plant Site					$0	$0	$0	$0		**to Demo tab**
Storage Tank	TBD	CuSO4				$0				tanks provided by supplier
Storage Tank	TBD	Magnafloc 10	10,600			$0				tanks provided by supplier
Storage Tank	TBD	PAX	3,000			$0				tanks provided by supplier
Storage Tank	TBD	Lime	22,500			$0				tanks provided by supplier
New - Phase 1 - Mine Site					$0	$0	$0	$0		**to Demo tab**
Mine Site Truck Fueling	TBD	# 1,2 Fuel Oil		Fueling and Maintenance Facility		$0				
New - Phase 2 - Plant Site					$0	$0	$0	$0		**to Demo tab**
Storage Tank	TBD	H2SO4	40,000			$0				tanks provided by supplier
Storage Tank	TBD	HCl	60,000			$0				tanks provided by supplier
Storage Tank	TBD	Liquid SO2	21,000			$0				tanks provided by supplier
Storage Tank	TBD	Magnafloc 342/351				$0				tanks provided by supplier
Storage Tank	TBD	Mg(OH)	80,000			$0				tanks provided by supplier
Storage Tank	TBD	NaHS	13,200			$0				tanks provided by supplier
Storage Tank	TBD	NaOH	40,000			$0				tanks provided by supplier
Removed										
Day Tanks	083	# 6 Fuel Oil	20,000	Tank Farm						
Day Tanks	084	# 6 Fuel Oil	20,000	Tank Farm						
Day Tanks	085	# 6 Fuel Oil	20,000	Tank Farm						
Blue		Waste oil		W side of Coarse Crusher						
Blue		Lube oil		NE cor. Fine Crusher						
White		Anti-Freeze		NW cor. Fine Crusher						
					Total	$223,625				

Appendix A-2

Legacy Long Term Cost Estimate

Appendix A-2 Legacy Long Term Cost Estimate 12/7/2017

Includes Tailings Basin Dewatering and 30 Years of MDNR, Site Mgr, Monitoring / Reporting (Water Quality, Dam Safety and Landfill), Snowplowing/Road Maint and Vehicles

						2.9%
	support tabs	Cash $	NPV $	Note	30 Yr Tot	NPV
Legacy Ferrous Total with Indirects		**$18,620,179**	**$13,269,809**			
Contingency	**10.0%**	**$1,692,744**	**$1,206,346**			
Adaptive Management	**2.0%**	**$135,100**	**$100,813**	On Water Tailings Basin only		
Engineering Redesign	**2.0%**	**$135,100**	**$100,813**	On Water Tailings Basin only		
Prime Contractor Markup	**2.5%**	**$423,186**	**$301,587**			
Mobilization	**4.0%**	**$0**	**$0**	included in pricing		
Legacy Ferrous Total (no Indirects)		**$16,927,435**	**$12,063,463**		10,172,414	7,022,792
Plant Site		$6,755,021	$5,040,671			
Water - Tailings Basin		$6,755,021	$5,040,671	Water Quality Monitoring Tailings Basin Closure (Site Specific Stds, Dewatering and Dam Breach)	6,755,021	5,040,671
Water Quality Monitoring		$1,395,625	$1,113,516	From PLM FY 2018 Budget (Tailings Basin) - assume reduced to 15% after 5 years	1,395,625	1,113,516
Tailings Basin Seepage Pumping		$1,424,070	$1,255,624	From PLM FY 2018 Budget	1,424,070	1,255,624
Tailings Basin Dewatering	Basin Closure	$3,792,526	$2,558,486		3,792,526	2,558,486
Monitoring/Application for Site Specific Standards		$142,800	$113,046	$10,000 annualy for Biological and $38,400 for Wild Rice Plus $50,000 for Application	142,800	113,046
Site Administration and Maintenance		$10,172,414	$7,022,792			
Site Manager FTE x $/hr from Unit $ = Annual $	0.5	$108	$112,320	NTS 4/22/16 letter Mid Level Professional		
Site Manager	Unit $ Long Term	$3,369,600	$2,262,059		3,369,600	2,262,059
DNR FTE x $/hr from Unit $ = Annual $	0.5	$116	$120,640	Provided by DNR flat rate for all staff including overhead and expenses		
DNR - Reclamation	Unit $ Long Term	$2,412,800	$1,837,496		2,412,800	1,837,496
DNR FTE x $/hr from Unit $ = Annual $	0.25	$116	$60,320	Provided by DNR flat rate for all staff including overhead and expenses		
DNR - Long Term	Unit $ Long Term	$603,200	$296,062		603,200	296,062
Dam Instrumentation Field Work + Report per Event from Unit $ Long Term	2	$10,536	$21,072	NTS 4/22/16 letter inactive basin		
Geotechnical Inspection and Report from Unit $ Long Term	1	$17,500	$17,500	Barr 4/1/16 letter inactive basin		
Dam Safety Monitoring		$585,364	$460,062	Starting at 2 monitoring events/year then reduced to 1 event after 5 years	585,364	460,062
Landfill Maintenance and Monitoring SW619	Unit $ Long Term	$658,710	$442,201	NTS 4/22/16 letter	658,710	442,201
Landfill Mantenance and Monitoring Coal Ash	Unit $ Long Term	$34,320	$28,663	PLM 2017 Budget	34,320	28,663
Tailings Basin Maintenance		$645,000	$445,309	PLM FY 2018 Budget decreased $20K/yr until $10K - Back to Budget + $5K for channels during channel construction then decrease by $20K/yr until $15K	645,000	445,309
Snow Plowing/Road Maintenance	Unit $ Long Term	$1,338,420	$898,500	PolyMet Snow Plowing (average of 2 highest of 3 years) and One day per month.	1,338,420	898,500
Vehicles (25,000 mi x $0.70/mi)	Unit $ Long Term	$525,000	$352,440	NTS Letter of 4/21/16	525,000	352,440

	Start	Bankruptcy													
	01/01/18	07/01/18	07/01/19	07/01/20	07/01/21	07/01/22	07/01/23	07/01/24	07/01/25	07/01/26	07/01/27	07/01/28	07/01/29	07/01/30	07/01/31
	1		2	3	4	5	6	7	8	9	10	11	12	13	14
	Oper	**Hold**													
Calandar Year	2018		2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Water Quality Monitoring	0	159,500	159,500	159,500	159,500	159,500	23,925	23,925	23,925	23,925	23,925	23,925	23,925	23,925	23,925
Tailings Basin Seepage Pumping	0	158,230	158,230	158,230	158,230	158,230	158,230	158,230	158,230	158,230	0	0	0	0	0
Tailings Basin Dewatering	0	0	0	0	0	0	0	0	0	0	254,144	173,281	1,537,421	207,048	196,948
Monitoring/Application for Site Specific Standards	0	0	0	0	0	0	0	0	46,400	96,400	0	0	0	0	0
Site Manager	0	112,320	112,320	112,320	112,320	112,320	112,320	112,320	112,320	112,320	112,320	112,320	112,320	112,320	112,320
DNR - Reclamation	0	120,640	120,640	120,640	120,640	120,640	120,640	120,640	120,640	120,640	120,640	120,640	120,640	120,640	120,640
DNR - Long Term	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dam Safety Monitoring	0	38,572	38,572	38,572	38,572	38,572	28,036	28,036	28,036	28,036	28,036	28,036	28,036	28,036	28,036
Landfill Maintenance and Monitoring SW619	0	21,957	21,957	21,957	21,957	21,957	21,957	21,957	21,957	21,957	21,957	21,957	21,957	21,957	21,957
Landfill Mantenance and Monitoring Coal Ash	0	2,640	2,640	2,640	2,640	2,640	2,640	2,640	2,640	2,640	2,640	2,640	2,640	2,640	0
Tailings Basin Maintenance	0	60,000	40,000	20,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	60,000	40,000	25,000
Snow Plowing/Road Maintenance	0	44,614	44,614	44,614	44,614	44,614	44,614	44,614	44,614	44,614	44,614	44,614	44,614	44,614	44,614
Vehicles (25,000 mi x $0.70/mi)	0	17,500	17,500	17,500	17,500	17,500	17,500	17,500	17,500	17,500	17,500	17,500	17,500	17,500	17,500

	07/01/32	07/01/33	07/01/34	07/01/35	07/01/36	07/01/37	07/01/38	07/01/39	07/01/40	07/01/41	07/01/42	07/01/43	07/01/44	07/01/45	07/01/46	07/01/47
	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Calandar Year	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047
Water Quality Monitoring	23,925	23,925	23,925	23,925	23,925	23,925	23,925	23,925	23,925	23,925	23,925	23,925	23,925	23,925	23,925	23,925
Tailings Basin Seepage Pumping	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tailings Basin Dewatering	107,301	107,301	107,301	107,301	726,051	149,964	118,464	0	0	0	0	0	0	0	0	0
Monitoring/Application for Site Specific Standards	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Site Manager	112,320	112,320	112,320	112,320	112,320	112,320	112,320	112,320	112,320	112,320	112,320	112,320	112,320	112,320	112,320	112,320
DNR - Reclamation	120,640	120,640	120,640	120,640	120,640	120,640	0	0	0	0	0	0	0	0	0	0
DNR - Long Term	0	0	0	0	0	0	60,320	60,320	60,320	60,320	60,320	60,320	60,320	60,320	60,320	60,320
Dam Safety Monitoring	28,036	28,036	28,036	28,036	28,036	0	0	0	0	0	0	0	0	0	0	0
Landfill Maintenance and Monitoring SW619	21,957	21,957	21,957	21,957	21,957	21,957	21,957	21,957	21,957	21,957	21,957	21,957	21,957	21,957	21,957	21,957
Landfill Mantenance and Monitoring Coal Ash	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tailings Basin Maintenance	15,000	15,000	15,000	15,000	60,000	40,000	25,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000
Snow Plowing/Road Maintenance	44,614	44,614	44,614	44,614	44,614	44,614	44,614	44,614	44,614	44,614	44,614	44,614	44,614	44,614	44,614	44,614
Vehicles (25,000 mi x $0.70/mi)	17,500	17,500	17,500	17,500	17,500	17,500	17,500	17,500	17,500	17,500	17,500	17,500	17,500	17,500	17,500	17,500

General Unit Costs Used in Long Term Estimates

Source Column indicates provider and date of unit cost

Source Name	Source Location
Ames 2017	Attachment H2
NTS 2016	Attachment I3
Barr 2016	Attachment K2
DOLI 2016	Attachment L
PolyMet 2016	Attachment M

Item	Description	Unit	Source	Basis for Quantities (drawing # or describe)	Unit Price	Comments
	General Services Reclamation					
	Pick Up Truck	$/mi	NTS 2016		$ 0.70	NTS Letter of 4/21/16
	Pump Maint Truck	$/mi	NTS 2016		$ 1.05	NTS Letter of 4/21/16 x 1.5 to cover truck with lift
	Basic Labor Rates (including OH and profit)					
	Skilled Maintenance	hr	DOLI 2016		$ 68.98	Mn DOLI #707 Dec 2016 Electrician * 1.15 to cover emoloyment costs
	Skilled Labor	hr	DOLI 2016		$ 45.99	MN DOLI #102 Dec 2016 Skilled Labor * 1.15 to cover emoloyment costs
	MDNR Rate	hr	DNR		$ 116.00	Provided by DNR flat rate for all staff including overhead and expenses
	Site Manager	yr	NTS 2016		$ 108.00	NTS 4/22/16 letter Mid Level Professional
	Monitoring and Maintenance					
	Tailings Basin Geotechnical Instruments Field Work	event	NTS 2016		$ 7,686.00	NTS 4/22/16 letter inactive basin
	Tailings Basin Geotechnical Instruments Report	event	NTS 2016		$ 2,850.00	NTS 4/22/16 letter inactive basin
	Tailings Basin Geotechnical Inspection and Report	yr	Barr 2016		$ 17,500.00	Barr 4/1/16 letter inactive basin
	Landfill SW619 Maintenance and Monitoring	yr	NTS 2016		$ 21,957.00	NTS 4/22/16 letter
	Coal Ash Landfill Maintenance and Monitoring	yr	allowance		$ 2,640.00	PLM 2017 Budget
	Snow Plowing	yr	PolyMet 2016		$ 25,414.00	PolyMet Snow Plowing (average of 2 highest of 3 years)
	FTB Dam Containment System Maintenance	yr	allowance		$ 60,000.00	Allowance for maintaining flow in the drain pipe, maintaining surface water controls, repair of cutoff wall. Note most years will be much less but some could be more.
	Legacy Cell 2W Reclamation	yr	allowance		$ 1,000,000.00	Allowance for 6 years to provide stable slopes, adequate vegetation cover, and drainage provisions to resist erosion and route precipitation away from Cell 2W
	Category 1 Stockpile Cover System Maintenance	yr	allowance		$ 24,000.00	Allowance to cover (1) management of plants with deep, woody roots (2) monitoring of the soil surface cover for erosion and (3) repairing erosion damage
	Category 1 Stockpile Containment System Maintenance	yr	allowance		$ 15,000.00	Allowance to cover maintaining flow in the drain pipe, maintaining surface water controls and repairing the cutoff wall. Note that most years will be much less that this but some could be more.
	FTB Maintenance	yr	allowance		$ 10,000.00	PolyMet's experience with vegetation maintenance and erosion control at this facility indicates that $10,000 annually is sufficient for the whole facility once reclamation is complete and $60,000 a year during reclamation ramping down by $20,000 a year until $10,000 a year once reclamation has been completed.
	HRF Maintenance	yr	TBD		$ 10,000.00	Allowance
	Road Grader	hr	Ames 2017		$ 200.00	One grader with Operator Ames Email 11/13/17
	Road Maintenance	yr	calculation	one day per month	$ 19,200.00	One day per month.
	Road Maintenance (during Reclamation)	yr	calculation	one day per week for 9 months	$ 62,400.00	One day per week during 9 month construction season.

Estimate of FTE Required for Remote Alarm Response		
Shifts per week - manned	12	Day Shift Every Day + Afternoon Shift Weekdays
Shift per week - unmanned	9	
Percent shifts unmanned	43%	
Shifts with alarms	5%	assume 5% of shifts have alarms
Shifts with alarms requiring OT	2%	
Shifts per year	1092	
Shifts requiring OT	23.4	
Hrs per response	8	assume each OT alarm response generates 8 hrs OT
OT hrs	187	
OT Preimum	150%	assume time and a half for overtime
Straight Time Hr equivelent to OT	281	
Annual Hrs for 3 FTE	6240	
Percent FTE to add for Alarm Response	**5%**	

Legacy Tailings Basin Cells 1E and 2E - Order of Magnitude Estimate of Closure Costs (05/24/2017)

Item	Description	Unit	Quantity	Unit Cost	Total Cost	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Note
A	**Total with Indirects**				**$3,792,526**	**$254,144**	**$173,281**	**$1,537,421**	**$207,048**	**$196,948**	**$107,301**	**$107,301**	**$107,301**	**$107,301**	**$726,051**	**$149,964**	**$118,464**	
1	Mobilization and Demobilization	LS	5%		$178,663	$12,102	$8,209	$71,868	$9,678	$9,378	$5,110	$5,110	$5,110	$5,110	$34,207	$7,141	$5,641	Allowance of 5% of Subtotal 1 Cost
2	Environmental Protection Measures (dust control)	LS	3%		$40,600	$0	$900	$28,200	$3,800	$0	$0	$0	$0	$0	$7,700	$0	$0	Assume Dust Control is Ancillary to Earthwork Items. Provide allowance of 3% of Subtotal 1 costs for erosion and sediment control on exterior of Cell 1E and Cell 2E. All other earthwork is within basin and no additional erosion and sediment control costs are assumed.
	Total (no indirects)				**$3,573,263**	**$242,042**	**$164,172**	**$1,437,353**	**$193,569**	**$187,569**	**$102,192**	**$102,192**	**$102,192**	**$102,192**	**$684,144**	**$142,823**	**$112,823**	
B	**Dewatering**				**$1,116,071**	**$161,042**	**$134,542**	**$142,156**	**$102,192**	**$116,192**	**$102,192**	**$102,192**	**$102,192**	**$102,192**	**$51,179**	**$0**	**$0**	
	Cell 2E to Cell 1E Pumping System				**$43,300**	**$22,767**	**$10,267**	**$10,267**	$0	$0	$0	$0	$0	$0	$0	$0	$0	
1	New Pole Mount Transformers / Motor Starter	LS	1	$6,500	$6,500	$6,500												
2	Electrical Installation	LS	1	$6,000	$6,000	$6,000												
3	800' of 8" DR11 HDPE fused and installed	LF	2,400	$7.00	$16,800	$5,600	$5,600	$5,600										Pipe length to accommodate decreasing pond footprint as dewatering progresses.
4	Allowance for Pump Relocations	LS	1	$8,000	$8,000	$2,667	$2,667	$2,667										Re-use Existing Pump from Cell 1E
5	Allowance for Electrical Modifications	LS	1	$6,000	$6,000	$2,000	$2,000	$2,000										
	Cell 1E to SD026 Pumping System				**$42,000**	**$14,000**		**$14,000**		**$14,000**								
6	Piping - 8" DR11 HDPE Procured and Installed	LF	4,000	$7.00	$28,000	$9,333		$9,333		$9,333								Pipe length to accommodate decreasing pond footprint as dewatering progresses.
7	New Pole Mount Transformers / Motor Starter	LS	0	$6,500	$0	$0												Already in Place
8	Electrical Installation	LS	0	$6,000	$0	$0												Already in Place
9	Allowance for Pump	LS	0	$20,000	$0	$0												Already in Place
10	Allowance for Pump Relocations	LS	1	$8,000	$8,000	$2,667		$2,667		$2,667								Pump Relocation Activities as Pond Level Drops
11	Allowance for Electrical Modifications	LS	1	$6,000	$6,000	$2,000		$2,000		$2,000								Electrical Modifications Associated with Pump Relocations
12	pH Adjustment System	LS	0	$45,000	$0	$0												Already in Place
	Pumping and CO2 Treatment O&M				**$1,030,771**	**$124,276**	**$124,276**	**$117,889**	**$102,192**	**$102,192**	**$102,192**	**$102,192**	**$102,192**	**$102,192**	**$51,179**	**$0**	**$0**	
	Cell 2E Pond Volume	Gal				577,042,805	364,174,805	151,306,805	0	0	0	0	0	0	0	0	0	Initial pond volume based on Barr stage volume model and pond elevation of 1561.4ft
	Cell 2E to Cell 1E Volume Pumped	Gal			577,042,805	212,868,000	212,868,000	151,306,805										450 gpm pump system with 90% availability
13	Cell 2E Dewatering	$	row above	$0	$59,865	$22,084	$22,084	$15,697										Unit Cost from Dewatering UC Development Tab
	Cell 1E Pond Volume	Gal				1,445,376,557	1,445,376,557	1,445,376,557	1,383,815,362	1,170,947,362	958,079,362	745,211,362	532,343,362	319,475,362	106,607,362	0	0	Initial pond volume based on Barr stage volume model and pond elevation of 1655.6ft
	Cell 1E to SD026 Volume Pumped/Treated	Gal			2,022,419,362	212,868,000	212,868,000	212,868,000	212,868,000	212,868,000	212,868,000	212,868,000	212,868,000	212,868,000	106,607,362			450 gpm pump system with 90% availability
14	Cell 1E Dewatering	$	row above	$0	$970,906	$102,192	$102,192	$102,192	$102,192	$102,192	$102,192	$102,192	$102,192	$102,192	$51,179			Unit Cost from Dewatering UC Development Tab
C	**Cell 2E - Grading and Dam Breach**				**$1,467,582**	**$0**	**$29,630**	**$1,295,198**	**$71,378**	**$71,378**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	
1	Mass Grading	CY	100,000	$2.50	$250,000			$250,000										Assume limited grading sufficient to resolve low spots, erosion, slope angle reduction, other. Some areas will require no grading; other areas will require substantial grading. The cubic yards estimated is an allowance; not a detailed estimate.
	Channel from Cell 2E Pond to Exterior of Dam Slope (quantities from Dam Breach Calc Tab)																	
2	Excavate Channel	CY	175,000	$1.60	$280,000			$280,000										Unit Cost from Unit $ Tab (Soil Excavation). See Dam Breach Calcs spreadsheet for channel dimension estimate.
3	Class II Riprap (24" Thick)	CY	1,481	$35.95	$53,260			$53,260										Unit Cost from Unit $ Tab (Rip-Rap Eronsion Protection). See Dam Breach Calcs spreadsheet for channel dimension estimate.
4	Filter Material (12" Thick)	CY	741	$35.95	$26,630			$26,630										Assume same Unit Cost as riprap.
	Channel from Elev. 1,568 to Toe of Slope Wetland Area (quantities from Dam Breach Calc Tab)																	
5	Excavate/Grade Channel	CY	18,519	$1.60	$29,630		$29,630											Unit Cost from Unit $ Tab (Soil Excavation). See Dam Breach Calcs spreadsheet for channel dimension estimate.
6	Class II Riprap (24" Thick)	CY	7,407	$35.95	$266,299			$266,299										Unit Cost from Unit $ Tab (Rip-Rap Eronsion Protection). See Dam Breach Calcs spreadsheet for channel dimension estimate.
7	Filter Material (12" Thick)	CY	3,704	$35.95	$133,150			$133,150										Assume same Unit Cost as riprap.
	Riprap Delta (450ft x 40ft)																	Assumed 450-ft Length and 40-ft width (FTB-017, Section 5 Stationing) | FTB-017 Riprap Overflow Channel Emergency Dissipater, Section 5
8	Class II Riprap (18" Thick)	CY	1,000	$35.95	$35,950			$35,950										Unit Cost from Unit $ Tab (Rip-Rap Eronsion Protection). See Dam Breach Calcs spreadsheet for channel dimension estimate.
9	Filter Material (6" Thick)	CY	333	$35.95	$11,983			$11,983										Assume same Unit Cost as riprap.
10	Initial Seeding (50% Cell area)	AC	310	$768	$237,925			$237,925										Unit Cost from Unit $ Tab (assume seeding 25% slope and 75% flat + mulch))
11	Re-Seeding (15% cell area each year for 2 years)	AC	93	$768	$142,755				$71,378	$71,378								Unit Cost from Unit $ Tab (assume seeding 25% slope and 75% flat + mulch))

Legacy Tailings Basin Cells 1E and 2E - Order of Magnitude Estimate of Closure Costs (05/24/2017)

Item	Description	Unit	Quantity	Unit Cost	Total Cost	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Note
D	**Cell 1E - Grading and Dam Breach**				**$858,610**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$632,965**	**$112,823**	**$112,823**	
1	Mass Grading	CY	50,000	$2.50	$125,000										$125,000			Assume limited grading sufficient to resolve low spots, erosion, slope angle reduction, other. Some areas will require no grading; other areas will require substantial grading. The cubic yards estimated is an allowance; not a detailed estimate.
	Channel from Cell 1E to Cell 2E (quantities from Dam Breach Calc Tab)																	
2	Excavate Channel	CY	32,500	$1.60	$52,000										$52,000			Unit Cost from Unit $ Tab (Soil Excavation). See Dam Breach Calcs spreadsheet for channel dimension estimate.
3	Class II Riprap (24" Thick)	CY	1,481	$35.95	$53,260										$53,260			Unit Cost from Unit $ Tab (Rip-Rap Eronsion Protection). See Dam Breach Calcs spreadsheet for channel dimension estimate.
4	Filter Material (12" Thick)	CY	741	$35.95	$26,630										$26,630			Assume same Unit Cost as riprap.
5	Initial Seeding (50% Cell area)	AC	490	$768	$376,075										$376,075			Unit Cost from Unit $ Tab (assume seeding 25% slope and 75% flat + mulch))
6	Re-Seeding (15% cell area each year for 2 years)	AC	147	$768	$225,645											$112,823	$112,823	Unit Cost from Unit $ Tab (assume seeding 25% slope and 75% flat + mulch))
E	**Other Activities**				**$131,000**	**$81,000**	**$0**	**$0**	**$20,000**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$30,000**	**$0**	
1	Removal of SD004, SD006 and SD026 Collection and Pumpback Systems	LS	1		$81,000	$81,000												Allowance for Removals - Roughly equal to 3-person crew and equipment at $200/hr, 10 hours per day for 5 days for each system.
2	Removal of Dewatering Pipelines, Electrical and Pumping Systems.	LS	1		$50,000				$20,000							$30,000		Value is a cost allowance assumed for this activity.

Notes:

1) Cell 1E and 2E Order of Magnitude Closure Costs shown are for construction of dam breaches and discharge channels of depths assumed sufficient to drain Cell 1E and 2E ponds.

2) Due to earthwork quantities required it would be impractical to grade Cells 1E and 2E to drain; dam breaches and discharge channels are assumed instead. Feasibility of channel construction has not been confirmed.

3) Closure cost estimate is for closure concept represented by computations and concepts contained in the cost estimate spreadsheet; no accommodation for contingency is included.

4) Costs are estimated present value costs throughout.

Computation Date 04/26/2017

Estimate of Annual Cost - Two pumps running separately with separate inlet lines and moving water simultaneously from Cell 2E to Cell 1E and from Cell 1E to Second Creek		
	Second Creek Pumping and C02 System	**Cell 2E Pumping System**
Pump Model	GPM Eliminator Model No. – SBLH4S50 - 4T4 - S 40 HP, 460V, 60A	GPM Eliminator Model No. – SBLH4S50 - 4T4 - S 40 HP, 460V, 60A
Flow Rate (gpm)	450	450
Pumping Months per Year	12 months per year	12 months per year
Pumping Days Per Year (assumed 90% availability)	328.5	328.5
Pumping Basis	Inlet lines to be buried to prevent freezing lines, separate inlet, pump and outlet lines	Inlet lines to be buried to prevent freezing lines, separate inlet, pump and outlet lines
Pumping Outlet	Second Creek (SD026)	Cell 1E Pond
Power Consumption (kWh/day)	662.40	662.4
Power Rate ($/kWh)	$0.090	$0.090
Power Cost ($/year)	**$19,584**	**$19,584**
CO2 Dewar Tank Fill ($/per)	$98	$0
Dewar Tank Rental ($/day)	$1.25	$0
CO2 Consumption (# Dewar tanks /week)	$3.00	$0
CO2 cost ($/week; includes spare dewar)	$329	$0
CO2 System Annual Cost ($/year)	**$17,108**	**$0**
Pump Maintenance	$2,500	$2,500
Vac Truck service	$0	$0
CO2 System maintenance, calibration, etc.	$3,000	$0
Monitoring Costs (Cell 1E inlet, Second Creek discharge)	$60,000	$0
Annual Maintenance and Monitoring Costs ($/year)	**$65,500**	**$2,500**
Annual Operating Costs	$102,192	$22,084
Volume pumped (gals/year)	212,868,000	212,868,000
Annual Operating Cost/1,000 Gallons	**$0.480**	**$0.104**

Cell 1E to Cell 2E Dam Breach Excavation Volume Estimate (See Table and Comments Below):

40 foot road width, 30 foot cut, 6H:1V max road grade, 3H:1V north dam slope, 330H:16V beach slope, 40 foot wide flat bottom at cut.

26,000 Cubic Yards (rough estimate)
32,500 Cubic Yards (with 25% additional for unknowns)

Cell 1E Dam Breach	Riprap (24" Loose Lift)	1,481	Cubic Yards
	Filter Material (12" Loose Lift)	741	Cubic Yards
	(riprap on last 200' section of breach, on base and 5 feet up sides)		

Cell 2E Breach Volume Estimate (See Table and Comments Below):

40 foot road width, 35 foot cut, 6H:1V max road grade, 4H:1V exterior dam slope, 330H:16V beach slope; 40 foot wide flat bottom at cut, 2,700 foot long channel (no riprap) with depth from zero at basin center to 10 feet at dam cut.

140,000 Cubic Yards (rough estimate)
175,000 Cubic Yards (with 25% additional for unknowns)

Cell 2E Dam Breach	Riprap (24" Loose Lift)	1,481	Cubic Yards
	Filter Material (12" Loose Lift)	741	Cubic Yards
	(riprap on last 200' section of breach, on base and 5 feet up sides)		
Dam Breach to Toe	Riprap (24" Loose Lift)	7,407	Cubic Yards
	Filter Material (12" Loose Lift)	3,704	Cubic Yards

Cell 1E to Cell 2E Channel - Assume Dam Crest Elevation at channel location is elevation 1674 (at central location on Cell 1E/2E splitter dam). Construct wide drivable channel to elevation 1644; assumed sufficient to accommodate full drainage of Cell 1E to Cell 2E. Assume 100' wide by 260' long riprap zone with gravel infill for driving zone.

Cell 2E to Wetland Channel - Assume Dam Crest Elevation at breach location is elevation 1588 (at eastern side of Cell at dam intersection with existing hillside). Construct channel to elevation 1558; assumed sufficient to accommodate full drainage of CEll 2E. Assume 100' wide by 260' long riprap zone with gravel infill for driving zone.

Cell 2E to Wetland General Earthwork - Assume 1,000 foot long by 100 foot wide earthwork zone with average 5' cut/fill along entire length.

Attachments

Attachment A

ESA Cliffs Erie 2003

PHASE I - ENVIRONMENTAL SITE ASSESSMENT

CLIFFS ERIE PROPERTIES INCLUDING; THE HOYT LAKES FACILITY, DUNKA PROPERTY, TACONITE HARBOR AND RAILROAD CORRIDORS

September, 2002
NTS Project # 5796.08

Prepared for:

Cliffs Erie, L.L.C.

Prepared by:

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DISCLAIMER

All information presented in this Phase I Environmental Site Assessment is based on reviews of available literature, records, and informal discussions with various governmental agencies, contractors, and other personnel involved with the property. Conclusions presented are a result of interpretations of the information collected by Northeast Technical Services, (NTS).

Since several conclusions reached in this evaluation were based on information from others or readily available documentation, newly documented or changed verbal information discovered after submittal of this report could result in reinterpretation and alteration of conclusions presented. No soil or water samples were collected or submitted for laboratory analysis as part of the Phase I ESA to verify or confirm the implied quality.

This report does not constitute an assurance or guarantee by NTS that the subject property is presently, nor will it necessarily remain free, from environmental impairment. However, NTS has made every effort to conduct a thorough and complete evaluation of the subject property before submitting this report.

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INTRODUCTION

The former LTV Steel Mining Company (LTVSMC) ceased mining operations in 2001 and subsequently Cliffs Erie, L.L.C. (CE) acquired portions of the facility directly related to mining and ore processing. Minnesota Power (MP) acquired portions not directly associated with the mine and processing. Minnesota Rules 6130 require a Mine Closure Plan for the facility. The CE Closure Plan (May 23, 2002) provides a framework for work to be conducted as part of the closure process. In general, closure work falls into two categories:

1. Work that falls under regulatory oversight by the Minnesota Department of Natural Resources (MDNR) Including:
   - Plans for pit to watercourse discharges.
   - Mineland reclamation.
   - Plans for tailings basin drainage.
2. Work that falls under regulatory oversight by the Minnesota Pollution Control Agency (MPCA) including:
   - Investigation and potential cleanup of contaminants in soil or groundwater related to the mining operations.
   - Protection of overall water quality.

CE retains the responsibility for closure of the mine (areas not currently owned by MP) and entered the Voluntary Investigation and Cleanup (VIC) Program of the MPCA on April 4, 2002. Conducting closure work as a volunteer in the VIC Program will result in legal or administrative assurances, issued by the Commissioner of the MPCA, that apply either to CE as an entity, or to specific legally described lands. These assurances are intended to streamline re-use or redevelopment of the idled facility. In essence, the facility is viewed as brownfield that must undergo routine Phase I assessment, Phase II investigation, and risk based decision making that incorporates planned land use regarding identified releases that arise from the Phase I and Phase II process.

Northeast Technical Services, Inc. (NTS) was retained by CE to conduct a Phase I Environmental Site Assessment (ESA) of the CE owned facility which consists of the following general land descriptions:

1. Mining areas at Hoyt Lakes and Dunka.
2. Plant area at Hoyt Lakes.
3. Railroad Corridor including Murphy City.
4. Taconite Harbor including the Pellet Dock, Marine Fueling, and Coal Ash Landfill.

METHODOLOGY AND LIMITATIONS

The purpose of this Phase I ESA is to provide the appropriate level of inquiry to delineate Areas of Concern (AOC) which will require Phase II investigation. An AOC is defined as a discrete area of the property where a known release, or a material threat of a release is identified by the level of inquiry provided by this document. Sampling and Analysis Plans (SAPs) will be developed for each of the areas of concern and will contain sufficient details regarding the practices and contaminants of concern to identify individual Recognized Environmental Conditions (RECs).

The scope of this Phase I ESA generally follows the 2000 version of ASTM Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process (Designation: E 1527-97) and is consistent with the MPCA VIC Guidance Document #8.

Due to the large land area and the unique use of the property, several limitations are noted:

1. Record searches did not designate a specific address. Rather, Environmental Data Resources (EDR) provided an "Area Search" for the Hoyt Lakes Facility and Taconite Harbor. Environmental record searches were not obtained for Murphy City, Dunka or the Railroad Corridor.
2. The historical land use was developed primarily from information obtained from interviews. Drawings, plans, and air photographs archived by CE Mine and Plant Engineering, were used to verify historical information.
3. Questions presented in the ASTM Owner Questionnaire are very difficult for one individual to answer given size of the facility and the recent change in ownership. Therefore, an owner questionnaire was not completed for the facility.
4. The entire facility was accessible for performance of the ESA. However, the very large land area made inspection of all land area practicably unascertainable.

Historical land use, development of the property and description of the mining process is presented for the property as a whole. Site descriptions (physiographic, geologic and hydrogeologic), standard environmental records searches, and interviews and site reconnaissance are presented separately for the following;

1. Hoyt Lakes (mining areas and plant) and Dunka,
2. Taconite Harbor
3. Railroad Corridor

GENERAL HISTORICAL BACKGROUND

The CE "Facility" consists of major portions of former LTVSMC. The historical development of the whole facility is important in understanding the overall property use.

The Erie Mining Company (EMC) was formed in 1940 to pursue a process for economic recovery of iron from taconite. The research culminated in the construction and operation of the Erie Experimental Taconite Plant (Pre-Tac) which operated between 1948 and 1957. Pre-Tac was located in the SW ¼, of the SE ¼ of Section 28, Township 59 North, Range 15 West, or near the western extent of the current Hoyt Lakes mine area.

The decision to proceed with construction of a full scale commercial taconite plant was largely based on the estimated reserves on lands controlled by EMC. The reserves would need to yield a minimum of 10.5 million long tons annually of agglomerated concentrate with an average dry iron content of 64% over a period of 40 years; or a total of 420 million long tons of concentrate. In 1951 EMC held lands were divided into the following areas:

1. Area 1 with a minimum yield of 83 million long tons of concentrate.
2. Area 2 with a minimum yield of 142 million long tons of concentrate.
3. Area 3 with a minimum yield of 83, million long tons of concentrate.
4. Area 3X with a minimum yield of 90 million long tons of concentrate.
5. Area 4 with a minimum yield of 92 million long tons of concentrate.

These yields exceeded the 420 million long ton requirement and EMC initiated construction of a full scale facility in 1954.

The EMC full scale facility was originally constructed and owned by Bethlehem Steel Corporation (45%), Youngstown Sheet and Tube Company (35%), Interlake Iron Corporation (10%) and Steel Company of Canada Limited (10%). The facility consisted of a 7.5 million ton annual capacity taconite processing plant at Hoyt Lakes, a coal fired steam electric generating plant in Taconite Harbor, and approximately 75 miles of railroad and power lines connecting the Hoyt Lakes plant to the generating plant. The facility was placed into production in September, 1957 with the first load of pellets shipped in December of 1957. Pickands Mather Company (PM) was the original managing agent for the mine.

The Taconite Tax Amendment, passed in November, 1964, provided tax structure for taconite producers. Consequently, in 1965, PM announced an expansion program for EMC which would bring it's pellet producing capacity to 10.6 million tons annually. Construction began in the same year and by 1967 EMC was meeting the new production rate. Additional mining areas were permitted over the years as production requirements dictated.

Ling-Temco-Vought Corporation (LTV Corporation) of Dallas Texas acquired 100% ownership of EMC in May, 1986 and renamed the facility LTV Steel Mining Company (LTVSMC) in 1987. Also in 1986, Cleveland Cliffs, Inc. (CCI) purchased PM and became managing agent for the facility.

On May 24, 2000, LTV Steel Corporation announced it would close LTVSMC in the summer of 2001. On December 6, 2000, the closure date was moved up to February 24, 2001. On January 3, 2001, it was announced that LTVSMC's Hoyt Lakes mine and processing plant would close immediately. The last product left the plant site, by railcar, on July 19, 2001 and the last ore boat departed Taconite Harbor Docks on July 22, 2001.

On October 30, 2001, CE, a subsidiary of CCI and MP purchased the facility and assets. MP now owns the Power Plant, former Taconite Harbor Village and some related lands. CE owns the mine sites, taconite processing plant, Pellet Dock, Marine Fueling, and Railroad Corridor.

GENERAL OVERVIEW OF THE TACONITE PROCESS

Unlike sulfide ore mining, the process of mining and processing taconite does not generate hazardous waste or hazardous substances as a result of the process. The process waste is overburden, waste rock, and tailings. These materials alone are not considered to lead to a release of contaminants of concern. One exception to this "benign waste rock and tailings rule" exists at Dunka where some sulfide minerals exist within some of the waste rock. This condition is discussed in a later section. In general, waste containing contaminants of concern are generated as a result of using materials related to the process such as fuels, lubricants, hydraulic fluids, etc. Therefore, this Phase I ESA was conducted by identifying areas where materials other than process waste where used or disposed. Locating these areas was largely dependent upon use of existing drawings and interviews with current and former employees.

The general taconite process is divided into the following categories; mining, crushing, concentrating, agglomerating, railroad, dock, and power plant.

MINING

Mining operations were conducted at the Hoyt Lakes location and the Dunka location. Mining included drilling, blasting and loading ore to an in-mine railroad. The mining lands are divided into the following areas which are shown on Figure 2 in Appendix A:

1. Area 1
2. Areas 2, 2 E, and Area 3
3. Area 2 W
4. Area 2 WX
5. Area 5
6. Area 6
7. Area 8 (Dunka)
8. Area 9 N

9. Area 9 S

One additional mine area, generally referred to as the McKinley Extension, exists near Area 6 and Area 9. The McKinley Extension is owned and was mined by US Steel Corporation except for a period of time during which the Northwest Ore Division leased the area. The McKinley Extension has been formally "closed" in accordance with Minnesota Rules 6130 and is not included in this Phase I.

In general, each mine area contains the following infrastructure:

- Fueling – Fueling in the mine areas consisted of above ground storage tanks (ASTs) containing fuel oil or gasoline for in-mine heavy equipment (haul trucks, loaders and rubber tired dozers). Early in development of the mining areas, fueling was accomplished with mobile ASTs which were either skid mounted, or consisted of a semi trailer transport tank. During the 1980s and 1990s ,fueling stations were installed that consisted of ASTs meeting standard construction specifications. The dispensers are located within large shelters with concrete floors. Any spills that occurred within the shelters during fueling were contained and drained to holding tanks that are pumped periodically. In-pit locomotive fueling was accomplished with Locomotive Fueling Stations located near the Area 1 and Area 2 Shops. Fueling for the mainline railroad locomotives was done at the Knox Locomotive Fueling Station which is discussed later. Tables 2 though 5 summarize the AST and underground storage tank (UST) inventory at the entire facility.
- Loading Pockets – Initially, shovels loaded rail cars directly. As the mine pits became deeper, the grade became too great for rail transport of crude ore directly to the plant. Therefore, shovels loaded crude ore into haul trucks for transport out of the pit. Loading Pockets provided a means of transferring the ore from the haul trucks into rail cars for the remaining transport to the processing plant. The pockets were generally in close proximity to the Truck Fueling Stations. The Loading Pockets used two types of feeders; the vibratory type and the Superpocket. The vibratory pockets were electrically powered and the only waste stream was small amounts of lubricant for wear surfaces. The Superpocket type was electric/hydraulic powered and therefore used hydraulic fluids.
- Reporting Area – A set of buildings where mine employees reported for work and general operations within the area were controlled was called the Reporting Area. The buildings contained locker rooms, showers, offices, lunch rooms, etc. Septic systems and drinking water systems (wells or holding tanks) were associated with each Reporting Area. The septic systems were connected to domestic type sewage only and are not considered a concern. Table 6 presents an inventory of wells and septic systems.

Other mine infrastructure that is not specific to all mine areas is the following:

- Area 1 Shops, Area 2 Shops and Dunka Shops –The shops were constructed during the original plant construction and upgraded in 1967 during the overall plant expansion. The reason for upgrading was primarily to accommodate the increasing size of equipment used. The Area 1 and Area 2 Shops provided general maintenance of in-mine equipment while Dunka shops provided only light maintenance such as brakes, lubrication etc.

CRUSHING

Ore delivered to the plant site was offloaded to the Coarse Crusher which used 60 inch and 36 inch gyratory crushers to reduce the crude ore size to six inches. The coarse crushed ore was delivered to the Fine Crusher which used a series of standard and shorthead crushers to reduce the crude ore to ¾ inch. Various heavy lubricants were used on the bearing surfaces of the crushers.

CONCENTRATING

Concentrating (a separation of the iron containing minerals from the rest of the crude ore) included the following components:

- Rod mill – A rotating drum filled with metal rods. The rotation pulverized the crushed ore to finer material. Water was added at this point and the concentrate was carried through the rest of the process as a slurry.
- Magnetic separators – Magnetite grains in the concentrate slurry was separated from the pulverized ore by rotating magnetic drums.
- Ball mill – Same as a rod mill except that metal balls rotating in a drum pulverized the ore.
- Floatation – final finishing separation step. Two reagents referred to as Frother (alcohol) and Collector (amines) were added to the concentrate slurry.

The process of concentrating used large amounts of water with tailings discharged to the Tailings Basin as a slurry. Once solids settled out of the slurry, water was recycled back to the plant in a closed system.

AGGLOMERATING

Agglomerating produced finished taconite pellets and included the following:

- Thickener - The concentrate slurry was delivered to the thickner were settling increased the concentrate to water ratio.
- Filter – The thickened slurry was filtered to provide a filter cake with acceptable moisture content for the balling step.
- Balling – Bentonite and concentrate were added to a rotating drum. The right mixture of moisture, bentonite and concentrate formed “green pellets”.
- Furnace - Furnaces fired the green pellets to form finished “hard” pellets. The original plant furnace was fired with #6 fuel oil stored in three large ASTs. The fuel was offloaded by railcar. The furnaces were converted to natural gas between 1965 and 1968 with #6 fuel oil used as backup.

RAILROAD

Railroad – Provides transport of finished pellets to the Pellet Dock at Lake Superior. The railroad consisted of the following:

- Rail corridor – Originally constructed concurrent with the original plant, the corridor was constructed with ballast (crushed rock), rail ties and rail lines. Switches are manual with the exception of several electric switches near the Taconite Harbor end of the rail line. Power for crossing signs and switches was provided by several battery houses (Photograph 5, Appendix D) with solar panels to recharge the batteries. Prior to solar panels the batteries were changed out periodically by railroad maintenance crews.
- Knox Locomotive Fueling Station - Located on the south edge of the plant and processing area. Locomotives were diverted off the mainline through the facility.
- Murphy City was originally a location from which the rail line construction was coordinated. Susequent use of the facility was for maintenance of way and consists of several buildings including a Minor Repair Building, Storage Building, and Reporting Building. Locomotives were not fueled at Murphy City but several ASTs exist for light vehicle fueling.

DOCK

Dock and Marine Fueling Facility – Provided unloading of finished taconite pellets from the railcars and loading to ore boats. The Marine Fueling Facility consisted of two large ASTs which were originally filled from rail cars. The filling since approximately 1968 was from truck transport. Above ground piping delivered fuel to the loading dock for marine traffic.

POWER PLANT

Power Plant and power line – provides electric power to operate the Hoyt Lakes plant. The Power Plant is not a portion of CE owned lands and is not included in this Phase I.

OTHER INFRASTRUCTURE

Infrastructure of the whole facility not described above includes the following:

1. Pellet Storage Area.
2. Administration Building.
3. General Shops – contained a weld shop, blacksmith shop, car shop, locomotive shop, electric shop, machine shop, rebuild shop, and carpenters shop.
4. Domestic Waste Water Treatment Plant (WWTP) - treated only sanitary sewage
5. Water Treatment Plant – provided potable water for the Hoyt Lakes facility.
6. Emergency Basin – received storm water and process overflow from the Coarse Crusher, Fine Crusher and Concentrator.
7. Red Water Basin – received storm water and process overflow from the Agglomerator and storm water from the Pellet Storage Area.
8. Colby Lake Pumping Station – provided water to the reservoir through a 36 inch line for plant process water and the Water Treatment Plant.
9. Dunka Constructed Wetland Treatment System and water treatment plant – provides metal reduction in water from waste rock stockpile seeps.
10. Heating Plant – provided hot water heat for the plant area buildings. Originally coal fired, the Heating Plant was converted to natural gas in 1994.

The primary buildings of the plant site are constructed into bedrock. Therefore, the lowermost portion of the building is well below grade. Floor drains and sump pumps discharge to the Emergency Basin or Red Water Basin.

UST AND AST INVENTORY

USTs were removed during the late 1980s and early 1990s and as a result there are currently no known USTs at the entire facility except for tank 001. Tank 001 is located at the Administration Building and was abandoned in place in the late 1970s to avoid building damage.

CE records provide documentation of existing ASTs and removed USTs. An attempt was made to inventory both existing and historical tanks using the following resources:

1. The AST Permit for the Hoyt Lakes Facility (AST Permit #5297).
2. The AST Permit for the Marine Fueling Facility (AST Permit # 51740).
3. The MPCA list of registered tanks (TABS site database) for Hoyt Lakes, Dunka, Murphy City, Marine Fueling Facility, and Taconite Harbor.
4. CE internal records.

5. Interviews with former LTVSMC Staff.
6. Site reconnaissance.

Tables 2 through 5 present existing outdoor ASTs, indoor ASTs, Removed ASTs and Removed USTs . The TABS database, and AST Permits are contained in Appendix E. It should be noted that the TABS site ID for Taconite Harbor applies to the Power Plant which is owned by MP and is not a part of this Phase I. However the Taconite Harbor database is presented in Appendix E to demonstrate apparent inaccuracies between the Power Plant tanks and tanks that existed at the Pellet Dock and Marine Fueling Facility. Some ASTs are listed under both databases and as result are listed in the AST permits. In addition, both databases contain several ASTs of approximately 180,000 gallon capacity. Review of air photos and interviews with former staff do not support the existence of these tanks. The only known tanks at the Marine Fueling Facility include the existing ASTs listed in Table 2 and one removed AST listed in Table 3. The removed AST stored #2 fuel oil used for heating the lines for the heavier #4 and #6 fuel oil.

The TABS databases listing for the Hoyt Lakes facility includes multiple listings for ASTs that cannot be accounted for through historical records reviewed to date. In addition, these ASTs are not included in the AST permit for Hoyt Lakes and are not included in Tables 2 through 5. The additional listings on the TABS database are either tanks that are accounted for under a different ID in Tables 2 through 5 or were mobile AST that no longer exist.

PROJECT BOUNDARIES AND OWNERSHIP

Lands that comprise the operating mine are those formerly owned or leased by LTVSMC. The purchase of the facility by CE and MP resulted in two parties owning lands within the mine area in addition to the leased lands. This Phase I applies to all lands that belonged to the operating mine that are not currently under ownership by MP.

Figure 1 presents a GIS map prepared by the MDNR, Minerals Division, that shows lands owned by CE, owned by MP and lands divided between CE and MP. It should be noted that the smallest land unit recognized by the map is a 40 acre parcel, although actual ownership may be less than the entire 40 acres.

MINE AND PLANT AREAS

REGIONAL GEOLOGY AND HYDROGEOLOGY

Bedrock geology underlying the entire mine and plant area consists of a sequence of, from oldest to youngest, (1) undifferentiated Archean volcanic and volcanogenic rocks, (2) the Pokegama Quartzite, (3) the Biwabik Iron Formation and (4) Virginia Formation. The sequence of the Pokegama, Biwabik and Virginia formations are gently folded and dip to the southwest at approximately 10 degrees. However, dips within localized areas of the mine may be very erratic with some dipping to the north. The Geologic Map of the Mesabi Iron Range (Meineke et.al.) is attached in Appendix F and contains descriptions of each geologic unit and shows the location of the mining areas and the plant site with respect to the various bedrock units. Notice that Area 6 (Dunka) lies at eastern extent of the Biwabik Iron Formation. Additional description of the bedrock geology can be found in Morey, D.G. (1993).

During the Pleistocene glacial event, the Biwabik Formation and associated bedrock provided an area more resistant to glacial erosion than bedrock to the north and south. The result is an east-west trending ridge that forms a watershed divide. Glacial deposits are distinctly different north of the divide from the deposits on the south side of the divide. North of the divide glacial sediments are associated with the Rainy Lobe and consist of thin patchy deposits of sandy, stony till overlying the scoured bedrock. Glacial deposits south of the divide are thicker, the uppermost associated with the DesMoine Lobe. These sediments are generally gray or red-brown silty to clayey tills. Most of the glacial sediments (overburden) have been stripped from the mine areas of the CE facility. In addition, other areas where overburden has not been stripped, contain overburden and waste rock stockpiles or tailings over the original ground surface.

The Hoyt Lakes Mine and plant area lies at the northern edge of the St. Louis River Watershed. Surface water from the Tailings Basin area flows north to the Embarrass River which drains south to a confluence with the St. Louis River. Surface water drainage from the most of the plant area and the mine area at Hoyt Lakes flows either south to Colby Lake, or east to the Partridge River which ultimately drains to the St. Louis River, via Colby Lake.

Local groundwater flow systems occur within the glacial overburden where it remains in sufficient thickness, and within overburden and waste rock stockpiles. These small local flow systems tend to be hydraulically isolated from other local flow, with discharge to small intermittent streams, wetlands or leakage to intermediate and regional flow systems within the Biwabik Iron Formation and Virginia Formation. The Virginia Formation and the Biwabik Iron Formation contain fracture systems sufficient to be considered as aquifers.

Mine dewatering over the years has produced enough drawdown around active mine pits that the water table lies within the fractured bedrock. Therefore, local groundwater elevations and flow directions are very complex across the entire facility.

The Dunka mine area lies within the Rainy Lake Watershed. Surface water drainage is easterly to the Dunka River which discharges to Birch Lake. Very little glacial overburden existed over the bedrock surface and mine dewatering has depressed the water table within the fractured bedrock. Local groundwater flow occurs within the overburden and waste rock stockpiles. Discharge from the these stockpiles occurrs as seeps to small streams and wetlands. Due to the geology of much of the waste rock from the Dunka mine, these seeps contain elevated concentrations of metals. Constructed Wetland Treatment Systems and an active Water Treatment Plant have been constructed to reduce the metal concentrations to acceptable levels prior to discharge to the Dunka River.

ENVIRONMENTAL RECORDS REVIEW

An Area Study Report was received from Environmental Data Resources, Inc. (EDR) and is attached in Appendix C. The Area Study Report differs from a Radius Report in that lands surrounding the subject property are not included. The ASTM criteria for minimum search radius surrounding the CE lands is not met. File evaluations included review of both federal and state records. The list of databases is included in the EDR report.

There were no reported sites, under any of the databases, that had sufficient location information for mapping. The Orphan Summary in the EDR Report lists all sites that may be within the area search boundaries based upon common location descriptions, but cannot be absolutely located. Review of the orphan listings yields the following sites that may be within the project boundary:

1. Former Monsanto Plant was obtained from the UST database with location information only as HWY 110. The listing contains two gasoline USTs and one fuel oil UST, all of which have been removed. The Tank owner was Viking Explosive. This site was not within the project boundary of this Phase I and is not considered an AOC.
2. Erie Mining Dump #2 was obtained from the MN LS database. Information within the listing states that the site is located approximately 2.5 miles north of CSAH 110. The MPCA ID is MNODIOOO1125. This is the same as site as the CE Private Landfill discussed elsewhere in this document.
3. Monsanto Co. was obtained from the RCRIS SQG-FINDS database. No violations were listed in the information and this site is not within the boundary of this Phase I.
4. Hoyt Lakes Demolition Landfill was obtained from the MN LS database. The location is listed as 2 miles north of 110. this is likely the same site as the closed Hoyt Lakes Landfill which is not a portion of this Phase I project area.
5. LTV Steel Mining Company was listed under FINDS, MN Spills, RCRIS-LQG, and MLTS databases. Most listings were related to specific waste generator manifest, record keeping violations, not necessarily related to a release. Eleven spill reports were included.
6. The USX Corp. McKinley Mine was obtained from the RCRIS-SQG database. No violations were reported in the listing and this property is not part of the CE property.

INTERVIEWS, ON SITE RECONNAISANCE AND ARIAL PHOTO REVIEW

One primary site reconnaissance of the Hoyt Lakes Facility was conducted on June 19, 2002. Several follow up visits occurred on July 24, 2002 and July 29, 2002. Jim Stanhope accompanied NTS on the primary reconnaissance. In addition, the following table summarizes the persons interviewed.

TABLE 1: SUMMARY OF VERBAL CONTACTS

Contact	Relationship to the facility	Title	Interview Date	Number
Jim Stanhope	EMC, LTVSMC employee 1968 to 2001	Environmental Engineering Supervisor	Various	218/225-4242
Richard Erchul	EMC, LTVSMC employee 1967 to 2001	Staff Services Coordinator	5/02 – 7/02	218/225-4263
Jim Scott	EMC and CCI employee 1970 to present	Manager of Operations	Various	218/225-4217
Bruce Gerlach	CCI employee	Facility Manager	7/25/02	218/225-4261
Dave Youngman	EMC, LTVSMC employee 1968 to 2001	Lands Supervisor	Various	218/225-4223

EMC and LTVSMC performed areal surveys of various portions of the facility routinely. The following photographs were reviewed:

1. Chronoflex photos of the plant and tailings basin areas for the years 1979 through 2000 (scale of the photos are 1" = 1500' to 1' = 200'.
2. Photomosaics for the Hoyt Lakes and Taconite Harbor areas for the years 1948 and 1955.
3. Regular air photos for the years 1980 though 1996.

The air photos were reviewed to determine if AOCs exist that were not identified through other data sources. The air photos were not necessarily used to document changing conditions of the AOCs already identified. It is anticipated that air photos will be an important resource in preparation of Sampling and Analysis Plans (SAPs).

Figure 2 presents the locations of each area within the Hoyt Lakes facility and Figures 3 through 12 provide details of each area along with locations of AOCs.

AREA 1

Area 1 is located at the northwest portion of the mine areas contains one of the largest open pits of the facility. The open pit was actively dewatered until 1987. The pit is currently overflowing through road grade at the southeast side of the area.

The Area 1 Shops (AOC-1, Figure 3) were visited during the reconnaissance. Figure 6 presents detail drawing of the Area 1 Shops. This area provided the mining service support mentioned earlier in this report. Domestic waste water is connected to a septic tank and drain field system. Floor drains and other industrial waste water was contained and reused with residuals from oil water separators disposed of through outside services. A closed leak site exists for the fueling portions of the shops.

The Area1 W petroleum contaminated soil land application site (AOC-2, Figure 3) was visited and appears in good condition, no odors or staining were apparent. An area near the western extent of Area 1 where municipal waste water treatment plant sludge from Aurora and Hoyt Lakes was land applied (AOC-3, Figure 3) has no discernable impacts. The land application site has heavy brush and is located on a north facing slope. Sludge application was discontinued during 1988.

The 1004 Material and Equipment Storage Area (AOC-4, Figure 3) is a lay-down area containing cable equipment, salvaged equipment and other materials. The area is on top of a waste rock stockpile. Several areas with soil staining were observed. The heaviest soil staining was observed in a portion of the area was used for salvaging equipment. A deep ravine borders the west edge of the 1004 area and contains large amounts of demolition debris, scrap metal and several barrels.

Several hundred feet east of the 1004 storage area is a demolition debris disposal area containing asphalt and rubber roofing material removed from various plant buildings (AOC-5, Figure 3). The roofing material was compacted with a loader or dozer during placement and buried with waste rock boulders. The material was observed commingled with the waste rock.

Interviews identified two areas that are not a portion of the Private Landfill, but are very close to the footprint. The first is an area were oily waste from floor drains in the General Shops area was dumped at the land surface (AOC-6, Figure 3). This disposal was discontinued in 1980 when Berg Oil (currently OSI Environmental, Inc.) was contracted to accept the waste. The second area near the landfill reportedly received a one time disposal of heavy lubricant (bull gear grease) in the 1970s (AOC-7, Figure 3). No visible signs of the disposal were evident during the site inspection or on air photos reviewed.

The Private Landfill (AOC-8, Figure 3) was a permitted (SW-17) industrial waste landfill that operated until 1993. The landfill has gone through routine hydrogeologic investigation as required by Minnesota Solid Waste Rules. Five monitoring wells installed around the perimeter of the landfill are currently monitored once per year with routine quarterly inspections of the cover. Hydrogeologic evaluation documents as well as annual monitoring reports are available for the landfill. During the site reconnaissance, the cover and vegetation appeared to be in good condition.

The Panel Yard (AOC-9, Figure 3) is located near the northeast portion of Area 1 and originally was an area where railroad panels were constructed. Railroad panels are sections of rail and ties prefabricated to allow temporary rail lines to be constructed. Areas near the perimeter of the panel yard contain large volumes of railroad ties. The ties are typically buried with waste rock. Several of the disposal areas contain co-mingled waste including scrap metal, wood, and other demolition and industrial waste. The Panel Yard has also been used as a general laydown area with equipment in various stages of demolition. Areas of soil staining are evident.

The Airport (AOC-10, Figure 3) is an area immediately south of the Panel Yard. The name Airport was adopted because it is where abundant equipment and materials “landed” after they were no longer serviceable. Currently most of the materials and equipment have been salvaged. However, several pieces remain. Areas of soil staining are evident throughout the Airport.

Several hundred feet south of the Airport is a Coal Ash Disposal Area (AOC-11, Figure 3). The ash was generated from the old stoker coal fired Heating Plant. The disposal was discontinued in the 1980s when ash was used to cover the Private Landfill. The Heating Plant was converted to natural gas in 1994. The coal ash has only marginal cover.

An area containing large volumes of mill rejects (hard rock fragments) and scrap material generated from various rebuild and improvement projects is located at the extreme northeast boundary of Area 1 (AOC-12, Figure 3).

AREA 2, 2E AND 3

This area lies near the eastern extent of the Hoyt Lakes facility and contains significantly less infrastructure and areas of potential concern than Area 1. The Dunka Road and the Taconite Harbor Railroad Corridor exit the Hoyt Lakes facility through this area.

At the far northern boundary of this area is the 2001 Material and Equipment Storage Area (AOC-13, Figure 4). Various types of equipment and materials, including transformers, were observed in this area with several areas of soil staining.

Near the northwest boundary of Area 2, 2E and 3 is a facility for sandblasting and painting locomotives and railcars (AOC-14, Figure 4). The facility consists of an open sided roofed structure with rail line entering, a sand hopper, and several storage buildings and compressor building. A buildup of blasting sands is evident.

Near the western boundary of Area 2, 2E and 3 is a railroad siding that is a designated railroad equipment storage area (AOC-15, Figure 4). Several locomotives and various other small equipment were observed in this area. Soil staining appeared to be limited to the siding tracks.

The Area 2 Loading Pckets were observed. One pocket is a vibratory type (AOC-16, Figure 4) and one pocket is a Superpocket (AOC-18, Figure 4). Small amounts of hydraulic oil stained soil was observed near the Superpocket. A Truck Fueling Station, constructed with a roof and containment system, is also located in this area.

A building for storage of solid blasting materials is located near the east end of this area. However, materials were containerized and no evidence of a release was identified.

AREA 2W

Very little infrastructure exists in Area 2W and no AOCs were identified. Reporting, truck fueling and loading for Area 2W was done at Area 2. The mainline Rail Corridor forms the eastern and northern boundary.

The Missabe Location existed in Area 2W but is not considered an AOC since large volumes of overburden and rock have been mined from the former location.

AREA 2WX

This is the most recently developed mining area and contains both a vibratory Loading Pocket (AOC-22, Figure 6) and a Superpocket (AOC-23, Figure 6). Both were observed during the site reconnaissance. A small lube station exists near the Superpocket. A Truck Fueling Station is located immediately south of the loading pockets and is constructed with a roof and containment system (AOC-21, Figure 6). The Reporting Area (AOC-19, Figure 6) includes an area for materials and equipment storage where several patches of soil staining were observed. A well, septic tank and drain field system remain in place. Finally, a shovel was dismantled in an area west of the loading pockets (AOC-20, Figure 6) where soil staining was observed.

AREA 5

This area is the most northern of the mining areas at the Hoyt Lakes Facility and contains the headwaters of Wyman Creek. Most of the eastern half of the area has undergone mine land reclamation and is covered with vegetation. Truck fueling in Area 5 was accomplished with mobile ASTs.

The Reporting Area (AOC-24, Figure 7) includes a scrap and salvage area where some stained soil was observed. Most of the scrap has been removed. A well, septic tank and drain field system remain in place.

The Area 5 vibratory Loading Pocket was observed (AOC-25, Figure 7). No soil staining was apparent in this area. However, the rail line to the Loading Pocket contains a siding where rail cars and locomotives have been stored. Some stained soils was observed along the siding.

AREA 6, AREA 9N AND AREA 9S

These areas comprise the southwest portion of the mining areas and are discussed here collectively. Of most significance is the location of Pre-Tac (AOC-30, Figure 9) which was located on the western edge of Area 9N. The plant was demolished in the late 1950s and the only observable evidence of the plant today is some concrete slabs and foundations. Figure 19 shows a drawing of the plant, although features on the drawing are not labeled. The location is currently only accessible by ATV or foot.

The former Area 1W Reporting Area was actually located in the northern section of Area 9N. This area is also only accessible by a ATV or foot. No observable environmental conditions were noted at this site however, a septic system was associated with this Reporting Area.

The Area 9 Loading Pocket (AOC-31, Figure 10) is a vibratory type. The Area 6 and Area 9 Reporting Area has a septic tank and drain field system in place. The former Aurora City Dump (AOC-28, Figure 8) was located at the west boundary of Area 9S. The majority of the dump was reported as removed during mining of Area 9S to Stockpile #9021(AOC-29, Figure 8). However some scrap wood, cans and litter are observable today.

A misfired blast (AOC – 27, Figure 8) occurred in Area 6 on March 8, 1999. Approximately 95, of 220 blast holes were undetonated. The blasting material consists primarily of 25% ammonium nitrate and 75% mineral oil.

The Evergreen Trailer Park was located within this area. The trailer park contained mobile homes and presumably had wells and septic systems. The only evidence of the trailer park today are remnants of roads and non-indigenous shrubbery.

PLANT AND PROCESSING AREA

The Tailings Basin portion of the plant and processing area is a large dike constructed of tailings with road access along the top of the lifts. Tailings were discharged as a slurry with process water. The design of the dikes allows the tailings to settle and the process water to be recycled back to the plant. The Colby Lake Pumping Station provided process water to offset any losses due to seepage, evaporation and water loss up the furnace stacks. Several pumping stations are located in the Tailings Basin and several transformers exist (AOC-48, Figure 12). CE records indicate that these transformers currently contain non-PCB mineral oil. An area within Cell 2W contains buried hornfels (AOC-53, Figure 12). Hornfels is a waste rock type containing sulfide minerals. Monitoring wells are installed surrounding the hornfels burial site and are monitored as part of the NPDES permit. The Tailings Basin Reporting Area (AOC-47, Figure 12) is located at the road access point. This Reporting Area contains a lube station. In addition, two USTs were removed in 1988 and a septic tank and drain field system remain in place.

Several other notable features surround the tailings basin dikes. An area immediately west of the Tailings Basin Reporting Area contains several small equipment and materials storage locations (AOC-51, Figure 12). Most of the salvageable materials are gone. However several soil stained areas were observed. The Cell 2W salvage area (AOC-52, Figure 12) is located along the western edge of the Tailings Basin. Salvage operations are evident with several small soil stained areas as well the remains of a mobile AST containing Choherex, a petroleum based dust suppressant.

The eastern margins of the Tailings Basin contain an area where WTP sludge from the Dunka Water Treatment Plant was staged (AOC-35, Figure 12). The sludge has been shipped offsite and little evidence of it’s existence were observed.

The Coal Ash Landfill (AOC-34, Figure 11) is located south of the sludge staging area. The coal ash was generated at the Taconite Harbor power plant and shipped back to Hoyt Lakes on rail cars. The landfill cover appears in good condition. Inspection of the cover is conducted as part of NPDES requirements.

The Line 9, Area 5 permitted petroleum land application site (AOC-36, Figure 12) is located adjacent east of the Tailings Basin. This land application site contains approximately 25,000 cubic yards of soil from the Area 1 Shops Tank Farm cleanup and the Knox Fueling Station cleanup. The site appears in good condition. Monitoring data is available.

The Area 2 Shops (AOC-38, Figure 12) were visited, this area was the primary shop for the eastern mining areas and currently contains a Locomotive Fueling Station for the in-mine locomotives. A septic tank and drain field remain in place.

The Knox Fueling Station (AOC-39, Figure 12) contains one AST. Containment structures are provided below the dispenser lines.

The Heavy Duty Garage (AOC-40, Figure 12) is located on a hill adjacent to the plant site proper. The facility has been used only for cold storage since approximately 1960. However, it was previously used for equipment maintenance and one UST has been removed near the facility.

The Oxygen Plant (AOC-41, Figure 12) produced oxygen through a series of ambient air compressions. The oxygen was used in drilling. With the introduction of more modern drilling methods the oxygen use was phased out. Several USTs have been removed from the Oxygen Plant.

The Bunker C Tank Farm (AOC-42, Figure 12) is currently being investigated under the LUST program (Leak #12254). The finished pellet storage and loadout area (AOC-45, Figure 12) is a large flat surface with little notable features. However, the rail line that access the loadout facility contains appreciable soil staining and heavy oil residue in an adjacent ditch.

The Administration Building (AOC-43, Figure 12) did not have any notable features. However, one heating oil UST was abandoned in place. Domestic waste was pumped to the plantsite WWTP. The Administration Building is still active. Therefore, a new well and septic system were installed in 2001. Several hundred feet from the Administration Building is the Main Gate Fueling Station (AOC-44, Figure 12). The station consists of two ASTs used for fueling light trucks.

The plant site proper (AOC-46, Figure 12) is considered the core of the plant and processing area where the taconite process was conducted. Figure 15 provides detail of the infrastructure of the plant itself.

The Colby Lake Pump Station (AOC-59) is located distant from the plant area but provides process and drinking water to the plant and therefore is considered part of the plant infrastructure. The pumps and associated equipment are located within a large block and metal sided building. One heating oil AST was removed in approximately 1970 when natural gas became available. The concrete pedestals for the AST remain. The pumps are electric and an associated transformer is located adjacent to the building.

AREA 8 (DUNKA MINE)

The Dunka Mine is remote from the other mining areas and the plant. A rail line provided shipping of ore back to the plant site. Since the mine was remote from the rest of the facility, a shops area (AOC-32, Figure 11) was constructed as previously mentioned. The shops were demolished in 1998 and the area has been covered and seeded. A closed leaksite exists in association with the Dunka Shops.

The North and South Loading Pockets (AOC-33 and AOC-34, Figure 11) existed at Dunka, each had a fueling system. The Reporting Area had well and septic systems which were abandoned.

The geology of the Dunka mine is different from the remaining mining areas in that the taconite is in close proximity to the Duluth Complex. This association produced a zone of sulfide rich rocks. Some of the sulfide mineral containing rocks have been removed and placed in stockpiles. Groundwater seeps that discharge from the stockpiles have elevated concentrations of several meals and low pH. A full scale metals water treatment system has been constructed. In addition, Constructed Wetland Treatment Systems have been built at each of the identified seeps. Since this condition is regulated through the NPDES permit, no addition scrutiny of the seeps is recommended as part of this Phase I. The Water Treatment Plant is powered by electricity. No fuel tanks were identified associated with the plant building.

TACONITE HARBOR

REGIONAL GEOLOGY AND HYDROGEOLOGY

A very thin layer of glacial drift may overlie volcanic bedrock, although bedrock is exposed at the ground surface throughout much of the Taconite Harbor Area. The drift is a red-brown, clay to silty clay. The volcanic bedrock is part of the Northshore Volcanic Group; a thick sequence of southeast dipping lava flows. The local members of the lava flows are named the Schroeder Basalt.

Taconite harbor lies within the Lake Superior Water shed where surface water flow is southeast toward Lake Superior. The thin drift may support a local groundwater flow system over the bedrock. If local flow occurs, discharge is typically at creeks, seeps or leakage to the bedrock flow system. Groundwater flow within bedrock occurs in fractured basalt or within inter-flow sediments. The fracture flow systems tend to be somewhat isolated from one another, often with dead-end flow (no discharge). Where, fracture zones are hydraulically connected, intermediate groundwater flows is southeast, toward Lake Superior.

ENVIRONMENTAL RECORDS REVIEW

An Area Study Report was received from EDR and is attached in Appendix D. There were seven sites listed in the report that had sufficient information to locate on a map of the search area.

1. The Taconite Harbor Power Plant was listed under the Emergency Response Notification System (ERNS) records. This site is not within the boundaries of this Phase I and is currently owned by MP.
2. The Taconite Harbor Power plant was listed under the state LUST database. This site is not within the boundaries of this Phase I and is currently owned by MP.
3. Three listings were found under the MN Spills database that contain sufficient information to attribute the spill to the power plant.
4. Two listings were found under the MN Spills database that did not have sufficient information to determine where the spill occurred.

The Orphan summary in the EDR report lists all sites that may be within the area search boundaries based upon common location descriptions, but cannot be adequately located. Review of the Orphan Summary did not find any sites attributable to the CE facility.

INTERVIEWS, ON-SITE RECONNAISSANCE AND ARIAL PHOTO REVIEW

The Taconite Harbor Pellet Dock and a Marine Fueling Facility were inspected on July 25, 2002. The Marine Fueling Facility consists of two Large ASTs (AOC-54, Figure 13) and associated lines and pump house are currently being addressed under the LUST program (Leak #12252).

The “Oil Track” (AOC-55, Figure 13) is a siding off the main rail line where fuel oil was off loaded from rail cars to the ASTs. The Oil Track was not used for off loading oil after approximately 1970. However, some buildup of heavy lubricants and oil was observed along the track grade. In addition, one mobile AST, used for fueling light track vehicles existed adjacent to the grade and some demolition debris and waste soils piles were observed adjacent to the track grade.

RAILROAD CORRIDOR AND MURPHY CITY

REGIONAL GEOLOGY AND HYDROGEOLOGY

The Railroad Corridor transects a remote portion of Northeast Minnesota and three seperate watersheds. The Corridor begins at Hoyt Lakes which lies within the St. Louis River Watershed and enters the Rainy Lake Watershed in T.59N, R.11W. Finally the railroad enters the Lake Superior Watershed in about T.58N, R.9W. Murphy City lies within the Lake Superior Watershed.

Bedrock geology at the western end of the corridor is shown on Appendix G and consists of the Animikie Group which contacts the Duluth Gabbro several miles east of the Hoyt Lakes facility. This contact between the Duluth Gabbro Complex and the Animikie Group has been extensively explored for non-ferrrous metal reserves. The corridor is underlain by the gabbro as it extends eastward. The Northshore Volcanic sequence as previously described, underlies the eastern sections of the corridor.

Glacial drift varies in thickness accross the corridor ranging from several feet on the eastern end to more than 100 feet on the mid sections of the corridor. The deposits tend to be sandy to stony till ranging in color from brown on the western end to red-brown on the eastern end. Peat and sandy glacial outwash is common on the western portions of the railroad

ENVIRONMENTAL RECORDS REVIEW

A database search of standard environmental records was not obtained for the railroad corridor or Murphy City.

INTERVIEWS, ON-SITE RECONNAISSANCE AND ARIAL PHOTO REVIEW

The entire corridor from the Hoyt Lakes facility to Taconite Harbor was inspected on July 25, 2002. In general, the Railroad Corridor contained few notable environmental conditions. Occasional railroad ties are discarded along the corridor and switches contain small areas with lubricant build-up on the ballast. However, this material is limited to the area immediately surrounding the switches. Near the Taconite Harbor end of the corridor, large curves exists in the track with rail lubricators installed at each curve (AOC-58, Figure 12). Rail lubricators also exist along the rail corridor east of Murphy city in the general vicinity of mile marker 55. Some buildup of the grease on the ballast was observed at these locations. Several Battery Houses were observed with all batteries removed. These are small structures containing batteries that operate signals, detectors and electrical switches. The batteries are recharged with solar panels. No indications of a release were observed around the battery houses.

Murphy City (AOC-57, Figure 17) consists of four main buildings; a Repair Building, Storage Building, Lubricant Oil Storage and Reporting Building. The Repair Building was used for light service on track maintenance equipment, soil staining was evident along the tracks leading into the Repair Building. A well and septic system are associated with the Reporting Building. The Oil Storage Building has a wood floor and contains some surrounding stained soil. Two USTs were removed from the Murphy City facility in the 1990s and replaced with two ASTs. These tanks are listed in Table 2 and 5. A laydown area for various wood, scrap metal, rails and railroad ties is located adjacent to the rail siding entering the facility, In addition a small pile of general demolition waste is located in the laydown area. Figure 17 presents a detail drawing of Murphy City.

CONCLUSIONS

NTS has performed this Phase I Environmental Site Assessment of the CE Facility in general conformance with the scope and limitations of ASTM Practice E 1527-00 as well as VIC Guidance document # 8. Uniqueness' in the methodology are described in the Limitations and Methodology section of this report. This report uses the term Area of Concern (AOC) as a discrete area of the property where a known release, or a material threat of a release is identified by the level of inquiry provided by this document. The term is not intended to include de minimis conditions that generally do not present a material risk of harm to public health or the environment and that generally would not be the subject or an enforcement action if brought to the attention of appropriate governmental agencies.

NTS has identified 59 AOCs which are summarized in Table 6. NTS recommends that CE determine a prioritization of the AOCs and prepare a Quality Assurance Plan (QAP) which outlines the Phase II methods and decision process. Following VIC Staff approval of the QAP Sampling and Analysis Plans (SAPs) should be prepared to address the AOCs. Each SAP should contain sufficient detail on the process and waste stream associated with the AOC. This detail should be used to develop a sampling strategy in accordance with the MPCAs Draft Risk Base Site Characterization and Sampling Guidance.

REFERENCES

Meinike, D.G., Buchheit, R.L., Dahlberg, E.H., Morey, G. B., Warren, L.E., 1999, Geologic Map Mesabi Iron Range, Minnesota, Second Edition.

Morey G.B., 1993, Geology of the Mesabi Iron Range: Institute on Lake Superior Geology Procedings, 39 Annual Meeting, Eveleth, MN, 1993, v.39, part 2, p1-18.

Attachment B

QAPP Cliffs Erie 2003

QUALITY ASSURANCE PROJECT PLAN TITLE SIGNITURE PAGE

Prepared by: Northeast Technical Services, Inc.

Prepared for: Cliffs Erie L.L.C.

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Rick Crum, P.G., Northeast Technical Services, Inc. (NTS Project Manager/QA Officer)	Date
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Amy Miller, MPCA (MPCA - VIC Project Manager)	Date
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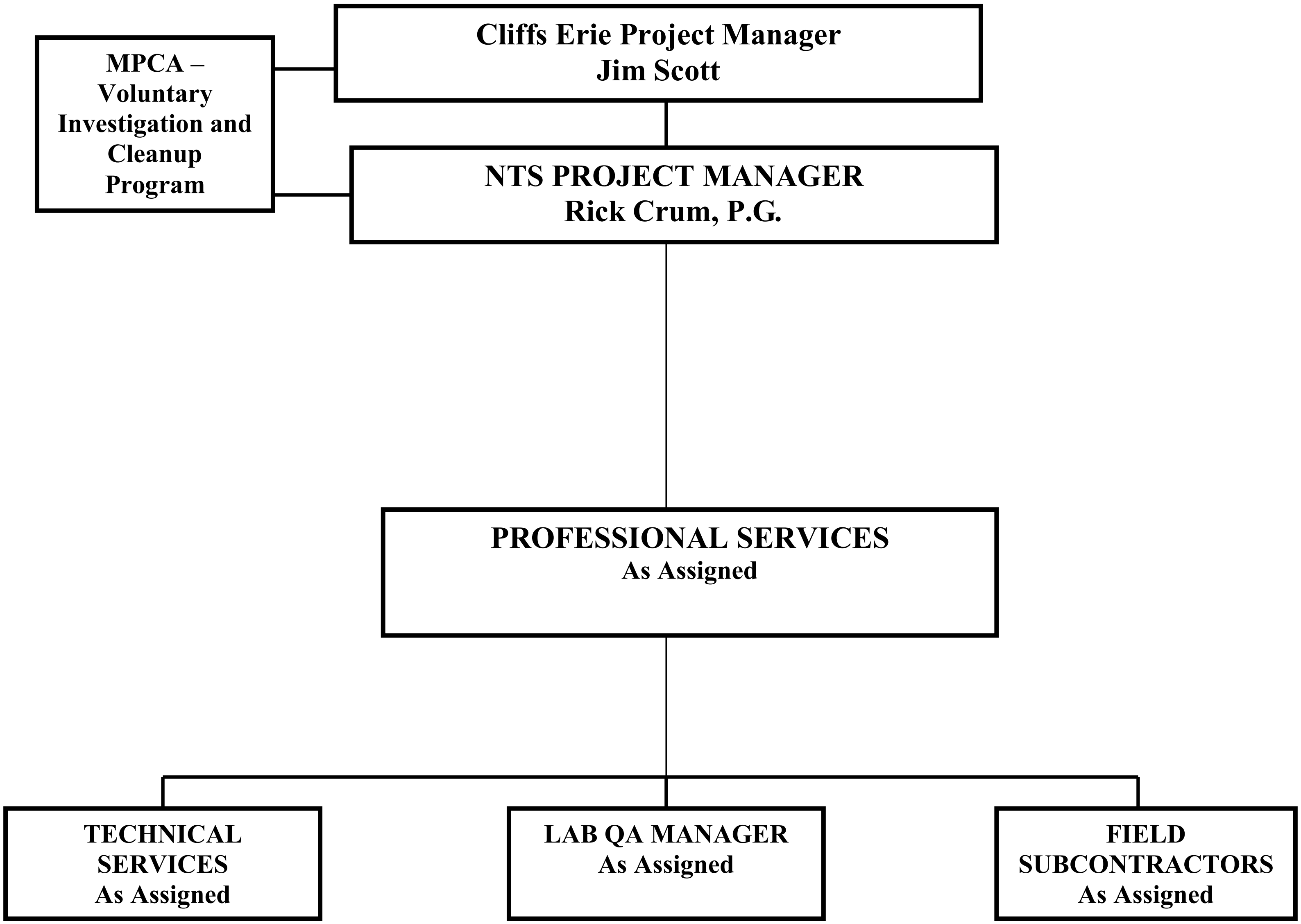
CLIFFS ERIE VIC ORGANIZATIONAL CHART



OVERVIEW

Cliffs Erie L.L.C. (CE) purchased the assets of LTV Steel Mining Company (LTVSMC), including LTVSMC's Hoyt Lakes Facility, Dunka Property, Taconite Harbor, and Railroad Corridors (the property) during 2001. CE has subsequently retained Northeast Technical Services, Inc. (NTS) as their consultant to assist in completing tasks that will allow CE to reuse, develop, or sell portions of the property. In order to obtain these objectives a process to "clear" the property was designed that would support closure of the property per the Mine Closure Plan (May 23, 2002) for the property and will allow CE to obtain legal or administrative assurances, issued by the Commissioner of the Minnesota Pollution Control Agency (MPCA), to limit environmental liability that may be associated with the property. The assurances may apply to CE and/or specific legally described lands.

The process to clear the property was initiated by performing a Phase I Environmental Site Assessment (<u>Phase I Environmental Site Assessment (ESA), Cliffs Erie Properties Including; The Hoyt Lakes Facility, Dunka Property, Taconite Harbor, and Railroad Corridors</u> (NTS, September 2002). The property consists of approximately 58,000 acres, including lands used by LTVSMC for mining activities or that were used to support mining activities. The Phase I ESA was performed per American Society for Testing and Materials (ASTM) Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process (E 1527-00). However, the size of the property, volume of information within LTVSMC records and the standard environmental records database search was not reasonably ascertainable and/or practicably reviewable. Specific tasks and decision making had to be defined in order for the process to clear the property to continue and ensure that due diligence per ASTM 1527-00 was performed. The purpose of this Quality Assurance Project Plan (QAPP) is to define the tasks and decision making process, as well as data quality objectives that will allow the process of clearing the property to continue.

The Phase I ESA for the property (September 2002) identified fifty-nine separate Areas of Concern (AOCs) on the property. The AOCs have been grouped into Sites. The Phase I ESA was submitted by CE to the MPCA along with an application for CE's inclusion in the MPCA's Voluntary Investigation and Cleanup (VIC) Program. Sites have been prioritized by CE and MPCA for further investigation (Phase II ESA Investigations) and eventual closure. Phase II ESA Investigations will be performed in accordance with the MPCA's Risk Based Site Evaluation (RBSE) process (MPCA Draft Guidelines-Risk Based Site Characterization and Sampling Guidance). Sampling and Analysis Plans (SAPs) will be prepared and submitted for MPCA approval for each Site and/or AOC based upon this QAPP and MPCA RBSE guidance.

Closure of a Site and/or AOC will be obtained upon justification of No Further Action with or without exceptions (e.g. groundwater not investigated) or successful implementation of a Response Action for cleanup. Response Action Plans will be based on the results of Phase II Investigations and planned property use.

As agreed upon by MPCA VIC staff and CE, this QAPP in conjunction with the SAPs for each Site will represent the workplan. The objectives of the workplan follow:

QAPP

- Defines the decision process.
- Specifies the Data Quality Objectives (DQO).
- Defines the data verification and usability process.
- Outlines potential sampling strategies

SAP

- Identifies Recognized Environmental Concerns (RECs) within each Site and/or AOC that have a reasonable probability to exist.

If a REC exists, the following additional objectives of the SAP are:

- Identifies Chemicals of Potential Concern (COPC) that have a reasonable probability to be present at each Site AOC.
- Determines the sample locations and quantities to be taken and analyses to be performed that will show that a REC exists or COPCs are present at each Site AOC.
- Defines the sampling protocol to be used.

TABLE OF CONTENTS

I. INTRODUCTION

A. PROBLEM DEFINITION/BACKGROUND

Cliffs Erie L.L.C. (CE) purchased the assets of LTV Steel Mining Company (LTVSMC), including LTVSMC's Hoyt Lakes Facility, Dunka Property, Taconite Harbor, and Railroad Corridors (the property) during 2001. CE has subsequently retained Northeast Technical Services, Inc. (NTS) as their consultant to assist in completing tasks that will allow CE to reuse, develop, or sell portions of the property. In order to obtain these objectives a process to "clear" the property was designed that would support closure of the property per the Mine Closure Plan (May 23, 2002) for the property and will allow CE to obtain legal or administrative assurances, issued by the Commissioner of the Minnesota Pollution Control Agency (MPCA), to limit environmental liability that may be associated with the property. The assurances may apply to CE and/or specific legally described lands.

CE acquired portions of the LTVSMC's facility directly related to mining and ore processing. Minnesota Rules 6130 require a Mine Closure Plan for the facility. The CE Closure Plan (May 23, 2002) provides a framework for work to be conducted as part of the closure process. In general, closure work falls into two categories:

1. Work that falls under regulatory oversight by the Minnesota Department of Natural Resources (MDNR) Including:
   - Plans for pit to watercourse discharges;
   - Mineland reclamation; and,
   - Plans for tailings basin drainage.

2. Work that falls under regulatory oversight of the MPCA including:
   - Investigation and potential cleanup of contaminants in soil or groundwater related to the mining operations; and,
   - Protection of overall water quality.

The purpose of this QAPP is to define the process to clear property with respect to potential environmental liability and that will address work that may fall under the regulatory oversight of the MPCA. CE retains the responsibility for closure of the mine and entered the MPCA Voluntary Investigation and Cleanup (VIC) Program on April 4, 2002. Conducting closure work as a volunteer in the VIC Program will result in legal or administrative assurances, issued by the Commissioner of the MPCA, that apply either to CE as an entity, or to specific legally described lands. These assurances are intended to streamline re-use or redevelopment of the idled facility. In essence, the facility is viewed as brownfield that must undergo routine Phase I assessment, Phase II investigation, and risk based decision making that incorporates planned land use regarding identified releases that arise from the Phase I and Phase II process. The process was initiated by performing a Phase I Environmental Site Assessment (Phase I Environmental Site Assessment (ESA), Cliffs Erie Properties Including; The Hoyt Lakes Facility, Dunka Property, Taconite Harbor, and Railroad Corridors (NTS, September 2002).

The property consists of approximately 58,000 acres, including lands used by LTVSMC for mining activities or that were used to support mining activities. The Phase I Environmental Site Assessment (ESA) was performed per American Society for Testing and Materials (ASTM) Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process (E 1527-00). However, the size of the property, volume of information within LTVSMC records and the standard environmental records database search was not reasonably ascertainable and/or practicably reviewable. The Phase I ESA for the property identified fifty-nine separate Areas of Concern (AOCs) on the property. The AOCs have been grouped into Sites where potential or identified recognized environmental concerns (RECs) exist.

Specific tasks and decision making had to be defined in order for the process to clear the property (i.e., clear the identified AOCs and/or Sites) to continue and ensure that due diligence per ASTM 1527-00 was performed. The purpose of this QAPP is to define the tasks and decision making process, as well as data quality objectives that will allow the process of clearing the property to continue.

II. PROJECT MANAGEMENT AND ORGANIZATION

A. PROJECT ORGANIZATION

Communication, management activities, and technical direction with the CE VIC project team will follow organization and arrangement protocol. Any directions or communications from the MPCA will flow from the MPCA Project Manager to the NTS Project Manager, who will keep the CE Project Manager apprised of developments. All written correspondence will be distributed according to the project distribution list. Overall organization and personnel for the project are depicted on the Organizational Chart following the Signature Page of this QAPP.

The NTS Project Manager will provide overall direction for project implementation utilizing professional and technical resources. These resources may be drawn from various sources as cost and availability dictate.

The specific responsibilities of the project team are described below.

1. CE Project Manager

1. Review and approve technical work and associated documents including the QAPP and SAPs.
2. See that work performed is consistent with the ultimate objectives of CE.
3. Approve and authorize project budgets prepared by the NTS Project Manager.
4. Approve subcontractors.

2. NTS Project Manager

1. Manage project scope, schedule, and cost.
2. Direct approval and review of QAPP and SAPs.
3. Provide technical consultation services to the CE Project Manager, and to project professional and technical staff.
4. Prepare progress reports detailing work accomplished.
5. Implement SAPs, provide direct supervision of assigned resources to meet schedule.
6. Review all project deliverables, project strategies, and decision making.
7. Review Data Review Checklist (Appendix L) and comparability assessment to determine usability of data (See Section V.A.).

3. Professional Services

1. Develop QAPP and SAPs under the direction of the NTS Project Manager.
2. Provide project schedule updates to the NTS Project Manager.
3. Prepare the Project Health and Safety Plan (HASP).
4. Review the HASP with appropriate field personnel and subcontractors.
5. Oversee site investigative activities.
6. Review field and laboratory data to assess the status and adequacy of the SAPs.
7. Develop and review Response Action Plans (RAP).
8. Prepare Phase II site investigation reports.
9. Complete Laboratory Data Checklist (Appendix L) and perform data comparability assessment per Section V.A. on individual data sets.

4. Lab QA Manager

1. Maintain records of laboratory QA/QC procedures as outlined in the laboratory's QA/QC Manual and Standard Operating Procedures.
2. Perform laboratory data verification per Section V.A.

5. Technical Services

1. Read and be familiar with the HASP.
2. Provide status updates to the NTS Project Manager.
3. Conduct sampling events in accordance with the Standard Operating Procedures (SOP) contained within Appendix F. Before sampling, discuss with NTS Project Manager and Project Hydrogeologist the sampling purposes, sampling methodology, number of samples, sample preservation methods, chain-of-custody requirements, analyses required, use of field forms, equipment decontamination procedures, and which samples will be duplicated in the field.
4. Be responsible for collection of equipment needed for site work, and inspect all field equipment prior to site use to verify that equipment is in proper working condition, has been decontaminated, batteries (if needed) have been properly charged, and properly calibrated.
5. Perform soil borings, push-probes, monitoring well installations, and test pitting.

Proposed NTS personnel and associated resumes are provided as Appendix C.

The project will be conducted within the MPCA-VIC program. Therefore, this QAPP and subsequent documentation produced will be supplied to VIC Staff for approval purposes.

All site personnel shall have completed applicable training as required by state and/or federal regulations. Also, all NTS professional staff shall be degreed environmental professionals with working knowledge of this QAPP and the HASP.

Any subcontractors used for the purpose of obtaining environmental media samples shall have completed OSHA training, in accordance with applicable regulations. Additionally, subcontractors will be required to comply with all site safety requirements addressed in the site-specific HASP, provided under a separate cover to this QAPP.

B. PROJECT DESCRIPTION AND SCHEDULE

Investigation of environmental conditions on the facility is contained in four steps. The steps along with resulting documentation and appropriate guidance or standards are summarized in the table below.

STEPS	RESULTING DOCUMENTS	APPROPRIATE GUIDANCE OR STANDARDS
PHASE I ESA	Phase I ESA Report (September 2002)	ASTM E 1527-00
ADDITIONAL PHASE I ESA	Multiple Phase I ESA	ASTM E 1527-00 and ASTM 1528-00
PHASE II ESA	One Project inclusive HASP	NIOSH/OSHA /EPA – Occupational Safety and Health Guidance for Hazardous Waste Site Activities. NIOSH Publ. # 85-115.
	One Project inclusive QAPP	EPA Requirements for Quality Assurance Project Plans (EPA QA/R-5).
	Multiple Separate SAPs	MPCA Draft Guidelines-Risk Based Site Characterization and Sampling Guidance.
	Multiple Separate Phase II Investigation Reports	MPCA VIC Guidance Document #12 MPCA VIC Risk-Based Site Evaluation Manual
RESPONSE ACTION PLAN	Multiple Separate Response Action Plan (RAP) Reports as required	MPCA VIC Risk Based Evaluation Manual
ASSURANCE	Multiple Separate Letters of Assurance	MPCA VIC Guidance Document #4

<u>Additional Phase I ESA</u>
A Phase I ESA for the project has been completed. However, it is anticipated that potential REC and/or potential AOC may be identified in the future that are not listed in the Phase I ESA completed during September 2002. The potential REC will be identified as an AOC on the current list included in the September 2002 Phase I ESA (reference Appendix B) and a Phase I assessment will be completed in accordance with the established decision process.

As indicated above, the standard environmental database search was not practicably reviewable and/or reasonably ascertainable per ASTM E 1527-00. Standard environmental database search results are provided for a given zip code. However, the location is typically given as a post office box number for the LTVSMC administrative offices and the records do not specifically identify locations. Given the size of the property (approximately 58,000 acres) a zip code location alone causes environmental database search results to not be practicably reviewable. Therefore, additional standard environmental database searches will not be performed for the property as part any additional AOC and/or Site work, and will not be performed during future Phase I ESA that may be conducted as part of the process outlined in this QAPP.

Phase II ESA Investigations

Phase II ESA Investigations may comprise the actual collection and analysis of various media and may consist of one or more of the following tasks:

1. Collection and analysis of soil samples.
2. Collection and analysis of sediment samples.
3. Collection and analysis of groundwater samples.
4. Collection and analysis of surface water samples.
5. Installation of temporary and/or permanent groundwater monitoring wells.
6. Performance of aquifer tests and evaluation of aquifer characteristics.
7. If required, risk based site evaluation.
8. If required, an evaluation of cleanup technologies and associated costs.
9. Assessment and usability of resulting data.

Health and Safety Plan (HASP) provides specific health and safety requirements for personnel involved in data collection on the property. This QAPP defines objectives of the project and documents procedures and practices that will allow quality assurance required by EPA QA/R-5. The SAPs are intended to be companion documents to this QAPP and provide details on the quantity, locations and intent, of any required sampling at each Site. The Phase II Reports present the results of the Phase II Investigation for a Site, including risk evaluation. Finally, the RAP is a plan for reducing or eliminating the risk at a Site, if the risk evaluation fails.

The inclusive results of all steps listed above are intended to provide CE and the MPCA with data of sufficient quality and quantity to:

1. determine if further action is required; and,
2. determine appropriate reuse of the project Sites.

C. PROBLEM STATEMENT

CE is in the process of mine closure of properties identified as idled mine land brownfields. An evaluation will characterize the environmental conditions present within each Site to the extent that it may be determined if the site may be reused for a specific purpose or identify the risk mitigation required to achieve an appropriate risk evaluation as documented within a RAP. A tiered evaluation of risk through direct exposure, soil leaching, groundwater, and surface water will be utilized.

Within this framework of evaluation, it is essential that the set of legal or administrative assurances provided by the MPCA also satisfy the CE Mine Closure Plan.

1. Decision Identification

CE and MPCA will use information resulting from an evaluation of each site or newly identified Site to make the following decisions:

1. Is a newly identified Site an AOC?
2. Will the Site require a cleanup or can an appropriate assurance be issued in accordance with Phase II information and RBSE criteria?
3. If cleanup is required and it is not cost effective based on the intended use, can the Site be developed for another use under assurance while satisfying all other regulatory requirements regarding environmental conditions?

Phase I ESA(s) will be performed for potential AOC(s) that are not included in a Site listed in the September 2002 Phase I ESA, in order to determine if a new AOC should be included on the list. As indicated above, a standard environmental database search will not be performed for future Phase I ESA since the search results are not practicably reviewable and/or reasonably ascertainable.

2. Decision Inputs

In assessing the AOCs and/or Sites, the presence of a Recognized Environmental Conditions (REC) will be determined. If required to assess the level of soil, sediment, surface water, and/or groundwater contamination present at the site, samples of these media will be collected for analysis as described in the specific SAPs. These samples will be collected for the purpose of answering the following decision inputs as diagramed in Figure 1:

Examples of specific questions related to the decision inputs associated with each AOC are the following:

1. What has been the historical mine related land use at the AOC and to what extent did these uses occur?
2. Have past uses of the AOC impacted the soil, sediment, surface water, or groundwater?
3. Did past hazardous substance handling/housekeeping activities (if any) impact the AOC?

4. If any former Underground Storage Tanks (USTs) existed on the AOC, does contamination exist near the area of the identified tank(s) or tank system components?
5. Have former Aboveground Storage Tanks (ASTs) (if any) impacted the surrounding media at an AOC?
6. Have uncontrolled dumping / landfilling activities occurred at the AOC? If so, have those activities impacted the environmental media?
7. Considering the planned Site use, what is the level of potential exposure to potentially contaminated media that exists at the Site?

3. Investigation Boundaries

A plan showing physical boundaries of the AOC will accompany each SAP. Within each investigation area, data may be collected from the ground surface, or at depth in order to assess all exposure pathways.

CE currently owns or leases all the properties and right to access does not affect physical boundaries of on-site investigation. If characterization of site conditions requires off-site sampling, right to access will be obtained prior to sampling.

Seasonal constraints on the investigation are limited. Sampling may be conducted during most weather conditions other than surface soil sampling during the winter.

4. CE's Decision Process

Tier-1 SRVs and SLVs as defined in the MPCA September, 1998 Working Draft-Risk Based Site Evaluation Manual (RBSE) and. Similarly, the Minnesota Department of Health (MDH) Health Risk Limits (HRLs) for drinking water will be used for decision and response action criteria.

With data of adequate quantity and quality, an assurance will be requested from MPCA if no release is identified. If a release is identified an assurance will be requested from MPCA if:

1. Soil sample results collected as part of this investigation are all below the applicable SRVs and SLVs.
2. The hydrogeologic conceptual model has been defined to the extent that SLV criteria indicate minimal risk to the aquifer.
3. The aquifer is encountered, physical parameters adequately measured, and groundwater chemistry defined with contaminant concentrations less than HRLs.

Occasionally, the soils and groundwater of Northeastern Minnesota contain background concentrations of analytes that exceed Tier-1 SRVs, SLVs or MDH HRLs. Background soil concentrations contained in the Tier-2 SRV calculation spreadsheet within the MPCA Risk Based Site Evaluation Manual will be used to establish standard background soil concentrations. Similarly 'Baseline Water Quality of Minnesota's Principal Aquifers, MPCA, 1998" will be referenced for groundwater background concentrations.

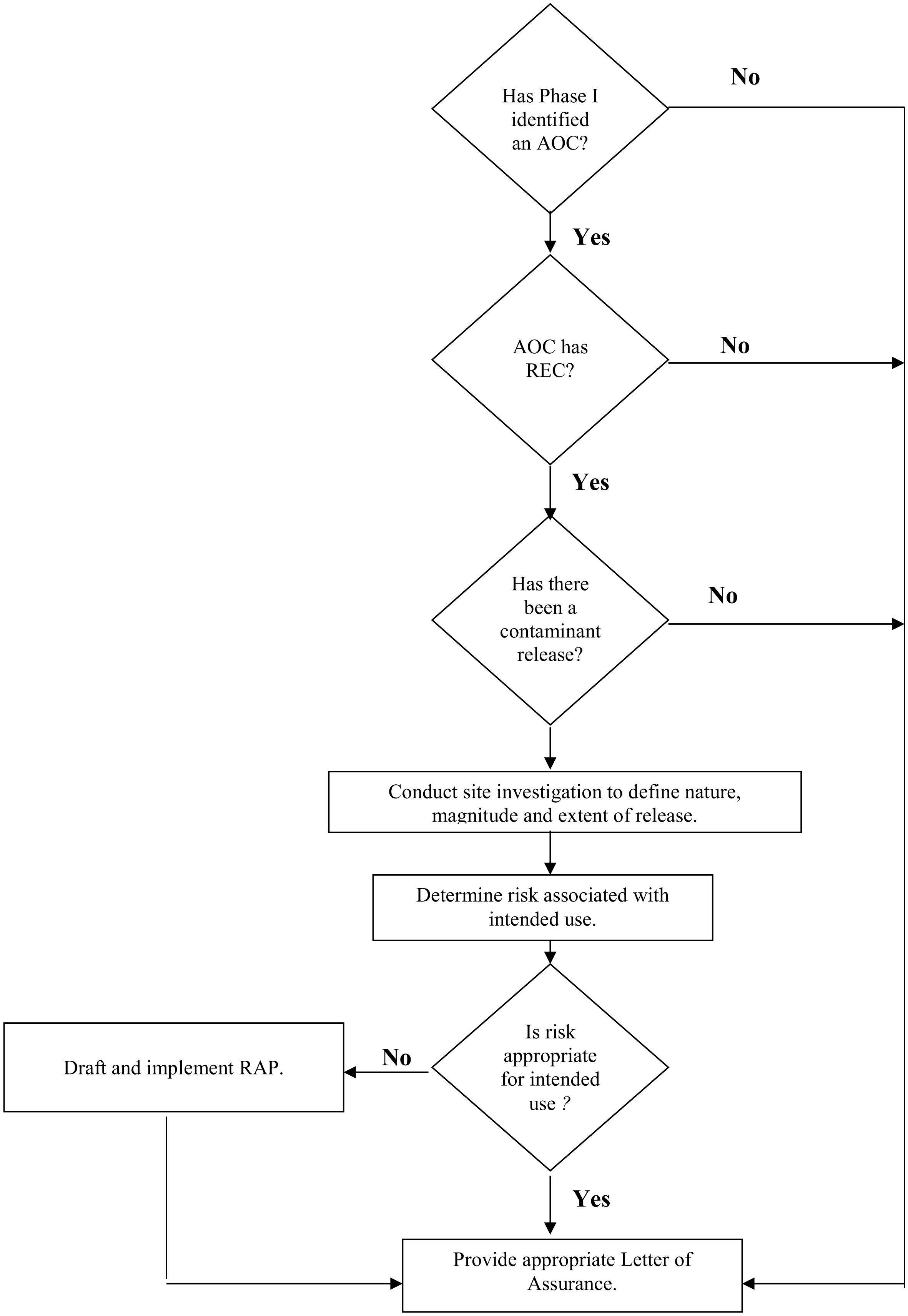


Figure 1 – AOC Decision Tree

If any of these criteria are not satisfied, CE will consider the following Response Action options:

1. If contaminant concentrations exceeding SRV/SLV/HRL are limited to less than 10% of the total number of soil and/or groundwater samples analyzed, then CE may resample specific locations indicating elevated contaminant levels. If resampling supports the original data, CE will proceed to the second option discussed below.
2. Can a cleanup strategy be developed to achieve contaminant concentrations less than the SRV/SLV/HRL for the proposed use of the site?

Can institutional controls or changes in planned site use achieve acceptable risk evaluation criteria?

D. DATA QUALITY OBJECTIVES

Data Quality Objectives (DQOs) are qualitative and quantitative statements that specify the quality of the data required to support the following;

1. Decisions made during the investigation and,
2. The ultimate conclusions produced from the data.

Different data uses require different levels of quality.

1. Data Acquisition Design

The purpose of the QAPP is to produce reliable data that will be generated throughout the investigation by:

1. Ensuring data validity and integrity;
2. Assuring and providing mechanisms for ongoing control of data quality;
3. Evaluating data quality in terms of precision, accuracy, reproducibility, and data recovery; and
4. Providing usable, quantitative data for analysis, interpretation, and decision making.

E. DOCUMENTATION REVISION CONTROL

The control of documentation revisions for documents generated during the course of the project is essential to the integrity of the document. Incorporation of agreed upon changes made during the document review and approval cycle are to be accomplished in an efficient manner in view of the voluminous nature of the documentation generated. Therefore, documentation changes will be noted in red within the margin of the affected page(s) of the original document, referring the reader to the project correspondence by date and subject. Any other copies of the document will be marked as "Copy" on the title page. The decision to release a revision of the document will remain with the responsible party. Documents generated by NTS will undergo Peer Review. All project correspondence held by NTS will be maintained per company policy.

III. MEASUREMENT DATA ACQUISITION

A. SAMPLING SRATEGY

SAPs developed for each project area will present rationale for proposed sampling and be in accordance with the MPCA 1998 Draft Guidelines – Risk Based Characterization and Sampling Guidance. Specifically the SAPs will address the following:

1. Media types that will be sampled.
2. Analytical parameters and associated methods for each media sample correlated to a COPC.
3. Quantities of samples.
4. Horizontal and vertical locations (UTM coordinates) for each proposed sample correlated to an AOC.
5. How CE's Decision Process is supported by the sampling and analysis plan.
6. Use of EPA SW-846, method 5035 for soil volatiles sampling.
7. Order of sample bottle filling to minimize volatiles loss.

In general, soil sampling is conducted to assess human and ecological risk associated with direct exposures to the soil and to assess the transport potential for soil contaminants to groundwater. Composite soil sampling will not be used unless an acceptable rationale is provided in the SAP. Locations of samples may be based on two strategies;

1. A *grid pattern* where the samples are collected at shallow depth. Grid sampling is used typically to assess the direct exposure pathway and field screening data is generally not used to make decisions regarding locations of other grid samples.
2. A *random pattern* where samples are collected at a specific point of potential release and radially out from the point of release. Random sampling is used to characterize, and determine extent and magnitude of the release. Therefore, samples are typically collected at various depths of the subsurface. Field screening data is very important for determining location for additional samples. The random pattern may be used to assess either direct exposure or transport to groundwater risks. However, follow up grid sampling may be required to adequately address direct exposure.

Groundwater sampling is divided into preliminary sampling and extensive groundwater monitoring.

1. *Preliminary sampling* is conducted to determine if a potential release has impacted groundwater, to determine the nature and extent of the impact, and for general characterization of the aquifer. Samples may be obtained from temporary (e.g., Geoprobe) well points or permanent monitoring wells. Generally, preliminary sampling is used to determine if extensive monitoring is required. In addition, if a legal or administrative assurance, inclusive of groundwater, is sought from the VIC program, preliminary sampling is required.
2. *Extensive monitoring* is conducted if preliminary sampling indicates groundwater contamination exists. The extensive monitoring consists of rigid characterization of aquifer parameters, extent of the groundwater plume, and monitoring of plume transport controls. The groundwater exposure pathway is evaluated using extensive monitoring data. In addition, remedy selections for groundwater conditions are determined through extensive monitoring data.

QA/QC samples will be submitted in accordance with the QAPP protocols presented in the following sections. Requirements for QA/QC samples are identified on Table 1, Appendix D.

B. ANALYTICAL METHODS REQUIREMENTS

CE will utilize the analytical services of the NTSL and their approved subcontracted laboratory(s) which will be specified within the SAP Selected laboratories will be Minnesota Certified. Based upon RECs identified at other mine land brownfields, as well as preliminary information on the project areas, COPC may include volatiles, semi-volatiles, agrichemicals, and metals. In addition, analysis of some soil chemistry parameters may be required for fate and transport calculations. The analysis of the carcinogenic polynuclear aromatic hydrocarbons (cPAHs)[1] will be accomplished during initial characterization where the REC identifies a potential leak. This method will also be used during the RBSE phase of the investigation. Table 2 (Appendix C) contains analyte lists for various analysis methods, QA objectives for each method, and the laboratory that will perform the analysis. The SAPs will designate specific methods for each media sample based upon:

1. Method reporting limits less than or equal to Tier-1 SRV/SLV or HRL.

[1] Reference MPCA's Office Memorandum of October 29, 2002.

2. Inherent reliability of the method.
3. Cost.

The potential parameter groups, analysis method, and laboratory used include:

1. Volatile organic compounds (VOCs) tested by NTSL using methods MDH 465F and MDH 466 F or tested by subcontract laboratory by SW-846, 8260.
2. Semi-volatile organic compounds (SVOCs) tested by NTSL using methods SW-846 and SW-8270.
3. Pesticides and herbicides tested by subcontract laboratory using methods SW-846, 3545, 3550, 8081, and 8141A.
4. Organochlorine pesticides tested by subcontract laboratory using methods SW-846 and 8081.
5. Polynuclear aromatic hydrocarbons (PAHs) tested by subcontract laboratory using methods SW-846 and 8310 or by NTSL using the extended Selective Ion Detection Method for cPAH.
6. Polycyclic biphenols (PCBs) tested by subcontract laboratory using methods SW-846 and 8081.
7. Metals tested by NTSL using methods SW-846, 6010B, 7041, 7060A, 7091, 7131, 7196A, 7421, 7470A, 7471A, 7740, 7760A, and 7841.
8. Petroleum compounds tested by NTSL using WI DNR Modified Methods.
9. Other tested by NTSL using methods 9010, 9060, and 9045.

Sample preservation, holding times, and volume requirements as specified by SW-846, and outlined in Table 3, for samples collected as part of this project will be strictly adhered to by the laboratory. The soil, sediment, surface water, and groundwater samples will be analyzed for known and suspected contaminant parameters common to past activities and RECs associated with each subject site.

All environmental media samples will be collected and analyzed in accordance with this QAPP, SOPs, and the NTSL and subcontract laboratory QA/QC Plans, as discussed below.

Bottles/containers utilized for the collection of samples will be provided by Environmental Sampling Supply (ESS). ESS will supply a "Precleaned Certified Certificate of Compliance" with each box of sample containers. Each certificate has a clearly identified lot number. Lot numbers from the certificate will be written on labels on all of the sample containers. NTSL tests a random container of each size, from each lot of plastic sample containers, and a random container from each lot of 40-ml glass containers. The selected containers are rinsed with deionized water and the rinse water from the plastic containers is analyzed for metals, and the rinse water from the glass containers is analyzed for VOCs. A copy of an ESS "Precleaned Certified Certificate of Compliance" is appended as Appendix E.

NTSL will prepare the sample bottles for use in the field. Preparation of sample bottles includes:

1. Affixing labels to each sample container.
2. Writing the appropriate lot number on each label.
3. Weighing and recording bottle weights.
4. Adding the appropriate preservative (if necessary).
5. Preparation of a Trip Blank, if VOC analyses are performed

Sample collection activities will conform to NTS standard operating procedures (SOPs) which are included in Appendix E.

C. QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT

Three data types are available to investigators.

1. Field screening data.
2. Mobile laboratory data (VOC/petroleum compounds).
3. Court defensible laboratory data.

Decision making uses of the data are different. Field screening provides a lower quality of data. However, field screening methods provide the most rapid results and are often used for health and safety monitoring and initial characterization to provide rationale for subsequent sampling locations. Quality assurance for field screening is addressed primarily through the use of SOPs, QA objectives specified in Table 4, and preventive maintenance specified in Table 5.

Mobile laboratory data is higher quality than field screening and still provides very rapid data delivery to the investigator. Mobile laboratory data is used for health and safety monitoring, initial characterization to provide rationale for subsequent sampling locations and preliminary comparison to SRVs or SLVs. Confirmation samples are collected of a specified number of samples and are submitted to a fixed based laboratory. The mobile laboratory is only used to analyze VOC and petroleum compound samples. QA objectives for mobile laboratory data is specified in the NTS Mobile Laboratory Quality Control Manual contained in Appendix G.

Laboratory data is used for decision making steps discussed under "The CE's Decision Process". Quality assurance objectives for laboratory data is dependent upon how the sample is obtained (Field Quality Objectives) and how the sample is analyzed (Laboratory Quality Objectives). The Quality assurance objectives are shown on Table 3 in Appendix D. The overall QA objective for each project is to develop and implement procedures for field sampling, chain-of-custody, laboratory analysis, and reporting that will provide legally defensible results. Specific procedures for sampling, chain-of-custody and sample transport are described in NTS SOPs. Specific procedures for laboratory instrument operation and reporting of data are described in the NTS Laboratory Quality Assurance/Quality Control Plan.

Data quality objectives for measurements during this project will be addressed in terms of precision, accuracy, representativeness, completeness, and comparability (PARCC parameters). The numerical PARCC parameters will be determined from the project DQOs to insure that they are met. The DQOs and resulting PARCC parameters will require that the sampling be performed using standard methods, with properly operated and calibrated equipment, and conducted by trained personnel.

1. Precision

Precision is the determination of the reproducibility of measurement under a given set of conditions of a quantitative measure of the variability of a group of measurements compared to their average value. Precision is either reported, depending on the end use of the data, as relative difference (RPD) or standard deviation. The following describes field and laboratory precision objectives.

a. Field Precision Objectives

Field precision will be assessed through the collection and analysis of duplicate samples. Water matrix samples can be readily duplicated due to their homogeneous nature; however, the duplication of soil or sediment (solid) sample is much more difficult due to the non-homogeneous nature of soils/sediments. Accordingly, field duplicates will only be collected for aqueous matrices. A summary of the duplicate samples to be collected is presented in Table 1 along with the other quality control samples. One duplicate sample will be collected per 20 analytical samples for water matrices.

b. Laboratory Precision Objectives

The precision of laboratory analyses will be based upon laboratory matrix spike/matrix spike duplicate (MS/MSD) analyses as discussed in the NTSL and subcontract laboratory QA/QC Plans in Appendix H. Precision is reported as Relative Percent Difference (RPD). MS/MSD analyses will be at a rate of 1 per 20 samples received by the laboratory.

2. Accuracy

The definition of accuracy is the degree between a measurement or observed value and an accepted reference or true value. The field and laboratory accuracy objectives are identified below.

a. Field Accuracy Objectives

Sampling accuracy will be assessed by evaluating the results of field and trip blank samples for contamination. A trip blank will consist of a laboratory-prepared sample of reagent grade water. Trip blanks will accompany sample containers and be subjected to the same procedures as the investigative samples. Trip blanks are only required when volatile organic compounds are a COPC. Trip blanks will be submitted for analysis at the rate of one trip blank per shipping container containing investigative samples for VOC analyses.

Field blanks (equipment blanks) will be collected by pouring laboratory-prepared water or distilled water over or through the sampling equipment and collecting the rinseate in the proper analytical containers. Field blanks are required at the rate of one per 20 investigative samples for all matrices, except groundwater. Field blanks for groundwater are required at the rate of one per 20 investigative samples with a minimum of one per scheduled groundwater sampling event. A scheduled groundwater sampling event is a routine sampling of all monitoring wells within the monitoring system.

b. Laboratory Accuracy Objectives

The analysis of MS/MSD samples can be utilized to determine laboratory accuracy. This analysis is discussed in the NTSL and subcontract laboratory QA/QC Plans. Additionally, the analysis of reference standard samples, laboratory control samples, surrogate compounds, and percent recoveries are also utilized for laboratory accuracy determinations. Accuracy goals for parameters to be analyzed will be in accordance with the provisions of the U.S. EPA methods.

3. Completeness

The measure of the quantity of valid data obtained from a measurement system compared to the quantity that was expected, under normal conditions, is the definition of completeness. Although a completeness goal of 100% is desirable, an overall completeness goal of 90% may be realistically achieved under normal field sampling and laboratory analysis conditions. Field and laboratory completeness are described below.

a. Field Completeness Objectives

The field sampling crew will take measures to have data generated in the field be valid data (complete): however, some samples may be lost or broken in transit. Field completeness goals for this project will have 90% of samples collected be valid data.

b. Laboratory Completeness Objectives

Laboratory completeness will be a measure of the quantity of valid data measurements and analyses obtained from all the measurements and analyses completed for the project (See NTSL and subcontract laboratory QA/QC Plans – Appendix H). The laboratory completeness objective is for 90% of the samples analyzed to be valid data.

4. Representativeness

Representativeness is a qualitative measure of the degree to which measured results accurately reflect the medium being sampled. It is addressed through the ability of the SAP design to characterize the media representative volume. Sample quantity, location and method for assuring that the sample collected is characteristic of "the whole".

Adherence to the prescribed analytical methods and procedures, including holding times, blanks, and duplicates, decreases uncertainties in representativeness. Homogenization of soils, following volatiles bottle preparation, increases representativeness. Stabilization of pH, conductivity and temperature and low flow sampling techniques increases representativeness for ground water samples.

5. Comparability

The confidence with which one data set can be compared to another is a measure of comparability. The ability to compare data sets is particularly critical when a set of data for a specific parameter is compared to historical data for determining trends. Field and laboratory comparability are described below.

a. Measures to Ensure Comparability of Field Data

The comparability of field data will be satisfied by ensuring that the Work Plan/SAP and associated QAPP are adhered to and that all samples are properly handled and analyzed. Also, an effort will be made to have sampling done in a consistent manner by the same samplers (when possible).

b. Measures to Ensure Comparability of Laboratory Data

Analytical data are comparable when the data are collected and preserved in the same manner followed by analysis with the same standard method and reporting limits. Data comparability is limited to data from the same environmental media. Analytical method quality specifications have been established to help ensure the data will produce results that are comparable.

D. DOCUMENTATION AND RECORDS

Records are a critical aspect of a successful project. Records that shall be a part of the project documentation for the investigation include field forms, field logbooks, laboratory data sheets, chain of custody forms, and technical papers. Copies of blank field forms used by NTS are presented in Appendix I.

The draft and final Investigation Report submittal packages will include, at a minimum, the following:

1. Text describing field sampling methodologies, analytical results, conclusions, and recommendations
2. Figures showing site location, known underground and above ground utility lines, site boundaries, sampling locations, and summaries of the extent of contamination.
3. Tables comparing laboratory data to applicable SRVS, SLVs and HRLs, or other goals where appropriate.
4. Complete laboratory data reports, including QA/QC analytical results and copies of all chain of custody records.
5. Soil boring, groundwater monitoring, sediment sampling, and/or surface water sampling logs.
6. Other relevant material required to support the site development scenario.

Copies of the draft and Final Investigation Report will be submitted to the CE Project Manager and to the MPCA VIC Program project manager.

E. SAMPLE HANDLING AND CUSTODY REQUIREMENTS

The admissibility of environmental data as evidence in a court of law is dependant upon custody of the data, among other factors. Custody procedures will therefore be used to document the relevance and authenticity of data collected during the investigation during the EMARP. The data requiring custody procedures includes both field samples, and data files that can include field books, logs, and laboratory reports. An item is considered in custody if it is:

- In a person's possession;
- In view of the person after being in possession;
- Sealed in a manner that it can not be tampered with after having been in physical possession; or
- In a secured area restricted to authorized personnel.

Various aspects of sample handling and shipment, as well as the proposed sample identification system and documentation, are discussed in the following subsections and in the NTSL and subcontract laboratory QA/QC Manuals in Appendix H.

1. Sample Identification System

Sample containers will be labeled prior to being filled. Each sample label shall, at a minimum, indicate the container distribution lot number, sample type, date/time of sample collection, sampler's initials, required analyses, type of preservative, sample number and/or sample code number label, and the NTS sample location number. All labels will be filled out with waterproof ink. Samples collected for analysis by the laboratories will include NTS personnel-assigned sample numbers. NTS soil sample location numbers will be designated as follows.

AB-CD (E′)

- AB provides information about how the sample was obtained (GP = geoprobe, SB = soil boring, HA = hand auger, etc.)
- CD provides a designation to identify the sampling location. Soil samples begin with the number 01 and continue as sample locations are initiated.
- (E′) provides the depth of the soil sample to the nearest tenth of a foot.

For example, the soil sample designation SB-05 (10.5′) indicates a soil sample collected from a soil boring at location "05" at a depth of 10.5 feet.

Similarily, groundwater and surface water samples will be designated as follows:

FG-HI (H_2O)

- FG provides information on how the sample was obtained (MW = monitoring well, SB = soil boring, TW = temporary well, GP = geoprobe, SW = surface water, etc.)
- HI provides information on the location of the sample.
- H_2O provides verification that the sample is water.

Trip blanks are pre-labeled "Trip Blanks" in the laboratory. Field duplicates and blanks are labeled by the field sampler, and information regarding the sample location is recorded on a field form. The samples, without sample location information, are submitted to the laboratory for a true laboratory check. All field-collected soils and groundwater samples, field duplicates and blank samples designations are recorded on a field form for future reference.

2. Sample Packaging and Shipping

Samples will be packaged and transported in a manner that maintains the integrity of the sample and permits the analysis to be performed within the prescribed holding time. Each sample container will be prepared in the field by attaching a completed sample label (Refer to Sample Identification Section).

Following sample collection, each soil and/or groundwater sample will be placed in sealable bags prior to placement into ice-cooled coolers. The samples will be submitted to the NTS laboratory on the day of collection. If it is necessary to ship samples to a subcontracted laboratory, each bulk sample container (cooler) will be sealed by NTS prior to shipment using a Custody Seal. Shipping cooler custody seals must be placed on two opposite corners of the cooler, and positioned to bisect the interface of the cooler body and lid. NTS laboratory personnel are responsible for coordinating sample transfer to the subcontracted laboratory.

Samples shipped to the laboratory will be documented on the chain-of-custody form(s). The completed form will be enclosed in a Ziploc bag and taped to the inside lid of the cooler that contains the samples listed on the form. Additionally, preaddressed shipping Airbill tickets will be provided with each cooler shipment to the subcontract laboratory in order to provide for return of the sample coolers to NTS.

a. Documentation

Custody of samples shall be maintained and documented at all times. Chain of custody begins with the collection of the samples in the field. The documentation for each sample will include, at a minimum, the following information:

- Chain of Custody Form
- Laboratory Sample Tracking Log Number
- Sample Identification Number
- Sample Shipment Log
- Shipping Documents

NTS's SOP for chain of custody forms requires the basic information on specific forms be carefully filled out prior to going into the field. Items entered prior to performing the fieldwork include project number, project name, shipping carrier, etc. The sample numbers, location identifier, time and date of collection, and sampler's signature will be filled out in the field at the appropriate time.

b. Final Evidence Files Custody Procedure

NTS will be responsible for the custody of the evidence files and maintain the contents of the files for the duration of the project. The evidence files include all relevant records, reports, logs, field notebooks, pictures, subcontractor reports, and data reviews at the NTS office. Data files will be retained for a period of ten years.

F. INSTRUMENT CALIBRATION AND FREQUENCY

The calibration procedures to be employed for both the field and laboratory instruments used during site investigation work are referenced in this section. Measuring and test equipment used in the field and laboratory will be subjected to a formal calibration program. The program will require equipment of the proper type, range, accuracy, and precision to provide data compatible with the specified requirements and desired results. Calibration of measuring and test equipment may be performed internally using in-house reference standards, or externally by agencies or manufacturers.

The responsibility for the calibration of laboratory equipment rests with the laboratory. NTS site personnel are responsible for the calibration of NTS field equipment and field equipment provided by subcontractors.

Documented and approved procedures will be used for calibrating measuring and testing equipment. Widely accepted procedures, such as those published by EPA, ASTM, or procedures provided by manufactures in equipment manuals, will be adopted.

Calibrated equipment will be uniquely identified by either the manufacture's serial number, a NTS equipment identification number, or other means. This identification, along with a label indicating when the next calibration is due (only for equipment not requiring daily calibration), will be attached to the equipment. If this is not possible, records traceable to the equipment will be readily available for reference. It will be the responsibility of all personnel to check the calibration status from the due date labels or records prior to using the equipment.

Measuring and test equipment will be calibrated at prescribed intervals and/or as part of operational use. Frequency will be based on the type of equipment, inherent stability, manufacturer's recommendations, values given in national standards, intended use, and experience. Equipment will be calibrated, whenever possible, using reference standards having known relationships to nationally recognized standards (e.g., National Institute of Standards and Technology) or accepted values of physical constants. If national standards do not exist, the basis for calibration will be documented.

Physical and chemical reference standards will be used only for calibration. Equipment that fails calibration or becomes inoperable during use will be removed from service and segregated to prevent inadvertent use and will be tagged to indicate the fault. Such equipment will be recalibrated and repaired to the satisfaction of the laboratory personnel or NTS site personnel, as applicable. Equipment that cannot be repaired will be replaced.

Records will be prepared and maintained for each piece of calibrated measuring and test equipment to document that established calibration procedures have been followed. Records for subcontractor field equipment and NTS equipment used only for this specific project will be kept in the project files. Laboratory calibration records will be maintained by the laboratory.

1. Field Instrument Calibration

Instruments used to collect, generate, or measure field environmental data will be calibrated with sufficient frequency and in such a manner that accuracy and reproducibility of results are consistent with the manufacturer's specifications. Field measurement instruments for the field investigations will include PID/FID units that are used for detecting VOC vapors, instruments for measuring pH, conductivity, and the temperature of liquids. As applicable, each field measurement instrument will be calibrated daily prior to use. Calibration procedures will be documented in the field logbook. Documentation will include the checklist shown below.

Field Instrument Calibration Checklist:

- Date and time of calibration
- Identity of the person performing the calibration
- Reference standard used, as applicable
- Reading taken and adjustments to attain proper reading
- Any corrective action

2. Laboratory Equipment Calibration

The proper calibration of laboratory equipment is a key element in the quality of the analysis done by the laboratory. Each type of instrumentation and each EPA-approved method has specific requirements for the calibration procedures, depending on the analytes of interest and the medium of the sample.

The calibration procedures and frequencies of the equipment used to perform the analyses will be in accordance with the requirements established by the U.S. EPA. The laboratory QA Manager will be responsible for assuring that the laboratory instrumentation is maintained in accordance with specifications. Individual laboratory standard operating procedures (SOPs) for each method for each laboratory will be followed for corrective actions and preventive maintenance frequencies.

G. DATA MANAGEMENT

Raw data obtained during field activities, for example lithologic logs, pH measurements, etc., will be recorded on the appropriate field forms or in individual site logbooks. This data will become part of the project files to be maintained as described previously in this QAPP.

NTS will be responsible for data management for all laboratory activities. Analytical data reports generated by NTS or a subcontract laboratory will present all sample results, including all QA/QC samples.

The NTS Data Management Officer will manage the data processing. All laboratory internal QA/QC measures will be performed in accordance with the NTSL and subcontract laboratory QA/QC Plans.

IV. ASSESSMENT/OVERSIGHT

Performance and system audits will be completed to ensure that the field sampling activities and laboratory analyses are performed following the procedures established in this QAPP, including the attached SOPs, and the investigation Work Plans/SAPs. The audits may be both internally and externally led, as further described below.

A. Field Data

An NTS geologist/hydrogeologist will be present at the site during the sampling activities. The geologist/hydrogeologist will provide all on-site supervision required during the project. The NTS Project Professional Services Staffwill conduct the audits of field activities. The field audit will include the following tasks:

1. Review of field sampling records.
2. Review of field measurements procedures.
3. Examination of the application of sample identifications.
4. Review of field instrument calibration records and procedures.
5. Review of the sample handling and packaging procedures.
6. Review of chain-of-custody procedures.

The individual responsible for on-site supervision will be in daily contact with the NTS Project Manager or designee, who will then review compliance with the project objectives and sampling protocol outlined in this QAPP. Any anticipated modifications to the sampling or measuring procedures will be reported to CE and MPCA Project Managers. NTS site personnel will report modifications in writing to the NTS Project Manager, and the modifications will be documented by the geologist/hydrogeologist in the field logbook.

Sampling data precision will be determined by the collection and subsequent analysis of sample duplicates, decon blanks, VOA trip blanks, and bottle blanks to verify reproducibility.

B. Report Preparation

Prior to submittal to CE and the MPCA, all reports will undergo a peer review conducted by a project team within NTS. The standard NTS Peer Review Form is contained in Appendix I.

C. Laboratory Data

Laboratory results will be reviewed for compliance against the DQO criteria for the level of reporting required. Data verification and usability will also be accomplished.

V. DATA VERIFICATION AND USABILITY

A. DATA VERIFICATION AND USABILITY

Data verification and usability assessments provide a two step process toward assuring defensible, properly documented data of sufficient quantity to meet the project objectives. Verification and usability are done primarily through the use of standard checklists. Examples of these checklists are contained in Appendix I and contain more specific instructions for each checklist item. The process for Usability Assessment is discussed in detail below and is documented in the Phase II Report.

1. Data Verification

Data verification is a laboratory process of evaluating completeness, adherence to standard methods and compliance with internal QC requirements as stated in Section 5 and Section 6 of the NTS QA/QC Manual. Data verification may result in accepted, qualified or rejected data. The NTS Laboratory Manager prepares a QC Cover Letter for each data set. The cover letter discusses internal QC checks, anomalies in the data and specifically identifies data qualifications.

A representative subcontract laboratory QC Protocol is outlined in Section 11.0 of the MVTL QA/QC Manual. According to the manual, "The quality control measures taken at MVTL are used to test the reproducibility and accuracy of all data generated." The MVTL manual is included in Appendix H.

2. Data Usability

Data usability is a Project Professional Services Staff function that extends scrutiny of data beyond verification to discuss laboratory and field data as well as QA Objectives for Measurement specified in Table 5, Appendix D. The Lab completes a Routine Lab Report Checklist. (Appendix I). A review of the data for usability results in accepted, qualified or rejected data and is summarized within the data set's usability assessment.

Data Usability Assessment (Data Assessment) is the process of :

1. confirming laboratory data against the Laboratory Data Checklist
2. providing a reasonability check of the laboratory data against field data
3. reviewing the data for conformance to project data quality objectives
4. determining the limitations of the data in its use.

Data Assessment is done upon receipt of each data set to allow corrective action if required. The assessment is documented by the Project's Professional Services staff. A final assessment is done after the investigation field work is complete and documented in the Phase II Report.

The steps that will be included for the Usability Assessment are discussed below.

a. Precision

Field Precision is calculated from field duplicates collected during the investigative field work. The quantity of field duplicates is specified in Table 1 and will be reflected in the SAP. The precision calculation is as follows:

$$RPD = \frac{(C_1 - C_2) * 100}{(C_1 + C_2) / 2}$$

where RPD is the relative percent difference, C_1 is the larger of the two observed values and C_2 is the smaller of the observed values. If three or more replicates are used, then precision is determined from the relative standard deviation, RSD:

$$RSD = (s/x) * 100$$

where s is the standard deviation and x is the mean of the replicate analyses.

Laboratory Precision is calculated from laboratory matrix spike and matrix spike duplicates analyzed along with each sample set. The quantity of matrix spike and matrix spike duplicates are specified in Table 1 and the calculations are the same as for field precision.

Overall Precision is affected by sampling technique, sample transport, and/or heterogeneous matrices. In order to identify the cause of imprecision, the field sampling design rationale and sampling techniques will be evaluated by the Project QA Officer; and, both field and analytical duplicate/replicate sample results should be reviewed. If poor precision is indicated in both the field and analytical duplicates/replicates, then the laboratory may be the source of error. If poor precision is limited to the field duplicate/replicate results, then the sampling technique, field instrument variation, sample transport, and/or heterogeneous sample matrices may be the source of error.

If the Data Validation Checklist indicates that analytical imprecision exists for a particular data set, then the impact of that imprecision on data usability must be discussed in the Data Assessment section of the Phase II Report.

The Data Assessment section of the Phase II Report will discuss and compare overall field duplicate precision data from multiple data sets collected for the project for each matrix, analytical parameter and concentration level. The Data Assessment section will describe limitations on the use of project data when overall precision is poor or when poor precision is limited to a specific sampling or laboratory/analytical group, data set, matrix, analytical parameter or concentration level.

If the Project Professional Services Staff determines that the overall project-required precision is not achieved and project data are not usable to support project decision making, then the project staff member will notify, in writing, the NTS and CE Project Managers. The two Project Managers will assess the impact of the imprecise data to the overall goals of the project. The Project Managers will address how this problem will be resolved and discuss the potential need for re-sampling. The Project Professional Services Staff determinations and the Project Managers' resolution will be discussed in the Data Assessment section of the Phase II Report.

b. Accuracy / bias

<u>Sample contamination</u>: If field contamination is evident based upon results of field and trip blanks, the impact on data usability will be discussed in the Data Assessment Report Differentiation of field sample collection and transport contamination (equipment/rinsate blanks, trip blanks) from contamination introduced at the time of sample preparation and/or analysis, (i.e., method blank, storage blank, analytical instrument blanks) will be identified. Sample contamination may result in either negative or positive bias. For example, improperly cleaned sample containers for metals analysis may result in the retention of metals on interior container walls. This would result in lower metals concentration being reported than are actually present in the collected sample (i.e., negative bias). A positive bias would occur when sample container contamination results in additive effect, i.e., reported analyte concentrations are higher than the true sample concentrations for that analyte.

<u>Laboratory Accuracy / Bias</u> is calculated from matrix spike analyses or analysis of a standard reference material and is expressed by the following:

$$\%R = \{(S - U) / CA\} * 100$$

where %R is the percent recovery, S is the measured concentration in the spiked sample, U is the measured concentration in unspiked sample, and CA is the concentration of spike added. For a standard reference material the accuracy is determined by:

$$\%R = (M / C) * 100$$

where M is the measured concentration and C is the concentration of the standard reference material.

If contamination and/or analytical inaccuracies/bias exist for a particular data set, then the impact of that contamination and/or analytical inaccuracies/bias on data usability must be discussed in the Data Assessment section of the Phase II Report.

Overall Accuracy / Bias: The Data Assessment section of the Phase II Report will discuss and compare overall contamination and accuracy/bias data from multiple data sets collected for the project for each matrix, analytical parameter and concentration level. The Data Assessment section will describe the limitations on the use of the project data if extensive contamination and/or inaccuracy / bias exists or when it is limited to a specific sampling or laboratory analytical group, data set, matrix, analytical parameter or concentration level. The Data Assessment section will identify qualitative and/or quantitative bias trends for each matrix, analytical parameter and concentration level. The impact of any qualitative and/or quantitative trends in bias on the sample data will be discussed.

If the Project Professional Services Staffdetermines that the overall project-required accuracy/bias is not achieved and project data are not usable to support project decision making, then the officer will notify, in writing, the NTS and CE Project Managers. The two Project Managers will assess the impact of the inaccurate/biased data to the overall goals of the project. The Project Managers will address how this problem will be resolved and discuss the potential need for re-sampling. The QA Officer's determinations and the Project Managers' resolution will be discussed in the Data Assessment section of the Phase II Report.

c. Sample Representativeness

The Data Assessment section of the Phase II Report will Discuss sampling SOPs, Split Sampling and Analysis Audits, and QC check and sample data to assess sample representativeness. If field duplicate precision checks indicate potential spatial variability, then this may trigger additional scoping meetings and subsequent re-sampling in order to collect data that are more representative of a non-homogeneous matrix.

The Data Assessment section will discuss and compare overall representativeness for each matrix, parameter and concentration level. Data Assessment will describe the limitations on the use of project data when overall non-representative sampling has occurred or when non-representative sampling is limited to a specific sampling group, data set, matrix, analytical parameter or concentration level.

d. Sensitivity and Quantitation Limits

The NTS and subcontract laboratory QA/QC Manuals in Appendix H contain methods and procedures for determination of Method Detection Limits (MDL) and Reporting Limits (RL). If Data verification/usability reports indicate that sensitivity and/or RLs were not achieved, then the impact of that lack of sensitivity and/or higher RLs on data usability will be discussed in the Data Assessment section of the Phase II Report.

The Data Assessment section will discuss and compare overall sensitivity and RLs from multiple data sets collected for the project for each matrix, analytical parameter and concentration level. Data Assessment will also describe the limitations on the use of the project data if project-required sensitivity and RLs were not achieved for all project data or when it is limited to a specific sampling or laboratory / analytical group, data set, matrix, analytical parameter or concentration level.

If project-required RLs are not achieved and project data are not usable to adequately address the Decision Process (eg., RL greater than the Tier-1 SRV) the Data Assessment will address how this problem will be resolved and discuss the potential need for re-sampling. In this case, the Data Assessment will clearly differentiate between usable and unusable data for the data users.

e. Completeness

Completeness is a percentage of the number of valid measurements collected for each matrix, analytical parameter, and concentration level and is calculated by the following equation:

$$\%C = 100*(V/n)$$

where %C is the percent completeness, V is the number of valid measurements, and n is the total number of measurements.

The Data Assessment will discuss and compare overall completeness of multiple data sets collected for the project for each matrix, analytical parameter and concentration level. If particular data sets are more critical than others in decision making the Data Assessment will highlight them.

If project required completeness is not achieved and sufficient data are not available to adequately address the Decision Process then the Data Assessment will address how this problem will be resolved and discuss the potential need for additional re-sampling.

f. Comparability

Overall Comparability:

The Data Assessment will discuss and compare overall comparability between multiple data sets collected for the project for each matrix, analytical parameter and concentration level. The Data Assessment section of the Phase II Report will describe limitations on the use of data when required comparability is not achieved for the overall project or when it is limited to a specific sampling or laboratory/analytical group, data set, matrix, analytical parameter or concentration level.

If screen/confirmatory comparability criteria are not met, then this should be documented in the Data Assessment section and the effect on data usability should be discussed. If oversight split sampling comparability criteria are not met, then this should be documented in the Data Assessment section and the effect on data usability should be discussed. If data are not usable to adequately address environmental questions and/or support project decision making, then the Data Assessment section of the Phase II Report should address how this problem will be resolved and discuss the potential need for re-sampling.

Finally, if long-term monitoring data are not comparable, then the Data Assessment section of the Phase II Report should address whether the data indicate a changing environment or the anomalies are a result of sampling and/or analytical error. If data are not usable to adequately address environmental questions and/or support project decision making, the Data Assessment section should address how this problem will be resolved and discuss the potential need for re-sampling.

APPENDIX A

ACRONYMS

ACRONYMS

AOC	Area of Concern
AST	Aboveground Storage Tank
ASTM	American Society of Testing Materials
CE	Cliffs Erie LLC
CLP	Contract Laboratory Program
COC	Chain of Custody
COPC	Chemical of Potential Concern
DCQAP	Data Collection Quality Assurance Plan
DMP	Data Management Plan
DQO	Data Quality Objective
EPA	United States Environmental Protection Agency
ESA	Environmental Site Assessment
FPH	Free Phase Hydrocarbon
GC	Gas Chromatograph
HASP	Health & Safety Plan
mg	Milligram
mL	Milliliter
MPCA	Minnesota Pollution Control Agency
MVTL	Minnesota Valley Testing Laboratory, Inc.
NFA	No Further Action
NGVD	National Geodetic Vertical Datum
NIOSH	National Institute for Occupational Safety and Health
NTS	Northeast Technical Services, Inc.
NTSL	Northeast Technical Services, Inc. Laboratory
O&M	Operation and Maintenance
OSHA	Occupational Safety and Health Administration
PID	Photo-ionization detector
ppb	Parts per billion
ppm	Parts per million
QA/QC	Quality Assurance / Quality Control
QAPP	Quality Assurance Project Plan
QC	Quality Control
RAP	Response Action Plan
REC	Recognized environmental condition
RFI	RCRA Facility Investigation
SAP	Sampling Analysis Plan
SLV	Soil Leaching Value
SOP	Standard Operating Procedure
SRV	Soil Reference Value
SVOC	Semi-volatile Organic Compound
UST	Underground Storage Tank

ACRONYMS (continued)

VES	Vapor Extraction System
VIC	Agency Voluntary Investigation and Cleanup
VOA	Volatile Organic Analysis
VOC	Volatile Organic Compound
VRU	Vapor Recovery Unit
VSI	Visual Site Inspection

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VIC AREAS OF CONCERN

APPENDIX C
RESUMES

Mr. Richard H. Crum, P.G.
Mr. Dennis L. Schubbe, P.G.

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NorthMet Project Closure Abatement Specification (Structures Only)

POLYMET
MINING

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NorthMet Project

Closure Abatement Specification (Structures Only)

June 23, 2016
Revision 2

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1.0 Background

PolyMet Mining Corporation (PolyMet) is a publicly traded mine development company with operational headquarters near the Company's mine in Hoyt Lakes, Minnesota, and executive offices in St. Paul, Minnesota. PolyMet is developing a copper-nickel-precious metals project in the established mining district of the Mesabi Iron Range in northeastern Minnesota. PolyMet controls 100% of the NorthMet ore deposit and owns a large crushing and grinding facility with extensive associated infrastructure, where it plans to process copper, nickel, gold, and platinum group metal ores from the NorthMet mine. The NorthMet Project (Project) would become the first non-ferrous ore mining operation in Minnesota. Shares are traded on the New York Stock Exchange (NYSE-A: PLM) and Toronto Stock Exchange (TSX: POM).

PolyMet is progressing with a two phased design, construction, and production plan. Phase I involves construction of the mine and related facilities, reconditioning and upgrading of the existing plant, construction of a flotation plant, and construction of a rail load-out facility for production of a dual filter cake. Products produced after Phase I construction include a copper rich concentrate and a nickel rich concentrate also holding platinum group metals.

Phase II includes the design, construction, and commissioning of a new hydrometallurgical facility and oxygen plant. Once completed, PolyMet will produce a combination of copper filter cake, nickel filter cake, nickel/cobalt hydroxide and gold/platinum group precipitate.

PolyMet designed its facility to maximize the reuse of the LTV Steel Mining Company's Erie Plant brownfield site and existing infrastructure.

2.0 Introduction

PolyMet is in the permitting process. As part of the Minnesota Department of Natural Resources' (MDNR) Permit to Mine, PolyMet will be required to provide adequate financial assurance to the State of Minnesota for proper closure of the Project. The planned closure of the Project is 20 years after startup, however, a condition of the Permit to Mine requires that the possibility of early closure is taken into account. The Permit to Mine will require the closure plans and the instrument of financial assurance to be updated annually. The updated closure plans and instrument of financial are submitted to the MDNR for review and acceptance that the financial assurance is sufficient to meet the existing obligations of closure and remediation.

At the time that the Permit to Mine is issued, PolyMet will have entered into a financial assurance agreement with the MDNR and provided the financial instrument that will guarantee payment for the closure of the project.

PolyMet is seeking to partner with a reputable abatement company (Contractor). The desired business arrangement is for the Contractor to provide closure estimates each year for the structural and equipment demolition work described within this specification. PolyMet would then enter into a yearly contract (the Closure Contract) with the Contractor for the performance of the work. In the event of closure of the Project, the Contractor will execute the Contract, payment of which is guaranteed by the financial instrument provided by PolyMet.

There will be salvage, demolition work, and asbestos removal required during the pre-construction and construction phase of the Project. This work is identified in the specification. Additionally there will be salvage and asbestos removal required during normal plant operations.

PolyMet intends to enter into a contract for the asbestos removal to be carried out in the Pre-Construction and Construction phases of the projects and to make a good faith effort toward establishing a long term relationship with the Contractor for on-going asbestos abatement requirements.

3.0 Request for Proposal

PolyMet is requesting a proposal for asbestos abatement from buildings associated with the Project as described herein. Abatement work in all of the other buildings, structures, and tunnels at the PolyMet NorthMet site are part of a separate abatement and demolition scope of work.

This document presents the specification for asbestos abatement from structures and equipment components of the Project as described in in Sections 8.1.1 through 8.1.14.

Notes:

- The planned closure of the Project is 20 years after startup. However, an unforeseen closure could occur anytime. PolyMet does realize that bidding many years into the future may not be a normal activity for Contractors. Please advise PolyMet in the form of a quotation for costs that would need to reimbursed (if any) in the creation of the proposal requested in this specification (i.e. estimator's time, etc.). The proposal will be considered and a separate purchase order may be issued if warranted.

- There will be demolition work and asbestos removal required during the Project, salvage and asbestos removal required during normal plant operations and possible pre-project salvage and asbestos removal associated with cleanup work required for plant health/safety. PolyMet intends to make a good faith effort toward establishing a long term relationship with the Contractor for on-going salvage, asbestos abatement, project demolition, and closure requirements.

4.0 Specification Support Documents

This specification includes:

- This specification document
- Figures 1 and 1A referenced in specification
- Plant Site drawing package per drawing index
- Plant Site asbestos and lead survey reports

5.0 Proposal Requirements

The demolition estimates shall include the following as a minimum:

- Asbestos remediation cost estimate by facility listed in Section 8.
- List of assumptions from which the proposal is based. Wherever possible describe any engineering concepts or assumptions from which the proposal is based (i.e. concrete will be placed in crusher basement, siding will be placed in landfill, etc.)
- List of exceptions to requests in the proposal including reason for exception.
- Biography of Contractor including any relevant experience in relation to the Contract.
- Experience working with Governmental Agencies (i.e. MDNR, MPCA, EPA) and Owner's agents to fulfill structure and equipment demolition obligations.
- An outline describing the major aspects of the Contractor's Safety Program shall be supplied.
- A performance bond may be required with yearly Contract. Provide information regarding any bonding capability, an indication of willingness to bond, and costs associated with bonding that would be passed on to PolyMet.
- Indicate anticipated yearly costs to provide an update to the estimate and Contract renewal for an additional one year. Note that these costs may be negotiated as we move forward and gain more understanding. However, an indication of costs is needed for internal use at PolyMet.

6.0 Contract Objective

The objective of the Contract is to place the facilities listed in Section 8 in a safe, secure, environmentally stable condition. In general, all environmental concerns will be evaluated, and all environmental hazards will be remediated to prepare the buildings for final demolition.

7.0 General Demolition Requirements

The following are general demolition requirements for the Contractor:

- Asbestos must be removed. The asbestos shall be disposed of at an off-site landfill approved by the U.S. Environmental Protection Agency which is operated in accordance with 40 CFR Section 61.154. If the landfill is operated in the state of Minnesota, ensure it is a MPCA approved solid waste facility permitted to accept the waste.
- The Contractor is responsible to obtain permits and submit all reports required by the state and federal agencies.
- Contractor shall plan to supply electricity from the Main Substation, water, offices, sanitary facilities, etc. as these items may not be available at the work site.
- MSHA requirements must be met while PolyMet is in operation. At closure PolyMet's plant site will be under the jurisdiction of OSHA.
- Contractor will control, clean up and dispose of all environmental releases as no releases of soils, waters, or liquids will leave the work site area.
- Services and utilities will be severed by others prior to commencement of demolition work.
- Demolition will require a General NPDES Construction Permit.
- Contractor shall provide PolyMet or MDNR with copies of all reports and permits that are required.

Notes:

- An asbestos and lead paint inventory has been performed for the Plant Site. The asbestos reports are provided as an attachment to this specification.

- PCB containing or contaminated items have been inventoried and removed from the PolyMet site. It is anticipated that no new PCB containing devices will be brought on site.

8.0 End of Year One Demolition Plan

Within three (3) years after closure begins, all buildings and structures will be removed and foundations razed to grade level. Provisions may be made for continued subsequent use of mine facilities that will have future benefits to the area including, pipelines, transmission lines, roads, and railroad lines. However, for the purposes of this document it shall be assumed that all of the PolyMet facilities must be removed and the facility footprints reclaimed.

All facilities listed in Sections 8.1.1 to 8.1.14 will be demolished over a maximum period of three years.

For building, area or equipment locations listed as headings in the following sections for the plants reference Figures 1 and 1A for details.

8.1 Existing Facilities

8.1.1 Area 1 Buildings

Area 1 shop buildings were and will be used for maintenance and repair of the mining equipment. Area 1 includes the following buildings; Shop and Truck Storage (220), Cold Storage (221), Boiler House (226), Fire Pump House (228), Reporting Building (231).

1. Remove and properly dispose all existing Category II Asbestos-Containing Materials identified in *Table II – Asbestos-Containing Materials Identification List* from Arrowhead Consulting & Testing Inc. Asbestos-Containing Materials Inspection Report, Zone H, Area 1 Truck Shop, dated October 2007 and identified during site visit and field inspection on May 12, 2016. **Note: ALL "Assumed" ACM will be treated as Category II Asbestos-Containing Material.**

Reference drawings for the Area 1 buildings include:

TE-8-142	Maintenance & Repair Shop Area 1 Phase 1 Fire Protection – Fire Pump & Tank
TE-8-310	Area 1 Shop Area Yard Piping System
TE-8-017	Sprinkler System for Traffic Control Center

TE-8-149 Maintenance & Repair Shop Area 1 Phase 2
Floor Plans-Existing Building

8.1.2 Area 2 Buildings

Area 2 buildings were and will be used for maintenance, mining employee reporting, and storage. Area 2 includes the following buildings; Service Shop (201), Truck Storage (202), Locomotive Service Shop (203), Cold Storage (204), Sample House (208), Hose House (209), Reporting Building (425), and Locomotive Fueling Building.

1. Remove and properly dispose all existing Category II Asbestos-Containing Materials identified in *Table II – Asbestos-Containing Materials Identification List* from Arrowhead Consulting & Testing Inc. Asbestos-Containing Materials Inspection Report, Zone I, dated June 2006. **Note: ALL "Assumed" ACM will be treated as Category II Asbestos-Containing Material.**

Reference drawings for the Area 2 buildings include:

MA-50-3	Service Area – East Pits Area Map
TE-8-008	General Revisions East Pit Service Shop
TE-8-014	Revised Shop Floor Plan East Pit Shops Bldg

8.1.3 General Shops

The General Shops, building number 601, were and will be used for maintenance and repair of the rail fleet as well as electrical equipment repairs, welding and fabrication, and other miscellaneous repairs. The General Shops buildings include the Welding Shop, Structural Shop, Locomotive Shop, Electric Shop, Machine Shop, Tool Room, and several offices and a locker room. The Acetylene Building, number 604 is considered to be part of the General Shops.

1. Remove and properly dispose all existing Category II Asbestos-Containing Materials identified in *Table II – Asbestos-Containing Materials Identification List* from Arrowhead Consulting & Testing Inc. Asbestos-Containing Materials Inspection Report, Zone A, dated May 2006. **Note: ALL "Assumed" ACM will be treated as Category II Asbestos-Containing Material.**

Reference drawings for the General Shops include:

TE-1	General Shops General Arrangement Plan
TE-50	General Shops Structural Steel Mezz. Framing Plans & Sections
TE-51	General Shops Architectural Elevations

8.1.4 Rebuild Shop

The Rebuild Shop, building number 602, was used for light fleet maintenance and is used for drill core storage and cutting.

1. Remove and properly dispose all existing Category II Asbestos-Containing Materials identified in *Table II – Asbestos-Containing Materials Identification List* from Arrowhead Consulting & Testing Inc. Asbestos-Containing Materials Inspection Report, Zone A, dated May 2006. **Note: ALL "Assumed" ACM will be treated as Category II Asbestos-Containing Material.**

Reference drawings for the Rebuild Shop include:

TE-267	Garage Building Structural Steel & Concrete Reinf. Warehouse Mezzanine and the Battery Storage Decks
TE-270	Garage Concrete Masonry Building Foundations
TE-271	Garage Concrete Masonry Building Foundations
TE-281	Garage Architectural Floor Plan and Section
TE-282	Garage Architectural Elevations
TE-284	Garage Architectural Door Schedule & Misc. Details

8.1.5 Lube House

The Lube House, building number 926, was and will be used as storage space for lubricants and paints.

1. Remove and properly dispose all existing Category II Asbestos-Containing Materials identified in *Table II – Asbestos-Containing Materials Identification List* from Arrowhead Consulting & Testing Inc. Asbestos-Containing Materials

Inspection Report, Lubricant Storage Building, dated July 28, 2008. **Note: ALL "Assumed" ACM will be treated as Category II Asbestos-Containing Material.**

Reference drawings for the Lube House include:

TE-316	Lubricating Oil & Paint Storage Structural Steel Plan & Details
TE-317	Lubricating Oil & Paint Storage Structural Steel Elevations & Details
TE-318	Lubricating Oil & Paint Storage Concrete Masonry Foundation Plan & Sects.
TE-319	Lubricating Oil & Paint Storage Concrete Masonry Section & Details
TE-320	Lubricating Oil & Paint Storage Concrete Reinforcing Foundation Plan Section & Details
TE-321	Lubricating Oil & Paint Storage Concrete Reinforcing Section & Details
TE-322	Lubricating Oil & Paint Storage Concrete Reinforcing Section & Details

8.1.6 Rubber Shop

The Rubber Shop, building number 605, was originally called the Untanking Tower and Emergency Diesel Generating Plant, both of those sections still exist in the building in addition to the rubber shop.

1. Remove and properly dispose all existing Category II Asbestos-Containing Materials identified in *Table II – Asbestos-Containing Materials Identification List* from Arrowhead Consulting & Testing Inc. Asbestos-Containing Materials Inspection Report, Rubber Storage Building, dated July 28, 2008. **Note: ALL "Assumed" ACM will be treated as Category II Asbestos-Containing Material.**

Reference drawings for the Rubber Shop include:

TD-680	Emergency Diesel Generating Plant General Arrangement Sections
TD-679	Emergency Diesel Generating Plant General Arrangement Plan
TD-698	Transformer Untanking Tower Diesel Generating Plant Structural Steel Plans & Details

TD-699 Transformer Untanking Tower
Diesel Generating Plant
Structural Steel Elevations & Details

TD-700 Transformer Untanking Tower
Diesel Generating Plant
Structural Steel Elevations & Details

TD-701 Transformer Untanking Tower
Diesel Generating Plant
Structural Steel Elevations & Details

8.1.7 Colby Lake Pump House

The Colby Lake Pump House is located approximately 5 miles from the plant site and supplied and will supply fresh water from Colby Lake to the plant site via a 36” diameter steel buried pipeline.

1. Remove and properly dispose all existing assumed Asbestos-Containing Materials identified during site visit and field inspection on May 12, 2016. **Note: ALL “Assumed” ACM will be treated as Category II Asbestos-Containing Material.**

Reference drawings for the Colby Lake Pumphouse include:

TG-18 Partridge Lake Pumping Station
Plan and Pipe Line Profile
Pipe Line from Pump Station to Reservoir

TG-19 Partridge Lake Pumping Station
36” Pipe Line to Plant Reservoir Details & B/M

TG-20 Partridge Lake Pumping Station
36” Pipe Line to Plant Reservoir
Plan and Profile

TG-21 Partridge Lake Pumping Station
36” Pipe Line to Plant Reservoir
Plan and Profile

TG-22 Partridge Lake Pumping Station
36” Pipe Line to Plant Reservoir
Plan and Profile

TG-23 Partridge Lake Pumping Station
36” Pipe Line to Plant Reservoir
Plan and Profile

TG-24 Partridge Lake Pumping Station
36” Pipe Line to Plant Reservoir
Plan and Profile

8.1.8 Warehouse 45 Electrical

The electrical warehouse, building number 921, acts as cold storage space.

1. Remove and properly dispose all existing Category II Asbestos-Containing Materials identified in *Table II – Asbestos-Containing Materials Identification List* from Arrowhead Consulting & Testing Inc. Asbestos-Containing Materials Inspection Report, Zone A, dated May 2006. **Note: ALL "Assumed" ACM will be treated as Category II Asbestos-Containing Material.**

Reference drawings for the electrical warehouse include:

TE-116	Warehouse General Plan
TE-117	Warehouse Elevations
TE-118	Warehouse Wall Sections
TE-5-067	Warehouse Office Edition
TE-5-069	Training Room Partitions Warehouse #1 – Office Area

8.1.9 Warehouse 49

Warehouse 49, building number 920, acts as cold storage space.

1. Remove and properly dispose all existing Category II Asbestos-Containing Materials identified in *Table II – Asbestos-Containing Materials Identification List* from Arrowhead Consulting & Testing Inc. Asbestos-Containing Materials Inspection Report, Zone A, dated May 2006. **Note: ALL "Assumed" ACM will be treated as Category II Asbestos-Containing Material.**

Reference drawings for the Warehouse 49 include:

TE-5-011	Erection Drawing Cold Storage Warehouse
TE-5-012	Exterior Sheeting & Flashing Detail Cold Storage Warehouse

8.1.10 Administration Building

The Administration Building houses the site administrative offices.

1. Remove and properly dispose all existing Category I and II Asbestos-Containing Materials identified in *Table II – Asbestos-Containing Materials Identification List* from Arrowhead Consulting & Testing Inc. Asbestos-Containing Materials Inspection Report, Administration Building, dated December 2008. **Note: ALL "Assumed" ACM will be treated as Category II Asbestos-Containing Material.**

Reference drawings for the Administration Building include:

TE-6-282	Elevations
TE-6-283	Building Sections
TE-6-279	Site Plan
TE-6-052	Ground Floor Plan
TE-6-053	First Floor Plan Interior Wall Elevations
TE-6-054	Second Floor Plan Room Finish Schedule
TE-6-062	Foundation Plan & Details
TE-6-264	Administration Building Second Floor Plan Rev

8.1.11 Main Gate (Gatehouse)

The Main Gate consists of a Gatehouse. The Gatehouse is used to provide shelter for site security personnel.

1. Remove and properly dispose all existing assumed Asbestos-Containing Materials identified during site visit and field inspection on May 12, 2016. **Note: ALL "Assumed" ACM will be treated as Category II Asbestos-Containing Material.**

Reference Drawings for the Main Gate include:

TE-6-001	Entrance Road Guard House Plans, Elev. & Det.
TH-1-050	Main Gate Gasoline Refueling & Storage Facility General Arrangement
TH-1-051	Main Gate Gas Station Details

	Piping Details
TH-1-1017	Main Gate Gasoline Dispensing Station Electrical Layout and Schematic

8.1.12 Sewage Treatment Plant

The Sewage Treatment Plant was used to treat sewage at the plant site.

1. Remove and properly dispose all existing assumed Asbestos-Containing Materials identified during site visit and field inspection on May 12, 2016. **Note: ALL "Assumed" ACM will be treated as Category II Asbestos-Containing Material.**

Reference Drawings for Sewage Treatment Plant include:

TL-2-006	Sewage Treatment Plant Location & Plat Plan
TL-2-008	Sewage Treatment Plant Plan of Primary Clarifier & Right & Left Side Elevations
TL-2-009	Sewage Plant Sections
TL-2-010	Sewage Treatment Plant Details
TL-2-011	Sewage Treatment Plant Isometric Piping & Details
TL-2-012	Sewage Treatment Plant Details
TL-2-013	Sewage Treatment Plant Steel Section and Floor Plans
TL-2-014	Sewage Treatment Plant Steel Sections
TL-2-015	Sewage Treatment Plant Electrical Plan

8.1.13 Water Treatment Plant

The Water Treatment Plant was used to treat raw water for potable water at the plant site.

1. Remove and properly dispose all existing Category II Asbestos-Containing Materials identified in *Table II – Asbestos-Containing Materials Identification List* from Arrowhead Consulting & Testing Inc. Asbestos-Containing Materials Inspection Report, Water Treatment Plant & Associated Buildings, dated July 2008.

Note: ALL "Assumed" ACM will be treated as Category II Asbestos-Containing Material.

The reference drawings for the Water Treatment Plant include:

TG-6-020	Location Map & Title Page
TG-6-021	Site and Foundation Plan
TG-6-022	Floor Plans
TG-6-023	Roof Plan
TG-6-024	Sections
TG-6-025	Elevations
TG-6-026	Details
TG-6-031	Piping and Equipment Plans and Details

8.1.14 Tailings Basin Buildings

The Tailings Basin buildings are located near the southeast corner of Cell 2W and were and will be used for storage, offices, oil dispensing, and locker rooms. They include the following buildings; Foreman's Office (718), Reporting Building (719), Lube House (720), Reporting Building (724), and Lube Oil Building (725).

1. Remove and properly dispose all existing assumed Asbestos-Containing Materials identified during site visit and field inspection on May 17, 2016. **Note: ALL "Assumed" ACM will be treated as Category II Asbestos-Containing Material.**

There are no reference drawings for the Tailings Basin Buildings.

9.0 Special Material Disposal

Surveys for Asbestos-Containing Materials (ACMs) have been completed. ACMs (siding, hot water heating system insulation, lube system insulation, floor tile, etc.) from structure demolition will be removed, properly packaged and disposed in an off-site landfill approved by the U.S. Environmental Protection Agency which is operated in accordance with 40 CFR Section 61.154. If the landfill is operated in the state of Minnesota, ensure it is a MPCA approved solid waste facility permitted to accept the waste.

Attachment C2

Mavo ACM Estimate

SOW I.D.	Description	Est. Man-hours						Est. Labor Cost	Est. Asbestos Volume (Cu. Yards)	Est. recovered Copper Lbs.
		Labor	Operator	IW	Painters	Asbestos	Electrician			
a.	**Coarse Crusher**									
1	Below the ground level elevation of 1710', remove **all** existing HTHW pipelines with damaged or deteriorated insulation and all insulation fragments.					1478		124,817		
2	Below the ground level elevation of 1710', remove all equipment lubrication lines with damaged or deteriorated insulation and all insulation fragments.					1469		124,057		
3	Below the ground level elevation of 1710', remove any loose or fallen paint chips.					80		6,756		
4	Above the ground elevation of 1710', remove all lubrication lines with damaged or deteriorated insulation and all insulation fragments. Remove the insulation on the lubrication holding tanks.					**730**		61,649		
5	In the electrical control room, remove all existing electric cable fireproofing wrap and all fragments of fireproofing wrap.					170		14,357		
6	In the electrical control room basement, remove all existing electric cable fireproofing wrap and all fragments of fireproofing wrap.					250		21,113		
7	Clean the Coarse Crusher building of all extraneous debris and taconite fines.	2564						204,248		
8	Kill and clean mold from all Coarse Crusher building surfaces.	80						6,373		
9	Install protective railings around floor openings on apron feeder floor. Reestablish the north conveyor gallery exit by replacing all structurally compromised stair treads.	200						15,932		
	Sub-totals	2844	0	0	0	4177	0	579,301	320	0
b.	**Conveyor 1A\1B tunnel & Drive house 1** (556 ft.)									
1	Remove approximately **1200'** of existing HTHW pipelines with damaged or deteriorated insulation and all fragments of insulation in 1A and 1 B tunnel.					418		35,300		
2	Abate any loose or fallen paint chips.					80		6,756		
3	Clean tunnel and Drive House walkways and stairs of extraneous debris and taconite fines.	1283						102,204		
4	Kill and clean mold from all tunnel and Drive House No. 1 building surfaces.	120						9,559		
5	In Drive House #1, remove approximately 120' of existing HTHW pipelines with damaged or deteriorated insulation and all fragments of insulation between 1A and 1B tunnel and S -3 tunnel. Patch remaining partially deteriorated HTHW pipeline insulation.					76		6,418		
	Subtotal	1403	0	0	0	574	0	160,237	0	0
	Totals	**4247**	**0**	**0**	**0**	**4751**	**0**	**$739,538**	**320**	**0**

Supervision & Field Administration	Man-hours est.	950	Est. Cost	$92,530.00
Craft support (Carpenters, teamster, Misc operator, Misc labor)	Man-hours est.		Est. Cost	
Estimated Equipment Costs (itemize)			Est. Cost	$132,900.00
Estimated Material Costs (Itemize)			Est. Cost	$5,000.00
Estimated Misc. Costs (Itemize)			Est. Cost	$100,650.00
			Total Estimated Cost	$1,070,618

SOW I.D.	Description	Est. Man-hours						Est. Labor Cost	Est. Asbestos Volume (Cu. Yards)	Est. recovered Copper Lbs.
		Labor	Operator	IW	Painters	Asbestos	Electrician			
c.	**Fine Crusher**									
1	Remove **all** existing HTHW pipelines with damaged or deteriorated insulation from the 4A/4B conveyor tunnel up to elevation 1794' on the north side of column 5. This insulation has tested positive for asbestos or probable ACM					496		41,887		
2	Remove all equipment lubrication lines damaged or deteriorated insulation and all insulation fragments from the 4A/4B conveyor tunnel up to the lube tanks at elevation 1817'-9" on the north side of column row 5. This insulation has tested positive for asbestos or probable ACM					901		76,089		
3	Remove any loose or fallen paint chips below the ground level elevation 1710'. The paint chips have tested positive for lead based material.					80		6,756		
4	Clean the Fine Crusher building of all extraneous debris and taconite fines.	987						78,624		
5	Kill and clean mold from Fine Crusher building surfaces.	80						6,373		
6										
	Sub-totals	1067	0	0	0	1477	0	209,730	0	0
f.	**Conveyors 4A\4B tunnel & Drive House No. 2** (120 ft. long)									
1	Remove approximately 275' of existing HTHW pipelines with damaged or deteriorated insulation and all fragments of insulation in 4A and 4B tunnel. The insulation has tested positive for asbestos or probable ACM.					139		11,739		
2	Abate any loose or fallen paint chips. The paint chips have tested positive for lead based material.					80		6,756		
3	Clean tunnel and Drive house walkways and stairs of extraneous debris and taconite fines.	607						48,354		
4	Kill and clean mold from all conveyor and Drive House No. 2 surfaces	80						6,373		
5	Remove approximately 120' of existing HTHW pipelines with damaged or deteriorated insulation and all fragments of insulation in Drive House No. 2. The insulation has tested positive for asbestos or probable ACM.					88		7,432		
	Sub-totals	687	0	0	0	307	0	80,653	0	0
	Totals	**1754**	**0**	**0**	**0**	**1784**	**0**	**$290,382**	**0**	**0**

Supervision & Field Administration	Man-hours est.	441	Est. Cost	42,953
Craft support (Carpenters, teamster, Misc operator, Misc labor)	Man-hours est.		Est. Cost	
Estimated Equipment Costs (itemize)			Est. Cost	$5,000.00
Estimated Material Costs (Itemize)			Est. Cost	$41,000.00
Estimated Misc. Costs (Itemize)			Est. Cost	$60,350.00
			Total Estimated Cost	$439,686

SOW I.D.	Description	Est. Man-hours Labor	Operator	IW	Painters	Asbestos	Electrician	Est. Labor Cost	Est. Asbestos Volume (Cu. Yards)
d	**Service Tunnels**								
d-i.	**Service Tunnel S-1** (20X10X440)								
1	Remove approximately 915' of existing HTHW pipelines with damaged or deteriorated insulation and all fragments of insulation.					234		19,761	
2	Abate any loose or fallen paint chips.					44		3,716	
3	Clean tunnel walkways of extraneous debris and taconite fines.					488		41,212	
4	Kill and clean mold from all tunnel surfaces.					30		2,534	
	Sub-total	0	0	0	0	796	0	67,222	51
d-ii	**Service Tunnel S-2** (20X10X530)								
1	Remove approximately 1,100' of existing HTHW pipelines with damaged or deteriorated insulation and all fragments of insulation.					341		28,797	
2	Abate any loose or fallen paint chips. The paint chips have tested positive for lead based material.					53		4,476	
3	Clean tunnel walkways of extraneous debris and taconite fines.					525		44,336	
4	Kill and clean mold from all tunnel surfaces.					27		2,280	
	Sub-total	0	0	0	0	946	0	79,890	61
d-iii	**Service Tunnel S-3** (9X9X67)								
1	Remove approximately 165' of existing HTHW pipelines with damaged or deteriorated insulation and all fragments of insulation.					58		4,898	
2	Abate any loose or fallen paint chips.					6		507	
3	Clean tunnel walkways of extraneous debris and taconite fines.					14		1,182	
4	Kill and clean mold from all tunnel surfaces.					4		338	
	Sub-total	0	0	0	0	82	0	6,925	7
d-iv	**Service Tunnel S-4** (10X10X372)								
1	Remove approximately 800' of existing HTHW pipelines with damaged or deteriorated insulation and all fragments of insulation.					198		16,721	
2	Abate any loose or fallen paint chips.					37		3,125	
3	Clean tunnel walkways of extraneous debris and taconite fines.					89		7,516	
4	Kill and clean mold from all tunnel surfaces.					22		1,858	
	Sub-total	0	0	0	0	346	0	29,220	34
d-v.	**Service Tunnel S-5** (7X8X31)								
1	Remove approximately 65' of existing HTHW pipelines with damaged or deteriorated insulation and all fragments of insulation.					41		3,462	
2	Abate any loose or fallen paint chips.					8		676	
3	Clean tunnel walkways of extraneous debris and taconite fines.					6		507	
4	Kill and clean mold from all tunnel surfaces.					4		338	
	Sub-total	0	0	0	0	59	0	4,983	3
d-vi.	**Service Tunnel S-6** (8X9X31)								
1	Remove approximately 70' of existing HTHW pipelines with damaged or deteriorated insulation and all fragments of insulation.					49		4,138	
2	Abate any loose or fallen paint chips.					6		507	
3	Clean tunnel walkways of extraneous debris and taconite fines.					3		253	
4	Kill and clean mold from all tunnel surfaces.					2		169	
	Sub-total	0	0	0	0	60	0	5,067	3
d-vii.	**Service Tunnel S-7** (7X8X659)								
1	Remove approximately 1300' of existing HTHW pipelines with damaged or deteriorated insulation and all fragments of insulation.					438		36,989	
2	Abate any loose or fallen paint chips.					65		5,489	
3	Clean tunnel walkways of extraneous debris and taconite fines.					165		13,934	
4	Kill and clean mold from all tunnel surfaces.					36		3,040	
	Sub-total	0	0	0	0	704	0	59,453	53
d-viii.	**Service Tunnel S-8** (7X8X30)								
1	Remove approximately 100' of existing HTHW pipelines with damaged or deteriorated insulation and all fragments of insulation.					48		4,054	
2	Abate any loose or fallen paint chips.					6		507	
3	Clean tunnel walkways of extraneous debris and taconite fines.					6		507	
4	Kill and clean mold from all tunnel surfaces.					4		338	
	Sub-total	0	0	0	0	64	0	5,405	4
d-ix.	**Service Tunnel S-9** (6-6X7-6X350)								
1	Remove approximately 750' of existing HTHW pipelines with damaged or deteriorated insulation and all fragments of insulation.					226		19,086	
2	Abate any loose or fallen paint chips.					42		3,547	
3	Clean tunnel walkways of extraneous debris and taconite fines.					50		4,223	
4	Kill and clean mold from all tunnel surfaces.					18		1,520	
	Sub-total	0	0	0	0	336	0	28,375	30
d-x.	**Service Tunnel S-10** (6X5X65)								
1	Remove approximately 150' of existing HTHW pipelines with damaged or deteriorated insulation and all fragments of insulation.					52		4,391	
2	Abate any loose or fallen paint chips.					10		845	
3	Clean tunnel walkways of extraneous debris and taconite fines.					9		760	
4	Kill and clean mold from all tunnel surfaces.					4		338	
	Sub-total	0	0	0	0	75	0	6,334	6
d-xi.	**Service Tunnel S-11** (8X6X54)								
1	Remove approximately 135' of existing HTHW pipelines with damaged or deteriorated insulation and all fragments of insulation.					48		4,054	
2	Abate any loose or fallen paint chips.					16		1,351	
3	Clean tunnel walkways of extraneous debris and taconite fines.					6		507	
4	Kill and clean mold from all tunnel surfaces.					4		338	
	Sub-total	0	0	0	0	74	0	6,249	5
	Totals	0	0	0	0	3542	0	299,122	257

Supervision & Field Administration	Man-hours est.	553	Est. Cost	$53,862
Craft support (Carpenters, teamster, Misc operator, Misc labor)	Man-hours est.		Est. Cost	
Estimated Equipment Costs (itemize)			Est. Cost	$44,685.00
Estimated Material Costs (Itemize)			Est. Cost	$5,000.00
Estimated Misc. Costs (Itemize)			Est. Cost	$76,360.00
			Total Estimated Cost	$479,029

SOW I.D.	Description	Est. Man-hours Labor	Operator	IW	Painters	Asbestos	Electrician	Est. Labor Cost	Est. Asbestos Volume (Cu. Yards)	Est. recovered Copper Lbs.
e.	**Electrical Tunnels**									
e-i.	**Electric Tunnel E-1N thru E-6N and E-1S thru E-4S** (7X8X268)									
1	Remove all existing electric cable fireproofing wrap and Transite conduit and all fragments of fireproofing wrap.					2109		178,105		
2	Remove all existing deteriorated electric cables.					782		66,040		
3	Remove extraneous debris and taconite dust in the tunnel.					302		25,504		
4	Kill and clean mold from all tunnel surfaces.					147		12,414		
5	Remove all taconite fines and reestablish the emergency egress hatches					224		18,917		
	Sub-total	0	0	0	0	3564	0	300,980	777	0
e-ii.	**Electric Tunnel E-7** (7X8X293)									
1	Remove all existing electric cable fireproofing wrap and Transite conduit and all fragments of fireproofing wrap.					424		35,807		
2	Remove all existing deteriorated electric cables.					147		12,414		
3	Remove extraneous debris and taconite dust in the tunnel.					24		2,027		
4	Kill and clean mold from all tunnel surfaces.					12		1,013		
	Sub-total	0	0	0	0	607	0	51,261	115	0
e-iii.	**Electric Tunnel E-8** (8 to 14 X 9-6 to 11 X 2756)									
1	Remove all existing electric cable fireproofing wrap and Transite conduit and all fragments of fireproofing wrap.					3125		263,906		
2	Remove all existing deteriorated electric cables.					1235		104,296		
3	Remove extraneous debris and taconite dust in the tunnel.					425		35,891		
4	Kill and clean mold from all tunnel surfaces.					211		17,819		
	Sub-total	0	0	0	0	4996	0	421,912	1008	0
e-iv.	**Electric Tunnel E-9** (5-6X6-9X248)									
1	Remove all existing electric cable fireproofing wrap and Transite conduit and all fragments of fireproofing wrap.					163		13,765		
2	Remove all existing deteriorated electric cables.					39		3,294		
3	Remove extraneous debris and taconite dust in the tunnel.					28		2,365		
4	Kill and clean mold from all tunnel surfaces.					15		1,267		
	Sub-total	0	0	0	0	245	0	20,690	86	0
e-v.	**Electric Tunnel E-10** (4-6X5-9X200)									
1	Remove all existing electric cable fireproofing wrap and Transite conduit and all fragments of fireproofing wrap.					151		12,752		
2	Remove all existing deteriorated electric cables.					38		3,209		
3	Remove extraneous debris and taconite dust in the tunnel.					28		2,365		
4	Kill and clean mold from all tunnel surfaces.					14		1,182		
	Sub-total	0	0	0	0	231	0	19,508	59	0
e-vi.	**Electric Tunnels E-11** (5-6X6-9X95), **E-12** (5X6-9X15 to 7-6X2-6X22), **E-13** (same as 12), **E-14** (7-6X2-6X22), **E-15** (same as 14), **West Service Tunnel, and East Service Tunnel** (both service tunnels (6X10X180)									
1	Remove all existing electric cable fireproofing wrap and Transite conduit and all fragments of fireproofing wrap.					374		31,584		
2	Remove all existing deteriorated electric cables.					102		8,614		
3	Remove extraneous debris and taconite dust in the tunnel.					74		6,249		
4	Kill and clean mold from all tunnel surfaces.					32		2,702		
	Sub-total	0	0	0	0	582	0	49,150	115	0
e-vii.	**Electric Tunnel E-16** (7X9-6X205)									
1	Remove extraneous debris and taconite dust in the tunnel.					80		6,756		
	Sub-total	0	0	0	0	80	0	6,756	0	0
	Concentrator									
6	In the North and South electrical control room basements, remove all existing ceiling tiles.					331		27,953		
7	In the North and South electrical control room basements, remove all existing electric cable fireproofing wrap and Transite conduit and all fragments of fireproofing wrap.					1433		121,017		
8	In the North and South electrical control room basements, remove all existing deteriorated electric cables					2143		180,976		
	Sub-total	0	0	0	0	3907	0	329,946	720	0
	Totals	0	0	0	0	14212	0	1,200,203	2880	0

Supervision & Field Administration	Man-hours est.	888	Est. Cost	86,491
Craft support (Carpenters, teamster, Misc operator, Misc labor)	Man-hours est.		Est. Cost	
Estimated Equipment Costs (itemize)			Est. Cost	210,100
Estimated Material Costs (Itemize)	**REPAIR BUDGET**		Est. Cost	15,000
Estimated Misc. Costs (Itemize)			Est. Cost	136,943
			Total Estimated Cost	1,648,738

SOW I.D.	Description	Est. Man-hours Labor	Operator	IW	Painters	Asbestos	Electrician	Est. Labor Cost	Est. Asbestos Volume (Cu. Yards)	Est. recovered Copper Lbs.
g.	**Concentrator (1400 ft long building)**									
1	Remove approximately 3,000' of existing HTHW pipelines along "F" and "G" column lines with damaged or deteriorated insulation and all fragments of insulation in 4A and 4B tunnel.					822		69,418		
2	Remove all insulated equipment lubrication lines and all insulation fragments.					1266		106,914		
3	Remove any loose or fallen paint chips.					200		16,890		
4	Kill and clean mold from all Concentrator building surfaces.					150		12,668		
5	Install protective railings around floor openings on separator deck and north side rod mill deck.					200		16,890		
9	Remove all floor tiles from the offices, locker rooms, washrooms, and central control room					901		76,089		
10	Remove all ceiling tiles from the offices, locker rooms, washrooms, and central control room.					1147		96,864		
11	In the North and South Air and Cable Ducts, remove all existing electric cable fireproofing wrap and Transite conduit and all fragments of fireproofing wrap					841		71,022		
12	In the North and South Air and Cable Ducts, remove all existing deteriorated electric cables.					584		49,319		
	Sub-totals	0	0	0	0	6111	0	516,074	0	0
d-xii.	**Service Gallery G-1, G-2, and Service Tunnel S-12** (20X10X470)									
1	Remove approximately 1000' of existing HTHW pipelines with damaged or deteriorated insulation and all fragments of insulation. This insulation has tested positive for asbestos or probable ACM					858		72,458		
2	Abate any loose or fallen paint chips. The paint chips have tested positive for lead based material.					98		8,276		
3	Clean tunnel walkways of extraneous debris and taconite fines.					168		14,188		
4	Kill and clean mold from gallery and tunnel surfaces					30		2,534		
	Subtotal	0	0	0	0	1154	0	97,455	0	0
d-xiii.	**Service Gallery G-3 North Pipeway** (20X10X700)									
1	Remove approximately 1500' of existing HTHW pipelines with damaged or deteriorated insulation and all fragments of insulation. This insulation has tested positive for asbestos or probable ACM					1296		109,447		
2	Abate any loose or fallen paint chips. The paint chips have tested positive for lead based material.					80		6,756		
3	Clean tunnel walkways of extraneous debris and taconite fines.					260		21,957		
4	Kill and clean mold from gallery and tunnel surfaces					30		2,534		
	Subtotal	0	0	0	0	1666	0	140,694	0	0
d-xiv.	**Service Gallery G-4 South Pipe way, G-5 Gallery, and Service Tunnel S-13** (20X10X2200)									
1	Remove approximately 4500' of existing HTHW pipelines with damaged or deteriorated insulation and all fragments of insulation. This insulation has tested positive for asbestos or probable ACM					2900		244,905		
2	Abate any loose or fallen paint chips. The paint chips have tested positive for lead based material.					355		29,980		
3	Clean tunnel walkways of extraneous debris and taconite fines.					576		48,643		
4	Kill and clean mold from gallery and tunnel surfaces					100		8,445		
	Subtotal	0	0	0	0	3931	0	331,973	0	0
	Totals	0	0	0	0	12862	0	$1,086,196	0	0

Supervision & Field Administration	Man-hours est.	804	Est. Cost	78,310
Craft support (Carpenters, teamster, Misc operator, Misc labor)	Man-hours est.		Est. Cost	
Estimated Equipment Costs (itemize)			Est. Cost	$102,260.00
Estimated Material Costs (Itemize)			Est. Cost	$15,000.00
Estimated Misc. Costs (Itemize)			Est. Cost	$253,470.00
			Total Estimated Cost	$1,535,236

Coarse Crusher

Misc Cost Breakdown

Air Samples	$1,000
Haul & Dispose of ACM	$48,430
Dispose of Lead Based Paint Scrapings	$2,750
Insurance (1%)	$7,400
MDH Fees	$5,870
Admin Exp (phones, office, facilities,etc.)	$5,200
HAZ/Reg Waste Collection	$20,000
Stair/Railing Repair	$10,000

SUBCONTRACT TOTAL ========> $100,650

Fine Crusher

Misc Cost Breakdown

Air Samples	$600
Haul & Dispose of ACM	$18,360
Dispose of Lead Based Paint Scrapings	$2,750
Insurance (1%)	$3,615
MDH Fees	$2,445
Admin Exp (phones, office, facilities,etc.)	$3,455
Scaffold	$21,000
Reg/Haz Waste Collection/Disposal	$8,125
SUBCONTRACT TOTAL ========>	$60,350

Service Tunnels

Misc Cost Breakdown

Air Samples	$1,600
Haul & Dispose of ACM, Fines, Salvage	$60,610
Dispose of Lead Based Paint Scrapings	$390
Insurance (1%)	$2,790
MDH Fees	$3,780
Admin Exp (phones, office, facilities,etc.)	$2,190
Access Construction (BUDGET)	$5,000
SUBCONTRACT TOTAL ========>	$76,360

Electrical Tunnels

Misc Cost Breakdown

Air Samples	$1,500
Haul & Dispose (acm, salvage)	$57,120
Dispose of Lead Based Paint Scrapings	$2,750
Insurance (1%)	$16,800
MDH Fees	$17,300
Haz/Reg Waste collection/disposal	$25,000
Admin Exp (phones, office, facilities,etc.)	$16,473
SUBCONTRACT TOTAL ========>	$136,943

CONCENTRATOR

Misc Cost Breakdown

Air Samples	$1,500
Haul & Dispose of ACM	$25,840
Dispose of Lead Based Paint Scrapings	$2,750
Insurance (1%)	$14,820
MDH Fees	$15,560
Admin Exp (phones, office, facilities,etc.)	$5,000
Reg/Haz Waste Collection/Disposal	$45,000
Scaffold	$143,000

SUBCONTRACT TOTAL ========> $253,470

Attachment C3

Mavo ACM Estimate Bid Form

Asbestos Abatement Cost Proposal - Bid Form

Scope of Work Description	Reference Information	Asbestos Removal & Disposal Costs
Legacy Area 1 - used by project		
Area 1 Shop and Truck Storage (Bldg. 220)	ACT Report Zone H	$82,500
Area 1 Cold Storage (Bldg. 221)	No ACT report	$5,000
Area 1 Reporting Building (Bldg. 231)	No ACT report	$5,000
Area 1 Boiler House (Bldg. 226)	ACT Report Zone H	$2,500
Area 1 Fire Pump House & Water Tank (Bldg. 228)	ACT Report Zone H	$2,500
Legacy Area 2 - used by project		
Area 2 Service Shop (Bldg. 201)	ACT Report Zone I	$93,050
Area 2 Truck Storage (Bldg. 202)	ACT Report Zone I	$3,000
Area 2 Cold Storage (204)	ACT Report Zone I	$3,000
Area 2 Shop Locomotive Service Shop (Bldg. 203)	ACT Report Zone I	$52,150
Hose House (Bldg. 209)	No ACT report	$2,500
Sample House (Bldg. 208)	No ACT report	$5,000
Reporting Building (Bldg. 425)	No ACT report	$3,500
Area 2 Shop Locomotive Fueling	ACT Report Zone I	$2,500
Legacy Tailings Basin Buildings - used by project		
Foreman's Office (Bldg. 718)	No ACT report	$6,500
Reporting Building (Bldg. 719)	No ACT report	$6,500
Lube House (Bldg. 720)	No ACT report	$2,500
Reporting Building (Bldg. 724)	No ACT report	$2,500
Lube Oil Building (Bldg. 725)	No ACT report	$2,500
Legacy Plant Area - used by project		
Rebuild Shop (Bldg 602)	ACT Report Zone A	$85,000
General Shop (Bldg. 601)	ACT Report Zone A	$480,800
Carpenter Shop (Bldg. 603)	ACT Report Zone A	$2,500
Warehouse 49 (Bldg. 920)	ACT Report Zone A	$49,000
Warehouse 45 (Bldg. 921, Electrical)	ACT Report Zone A	$13,500
Lube House (Bldg. 926)	ACT Report Lubricant Storage Building	$52,000
Rubber Shop (Bldg. 605)	ACT Report Rubber Storage Building	$24,000
Water Treatment Plant & Storage Tanks	ACT Report Water Treatment Plant	$45,000
Colby Pump House	No ACT report	$2,500
Administration Building	ACT Report Administration Building	$850,000
Main Gate	No ACT report	$5,000
Sewage Treatment Plant	No ACT report	$5,000
Return Water Barge	No ACT report	$5,000

Total ACM Abatement Cost: **$1,902,000**

Attachment D

Arrowhead ACM Survey Estimate

Attachment D1

Arrowhead ACM Survey Estimate

Arrowhead Consulting & Testing, Inc.
5606 Miller Trunk Highway • Duluth, Minnesota 55811 • Phone: 218/729-0987 • Fax: 218/729-8297

May 20, 2016

Mr. Michael Glissman
PolyMet Mining
P.O. Box 475
County Highway 666
Hoyt Lakes, Minnesota 55720

RE: **Asbestos Inspections - Miscellaneous Buildings**
Hoyt Lakes, Minnesota

In response to your request for proposal, Arrowhead Consulting & Testing, Inc., (Arrowhead) is pleased to provide PolyMet Mining (PolyMet) with the following proposal for an asbestos inspections of 10 miscellaneous buildings located at PolyMet in Hoyt Lakes, Minnesota. This document provides Arrowhead's scope of work, qualifications and fees for services provided per your request.

SCOPE OF WORK

Arrowhead will identify, quantify, sample and analyze suspect asbestos-containing materials (ACM) located throughout the Coarse and Fines Crushers. The Asbestos Hazard Emergency Response Act (AHERA) guidelines will be followed when conducting the inspection. A report will be prepared documenting, in an excel spreadsheet, the ACM identified by the inspection.

A Minnesota certified and licensed asbestos inspector will perform the inspection and sample collection. Three to nine samples will be collected for each suspect homogeneous ACM based upon surfacing area and material type. The sample materials will be grouped into homogeneous areas. An accredited laboratory (NVLAP certified) will perform analysis of suspect ACM. Analysis will be conducted only on the minimum number of samples required to confirm a material is ACM. However, as per the 40 CFR (EPA regulations) protocol for laboratory analysis of suspect ACM, analysis of all homogeneous samples will be conducted on any material determined to be non-asbestos-containing, to provide an adequate confirmation of the analytical results.

PROJECT COST

One Arrowhead asbestos inspector will inspect suspect asbestos containing materials including roofs and exterior siding. Arrowhead will collect samples of suspect ACM identified during the inspection and analyze the samples for asbestos content. The cost to provide these services is on a time and materials not to exceed cost. The following list summarizes the building cost to complete each building inspection.

Building	Cost
Building 951- Main Gate	$900.00
Building 231 – Reporting Building	$850.00
Sewage Treatment Plant	$900.00
The Barge (Return Water Barge)	$1300.00
Building 724	$900.00
Building 718	$1100.00
Building 719	$1100.00
Building 725	$850.00
Building 720 (Lube House)	$850.00
Building 709 (Colby Lake Pump House)	$1000.00

The costs are based upon completing each building individually as separate trips. The cost will be reduced if more than one building is inspected in one trip. PolyMet will only be charge for the number of samples analyzed for the project.

TIME TABLE

Arrowhead can begin the assessment within one week upon award of the contract. One Arrowhead professionals will collect the field data. It is estimated that five days will be needed to complete the inspection.

Arrowhead will compile the field data and submit a formal report within two weeks of completion of the inspection. The formal report will include an excel spreadsheet, documenting both non-asbestos and asbestos containing materials.

SAFETY

Arrowhead understands and respects the safety concerns of PolyMet Mining. Arrowhead personnel will provide the necessary safety equipment to safely perform the inspection, and will comply with PolyMet *Independent Contractor Safety Program*.

If you have any questions regarding the information provided, please call me at (218) 729-0987. We look forward to your favorable response.

Sincerely,
Arrowhead Consulting & Testing, Inc.

Linda K. Thiry

Linda K. Thiry
Owner/Industrial Hygienist

Attachment D2

Arrowhead ACM Survey Estimate

Arrowhead Consulting & Testing, Inc.
5606 Miller Trunk Highway • Duluth, Minnesota 55811 • Phone: 218/729-0987 • Fax: 218/729-8297

June 23, 2016

Mr. Michael Glissman
PolyMet Mining
P.O. Box 475
County Highway 666
Hoyt Lakes, Minnesota 55720

RE: **Asbestos Inspections – Additional Miscellaneous Buildings**
Hoyt Lakes, Minnesota

In response to your request for proposal, Arrowhead Consulting & Testing, Inc., (Arrowhead) is pleased to provide PolyMet Mining (PolyMet) with the following proposal for an asbestos inspections of 10 miscellaneous buildings located at PolyMet in Hoyt Lakes, Minnesota. This document provides Arrowhead's scope of work, qualifications and fees for services provided per your request.

SCOPE OF WORK

Arrowhead will identify, quantify, sample and analyze suspect asbestos-containing materials (ACM) located throughout the Coarse and Fines Crushers. The Asbestos Hazard Emergency Response Act (AHERA) guidelines will be followed when conducting the inspection. A report will be prepared documenting, in an excel spreadsheet, the ACM identified by the inspection.

A Minnesota certified and licensed asbestos inspector will perform the inspection and sample collection. Three to nine samples will be collected for each suspect homogeneous ACM based upon surfacing area and material type. The sample materials will be grouped into homogeneous areas. An accredited laboratory (NVLAP certified) will perform analysis of suspect ACM. Analysis will be conducted only on the minimum number of samples required to confirm a material is ACM. However, as per the 40 CFR (EPA regulations) protocol for laboratory analysis of suspect ACM, analysis of all homogeneous samples will be conducted on any material determined to be non-asbestos-containing, to provide an adequate confirmation of the analytical results.

PROJECT COST

One Arrowhead asbestos inspector will inspect suspect asbestos containing materials including roofs and exterior siding. Arrowhead will collect samples of suspect ACM identified during the inspection and analyze the samples for asbestos content. The cost to provide these services is on a time and materials not to exceed cost. The following list summarizes the building cost to complete each building inspection.

Building	Cost
Building 208	$950.00
Building 209	$850.00
Building 425	$850.00

The costs are based upon completing each building individually as separate trips. The cost will be reduced if more than one building is inspected in one trip. PolyMet will only be charge for the number of samples analyzed for the project.

TIME TABLE

Arrowhead can begin the assessment within one week upon award of the contract. One Arrowhead professionals will collect the field data. It is estimated that five days will be needed to complete the inspection.

Arrowhead will compile the field data and submit a formal report within two weeks of completion of the inspection. The formal report will include an excel spreadsheet, documenting both non-asbestos and asbestos containing materials.

SAFETY

Arrowhead understands and respects the safety concerns of PolyMet Mining. Arrowhead personnel will provide the necessary safety equipment to safely perform the inspection, and will comply with PolyMet *Independent Contractor Safety Program*.

If you have any questions regarding the information provided, please call me at (218) 729-0987. We look forward to your favorable response.

Sincerely,
Arrowhead Consulting & Testing, Inc.

Linda K. Thiry

Linda K. Thiry
Owner/Industrial Hygienist

Attachment E

Lakehead Additive Building and Heating Plant Estimate

Attachment E1

Lakehead Additive Building and Heating Plant Estimate

NorthMet Project

Heating & Additives Plant – Demolition Specification

August 16, 2016
Revision 1

Table of Contents

Attachments:

Enclosure 1 - Standard Form Contract
Enclosure 2 - MSHA Requirements
Enclosure 3 - General Conditions
Enclosure 4 - Safety Policy
Enclosure 5 - Environmental Policy

Exhibit A - Project Labor Agreement with Signature Page
Exhibit B - Confidentiality Agreement

Figures 1-2

Figure 1	Building Locations (Overview)
Figure 1 A	Process Plant Detail
Figure 2	Pipe Gallery/Tunnel Detail

Heating & Additives Plant Drawing Index and Reference Drawings Package

Heating & Additives Plant Asbestos and Lead Survey Reports (Zones D and E)

1.0 Background

PolyMet Mining Corporation (PolyMet) is a publicly traded mine development company with operational headquarters near the Company's mine in Hoyt Lakes, Minnesota, and executive offices in St. Paul, Minnesota. PolyMet is developing a copper-nickel-precious metals project in the established mining district of the Mesabi Iron Range in northeastern Minnesota. PolyMet controls 100% of the NorthMet ore deposit and owns a large crushing and grinding facility with extensive associated infrastructure, where it plans to process copper, nickel, gold, and platinum group metal ores from the NorthMet mine. The NorthMet Project (Project) would become the first non-ferrous ore mining operation in Minnesota. Shares are traded on the New York Stock Exchange (NYSE-A: PLM) and Toronto Stock Exchange (TSX: POM).

PolyMet is progressing with a two phased design, construction, and production plan. Phase I involves construction of the mine and related facilities, reconditioning and upgrading of the existing plant, construction of a flotation plant, and construction of a rail load-out facility for production of a dual filter cake. Products produced after Phase I construction include a copper rich concentrate and a nickel rich concentrate also holding platinum group metals.

Phase II includes the design, construction, and commissioning of a new hydrometallurgical facility and oxygen plant. Once completed, PolyMet will produce a combination of copper filter cake, nickel filter cake, nickel/cobalt hydroxide and gold/platinum group precipitate.

PolyMet designed its facility to maximize the reuse of the LTV Steel Mining Company's Erie Plant brownfield site and existing infrastructure.

2.0 Introduction

PolyMet is in the advanced stages of the environmental review process and anticipates receiving the necessary permits to begin construction later this year. PolyMet intends to ensure the safety and health of everyone who enters the site. The existing Heating and Additives Plants have been identified as potential hazardous areas, therefore they will need to be razed to grade level.

Work on the Heating and Additives Plants includes equipment salvage, demolition work, and asbestos removal. This work is identified in Section 9.0 of this specification.

3.0 Request for Proposal

PolyMet is requesting proposals for demolition of structures and equipment associated with the Heating and Additives Plant as described in Section 9.0 of this specification. These demolition activities are driven by the current conditions of the facilities with regards to health and safety.

- PolyMet is seeking lump sum bids for the Heating and Additives Plant demolition activities as described in Section 9.0 of this specification. Contractor will retain all salvage materials unless noted otherwise.

4.0 Bidding Schedule

Site visitations can be conducted beginning May 13th, 2015 and bids are due on June 1st, 2015. Changes to the bidding schedule will be considered upon request.

5.0 Specification Support Documents

This specification includes:

- Pages 1-11 of this document
- Figures 1-2 referenced in specification
- Heating & Additives Plant drawing package per drawing index
- Heating & Additives Plant asbestos and lead survey reports

6.0 Proposal Requirements

The demolition estimates shall include the following as a minimum:

- Asbestos remediation cost estimate by facility listed in Section 9.
- Reclamation dirt work and seeding cost estimate by facility listed in Section 9.
- Concrete demolition cost estimate by facility listed in Section 9.
- Salvage value estimate broken down by salvage area (i.e. structural steel, electrical wire, equipment, etc.) by facility listed in Section 9.
- List of assumptions from which the proposal is based. Wherever possible describe any engineering concepts or assumptions from which the proposal is based (i.e. concrete will be crushed and used for fill, siding will be placed in landfill, etc.)

- List of exceptions to requests in the proposal including reason for exception.
- Biography of Contractor including any relevant experience in relation to the Contract.
- Experience working with Governmental Agencies (i.e. MDNR, MPCA, EPA) and Owner's agents to fulfill structure and equipment demolition obligations.
- An outline describing the major aspects of the Contractor's Safety Program shall be supplied.
- A performance bond may be required. Provide information regarding any bonding capability, an indication of willingness to bond, and costs associated with bonding that would be passed on to PolyMet.

7.0 Contract Objective

The objective of the Contract is to place the facilities listed in Section 9 in a safe, secure, environmentally stable condition. In general, all environmental concerns will be evaluated, environmental hazards will be remediated, all buildings and structures will be demolished, and all associated sites reclaimed and vegetated.

8.0 General Demolition Requirements

The following are general demolition requirements for the Contractor:

- Asbestos must be removed. The asbestos shall be disposed of at an off-site landfill approved by the U.S. Environmental Protection Agency which is operated in accordance with 40 CFR Section 61.154. If the landfill is operated in the state of Minnesota, ensure it is a MPCA approved solid waste facility permitted to accept the waste.
- The Contractor is responsible to obtain permits and submit all reports required by the state and federal agencies.
- Removal of asbestos containing Galbestos siding must be removed from the building in an environmentally safe manner so that no material is allowed to become airborne. Contractor must have an asbestos certified Site Supervisor oversee the removal of the Galbestos siding in accordance with all state and federal agencies. The Galbestos siding shall be disposed of at an off-site landfill approved by the U.S. Environmental Protection Agency which is operated in accordance with 40 CFR Section 61.154. If the landfill is operated in the state of Minnesota, ensure it is a MPCA approved solid waste facility permitted to accept

the waste.

- Removal of hazardous materials is the responsibility of the Contractor. Contractor must have a hazardous waste subcontractor inspect, inventory, remove and dispose of all hazardous waste. The Contractor is responsible to obtain permits and submit all reports required by the state and federal agencies.
- Removal of lead based paint is the responsibility of the Contractor. Contractor must have a licensed subcontractor inspect, inventory, remove and dispose of all lead based paints in accordance with all regulatory agency notification reports/permits.
- Contractor is responsible for the disposal of any item that has petroleum residue (in or on it), lead painted items, PCB containing or contaminated items, mercury containing or contaminated items (including lamps), CFC refrigeration devices, electrical transformers and related fluids, and batteries, etc.
- Concrete from the building demo may be used to fill in the existing foundations. Concrete that is crushed and used as fill material shall be no greater than 4" in diameter.
- Roofing must be characterized as asbestos containing or asbestos free. The asbestos containing roofing shall be disposed of at an off-site landfill approved by the U.S. Environmental Protection Agency which is operated in accordance with 40 CFR Section 61.154. If the landfill is operated in the state of Minnesota, ensure it is a MPCA approved solid waste facility permitted to accept the waste. The Contractor must secure the appropriately knowledgeable, certified, and/or licensed personnel to perform all asbestos abatement activities. The Contractor is responsible to obtain permits and submit all reports required by the state and federal agencies. Asbestos free roofing may be sold by the Contractor.
- Buildings must be demolished to ground level. Specific elevations are shown in Section 9. All existing floors below ground level may be left in place.
- Contractor shall provide filling of basements and the foundations will be covered with a minimum of two feet of surface overburden according to Minnesota Rules 6132.3200.
- Contractor shall plan to supply electricity from the Main Substation, water, offices, sanitary facilities, etc. as these items may not be available at the work site.
- MSHA requirements must be met while performing demolition work at PolyMet.
- Contractor will control, clean up and dispose of all environmental releases as no releases of soils, waters, or liquids will leave the work site area.

- Services and utilities will be severed by others prior to commencement of demolition work.
- Demolition will require a General NPDES Construction Permit.
- Contractor shall provide PolyMet or MDNR with copies of all reports and permits that are required.
- Contractor will have access to the PolyMet site for an extended period while preparing the package.

Notes:

- An asbestos and lead paint inventory has been performed for the Heating and Additives Plant. The asbestos reports are provided as an attachment to this specification.
- PCB containing or contaminated items have been inventoried and removed from the PolyMet site. It is anticipated that no new PCB containing devices will be brought on site.

9.0 2015 Health and Safety Demolition Sites

Within the summer/fall of 2015, all building and structures listed in Section 9.0 will be removed and foundations razed to grade level. Demolition of the structures listed is necessary to eliminate possible health and environmental hazards. This includes asbestos and possible mold contained within, degradation of support structures due to lack of upkeep and water damage, and deteriorated processing related buildings or power grid structures.

The timing of demolition for the individual buildings shall be suggested by the Contractor. All facilities listed in Sections 9.1.1 to 9.1.3 will be demolished over a maximum one year.

Reference Sections 9.1.1 to 9.1.3 for details for building, area or equipment locations listed as headings in the following sections. .

For major process equipment reference the Equipment List (attached).

9.1.1 Heating/Additive Plant (Soda Ash Silos)

The heating plant houses coal and natural gas boilers that were used to heat all of the site facilities with high temperature hot water. The additive plant houses tanks and material handling equipment that fed additives to the old taconite process. The Heating and Additive plant buildings will not be used as part of the Project and will be demolished during 2015 dependent upon scheduling with the Contractor.

The heating/additive plant contains the following large equipment in addition to many auxiliary systems:

- (2 ea) coal fired boilers (1950's vintage)
- (2 ea) natural gas fired boilers (1990's vintage)
- Compressors
- Tanks
- Pumps
- Conveyor

The site shall be left as follows:

- Remove all equipment (including boilers), piping, wiring, ductwork, equipment structures, etc. from interior of building of both the Heating and Additive buildings.
- Demolish the Heating and Additive buildings to elevation 1581'-0" including the conveyor gallery, G-6 gallery, and Soda Ash silos.
- To remain in PolyMet's possession after demolition are 4 high voltage transformers located in both heating and additive plant. These transformers will be flagged by PolyMet prior to demolition.
- Place clean fill in basement below elevation 1581'-0".
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

Reference drawings for the heating/additive plant include:

TC-297	Storage and Handling of Additives Coal Handling Drag Conveyors 1A to 1D General Arrangement
TC-298	Storage and Handling of Additives Additive Plant Coal Drying System with 14'-0" Cyclone Elevations Plan C B/M
TC-307	Storage and Handling of Additives Additive Plant General Arrangement Plan
TC-308	Storage and Handling of Additives Additive Plant General Arrangement Elevations A-A & B-B
TC-309	Storage and Handling of Additives Additive Plant

	General Arrangement Elevations C-C & D-D
TC-475	Storage and Handling of Additives Structural Steel Elevations & Sections
TC-641	Storage and Handling of Additives General Arrangement Plans & Elevations
TC-701	Storage and Handling of Additives Coal Drying and Grinding General Arrangement Elevations
TC-702	Storage and Handling of Additives Coal Drying and Grinding General Arrangement Elevation and Plans
TC-704	Pelletizing Plant Pipe Gallery G-7 Service Piping General Arrgt, Details & B/M
TC-710	Storage and Handling of Additives Starch Handling 6” Screw Conv. 3 9 Merchen Scale Feeder Arrangement, Details & B/M
TJ-114	Heating & Compressor Plant Operating Floor Plan Location of Foundations and Openings
TJ-115	Heating & Compressor Plant Cross Sections thru Boiler and Compressor Foundations
TJ-116	Heating & Compressor Plant General Arrangement Basement Plan
TJ-117	Heating & Compressor Plant General Arrangement Operating Floor Plan
TJ-119	Heating & Compressor Plant General Arrangement Cross Section X – X
TC-464	Storage & Handling of Additives Structural Steel Column Location Plan
TC-472	Storage & Handling of Additives Structural Steel Starch Bins Sections & Details
TC-1217	Storage & Handling of Additives Concrete Masonry & Reinfig Additive Building Floor Slab in Unloading Shed

Additional Resources (Heating Plant):

File Type	Number	Description
TJ-12	102	Demolition Plan & Sections
TJ-12	103	Underground Plumbing Plan Detail
TJ-12	104	Basement Plumbing Plan Detail
TJ-12	105	Floor Plan- HTTW, Glycol Piping
TJ-12	106	Floor Plan- Compressed Air, Safety Valve, Fuel Oil & Natural Gas Piping

TJ-12	107	Building Section
TJ-12	108	Building Section
TJ-12	109	Sections
TJ-12	110	Control and Instrumentation Diagram
TJ-12	111	Systems Flow Diagram
TJ-12	112	Diagrams
TJ-12	113	Details
TJ-12	114	Details
TJ-12	115	Schedules
TJ-12	1031	Electrical Floor Plan
TJ-12	1032	Existing Schematics
TJ-12	1033	Existing Wiring Diagrams MCC
TJ-12	1034	MCC
TJ-12	1035	Electrical Legend Schedule Details

Additional Resources (Additives Plant):

File Type	Number	Description
TC	482	misc. structure
TC	479	Roofing Siding Detail
TC	480	Roofing Siding Detail
TC	481	Platform Electrical Control Room
EDR-T	921	Soda Ash Silo (Portible Pump)
TJ	81	Sewage Piping
TC	490	Anthro Fine bin
TC	491	Anthro Fine bin
TG	251	Piping Yard Survey (gilsulate)
TC	87	Demo
TC	703	Pipe support gallery
TC	388	Demo
TC	472	Starch bin
TJ	107	Clad Cinder Demo (TJ 106)
TC	304	Drag chain
TC	305	Equipment & Drag Chain
EDR-T	946	Cyclone Ganite Lining & Fan Drive motor = appx. 200hp
TC	466	Coal Bunker (467-468 & 483)
TH	106	Shuttle Conveyor (parting line info) Anthrocite Bunker

TH	107	Shuttle Conveyor (parting line info)
TC	484	misc. Structure
TC	485	Platforms
TJ	217	Heating Plant annex
TC	288	Fire Wall annex
TC	289	Hot Air Stack
TC	463	Roofing Structure (464-465)
JC	928	Ash Piping
TC	922	Shoots Cyclone (light steel)
TC	464	Roofing Structure
TC	1217	Unloading Shed
TC	475	misc. structure
TJ	62	Insulated Building- Galbestos (E-DRT by H.H Robertson)
TJ	216	Heating (217-218)
TC	469	Bentonite/Ash Bins (470-471)
TJ	140	Flash Vessel Expansion Tank
TD	2	Electrical Print

11.0 Demolition Waste Disposal Plan

Concrete from demolition will be crushed to 4" or smaller and placed in building basements. All remaining non-hazardous demolition waste shall be disposed of in an off-site landfill.

12.0 Special Material Disposal

Surveys for Asbestos-Containing Materials (ACMs) have been completed. ACMs (siding, hot water heating system insulation, lube system insulation, floor tile, etc.) from structure demolition will be removed, properly packaged and disposed in an off-site landfill approved by the U.S. Environmental Protection Agency which is operated in accordance with 40 CFR Section 61.154. If the landfill is operated in the state of Minnesota, ensure it is a MPCA approved solid waste facility permitted to accept the waste.

Partially used paint, chemical and petroleum products will be collected and properly disposed.

Fluorescent and sodium halide bulbs will be removed from fixtures collected and properly disposed.

13.0 Cover and Vegetation of Building Area

After demolition of facilities listed in Section 9, 2 feet of overburden material suitable for vegetation will be placed upon the facility's former footprint.

Building areas will be reclaimed and vegetated according to Minnesota Rules 6132.2700.

Attachment E2

Lakehead Additive Building and Heating Plant Estimate

LAKEHEAD constructors inc.
Safety • Quality • Service • Innovation
ISO 9001 • Registered Quality System • LAKEHEAD CONSTRUCTORS

PolyMet Mining, Inc. 3/3, 2016
PO Box 475
County Highway 666
Hoyt Lakes, MN 55750

Attn: Mr. Steve DeVaney

Re: Heating / Additive Plant Demolition

Mr. DeVaney:

Lakehead Constructors, Inc. (LCI) appreciates the opportunity to provide this proposal for the Northmet Project Heating & Additives Plant Demolition as described in the May 11 2015 specifications, associated drawings and documents as found on your drop box site, our site visit and conversations and on the clarifications below;

Work Included Pricing Estimate:

- Permit Fees and Notification
- Appropriate competent supervision for work provided by Rachel Contracting
- Mobilization and perdiem costs
- Engineering Surveys and erosion control BMP's
- Remove asbestos materials to materials identified in Arrowood Consulting reports dated June 2006 in compliance to current EPA, MPCA & Department of Health regulations
- Collection of Regulated and universal wastes

Heating Plant

- Complete removal of heating plant to 1' below surrounding grade
- Transport C&D waste to on-site landfill (SW-619)
- Backfill basement void with on-site tailing within 5 mile radius
- Top with on-site backfill and seed disturbed area upon completion

Additives Plant

- Demolition of building structure and remaining equipment in the additives plant to finish floor elevation matching surrounding grade
- Transport C&D waste to onsite landfill (SW-619)
- Fill in basement area of additives plant with tailings material supplied by Northmet
- Cap & grade remaining slab and foundations with 1.5' of cover (tailings)
- Place 6" topsoil layer and provide turf establishment

Project Assumptions

- Project will start in the summer or fall of 2016 (non-freezing months)
- Rachel Contracting retains all rights revenues from scrap and salvageable equipment remaining in the structures per site visit in June of 2015.
- Removal and disposal or residual product in tanks will be done on time and material basis

Work Excluded:

- Removal of any asbestos or other environmental hazards not identified in the surveys
- Concrete or foundation removal below 1st level top of finish slab existing slab elevation
- Allowances or costs for disconnection or abandonment of any utilities serving the buildings

Estimated Cost of Decommissioning Services:

Lump sum:	$1,385,800
ADD FOR OFF SITE DISPOSAL OF ASBESTOS AND C&D	$107,500
Add: Budgetary allowance for removal of remaining products in tanks	$100,000

All labor, equipment, materials, fuel and scrap values were priced at the values in February 2016. Pricing is good for 30 days & may fluctuate if project is delayed.

Thank you for the opportunity to present this proposal for your review. We trust it is complete and responsive to your needs. Our acceptance of your offer of a contract to perform this work will be contingent upon mutually agreeable contract terms and conditions between Polymet and Lakehead Constructors, Inc.

Sincerely,

Brad Jones

Brad Jones
Lakehead Constructors, Inc.

General Contractors and Equipment Rental Specialists
Main Office: 2916 Hill Avenue • Superior, WI 54880-5560 • 715/392-5181 • Fax 715/392-7566
Mt. Iron Branch: 8371 North Enterprise Drive • Mt. Iron, MN 55792 • 218/744-1497 • Fax 218/741-8032
www.lakeheadconstructors.com
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AISC CERTIFIED ERECTOR

Attachment F

Lakehead Other Than Additive Building and Heating Plant Estimate

Attachment F1

Lakehead Other Than Additive Building and Heating Plant Estimate

POLYMET
MINING

NorthMet Project

Closure and Demolition Specification (Structures and Equipment Only)

June 30, 2016
Revision 6

Table of Contents

Attachments

Figures 1-8

1.0 Background

PolyMet Mining Corporation (PolyMet) is a publicly traded mine development company with operational headquarters near the Company's mine in Hoyt Lakes, Minnesota, and executive offices in St. Paul, Minnesota. PolyMet is developing a copper-nickel-precious metals project in the established mining district of the Mesabi Iron Range in northeastern Minnesota. PolyMet controls 100% of the NorthMet ore deposit and owns a large crushing and grinding facility with extensive associated infrastructure, where it plans to process copper, nickel, gold, and platinum group metal ores from the NorthMet mine. The NorthMet Project (Project) would become the first non-ferrous ore mining operation in Minnesota. Shares are traded on the New York Stock Exchange (NYSE-A: PLM) and Toronto Stock Exchange (TSX: POM).

PolyMet is progressing with a two phased design, construction, and production plan. Phase I involves construction of the mine and related facilities, reconditioning and upgrading of the existing plant, construction of a flotation plant, and construction of a rail load-out facility for production of a dual filter cake. Products produced after Phase I construction include a copper rich concentrate and a nickel rich concentrate also holding platinum group metals.

Phase II includes the design, construction, and commissioning of a new hydrometallurgical facility and oxygen plant. Once completed, PolyMet will produce a combination of copper filter cake, nickel filter cake, nickel/cobalt hydroxide and gold/ platinum group precipitate.

PolyMet designed its facility to maximize the reuse of the LTV Steel Mining Company's Erie Plant brownfield site and existing infrastructure.

2.0 Introduction

PolyMet is in the permitting process. As part of the Minnesota Department of Natural Resources' (MDNR) Permit to Mine, PolyMet will be required to provide adequate financial assurance to the State of Minnesota for proper closure of the Project. The planned closure of the Project is 20 years after startup, however, a condition of the Permit to Mine requires that the possibility of early closure is taken into account. The Permit to Mine will require the closure plans and the instrument of financial assurance to be updated annually. The updated closure plans and instrument of financial are submitted to the MDNR for review and acceptance that the financial assurance is sufficient to meet the existing obligations of closure and remediation.

At the time that the Permit to Mine is issued, PolyMet will have entered into a financial assurance agreement with the MDNR and provided the financial instrument that will guarantee payment for the closure of the project.

There will be salvage, demolition work and asbestos removal required during the pre-construction and construction phase of the Project. That work is not part of this scope of work specification.

3.0 Request for Demolition Estimate

PolyMet is requesting an estimate for demolition of structures and equipment associated with the Project as described herein.

This document presents the specification for demolition of structures and equipment components of the Project in two parts:

- PolyMet is seeking an estimate for Year 1 demolition activities as shown in Section 8.0 of this specification.
- PolyMet is also seeking estimates for future plant closure demolition activities (i.e. Year 20) as generally described previously. These activities are described in Section 9 of this specification.

There are two components to our site that need to be considered for each portion of the estimate:

- The Plant Site components are the portions of Cliffs Erie Plant Site acquired by PolyMet (see 8.1.1 to 8.1.29, and 8.2.1 to 8.2.6) and portions of the Plant Site to be constructed as part of the Project (see 9.1.1 to 9.1.3 and 9.3.1).
- The mine components are new facilities to be constructed at the Mine Site (see 9.2.1 to 9.2.3).

Notes:

- The planned closure of the Project is 20 years after startup. . However, an unforeseen closure could occur anytime.

4.0 Specification Support Documents

This specification includes:

- This specification document
- Figures 1- 9 referenced in specification
- Plant Site drawing package per drawing index
- Plant Site asbestos and lead survey reports
- Process equipment list (see attachments)
- PolyMet demolition quantity estimates (as reference where available)
- Mine Site drawing package

- Process Flow Diagrams – Process flow diagrams are provided for the existing plants and concentrate handling areas. An entire process flow diagram is available if required. In order to obtain a copy of the entire process flow diagram including the flotation area then the Contractor must enter into a confidentiality agreement with PolyMet.

5.0 Estimate Requirements

The demolition estimates shall include the following as a minimum:

- Reclamation dirt work and seeding cost estimate by facility listed in Section 8 and 9.
- Concrete demolition cost estimate by facility listed in Section 8 and 9.
- List of assumptions from which the proposal is based. Wherever possible describe any engineering concepts or assumptions from which the proposal is based (i.e. concrete will be placed in crusher basement, siding will be placed in landfill, etc.)
- List of exceptions to requests in the proposal including reason for exception.
- Biography of Contractor including any relevant experience in relation to the Contract.
- Experience working with Governmental Agencies (i.e. MDNR, MPCA, EPA) and Owner's agents to fulfill structure and equipment demolition obligations.
- An outline describing the major aspects of the Contractor's Safety Program shall be supplied.
- A performance bond may be required with yearly Contract. Provide information regarding any bonding capability, an indication of willingness to bond, and costs associated with bonding that would be passed on to PolyMet.
- Preliminary design drawings (i.e. layouts, arrangements) are provided for the Contractor for the demolition of new facilities. Note that the drawings shown are preliminary design layouts. PolyMet will provide more information to the selected Contractor as more detailed design drawings become available. The Contractor will have the opportunity to update the Contract as more detailed information is made available regarding the new facilities to be constructed by PolyMet.

6.0 Closure Estimate Objective

The objective of the Closure Estimate is to accurately estimate the costs to place the facilities listed in Section 8 and 9 in a safe, secure, environmentally stable condition. In general, all environmental concerns will be evaluated, environmental hazards will be remediated, all buildings and structures will be demolished, and all associated sites reclaimed and vegetated.

7.0 General Demolition Requirements

The following are general demolition requirements for the Contractor:

- Asbestos containing Galbestos siding must be removed from the building in an environmentally safe manner so that no material is allowed to become airborne. Contractor must have an asbestos certified Site Supervisor oversee the removal of the Galbestos siding in accordance with all state and federal agencies. The Galbestos shall be disposed of at an off-site landfill approved by the U.S. Environmental Protection Agency which is operated in accordance with 40 CFR Section 61.154. If the landfill is operated in the state of Minnesota, ensure it is a MPCA approved solid waste facility permitted to accept the waste.
- The Contractor is responsible to obtain permits and submit all reports required by the state and federal agencies.
- Removal of hazardous materials is the responsibility of the Contractor. Contractor must have a hazardous waste subcontractor inspect, inventory, remove and dispose of all hazardous waste. The Contractor is responsible to obtain permits and submit all reports required by the state and federal agencies.
- Concrete from the building demo may go to the sites located in Figure 8 “Concrete Demolition Disposal Locations”. Concrete that is crushed and used as fill material shall be no greater than 4” in diameter.
- Roofing must be characterized as asbestos containing or asbestos free. Asbestos free roofing may be sold by the Contractor.
- Buildings must be demolished to ground level. Specific elevations are shown in Section 8 and 9. All existing floors below ground level may be left in place.
- Contractor shall provide filling of basements and the foundations will be covered with a minimum of two feet of surface overburden according to Minnesota Rules 6132.3200.
- Contractor shall plan to supply electricity from the Main Substation, water,

offices, sanitary facilities, etc. as these items may not be available at the work site.

- MSHA requirements must be met while PolyMet is in operation. At closure PolyMet's plant site will be under the jurisdiction of OSHA.
- Contractor will control, clean up and dispose of all environmental releases as no releases of soils, waters, or liquids will leave the work site area.
- Services and utilities will be severed by others prior to commencement of demolition work.
- Demolition will require a General NPDES Construction Permit.
- Contractor shall provide PolyMet or MDNR with copies of all reports and permits that are required.
- Contractor shall assume that all equipment referenced in this specification is left in place for the Contractor at time of closure and that no other entities have salvaged the equipment for value.

Notes:

- An asbestos and lead paint inventory has been performed for the Plant Site. The asbestos reports are provided as an attachment to this specification. Abatement of these materials will take place during the pre-construction phase of the project and are not considered to be part of this scope of work.
- PCB containing or contaminated items have been inventoried and removed from the PolyMet site. It is anticipated that no new PCB containing devices will be brought on site.

8.0 Year 1 Demolition Plan

Within three (3) years after closure begins, all buildings and structures will be removed and foundations razed to grade level. Provisions may be made for continued subsequent use of mine facilities that will have future benefits to the area including, pipelines, transmission lines, roads, and railroad lines. However, for the purposes of this document it shall be assumed that all of the PolyMet facilities must be removed and the facility footprints reclaimed.

All facilities listed in Sections 8.1.1 to 8.1.29 and 8.2.1 to 8.2.6 will be demolished over a maximum period of three years. Facilities described in Section 9.4 may remain in service after closure (see Section 9.4).

For building, area or equipment locations listed as headings in the following sections for the plants reference Figures 1 and 1A for details.

For major process equipment reference the Equipment List (attached) and the Process Flow Diagrams (attached).

For the new facilities preliminary design drawings (i.e. layouts, arrangements) are provided for the Contractor. Note that the drawings shown are preliminary design layouts. The layout of equipment, etc. will change throughout the design process. These drawings show equipment and building sizes that are approximate. PolyMet will provide more information to the selected Contractor as more detailed design drawings become available.

8.1 Existing Facilities

8.1.1 Coarse Crushing Facilities

The Coarse Crusher houses two stages of crushing to reduce crude ore from run-of-mine size (up to 48”) to 6” size. See the process flow diagram (drawing 010-P120-001-001 Rev D and 010-P120-001-002 Rev B) for major equipment reference.

The coarse crusher contains the following large equipment in addition to many auxiliary systems:

- (2 ea) 60” x 102” gyratory crusher
- (2 ea) 900 hp motor
- (8 ea) 36” x 70” gyratory crusher
- (8 ea) 400 hp motor
- (8 ea) Apron feeders
- (2 ea) 60” conveyors
- Overhead cranes
- Dust collection systems

The site shall be left as follows:

- Demolish structure to elevation 1711-0”.
- Remove all equipment, piping, wiring, ductwork, equipment structures, etc. below elevation 1711’-0”.
- Utility tunnels leaving the Coarse Crushing Facility will be sealed and closed in place.
- Basement levels below elevation 1711’-0” may be used for concrete disposal per the specification.
- Place clean fill in basement below elevation 1711-0” or fill with concrete demolition materials from other plant locations before final cover is placed
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

Reference drawings for the Coarse Crusher include:

TA-556	Coarse Crushing Plant Concrete Masonry Plan at El. 1711’-0”
TA-557	Coarse Crushing Plant Concrete Masonry Plan at El. 1711’-0”
TA-558	Coarse Crushing Plant Concrete Masonry Plan at El. 1711’-0”
TA-600	Coarse Crushing Plant Concrete Masonry Reinforcing Change House Foundations
TA-690	Coarse Crushing Plant Concrete Masonry Walls Between Elev. 1668’-6 & Elev.1694-0”
TA-691	Coarse Crushing Plant Concrete Masonry Walls Between Elev. 1668’-6 & Elev.1694-0”
TA-715	Coarse Crushing Plant Concrete Reinforcing Floor @ Elev. 1668’-6 & Elev.1694-0”
TA-716	Coarse Crushing Plant Concrete Reinforcing Floor @ Elev. 1668’-6 & Elev.1694-0”
TA-717	Coarse Crushing Plant Concrete Reinforcing Floor @ Elev. 1668’-6 & Elev.1694-0”
TA-718	Coarse Crushing Plant Concrete Masonry Walls Between El. 1694’-0 & Elev.1711’-0”
TA-719	Coarse Crushing Plant Concrete Masonry Walls Between El. 1694’-0 & Elev.1711’-0”
TA-720	Coarse Crushing Plant Concrete Reinforcing Walls Between El. 1668’-6 & Elev.1694-0”
TA-1-520	Coarse Crusher Change House Locker & Lunch Room Alteration
TA-1-556	Coarse Crushing Plant Silica Assay System Piping Arrangement
TA-1-557	Coarse Crushing Plant Silica Assay System Pump & Sump @ Dust Collector 27N
TA-1-558	Coarse Crushing Plant Silica Assay System Detail 27S Sump & Tailings Sump
010-P120-001-001 Rev D	Area 10 Coarse Crushing Process Flow Diagram
010-P120-001-002 Rev B	Area 10 Coarse Crushing Process Flow Diagram

8.1.2 Drive House 1

Drive House 1 contains the transfer points and drives for the 1A, 1B, 2A, and 2B conveyors.

The drive house contains the following large equipment in addition to auxiliary systems:

- (2 ea) 60" conveyors
- (4 ea) 600 hp primary drive motors and gearcases
- (4ea) 300 hp secondary drive motors and gearcases
- Overhead crane
- Dust collection systems

The site shall be left as follows:

- Demolish the conveyor gallery leading to the Fine Crusher and drive house 1 to elevation 1711-0".
- Remove all equipment, piping, wiring, ductwork, equipment structures, etc. below elevation 1711'-0".
- Seal conveyor tunnel to the Coarse Crushing Facility and close in place.
- Place clean fill in spaces below elevation 1711-0" before final cover is placed.
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

Reference drawings for the Drive House 1 include:

TA-18	Conveyors to Sec. Cr. Plant Junction & Drive House No. 1 Dust Control System Gen. Arrg't & Bill of Material
TA-40	Conveyors to Secondary Crushing Plant 60" Belt Conveyors Nos. 2A & 2B (2nd Unit) General Arrangement and B/M
TA-41	Conveyors to Secondary Crushing Plant 60" Belt Conveyors Nos. 2A & 2B (2nd Unit) Curved Section-Horizontal to Incline Arrangement & Details
TA-42	Conveyors to Secondary Crushing Plant 60" Belt Conveyors Nos. 2A & 2B (2nd Unit) Drive & Take-Up Arrangement & Details Plan
TA-43	Conveyors to Secondary Crushing Plant 60" Belt Conveyors Nos. 2A & 2B (2nd Unit) Drive & Take-Up Long'l Elevation & Sections
TA-44	Conveyors to Secondary Crushing Plant 60" Belt Conveyors Nos. 2A & 2B (2nd Unit) Drive & Take-Up Sections & Details

TA-45	Conveyors to Secondary Crushing Plant 60" Belt Conveyors Nos. 2A & 2B (2nd Unit) Curved Section, Incline to Horizontal Arrangement and Details
TA-46	Conveyors to Secondary Crushing Plant 60" Belt Conveyors Nos. 2A & 2B (2nd Unit) Tail End Arrangement & Details
TA-47	Conveyors to Secondary Crushing Plant 60" Belt Conveyors Nos. 2A & 2B (2nd Unit) Head End Arrangement & Details
TA-48	Conveyors to Secondary Crushing Plant 60" Belt Conveyors #1A & #2A, & #1B & #2B (2nd Unit) Drive House #1 and Transfer Junction General Arrangement.
TA-49	Conveyors to Secondary Crushing Plant 60" Belt Conveyors #1A & #1B (2nd Unit) Head End, Dual Drive & Take-Up Arrangement & Sections
TA-50	Conveyors to Secondary Crushing Plant 60" Belt Conveyors #1A & #1B (2nd Unit) General Arrangement and B/M
TA-51	Conveyors to Secondary Crushing Plant 60" Belt Conveyors #1A & #1B (2nd Unit) Dual Drive Sections & Details
TA-52	Conveyors to Secondary Crushing Plant 60" Belt Conveyors #1A & #1B (2nd Unit) Gravity Take-Up Arrangement, Sections & Details
TA-53	Conveyors to Secondary Crushing Plant 60" Belt Conveyors #1A & #1B (2nd Unit) Curved Section Arrangement and Sections
TA-54	Conveyors to Secondary Crushing Plant 60" Belt Conveyors #1A & #1B (2nd Unit) Loading at 1st Unit Crushers Arrangement & Sections
TA-55	Conveyors to Secondary Crushing Plant 60" Belt Conveyors #1A & #2B (2nd Unit) Drive House #1 and Transfer Junction General Arrangement, Section BB & CC
TA-77	Conveyor Gallery – Conv. #2A & #2B Structural Steel Plans, Elevations & Sections
TA-78	Conveyor Gallery – Conv. #2A & #2B Structural Steel Details
TA-252	Conveyors to Secondary Crush. Plt. Structural Steel Drive House 1 Plans & Elevations
TA-253	Conveyors to Secondary Crush. Plt. Structural Steel Drive House 1 Sections & Details
TA-254	Conveyors to Secondary Crush. Plt.

	Structural Steel Drive House 1 Trusses T-1, T-2, T-3 & Details
TA-255	Conveyors to Secondary Crush. Plt. Structural Steel Drive House 1 Crane Girder & Col. Base Details
TA-259	Conveyors to Secondary Crush. Plant. Structural Steel Drive Hse Supports for Conv. 2A & 2B
TA-260	Conveyors to Secondary Crush. Plt. Concrete Masonry Drive House No.1
TA-261	Conveyors to Secondary Crush. Plt. Concrete Masonry Drive House No.1
TA-262	Conveyors to Secondary Crush. Plt. Concrete Masonry Drive House No.1
TA-263	Conveyors to Secondary Crush. Plt. Concrete Masonry Drive House No.1
TA-264	Conveyors to Secondary Crush. Plt. Concrete Masonry Drive House No.1
TA-265	Conveyors to Secondary Crush. Plt. Concrete Reinforcing Drive House No.1

8.1.3 Drive House 2

Drive House 2 contains the drives for the 4A and 4B conveyors. These conveyors feed ore from the Fine Crushers to the Concentrator.

The drive house contains the following large equipment:

- (2 ea) large 60” conveyors
- (2 ea) 500 hp primary drive motors and gear cases
- (2ea) 250 hp secondary drive motors and gear cases

The site shall be left as follows:

- Demolish the conveyor gallery to the concentrator and drive house 2 to elevation 1710-6”.
- Remove all equipment, piping, wiring, ductwork, equipment structures, etc. below elevation 1710’-6”.
- Seal conveyor tunnel to the Fine Crushing Facility and close in place.
- Place clean fill in spaces below elevation 1711-0” before final cover is placed.
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

Reference drawings for the Drive House 2 include:

TA-157	Conveyors to Concentrator 60" Belt Conveyors #4A & #4B General Arrangement & B/M
TA-161	Conveyors to Concentrator 60" Belt Conveyors #4A & #4B Drive House #2 Arrangement and Details

8.1.4 Fine Crushing Facility

The Fine Crusher houses two stages of crushing to reduce crude ore from 6" size to gravel size. See the process flow diagram (drawing 010-P120-001-001 Rev D and 010-P120-001-002 Rev B) for major equipment reference.

The fine crusher contains the following large equipment in addition to many auxiliary systems:

- (6 ea) 7' standard cone crusher
- (10 ea) 7' short head crusher
- (12 ea) 350 hp motor
- (12 ea) vibrating screen decks and feeders
- (18 ea) feeder with feed chute
- Several process support conveyors
- (3 ea) 100 ton Overhead cranes
- Dust collection systems
- (2ea) 60" conveyor and tripper

The site shall be left as follows:

- Demolish structure to elevation 1711-0".
- Remove all equipment, piping, wiring, ductwork, equipment structures, etc. below elevation 1711'-0".
- Utility tunnels leaving the Fine Crushing Facility will be sealed and closed in place.
- Place clean fill in basement below elevation 1711-0".
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

Reference drawings for the Fine Crusher include:

TA-58	Secondary Crushing Plant Structural Steel North Elevation
TA-59	Secondary Crushing Plant

	Structural Steel South Elevation
TA-60	Secondary Crushing Plant Structural Steel Transverse Sections
TA-61	Secondary Crushing Plant Structural Steel Bin Walls Plan & Sections
TA-64	Secondary Crushing Plant Structural Steel Crane Girder Details
TA-69	Secondary Crushing Plant Structural Steel Bin Main Longitudinal Girder
TA-70	Secondary Crushing Plant Structural Steel Longitudinal Sections
TA-71	Secondary Crushing Plant Structural Steel Longitudinal Sections
TA-79	Secondary Crushing Plant Structural Steel Bin Floor Members
TA-85	Secondary Crushing Plant Structural Steel Platforms at El 1755'-91/2"
TA-86	Secondary Crushing Plant Structural Steel Tripper Floor and Platform Plans
TA-88	Secondary Crushing Plant Structural Steel Frame F-1
TA-94	Secondary Crushing Plant Structural Steel Tunnel Roof Framing @ Repair Bay Plan, Sections & Details
TA-95	Secondary Crushing Plant Structural Steel Tunnel Roof Framing @ Repair Bay Girder Details
TA-96	Secondary Crushing Plant Structural Steel Change Room, Tool Room And Offices – Framing Plan & Elevs.
TA-98	Secondary Crushing Plant Structural Steel Tunnel Roof Framing @ Repair Bay Girder Details
TA-107	Secondary Crushing Plant Structural Steel Repair Bay Bracing @ El 1782'-5" Plan & Details
TA-109	Secondary Crushing Plant Conveyor Gallery Conv. #2A & #2B Masonry & Reinforced Concrete Gallery Footings
TA-110	Secondary Crushing Plant Concrete Masonry Foundation Plan
TA-111	Secondary Crushing Plant Concrete Masonry Repair Bay North Elevation

TA-112	Secondary Crushing Plant Concrete Reinforcing Repair Bay North Elevation
TA-113	Secondary Crushing Plant Concrete Reinforcing Repair Bay North Elevation
TA-114	Secondary Crushing Plant Concrete Masonry & Reinforcing Foundations Col. Line
TA-115	Secondary Crushing Plant Concrete Masonry Longitudinal Section of Crusher Wall on “B” Line
TA-116	Secondary Crushing Plant Concrete Masonry Longitudinal Section of Crusher Wall on “B” Line
TA-117	Secondary Crushing Plant Concrete Masonry Longitudinal Section of Crusher Wall on “D” Line
TA-118	Secondary Crushing Plant Concrete Masonry East & West Crusher Walls Between Col. Lines (9) & (15)
TA-119	Secondary Crushing Plant Concrete Masonry East & West Crusher Walls Between Col. Lines (5) & (9)
TA-120	Secondary Crushing Plant Concrete Masonry South Elevation
TA-121	Secondary Crushing Plant Concrete Reinforcing South Elevation
TA-122	Secondary Crushing Plant Concrete Masonry Repair Bay East Elevation
TA-123	Secondary Crushing Plant Concrete Masonry Repair Bay West Elevation
TA-124	Secondary Crushing Plant Concrete Masonry Floor at Repair Bay
TA-125	Secondary Crushing Plant Concrete Masonry Floor at Repair Bay
TA-126	Secondary Crushing Plant Concrete Masonry Floor at Repair Bay
TA-127	Secondary Crushing Plant Concrete Masonry Standard Crusher Foundations Plans, Sections & Details

TA-128	Secondary Crushing Plant Concrete Masonry Longitudinal Section Of Crusher Wall on D Line
TA-129	Secondary Crushing Plant Concrete Reinforcing Service Tun'l at Repair Bay Sections & Bar Schedule
TA-130	Secondary Crushing Plant Concrete Reinforcing Floor at Repair Bay
TA-131	Secondary Crushing Plant Concrete Reinforcing Floor at Repair Bay
TA-132	Secondary Crushing Plant Concrete Reinforcing Floor at Repair Bay
TA-133	Secondary Crushing Plant Concrete Reinforcing Floor at Repair Bay
TA-134	Secondary Crushing Plant Concrete Masonry Tunnel for Conveyors #4A-4B Roof Plan, Sections & Details
TA-135	Secondary Crushing Plant Concrete Masonry Tunnel for Conveyors #4A-#4B North Wall – Elev. & Dets.
TA-136	Secondary Crushing Plant Concrete Masonry Tunnel for Conveyors #4A-4B South Wall – Elevs. & Dets.
TA-137	Secondary Crushing Plant Concrete Masonry Tunnel for Conveyors #4A-#4B Bottom Plan, Sections & Dets
TA-138	Secondary Crushing Plant Concrete Reinforcing Tunnel for Conveyors #4A-#4B Plan & Sections
TA-139	Secondary Crushing Plant Concrete Reinforcing Tunnel for Conveyors #4A-4B Roof Plan
TA-140	Secondary Crushing Plant Concrete Reinforcing Tunnel for Conveyors #4A-#4B North Wall – Sect. & Dets.
TA-141	Secondary Crushing Plant Concrete Reinforcing Tunnel for Conveyors #4A-#4B North Wall – Sects. & Bar Schedule
TA-142	Secondary Crushing Plant Concrete Reinforcing Tunnel for Conveyors 4A & 4B South Wall Elevs. & Dets.
TA-143	Secondary Crushing Plant Concrete Reinforcing Tunnel for Conveyors #4A & 4B

	South Wall – Sections & Bar Schedule
TA-144	Secondary Crushing Plant Concrete Reinforcing Tunnel for Conveyors #4A & #4B Bottom Plan & Sections
TA-145	Secondary Crushing Plant Concrete Reinforcing Tunnel for Conveyors #4A & #4B Bottom Plan & Sections
TA-146	Secondary Crushing Plant Concrete Reinforcing Repair Bay – East Elevation Elevation & Sections
TA-147	Secondary Crushing Plant Concrete Reinforcing Repair Bay – East Elevation Sections & Bar Schedule
TA-148	Secondary Crushing Plant Concrete Reinforcing West Elevation
TA-149	Secondary Crushing Plant Concrete Reinforcing West Elevation Sections & Bar Schedule
TA-150	Secondary Crushing Plant Concrete Reinforcing Tunnel for Conveyor 4A & 4B Footing $ Dowel Plan
TA-510	Secondary Crushing Plant Architectural Plan of Change Room Tool Room, Offices, Etc.
TA-511	Secondary Crushing Plant Architectural Change Rm, Tool Rm & Offices Elevations & Sections
TA-512	Secondary Crushing Plant Architectural Change Rm, Tool Rm & Offices Miscellaneous Details.

015-P120-001-001 Rev D Area 10 Fine Crushing Process Flow Diagram

8.1.5 Concentrator (including pipe gallery to Booster Pumphouse #1 and the Load Out)

The Concentrator houses two stages of wet grinding mills to reduce crude ore from gravel size to powder in slurry form that feeds the new flotation plant. See the process flow diagram (drawing 020-P120-001-001 Rev E) for major equipment reference.

The Concentrator contains the following large equipment in addition to many auxiliary systems:

- (29 ea) Rod mill with 800 hp motor
- (30 ea) Ball mill with 1250 hp motor
- (3 ea) Regrind mill with 1850 hp motor
- (34 ea) Ball mill cyclone cluster
- (34 ea) Ball mill cyclone feed pump
- (2 ea) 60” Conveyor and Tripper
- Fine ore bin
- Overhead cranes
- Piping and tankage
- Dust collection systems

The site shall be left as follows:

- Remove all equipment, piping, wiring, ductwork, equipment structures, etc.
- Demolish structure to elevations 1710-8”, 1688’-6”, 1665’-0”, 1651’-0” and 1617’9”. These elevations coincide with the upper elevations of the sloping finished floor in the building sections (see drawing 322-1002 for reference).
- The Contractor may leave the mill pedestals above the finished floor but must provide clean fill to bury the pedestals prior to establishment of final cover.
- Utility tunnels leaving the Concentrator and completely contained inside of the Concentrator (i.e. electrical tunnels/vaults) will be sealed and closed in place.
- Place clean fill in any basement elevations (i.e. sumps).
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.
- The final cover must be a natural slope from elevation 1710’-8” to 1616’-0” and to ensure proper water drainage.

Reference drawings for the Concentrator include:

322-1002	Concentrator General Arrangement Elevation Looking South
322-1001	Concentrator General Arrangement Plan
332-1003	Regrind Annex Gen. Arrg’t Plans
332-1004	Regrind Annex Gen. Arrg’t Elevations
332-1005	Regrind Annex Gen. Arrg’t Elevations
331-3303	Regrind Annex Structural Steel Base Details & Misc. Steel
331-3307	Regrind Annex Structural Steel

	Floor Framing at El. 1652'-71/4" Plan, Sections & Details
331-3111	Regrind Annex Concrete Masonry & Reinf'g Slab at Elevation 1666'-0" Plan, Sections & Det.
TB-81	Concentrator Concrete Masonry & Reinforcing FNDNS in Repair Area Slab at Elev. 1710'-6"
TB-84	Concentrator Concrete Masonry & Reinforcing Foundations in Repair Area Mezzanine Floor
TB-85	Concentrator Concrete Masonry & Reinforcing Foundations in Repair Area Mezzanine Floor
TB-91	Concentrator Concrete Masonry Main Pipe Tunnel Col. Lines Y to F Panel 7
TB-99	Concentrator Concrete Masonry & Reinforcing Foundations in Repair Area Mezzanine Floor
TB-301	Electric Light & Power List of Drawings "TB"
TB-811	Concentrator Architectural Plan of Change Room & Offices at Elev. 1698'-6"
TB-812	Concentrator Architectural Plan of Toilet at Elev. 1686'-6"
TB-813	Concentrator Architectural Sections Thru Change Rm. Toilets, Offices, Etc.
020-P120-001-001 Rev E	Area 20 Grinding Process Flow Diagram

8.1.6 Area 1 Buildings

Area 1 shop buildings are used for maintenance and repair of the mining equipment and include the following buildings; Shop and Truck Storage (Bldg. 220), Cold Storage (Bldg. 221), Boiler House (Bldg. 226), Fire Pump House & Water Tank (Bldg. 228), Locomotive Fueling, Reporting Station (Bldg. 231) There is no large process equipment in this area.

The site shall be left as follows:

- Demolish the Area 1 shop buildings to elevation 1673'-0" (finished floor elevation).
- Demolish outlying cold storage, tanks and other buildings/equipment to existing grade level.
- Place clean fill in spaces below elevation 1673'-0" before final cover is placed.
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules

6132.3200.

Reference drawings for the Area 1 buildings include:

TE-8-142	Maintenance & Repair Shop Area 1 Phase 1 Fire Protection – Fire Pump & Tank
TE-8-310	Area 1 Shop Area Yard Piping System
TE-8-017	Sprinkler System for Traffic Control Center
TE-8-149	Maintenance & Repair Shop Area 1 Phase 2 Floor Plans-Existing Building

8.1.7 Area 2 Buildings

Area 2 buildings are used for reporting mining employee reporting and storage and include the following buildings; Cold Storage (Bldg. 204), Locomotive Service Shop (Bldg. 203), Maintenance Service Shop (Bldg. 201), Truck Storage Garage (Bldg. 202), Hose House (Bldg. 209), Sample House (Bldg. 208), Reporting Building (Bldg. 425), and Area 2 Locomotive Fueling.

There is no large process equipment in this area.

The site shall be left as follows:

- Demolish the Area 2 Service Shop and Truck Storage buildings to elevation 1672'-0" (finished floor elevation).
- Demolish the Area 2 Cold Storage building to elevation 1678.75' (finished floor elevation).
- Demolish Oil House to elevation 1674.58 and outlying tanks, locomotive sanding towers, and other buildings/equipment to existing grade level.
- Place clean fill in spaces below elevation 1672'-0" in Service shop before final cover is placed.
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

Reference drawings for the Area 2 buildings include:

MA-50-3	Service Area – East Pits Area Map
TE-8-008	General Revisions East Pit Service Shop
TE-8-014	Revised Shop Floor Plan

East Pit Shops Bldg

8.1.8 General Shops

The General Shops, building number 601, were and will be used for maintenance and repair of the rail fleet as well as electrical equipment repairs, welding and fabrication, and other miscellaneous repairs. The General Shops buildings include the Welding Shop, Structural Shop, Locomotive Shop, Electric Shop, Machine Shop, Tool Room, and several offices and a locker room. The Acetylene Building, number 604 is considered to be part of the General Shops. There is no large process equipment in this area except for overhead cranes.

The site shall be left as follows:

- Demolish the building, equipment, etc. to elevation 1710'-6" (finished floor elevation).
- Place clean fill in spaces below elevation 1710'-6" before final cover is placed.
  Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

Reference drawings for the General Shops include:

TE-1	General Shops General Arrangement Plan
TE-50	General Shops Structural Steel Mezz. Framing Plans & Sections
TE-51	General Shops Architectural Elevations

8.1.9 Rebuild Shop

The Rebuild Shop, building number 602, is used for drill core storage and cutting. There is no large process equipment in this area. There are overhead cranes.

The site shall be left as follows:

- Demolish the building to elevation 1711'-0" (finished floor elevation).
- Utility tunnels leaving the Rebuild Shop will be sealed and closed in place.
- Place clean fill in spaces below elevation 1711'-0" before final cover is placed.
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

Reference drawings for the Rebuild Shop include:

TE-267	Garage Building Structural Steel & Concrete Reinf. Warehouse Mezzanine and the Battery Storage Decks
TE-270	Garage Concrete Masonry Building Foundations
TE-271	Garage Concrete Masonry Building Foundations
TE-281	Garage Architectural Floor Plan and Section
TE-282	Garage Architectural Elevations
TE-284	Garage Architectural Door Schedule & Misc. Details

8.1.10 Lube House

The Lube House, building number 926, acts as storage space for lubricants and paints. The building does not contain any major pieces of equipment.

The site shall be left as follows:

- Demolish the building to elevation 1711’-0”.
- Utility tunnel under the Lube House will be sealed and closed in place.
- Place clean fill in spaces below elevation 1711’-0” before final cover is placed.
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

Reference drawings for the Lube House include:

TE-316	Lubricating Oil & Paint Storage Structural Steel Plan & Details
TE-317	Lubricating Oil & Paint Storage Structural Steel Elevations & Details
TE-318	Lubricating Oil & Paint Storage Concrete Masonry Foundation Plan & Sects.
TE-319	Lubricating Oil & Paint Storage Concrete Masonry Section & Details
TE-320	Lubricating Oil & Paint Storage Concrete Reinforcing Foundation Plan Section & Details
TE-321	Lubricating Oil & Paint Storage Concrete Reinforcing Section & Details

TE-322 Lubricating Oil & Paint Storage
Concrete Reinforcing Section & Details

8.1.11 Analytical Lab

The Analytical Lab is the on-site laboratory. The building does not contain any major pieces of equipment.

The site shall be left as follows:
- Demolish the building to elevation 1618'-0" (finished floor elevation).
- Place clean fill in spaces below elevation 1618'-0" before final cover is placed.
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

Reference drawings for the Analytical Lab include:

TE-4-007	Commercial Plant Analytical Laboratory Basement Floor – Plot Plan
TE-4-008	Commercial Plant Analytical Laboratory Main Floor Plan
TE-4-009	Commercial Plant Analytical Laboratory Exterior Elevation
TE-4-010	Analytical Laboratory Sections & Details
TE-4-013	Commercial Plant Analytical Laboratory Main Floor Framing
TE-4-014	Commercial Plant Analytical Laboratory Roof Framing Plan
TE-4-015	Commercial Plant Analytical Laboratory
TE-4-016	Commercial Plant Analytical Laboratory
TE-4-017	Analytical Laboratory, Supplementary Vent. Syst. Main Floor Plan

8.1.12 Water Tower (Plant Site) and Plant Reservoir

The Plant Site Water Tower site and Reservoir shall be left as follows:
- Plant Site Water Tower would be removed to elevation 1776'-0" (top of piers) at closure.
- Utility tunnel under Water Tower for the plant reservoir will be sealed and closed in place.
- Place clean fill in spaces below elevation 1776'-0" at the Water Tower Site and

Reservoir before final cover is placed.
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

Reference Drawings for the Water Towers include (note that the tank details could not be found at this time):

TG-162	Fire Fighting System Concrete Masonry 100,000 Gal. Elevated Tank Foundation Details
TG-163	Fire Fighting System Concrete Reinforcing 100,000 Gal. Elevated Tank Foundation Details

8.1.13 Colby Lake Pump House

The Colby Lake Pump House is located approximately 5 miles from the plant site and supplies fresh water from Colby Lake to the plant site via a 36" diameter steel buried pipeline. The Colby Lake Pump House contains the following large pieces of equipment:
- (3 ea) Vertical turbine pump w/ 600 hp motor
- Service crane

The site shall be left as follows:
- Demolish the building to elevation 1448'-6" (finished floor elevation).
- Seal intake tunnel and fill pump area with clean fill.
- Place clean fill in areas lower the 1448'-6".
- Remove or fill pipe access manways.
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

Reference drawings for the Colby Lake Pumphouse include:

TG-18	Partridge Lake Pumping Station Plan and Pipe Line Profile Pipe Line from Pump Station to Reservoir
TG-19	Partridge Lake Pumping Station 36" Pipe Line to Plant Reservoir Details & B/M
TG-20	Partridge Lake Pumping Station 36" Pipe Line to Plant Reservoir

	Plan and Profile
TG-21	Partridge Lake Pumping Station 36" Pipe Line to Plant Reservoir Plan and Profile
TG-22	Partridge Lake Pumping Station 36" Pipe Line to Plant Reservoir Plan and Profile
TG-23	Partridge Lake Pumping Station 36" Pipe Line to Plant Reservoir Plan and Profile
TG-24	Partridge Lake Pumping Station 36" Pipe Line to Plant Reservoir Plan and Profile

8.1.14 Bentonite Silos

The Bentonite Silos were used to contain Bentonite used in tailings dam construction.

The site shall be left as follows:
- Demolish bentonite silos, these are 120 ton and 90 ton bins.
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

Reference drawings for the heating/additive plant include:

TC-641	Storage and Handling of Additives General Arrangement, Plans & Elevations

8.1.15 Warehouse Electrical

The electrical warehouse, building number 921, acts as cold storage space. The building does not contain any major pieces of equipment.

The site shall be left as follows:
- Demolish the building to elevation 1711'-0" (finished floor elevation).
- Place clean fill in spaces below elevation 1711'-0" before final cover is placed.
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200. Slope overburden to elevation 1710'-0".

Reference drawings for the electrical warehouse include:

TE-116	Warehouse General Plan
TE-117	Warehouse Elevations
TE-118	Warehouse Wall Sections
TE-5-067	Warehouse Office Edition
TE-5-069	Training Room Partitions Warehouse #1 – Office Area

8.1.16 Warehouse 49

Warehouse 49, building number 920, acts as cold storage space. The building does not contain any major pieces of equipment.

The site shall be left as follows:

- Demolish the building to elevation 1711'-0" (finished floor elevation).
- Place clean fill in spaces below elevation 1711'-0" before final cover is placed.
- Utility tunnels under the Warehouse will be sealed and closed in place.
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200. Slope overburden to elevation 1710'-0".

Reference drawings for the Warehouse 49 include:

TE-5-011	Erection Drawing Cold Storage Warehouse
TE-5-012	Exterior Sheeting & Flashing Detail Cold Storage Warehouse

8.1.17 Administration Building

The Administration Building houses the site administrative offices. The building does not contain any major pieces of equipment.

The site shall be left as follows:

- Demolish the building to elevation 1500'-6" (finished floor elevation).
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200. Slope overburden at 3:1 from level 1513'-6" to level 1500'-6".

Reference drawings for the Administration Building include:

TE-6-282	Elevations
TE-6-283	Building Sections
TE-6-279	Site Plan
TE-6-052	Ground Floor Plan
TE-6-053	First Floor Plan Interior Wall Elevations
TE-6-054	Second Floor Plan Room Finish Schedule
TE-6-062	Foundation Plan & Details
TE-6-264	Administration Building Second Floor Plan Rev

8.1.18 Main Gate (Gatehouse and Gas Station)

The Main Gate consists of a Gatehouse and Gas Station. The Gatehouse is used to supply site security. The Gas Station includes tanks and pumps that supply gas to plant site vehicles during operations.

The site shall be left as follows:

- This Gatehouse building shall be demolished in total to the road way elevation.
- Gas Station tanks shall be demolished in a manner consistent with Section 9.4.4 of this specification.
- Site will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

Reference Drawings for the Main Gate include:

TE-6-001	Entrance Road Guard House Plans, Elev. & Det.
TH-1-050	Main Gate Gasoline Refueling & Storage Facility General Arrangement
TH-1-051	Main Gate Gas Station Details Piping Details
TH-1-1017	Main Gate Gasoline Dispensing Station Electrical Layout and Schematic

8.1.19 Tailings Booster Pump House #1

The Tailings Booster Pump House is used to boost pumping pressure to deliver tailings from the plant to the tailings basin. The Tailings Booster Pump House contains the following large pieces of equipment:

- (8 ea) GIW 14x39 pump w/ 500 hp motor
- Service crane

The site shall be left as follows:

- Demolish the building to elevation 1659’-0” (finished floor elevation).
- Seal floor drain pipe and fill areas below 1659’-0” with clean fill.
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

Reference Drawings for Booster Pump House include:

TB-7-101	Tailings Disposal Booster Pumping Station No. 1 Addition – General Arrangement
TB-7-102	Tailings Disposal Booster Pumping Station No. 1 Addition – General Arrangement
TB-1650	Tailings Disposal Booster Pumping Station Conc. Masonry & Reinf. Foundation Plan & Details
TB-1651	Tailings Disposal Booster Pumping Station Conc. Masonry & Reinf. Footing Details
TB-1652	Tailings Disposal Booster Pumping Station Conc. Masonry & Reinf. Footing Details
TB-1653	Tailings Disposal Booster Pumping Station Conc. Masonry & Reinf. Footing Details
TB-1654	Tailings Disposal Booster Pumping Station Conc. Masonry & Reinf. Footing Details
TB-1655	Tailings Disposal Booster Pumping Station Conc. Masonry & Reinf. Foundation Walls Elevs. & Sects.
TB-1657	Tailings Disposal Booster Pumping Station Conc. Masonry Equipment Foundations – Plans & Dets.
TB-662	Tailings Disposal Main and Auxiliary Transfer Pumps and Piping General Arrangement & B/M
TB-663	Tailings Disposal Auxiliary Transfer Pumps and Piping Plan, Elevs, Sects and Dets
TB-664-N	Tailings Disposal Main Transfer Pumps and Piping Plans. Elevs., Sects. and Dets
TB-664-S	Tailings Disposal Main Transfer Pumps and Piping Plans. Elevs., Sects. and Dets
TB-666	Tailings Disposal Booster Pumping Station No. 1 General Arrangement

8.1.20 Sewage Treatment Plant

The Sewage Treatment Plant is used to treat sewage at the plant site. This building does not contain major pieces of equipment but does have a digester and aerator.

The site shall be left as follows:

- Demolish the building to elevation 1546.35'.
- Fill areas below 1546.35' with clean fill.
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

Reference Drawings for Sewage Treatment Plant include:

TL-2-006	Sewage Treatment Plant Location & Plat Plan
TL-2-008	Sewage Treatment Plant Plan of Primary Clarifier & Right & Left Side Elevations
TL-2-009	Sewage Plant Sections
TL-2-010	Sewage Treatment Plant Details
TL-2-011	Sewage Treatment Plant Isometric Piping & Details
TL-2-012	Sewage Treatment Plant Details
TL-2-013	Sewage Treatment Plant Steel Section and Floor Plans
TL-2-014	Sewage Treatment Plant Steel Sections
TL-2-015	Sewage Treatment Plant Electrical Plan

8.1.21 Carpenter's Shop

The Carpenter's Shop acts as cold storage space. The building does not contain any major pieces of equipment.

The site shall be left as follows:

- Demolish the building to elevation 1710'-0" (finished floor elevation).
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

Reference drawings for the Carpenter's Shop do not exist. This building is a wood frame building with tin siding with dimensions of 55 ft x 101 ft.

8.1.22 Tailings Portable Pump Houses

Each Tailings Portable Pump House contains one tailing booster pumps. The pump is equipped with 500 hp motors and are used to boost line pressure to ensure proper tailings deposition. There are 29 portable pump houses located on site.

The site shall be left as follows:

- Demolish the Tailings Portable Pump Houses in entirety.

Reference Drawings for Tailings Basin Portable Pump House include:

TB-7-093	Skid & Roof Details for Booster Pumphouse with 16" SRT Pump & 300 H.P. Drive – Station #5
TB-7-094	Gen. Arrg't & Wall Elevations for Booster Pumphouse With 16" SRT Pump & 300 H.P. Drive – Station #5
TB-7-095	Typical Wall & Removable Roof Detail Booster Pumphouse Station #5

8.1.23 Return Water Barge

The Return Water Barge is used to return water from the tailings basin to the plant site reservoir. The Barge contains four water pumps each with 700 hp motors.

The site shall be left as follows:

- Demolish the Barge in its entirety.

Reference Drawings for Return Water Barge include:

TB-703	Pump Station Tailings Pond Pumping Barge General Arrangement
TB-1631	Pump Station Tailings Pond Pumping Barge Mill Water Air & Priming Piping Gen'l Arrg't & B/M

8.1.24 Hinsdale Bridge

The Hinsdale Bridge was used to deliver ore from the taconite pits located west of the plant site to the Coarse Crusher. The bridge will not be used at this time but will remain in place until closure.

The site shall be left as follows:

- Demolish the Hinsdale Bridge including concrete supports to the existing grade.
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

Reference Drawings for the Hinsdale Bridge include:

Sheet 1	D.M. & I.R.R.Y. Crossing Bridge General Plan and Elevation
Sheet 2	D.M. & I.R.R.Y. Crossing Bridge Foundation Location Plan and Log of Borings
Sheet 3	D.M. & I.R.R.Y. Crossing Bridge Abutments 1 & 6 and Pedestal for Bents 2 & 5
Sheet 4	D.M. & I.R.R.Y. Crossing Bridge Piers 3 & 4
Sheet 5	D.M. & I.R.R.Y. Crossing Bridge 96' Deck Girder Span
Sheet 6	D.M. & I.R.R.Y. Crossing Bridge 120' Deck Girder Span
Sheet 7	D.M. & I.R.R.Y. Crossing Bridge Shoes
Sheet 8	D.M. & I.R.R.Y. Crossing Bridge Bents 2 & 5
Sheet 9	D.M. & I.R.R.Y. Crossing Bridge Deck Details
Sheet 10	D.M. & I.R.R.Y. Crossing Bridge Deck Details and Inspection Walks
Sheet 13	D.M. & I.R.R.Y. Crossing Bridge Grading Details and Method of Removing Fill

8.1.25 Thickeners

The Thickeners were used in the processing of taconite and will no longer be used. Two thickeners will remain after construction.

The site shall be left as follows:

- Remove structures above grade 1616'-0" (top of concrete cone).
- Pipe tunnels under thickeners will be sealed and closed in place.
- Fill areas below 1616'-0" with clean fill.
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

Reference Drawings for Thickeners include:

TB-651	Concentrator Tailings Thickeners Excavation
TB-652	Tailings Disposal Concrete Masonry Pipe Tunnel Under R.R. Embankment Plan, Sections & Details
TB-653	Tailings Disposal Concrete Reinforcement Pipe Tunnel Under R.R. Embankment Plan, Sections & Details
TB-921	Tailings Disposal Concrete Masonry Tailings Thickeners Center Piers
TB-922	Tailings Disposal Concrete Masonry Tailings Thickeners Center Piers
TB-925	Tailings Disposal Structural Steel 255' Dia. Tailings Thickener Tanks
TB-926	Tailings Disposal Structural Steel 255' Dia. Tailings Thickener Tanks
TB-1040	Tailings Disposal Concrete Masonry & Reinforcing Overflow & Roof Drain Launders Plans & Sections
TB-1041	Tailings Disposal Concrete Masonry & Reinforcing 255' Dia. Tailings Thickener Tanks Tank Slab & Ring Wall
TB-1042	Tailings Disposal Concrete Masonry & Reinforcing 255' Dia. Tailings Thickener Tanks Ring Walls

8.1.26 Rubber Shop

The Rubber Shop, building number 605, was originally called the Untanking Tower and Emergency Diesel Generating Plant, both of those sections still exist in the building in addition to the rubber shop.

The site shall be left as follows:

- Remove structures above grade 1710'.
- Fill areas below 1710' with clean fill.
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

Reference Drawings for the Rubber Shop include:

TD-680	Emergency Diesel Generating Plant General Arrangement Sections
TD-679	Emergency Diesel Generating Plant General Arrangement Plan
TD-698	Transformer Untanking Tower Diesel Generating Plant Structural Steel Plans & Details
TD-699	Transformer Untanking Tower Diesel Generating Plant Structural Steel Elevations & Details
TD-700	Transformer Untanking Tower Diesel Generating Plant Structural Steel Elevations & Details
TD-701	Transformer Untanking Tower Diesel Generating Plant Structural Steel Elevations & Details

8.1.27 Water Treatment Plant & Storage Tanks

The Water Treatment Plant was used to treat raw water for potable water at the plant site.

The site shall be left as follows:

- Remove structures above grade 1777'.
- Fill areas below 1777' with clean fill.
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules

6132.3200.

Reference Drawings for the Water Treatment Plant & Storage Tanks include:

TG-6-020 Location Map & Title Page
TG-6-021 Site and Foundation Plan
TG-6-022 Floor Plans
TG-6-023 Roof Plan
TG-6-024 Sections
TG-6-025 Elevations
TG-6-026 Details
TG-6-031 Piping and Equipment Plans and Details

8.1.28 Tailings Basin Buildings

The Tailings Basin buildings are located near the southeast corner of Cell 2W and were and will be used for storage, offices, oil dispensing, and locker rooms. They include the following buildings; Foreman's Office (718), Reporting Building (719), Lube House (720), Reporting Building (724), and Lube Oil Building (725).

There are no reference drawings for the Tailings Basin Buildings. However, the following dimensions of each building are shown below:

Foreman's Office (719) – 20' x 40'
Reporting Building (718) – 20' x 40'
Lube House (720) – 12' x 22'
Reporting Building (724) – 12' x 22' w/ 6' x 12' lean-to
Lube Oil Building (725) – 12' x 21'

8.1.29 Area 2 Water Tower

The Water Tower at Area 2 is in a poor deteriorated condition and will not be used as part of the project. The Water Tower at Area 2 will be demolished prior to Phase 1 Construction, but may remain in place at the end of year 1.

The Area 2 Water Tower site shall be left as follows:

- Area 2 Water Tower would be removed to top of existing grade (top of concrete piers).
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

Reference Drawings for the Water Towers:

TG-162	Fire Fighting System Concrete Masonry 100,000 Gal. Elevated Tank Foundation Details
TG-163	Fire Fighting System Concrete Reinforcing 100,000 Gal. Elevated Tank Foundation Details

8.2 General Facilities – Existing Plant

8.2.1 Sanitary Systems and Well

The septic systems will be pumped out and the tanks filled with soil or crushed rock and backfilled. The well will be sealed by a licensed well driller in accordance with Minnesota Department of Health rules. Sanitary systems and well (See Figure 3 for locations).

- Area 1 Shops Septic System
- Area 2 Shops Septic System
- Administration Building Septic System
- Administration Building Well No. 665923
- Tailings Basin Reporting Septic System
- Booster Pumphouse #1 Septic System

Reference Drawings for the sanitary systems include:

Figure 3-1	Sanitary System Locations
MH-1-3	West Pit Service Area (Area 1) Detail of Sanitary Sewer Line
MH-22-2	Area #2 Service Area Septic Tank Details
MH-24	Area #2 Service Area Details of Sanitary Sewer & Floor Drains
TL-2-215	Wastewater Treatment System Improvements
TB-7-175	Tailings Basin Reporting Center Plot Plan
B-TB-7-202	Tailing Basin Reporting Center Alternate Sewage Disposal Method

8.2.2 Pipelines, Pipe Galleries, and Tunnels

Pipelines that will not remain as regional infrastructure will be removed, recycled or disposed, or abandoned in place. Major pipeline systems include (see Figure 4 for locations):

- Tailings Transport and Deposition- tailings transport lines from Booster Pumphouse #1 to the basin ponds reclaim water line from Barge #2 to Barge #1, water reclaim line from Barge #1 to the Concentrator
- Water Supply Pipeline from Colby Lake Pumphouse to the Plant Reservoir
- Inter-Pit Pipeline from the Plant Reservoir to the Area 1 Shop and Area 2 Shop
- Natural Gas Line from the Town Border Station to the demolished Pellet Plant

Above-ground pipelines will be disassembled or demolished and the material recycled or disposed. Underground pipelines will be abandoned in place. Manholes and above-ground pipeline supports and foundations will be demolished to ground level or below and covered with at least two feet of soil. Surface disturbances will be ripped and vegetated to achieve final reclamation.

Tunnels and Pipe Galleries (see Figure 2) shall be left in the following condition:

- Pipe Galleries shall be removed in total.
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.
- Tunnels shall have contents removed and shall be sealed in place.

Reference Drawings for the Pipe Lines, Pipe Galleries, and Tunnels include:

Figure 2 Pipe Gallery/Tunnel Detail
Figure 4 Pipeline Locations

8.2.3 Power Lines and Substations

Power lines (poles, pole hardware and conductors) and substations that will not remain as regional infrastructure will be removed and recycled. Foundations and anchors will be removed or demolished to at least ground surface and covered with at least two feet of soil and vegetated to achieve final reclamation. During Phase 1 construction, the unused power lines from Area 1 to North gate and Area 2 West Pit are to be reclaimed. In addition, due to degrading structural integrity and as preemptive fault prevention, the power line from the P1 substation to the 411 distribution line shall be reclaimed. However, for this specification, assume that these are part of Year 1 demolition.

Power lines to be removed include (See Figure 5 and 5-1 for locations):

- 13.8 Kv Line from the Main Substation to Colby Lake Pumphouse
- 13.8 Kv Lines from the Main Substation to Area 1 Shop and Area 2 Shop
- 13.8Kv and 4.16 Kv distribution lines from the Main Substation to the Tailings Basin and at the Tailings Basin (except those needed to support the Interception Wells and the Tailings Basin Waste Water Treatment Facility)
- 13.8 Kv distribution lines at the Mine Site (except those needed to support the Mine Site Waste Water Treatment Facility)
- 16,000ft of 3 conductor cable starting at Area 1 shop and heading along the north road (rd 666), ending at the North gate. (Figure 5-1)
- 21,800ft of 3 conductor cable starting at the main switch yard and heading south around Area 2 West mine pit. (Figure 5-1)
- 4,000ft of 3 conductor cable starting at the switch yard and heading east to Area 2 shop/ SD-026 pumping station. (Figure 5-1)

Reference Drawings for the Power Lines include:

Figure 5	Power Line Locations
Figure 5-1	Power Line Demo
TD-4-1308	Tailings Basin Power Distribution
TD-1	Power Distribution One Line Diagram Sheet 1 of 2
TD-2	Power Distribution One Line Diagram Sheet 2 of 2
TD-4-1259	Mine Power Distribution 13.8KV One-line Diagram

8.2.4 Tanks

The inventory of tanks that will require demolition is included in Table 2-3. See Figure 6 for locations of tanks.

Large above-ground storage tanks will be cleaned and painted surfaces tested for lead prior to demolition. Tanks with insulation and associated wall and/or roof covers will be evaluated for potential asbestos containing material. Insulation and coverings will be removed and disposed appropriately. Tank cleaning will remove remaining materials and sludge. The tanks will be cleaned and removed materials and cleaning residues will be sent to an appropriate recycling or waste disposal facility.

Tanks will be disassembled for disposal or recycling as appropriate. Where lead paint abatement is required, the disposal/recycling will be modified to accommodate the lead content. Below-grade foundations will be left in place and covered with a minimum of two feet of soil and vegetated. Smaller above-ground storage tanks will be cleaned and removed without disassembly.

Table 2-3 Inventory of Existing Tanks Requiring Demolition (See Figure 6 for Locations)

Tank Number	AST Contents (Above-Ground Storage Tanks) *All Tanks are out of service and outdoors unless stated otherwise*	Location	Storage Tank Size (gallons)
015	Fuel Oil	Concentrator	12,000
304	Mineral Oil	Concentrator	12,000
305	Mineral Oil	Concentrator	12,000
306	Mineral Oil	Concentrator	12,000
421	Waste Oil	Concentrator	
032	Fuel Oil (tanks have been cleaned)	Pellet Plant	3,384,000
033	Fuel Oil (tanks have been cleaned)	Pellet Plant	3,384,000
034	Fuel Oil (tanks have been cleaned)	Pellet Plant	3,384,000
080	Fuel Oil	Area 1 – Railroad South Grade Area	20,000
121	Gasoline (in-service)	Guard House – Entrance of County Road 666	6,000
122	Gasoline (in-service)	Guard House – Entrance off County Road 666	6,000
001	Fuel Oil (Underground)	Administration Building	

Reference Drawings for the Tanks include:

TH-67	Fuel Oil Storage & Distribution General Arrangement
TH-70	Fuel Oil Storage & Distribution Storage Tanks General Arrangement & Section
TH-81	Fuel Oil Storage & Distribution Steam Condensate & Hot Water Flow Diagram
TH-83	Fuel Oil Storage & Distribution Piping Inside of Storage Tanks
TH-134	Fuel Oil Storage & Distribution Concrete Masonry & Reinforcing Fuel Oil Storage Tank Ring Wall
TH-199	Fuel Oil Storage & Distribution Service Tanks & Misc. Tank Supports Conc. Masonry & Reinf. Plan, Sects. & Details
Figure 6	Outdoor Tank Locations

8.2.5 Railroad Tracks

Railroad track and ties controlled by PolyMet will be removed and recycled or disposed. Reclamation with overburden and subsequent vegetation will be used where roadbed is not needed for access. See Figure 7 for locations.

Railroad tracks to be grouped as follows:

- Existing track in the Plant Site area

Reference drawings include:

Figure 7	Railroad track locations
C1	Krech Ojard Drawing Ore Concentrates Handling

8.2.6 Roads and Parking Lots

Plant area roads which are deemed not necessary for access by the MDNR will be abandoned, scarified, and vegetated. Asphalt from paved surfaces will be removed and recycled. Reclamation of roads not controlled by PolyMet, such as the Dunka Road and the road from the North Gate, are not included in this plan or estimate; reclamation of these features is the responsibility of the owner of record for the roads. See Figure 9 for locations.

Building areas, roads and parking lots will be reclaimed and vegetated according to Minnesota Rules 6132.2700 by a qualified reclamation contractor. Any roads that may develop into unofficial off-road vehicle trails (Minnesota Rules 6132.3200) will require a variance to allow a 15-foot wide unpaved and un-vegetated track down the centerline of the road once reclamation is completed.

Roads and parking lots are to be grouped as follows:

- Existing roads and parking lots in the Plant Site area
- Existing roads in the Tailings Basin

Reference drawings include:

Figure 9	Road and Parking Lot Locations
Figure 9A	Road and Parking Lot Locations – Process Plant Detail
TJ-3-015	Plant site Parking Arrangement

TJ-3-026 Parking & Driveway Arrangement Administration Building

9.0 Twenty Year Demolition Plan

Within three (3) years after closure begins, all buildings and structures will be removed and foundations razed to grade level. Provisions may be made for continued subsequent use of mine facilities that will have future benefits to the area including, pipelines, transmission lines, roads, and railroad lines. However, for the purposes of this document it shall be assumed that all of the PolyMet facilities must be removed and the facility footprints reclaimed.

The timing of demolition for the individual buildings shall be suggested by the Contractor. All facilities listed in Sections 9.1 to 9.3 will be demolished over a maximum period of three years. Facilities described in Section 9.4 may remain in service after closure and will be bid separately (see Section 9.4).

For building, area or equipment locations listed as headings in the following sections for the plants reference Figures 1 and 1A for details.

For major process equipment reference the Equipment List (attached) and the Process Flow Diagrams (attached).

For the new facilities preliminary design drawings (i.e. layouts, arrangements) are provided for the Contractor. Note that the drawings shown are preliminary design layouts. The layout of equipment, etc. will change throughout the design process. These drawings show equipment and building sizes that are approximate. PolyMet will provide more information to the selected Contractor as more detailed design drawings become available.

9.1 Plant Site Facilities Constructed by PolyMet in Phase 1

9.1.1 Flotation Plant and Reagent Storage Building

A new Flotation Plant and Reagent Storage Building will be constructed as part of the Phase 1 Project operation. These buildings will be used to extract the sulfide minerals from the ore.
The flotation plant will house the following large pieces of equipment:

- Flotation Cells of varying sizes of tanks and drive systems
- Fine grinding mill
- Froth and slurry pumps
- Reagent storage tanks and mixing systems

The site shall be left as follows:

- Remove structures and equipment above grade 1616'-0".
- Fill areas below 1616'-0" with clean fill.
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

The reference drawings for the Flotation Plant and Reagent Storage Building include:

SK-11-067	Option 20 Plant Layout Plan
025-15-11-013	Northmet Project General Arrangement Flotation Area - Section
025-15-11-014	Northmet Project General Arrangement Reagent Area – Sections
025-15-11-015	Northmet Project General Arrangement Section G
025-15-11-016	Northmet Project General Arrangement Section H
025-15-11-017	Northmet Project General Arrangement Section K
E0-18-11-400	Architectural Flotation Annex – Exterior Shell Cover Sheet
E0-18-11-401	Architectural Flotation Annex – Exterior Shell Floor Plan
E0-18-11-402	Architectural Flotation Annex – Exterior Shell Roof Plan
E0-18-11-411	Architectural Flotation Annex – Exterior Shell Building Elevations
E0-18-11-412	Architectural Flotation Annex – Exterior Shell Building Elevations
E0-18-11-421	Architectural Flotation Annex – Exterior Shell Building Sections
E0-18-11-422	Architectural Flotation Annex – Exterior Shell Building Sections/Door Schedule
E0-18-11-431	Architectural Flotation Annex – Exterior Shell Wall Sections
E0-18-11-432	Architectural Flotation Annex – Exterior Shell Wall Sections
E0-18-11-461	Architectural Flotation Annex – Exterior Shell Details
E0-18-11-462	Architectural Flotation Annex – Exterior Shell Details
E0-18-11-463	Architectural Flotation Annex – Exterior Shell Details

Note that the drawings shown are preliminary design layouts. The layout of equipment, etc. will change throughout the design process. These drawings show equipment and building sizes that are approximate. PolyMet will provide more information to the selected Contractor as more detailed design drawings become available.

9.1.2 Concentrate Storage and Loadout Facility

A new Concentrate Storage and Loadout Facility will be constructed as part of the Phase 1 Project operation. The location of these facilities will be close to existing location of the existing heating/additive plant that will no longer be required. The Concentrate Storage Building will be used to store copper and nickel concentrates for shipment via rail. The Concentrate Loadout Facility will be used to load concentrate into rail cars prior to shipment. These building will house the following large pieces of equipment:

- Concentrate tanks and thickeners
- Concentrate filter press (2 ea.)
- Conveyor systems

The site shall be left as follows:

- Remove structures and equipment above grade 1581'-0" (top of finished floor).
- Fill areas below 1581'-0" with clean fill.
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

The reference drawings for the Concentrate Storage and Loadout Facility include:

SK-11-033	Preliminary Filter ISO Layout
SK-11-038	Building Layout Option 2 Elevations Conveyor Feed System
SK-11-039	Building Layout Option 2 Plan Conveyor Feed System
027-P120-001-001	Copper Concentrate Loadout Process Flow Diagram
028-P120-001-001	Nickel Concentrate Loadout Process Flow Diagram

Note: No drawings have been created for the Concentrate Storage Facility. The amount of storage capacity and thus the size of the facility are being determined.

Note that the drawings shown are preliminary design layouts. The layout of equipment, etc. will change throughout the design process. These drawings show equipment and

building sizes that are approximate. PolyMet will provide more information to the selected Contractor as more detailed design drawings become available.

9.1.3 Plant Site Sewage Treatment

A new Plant Site Sewage Treatment plant will be constructed as part of the Phase 1 Project operation. The location of this facility will be at the location of the existing Sewage Treatment Plant. The building will house the following large pieces of equipment:

- Grinder pump
- Submersible pumps (2ea.)
- Valves and piping systems

The site shall be left as follows:

- Remove structures and equipment above grade 1548’-5” (top of finished floor).
- Fill areas below 1548’-5” with clean fill.
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

The reference drawings for the Plant Site Sewage Treatment Plant include:

SWGT-001	Overall Site Plan
SWGT-002	Mechanical Treatment Site Plan
SWGT-003	Stabilized Pond Option
SWGT-004	Lift Station and Grinder Pump Details
SWGT-005	Lift Station Details Stabilization Pond Option
SWGT-006	Miscellaneous Details

Note that the drawings shown are preliminary design layouts. The layout of equipment, etc. will change throughout the design process. These drawings show equipment and building sizes that are approximate. PolyMet will provide more information to the selected Contractor as more detailed design drawings become available.

9.2 Mine Site Facilities Constructed by PolyMet in Phase 1

9.2.1 Maintenance Service and Fueling Facility

As part of the Phase 1 operation a new Maintenance Service Facility and Fueling Facility will be built at the mine site. These facilities will be used for light maintenance and fueling of mining equipment.

The site shall be left as follows:

- Maintenance Service Facility shall be removed in total.
- Fueling Facility shall be removed in total.
- Foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

Reference Drawings for the Maintenance Service and Fueling Facility include (note that there are 2 each of the building represented in the following drawings):

D93-048205-00	Cover Drawing
D93-048205-01	Specific Anchor Bolt Drawing
D93-048205-01A	Specific Reaction Drawing
D93-048205-01B	Anchor Bolt Detail Sheet
D93-048205-02	Cross Section Erection Drawing
D93-048205-02A	Cross Section Erection Drawing Detail Sheet
D93-048205-03	Wind Bracing Drawing
D93-048205-04	Roof Secondary Structural Framing Plan
D93-048205-04A	Roof Secondary Structural Detail Sheet
D93-048205-05	Wall Secondary Structural Elevation
D93-048205-05B	Wall Secondary Structural Elevation
D93-048205-05C	Wall Secondary Structural Elevation
D93-048205-05D	Wall Secondary Structural Elevation Detail Sheet
D93-048205-06	Wall Panel Drawing
D93-048205-06A	Wall Panel Drawing
D93-048205-07	Roof Panel Drawing
TH-1-066	Mobile Equipment Fueling Building Concrete Slab – Area 6, 2E, & 2WX

9.2.2 Rail Transfer Hopper

The rail transfer hopper is located at the mine site. The Rail Transfer Hopper is used to hold ore dumped via truck and subsequently fill rail cars for transport of ore to the Plant. The Rail Transfer Hopper includes a Control Building, and Platform.

The site shall be left as follows:

- Rail Transfer Hopper shall be removed in total.
- Foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

Reference Drawings for the Rail Transfer Hopper include:

Barr Engineering	SOW – 15 Rail Transfer Hopper
93909-S1	Area II East Superpocket

	Electrical & Hydraulic Room Plans & Elevations
93909-A3	Area II East Superpocket Control Room Steel Elevations
93909-A1	Area II East Superpocket Control Room Plans, Elevations & Details
93909-M3	Area II East Superpocket Discharge Chute Gate
93909-M2	Area II East Superpocket Discharge Chute
93909-M1	Area II East Superpocket Feeder Hopper Assembly
93909-3	Area II East Superpocket Section - A
93909-1	Area II East Superpocket Plot Plan

9.2.3 Central Pumping Station

The Central Pumping Station is located at the mine site. The Central Pumping Station is used to pump treated mine water back to the tailings basin for use in the plants.

The site shall be left as follows:

- Central Pumping Station shall be removed in total.
- Treated Water Pipeline from the Mine Site Central Pumping Station to the tailings basin shall be removed in total.
- Foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

Reference Drawings for the Central Pumping Station include:

Central pumping station
WWTF & CPS Plan

9.3. General Facilities – Phase 1

9.3.1 Pipelines

Pipelines that will not remain as regional infrastructure will be removed, recycled or disposed, or abandoned in place.

- Plant Site pipelines constructed by PolyMet (Phase 1)

- Mine Site pipelines constructed by PolyMet (Phase 1)

Above-ground pipelines will be disassembled or demolished and the material recycled or disposed. Underground pipelines will be abandoned in place. Manholes and above-ground pipeline supports and foundations will be demolished to ground level or below and covered with at least two feet of soil. Surface disturbances will be ripped and vegetated to achieve final reclamation.

Reference Drawings for the Pipe Lines:

Barr Engineering SOW – 05 Process Water Systems
Barr Engineering SOW – 06 WWTF
Barr Engineering SOW – 08 TWP
Barr Engineering SOW – 12 Tailings Basin Seepage Recovery
Barr Engineering SOW – 14 Flotation Tailings Basin Dam Construction

9.3.2 Power Lines and Substations

Power lines (poles, pole hardware and conductors) and substations that will not remain as regional infrastructure will be removed and recycled. Foundations and anchors will be removed or demolished to at least ground surface and covered with at least two feet of soil and vegetated to achieve final reclamation.

Reference Drawings for the Power Lines include:

Barr Engineering SOW – 13 Mine Site Electrical Distribution
SK-11-255 Building Layout Option 3
General Arrangement Plan

9.3.3 Railroad Tracks

Railroad track and ties controlled by PolyMet will be removed and recycled or disposed. Reclamation with overburden and subsequent vegetation will be used where roadbed is not needed for access. See Figure 7 for locations.

Railroad tracks to be grouped as follows:

- Plant Site track constructed by PolyMet for concentrate handling (Phase 1)
- Connection (CE main line to crusher feed) constructed by PolyMet (Phase 1)
- Mine Site spur for Rail Transfer Hopper (Phase 1)
- VSEP Concentrate Track (Phase 1)

Reference drawings include:

Figure 7	Railroad track locations
C1	Krech Ojard Drawing Ore Concentrates Handling
Barr Engineering	SOW – 16 Rail and Earthwork for Rail Transfer Hopper
Barr Engineering	SOW – 17 Rail Connection Track
Barr Engineering	SOW – 18 VSEP Concentrate Track
Barr Engineering	SOW – 19 Plant Site Rail

9.3.4 Roads and Parking Lots

Plant area roads which are deemed not necessary for access by the MDNR will be abandoned, scarified, and vegetated. Asphalt from paved surfaces will be removed and recycled. Reclamation of roads not controlled by PolyMet, such as the Dunka Road and the road from the North Gate, are not included in this plan or estimate; reclamation of these features is the responsibility of the owner of record for the roads. See Figure 9 for locations.

Building areas, roads and parking lots will be reclaimed and vegetated according to Minnesota Rules 6132.2700 by a qualified reclamation contractor. Any roads that may develop into unofficial off-road vehicle trails (Minnesota Rules 6132.3200) will require a variance to allow a 15-foot wide unpaved and un-vegetated track down the centerline of the road once reclamation is completed.

Roads and parking lots are to be grouped as follows:

- Plant Site roads and parking lots constructed by PolyMet (Phase 1)
- Mine Site roads and parking lots constructed by PolyMet (Phase 1)

Reference drawings include:

Barr Engineering	SOW – 01 Haul Roads
Figure 9	Road and Parking Lot Locations
Figure 9A	Road and Parking Lot Locations – Process Plant Detail
TJ-3-015	Plantsite Parking Arrangement
SK-11-255	Building Layout Option 3 General Arrangement Plan

9.4 Plant Site Facilities Constructed by PolyMet in Phase 2

9.4.1 Oxygen Plant, Limestone Preparation, Hydrometallurgical Plant, Hydrometallurgical Reagents

A Hydrometallurgical Processing Plant will be constructed as part of the Phase 2 Project operation. These buildings will be used to produce oxygen gas, process limestone, and house the Autoclave where high pressure and temperature is used to treat nickel concentrates to extract and isolate platinum group, precious metals, and base metals. At this time, no detailed engineering has been completed in regard to these buildings, therefore, only a general arrangement drawing is available.

The hydrometallurgical plant buildings will house the following large pieces of equipment:

- Autoclave
- Reagent storage tanks and mixing systems
- Cryogenic oxygen processing equipment
- Limestone processing and slurrification equipment
- Residue Transport and Deposition - residue transport lines from Booster Pumphouse #1 to the Hydrometallurgical Residue Facility
- Water reclaim line from the Hydrometallurgical Residue Facility to Booster Pumphouse #1
- Railroads
- Pipelines
- Power Lines
- Roads and Parking Lots

The site shall be left as follows:

- Remove structures and equipment above grade elevations.
- Fill areas below grade elevations with clean fill.
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.
- Railroad track and ties controlled by PolyMet will be removed and recycled or disposed. Reclamation with overburden and subsequent vegetation will be used where roadbed is not needed for access. See Figure 7 for locations.
- Above-ground pipelines will be disassembled or demolished and the material recycled or disposed. Underground pipelines will be abandoned in place. Manholes and above-ground pipeline supports and foundations will be demolished to ground level or below and covered with at least two feet of soil. Surface disturbances will be ripped and vegetated to achieve final reclamation.
- Power lines (poles, pole hardware and conductors) and substations that will not remain as regional infrastructure will be removed and recycled. Foundations and anchors will be removed or demolished to at least ground surface and covered with at least two feet of soil and vegetated to achieve final reclamation.
- Roads and parking lots will be reclaimed and vegetated according to Minnesota

Rules 6132.2700 by a qualified reclamation contractor. Any roads that may develop into unofficial off-road vehicle trails (Minnesota Rules 6132.3200) will require a variance to allow a 15-foot wide unpaved and un-vegetated track down the centerline of the road once reclamation is completed.

9.5 Facilities Needed for Closure – demolition date (To Be Determined)

9.5.1 Mine Site Waste Water Treatment Facility (Including power supply from main substation and pipelines from WWTF to East and West Pits)

There will be a Mine Site Waste Water Treatment Facility that may remain at closure for a number of years while the pits are filling with water. At the time of this writing, the length of time that the facility must remain in service has not been well defined. At this time, no detailed engineering has been completed in regard to this building, therefore, only general arrangement drawings are available. Note: For purposes of this demolition specification, assume that the equalizer basins and CPS pond and liners will be demolished and reclaimed by another party.

The Mine Site Waste Water Treatment Facility (WWTF) will house the following large pieces of equipment:

- Chemical storage tanks and mixing systems
- Reverse Osmosis water processing equipment
- Chemical precipitation thickener tanks
- Pumping systems
- Greensand filtering systems
- Filter presses

The site shall be left as follows:

- Remove structures and equipment above grade elevations.
- Fill areas below grade elevations with clean fill.
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.
- Above-ground pipelines will be disassembled or demolished and the material recycled or disposed. Underground pipelines will be abandoned in place. Manholes and above-ground pipeline supports and foundations will be demolished to ground level or below and covered with at least two feet of soil. Surface disturbances will be ripped and vegetated to achieve final reclamation.

- Railroad track and ties controlled by PolyMet will be removed and recycled or disposed. Reclamation with overburden and subsequent vegetation will be used where roadbed is not needed for access.
- Power lines (poles, pole hardware and conductors) and substations that will not remain as regional infrastructure will be removed and recycled. Foundations and anchors will be removed or demolished to at least ground surface and covered with at least two feet of soil and vegetated to achieve final reclamation.
- Roads and parking lots will be reclaimed and vegetated according to Minnesota Rules 6132.2700 by a qualified reclamation contractor. Any roads that may develop into unofficial off-road vehicle trails (Minnesota Rules 6132.3200) will require a variance to allow a 15-foot wide unpaved and un-vegetated track down the centerline of the road once reclamation is completed.

Reference drawings include:

Barr Engineering SOW – 06 WWTF

9.5.2 Tailings Basin Waste Water Treatment Plant (Including power supply from main substation, containment system, collection pumps and piping at toe of tailings basin, pipelines from collection system to WWTP, and pipelines from WWTP to discharge points)

There will be a Tailings Basin Waste Water Treatment Plant that may remain at closure for a number of years to control water at the tailings basin. At the time of this writing, the length of time that the facility must remain in service has not been well defined. At this time, no detailed engineering has been completed in regard to this building, therefore, only general arrangement drawings are available. Note: For purposes of this demolition specification, assume that the pretreatment basin and liner will be demolished and reclaimed by another party.

The Tailings Basin Waste Water Treatment Plant (WWTP) will house the following large pieces of equipment:

- Limestone storage tanks and mixing systems
- Reverse Osmosis water processing equipment
- Pumping systems
- Greensand filtering systems

The site shall be left as follows:

- Remove structures and equipment above grade elevations.
- Fill areas below grade elevations with clean fill.
- Remaining floor and/or foundations will be covered with a minimum of two feet of

surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

- Above-ground pipelines will be disassembled or demolished and the material recycled or disposed. Underground pipelines will be abandoned in place. Manholes and above-ground pipeline supports and foundations will be demolished to ground level or below and covered with at least two feet of soil. Surface disturbances will be ripped and vegetated to achieve final reclamation.
- Power lines (poles, pole hardware and conductors) and substations that will not remain as regional infrastructure will be removed and recycled. Foundations and anchors will be removed or demolished to at least ground surface and covered with at least two feet of soil and vegetated to achieve final reclamation.
- Roads and parking lots will be reclaimed and vegetated according to Minnesota Rules 6132.2700 by a qualified reclamation contractor. Any roads that may develop into unofficial off-road vehicle trails (Minnesota Rules 6132.3200) will require a variance to allow a 15-foot wide unpaved and un-vegetated track down the centerline of the road once reclamation is completed.

Reference drawings include:

Barr Engineering SOW – 20 WWTP

10.0 Demolition Waste Disposal Plan

Demolition waste from structure removal will be disposed of in an off-site landfill. Concrete from demolition will be placed in building basements where possible including coarse crusher basement, fine crusher basement and concentrator basement and the Plant Reservoir. (See Figure 2-06 for locations.)

11.0 Special Material Disposal

Surveys for Asbestos-Containing Materials (ACMs) have been completed. ACMs (i.e., pipe and electrical insulation) in utility tunnels will be sealed prior to the tunnels being sealed.

During initial closure of the Cliffs Erie facility, all PCB transformers (including sixteen large ones) and capacitors were removed and properly disposed.

During closure of the Cliffs Erie facility, all nuclear sources were inventoried and disposed.

Partially used paint, chemical and petroleum products will be collected and properly disposed.

Fluorescent and sodium halide bulbs will be removed from fixtures collected and properly disposed.

12.0 Cover and Vegetation of Building Area, Road, Parking Lots

After demolition of facilities listed in Sections 8 and 9, 2 feet of overburden material suitable for vegetation will be placed upon the facility's former footprint. Plant area roads which are not deemed necessary for access by the MDNR will also be abandoned and, if necessary, covered with 2 feet of overburden material that is suitable for vegetation. Asphalt from paved surfaces will be removed and recycled. Reclamation of roads not controlled by PolyMet, such as the Dunka Road, and the road from the North Gate are not contained within this estimate.

Building areas, roads and parking lots will be reclaimed and vegetated according to Minnesota Rules 6132.2700. Any roads that may develop into unofficial off-road vehicle trails (Minnesota Rules 6132.3200) will require a variance to allow a 15-foot wide unpaved and un-vegetated track down the centerline of the road.

Attachment F2

Lakehead Other Than Additive Building and Heating Plant Estimate

September 1, 2016

Mike Glissman
Polymet Mining

Re: 2013 Northmet Closure and Demolition Price Proposal Update

Mr. Glissman

The terms and conditions of our proposal response to the Polymet Inquiry No. PR-0027 dated 6 August 2013 remain unchanged for bid form item 1except as amended by the following;

- Subsequent pricing requests, latest of which is per the provided Closure and Demolition Specification (Structures and Equipment Only) Rev. 4 document, associated spreadsheet titled “demo data needed final adjustments 7-28-2016” and scope clarification emails and attachments provided.
- Attached version of the aforementioned spreadsheet is current as of August 15, 2016.
- The labor and equipment rates provided are no longer current and would be subject to change dependent upon final contract date.

Conditions and pricing for additional bid items found in our proposal are no longer valid or have been subsequently updated or amended by alternate pricing requests.

Sincerely,

Brad Jones

Brad Jones
Sr. Estimator
Lakehead Constructors

Demo and Asbestos Abatement Cost Summary

			Lakehead 2014 Updates							ACT 10/11/13
Scope of Work Description	**Demo Specification Section Number**	**Reference Information / Drawings**	**Miscellaneous**	**Universal Waste Collection**	**Galbestos Removal**	**Demolition**	**Total Demo**	**Site Restoration**	**Assets Recovery**	**Asbestos Lead Paint Mold**
Pre-Demolition Services			$54,400							
Legacy - demoed as part of construction										
Additive Building & Heating Plant		Galbestos removal included in ACT abatement		$7,500.00		$932,800.00	$940,300	$53,000.00		$600,000.00
Bentonite silos	8.1.14						$1,326,500			
Area 2 Water Tower (price separate from Heating & Additives buildings)	8.1.29									
Legacy Tailings Basin Buildings - Demoed as part of construction										
Foreman's Office (Bldg. 718)	8.1.28	No ACT report			~~$13,500.00~~	$9,350.00		$400.00		
Reporting Building (Bldg. 719)	8.1.28	No ACT report			~~$15,400.00~~	$9,900.00		$400.00		
Lube House (Bldg. 720)	8.1.28	No ACT report			~~$2,500.00~~	$2,500.00		$400.00		
Reporting Building (Bldg. 724)	8.1.28	No ACT report			~~$3,300.00~~	$3,300.00		$400.00		
Lube Oil Building (Bldg. 725)	8.1.28	No ACT report			~~$2,500.00~~	$2,500.00		$400.00		
							inc in above			
Legacy Area 1 - used by project										
Area 1 Shop and Truck Storage (Bldg. 220)	8.1.6	ACT Report Zone H		$2,900.00	$106,900	$103,332	$213,132	$74,669	$37,000	
Area 1 Cold Storage (Bldg. 221)	8.1.6	ACT Report Zone H		$400.00	$48,970	$10,860	$60,230	$13,400	$2,800	
Area 1 Reporting Building (Bldg. 231)	8.1.6	No ACT report				$9,900				
Area 1 Boiler House (Bldg. 226)	8.1.6	ACT Report Zone H		$200.00	$13,500	$9,875	$23,575	$3,000	$200	
Area 1 Fire Pump House & Water Tank (Bldg. 228)	8.1.6	TE-8-142 and TE-8-144, ACT Report Zone H		$410.00		$11,250	$11,660			
Area 1 Locomotive Fueling	8.1.6	ACT Report Zone H		$500.00	$22,500	$10,100	$33,100	$6,250	$1,000	
Legacy Area 2 - used by project										
Area 2 Service Shop (Bldg. 201)	8.1.7	ACT Report Zone I		$2,200.00	$160,900	$38,990	$202,090	$37,334	$10,940	
Area 2 Truck Storage (Bldg. 202)	8.1.7	ACT Report Zone I		$2,000.00	$63,190	$9,175	$74,365	$13,988	$3,075	
Area 2 Cold Storage (204)	8.1.7	ACT Report Zone I		$697.00	$42,560	$13,080	$56,337	$14,100	$1,700	
Area 2 Shop Locomotive Service Shop (Bldg. 203)	8.1.7	ACT Report Zone I		$3,400.00	$20,500	$12,300	$36,200	$11,113	$1,625	
Area 2 Locomotive Fueling	8.1.7	ACT Report Zone I		$2,000.00	$20,900	$11,800	$34,700	$6,250	$975	
Hose House (Bldg. 209) Not to be used in project	8.1.7	No ACT report			$3,000	$9,150				
Sample House (Bldg. 208) Not to be used in project	8.1.7	No ACT report			$25,400	$20,300				
Reporting Building (Bldg. 425) Not to be used in project	8.1.7	No ACT report			$3,300	$9,200				
Legacy Plant Area - used by project										
Rebuild Shop (Bldg 602)	8.1.9	ACT Report Zone A		$3,000.00	$70,200	$125,600	$198,800	$27,560	$13,940	
General Shop (Bldg. 601) Includes Acetylene Building (Bldg.604)	8.1.8	ACT Report Zone A		$15,000.00	$199,190	$353,600	$567,790	$182,300	$113,796	
Carpenter Shop (Bldg. 603)	8.1.21	ACT Report Zone A		$2,000.00	$10,200	$13,250	$25,450	$3,300	$100	
Coarse Crusher	8.1.1			$10,000.00	$313,345	$1,551,800	$1,875,145	$593,890	$199,325	
Drive House 1 conv and housings	8.1.2	Drive Houses 1 & 2 and conveyors are all considered	$133,200	$7,500.00	$165,569	$141,540	$314,609	$46,900	$41,050	
Drive House 2 inc conv and housings	8.1.3	to be one structure	inc in above		inc in above	inc in above	inc in above	inc in above	inc in above	
Fine Crusher	8.1.4			$45,000.00	$302,430	$1,373,460	$1,720,890	$203,400	$205,250	
Warehouse 49 (Bldg. 920)	8.1.16	ACT Report Zone A		$6,500.00	$27,586	$82,800	$116,886	$15,947	$5,350	
Warehouse 45 (Bldg. 921, Electrical)	8.1.15	ACT Report Zone A		$2,500.00	$35,159	$72,700	$110,359	$15,947	$3,590	
Lube House (Bldg. 926)	8.1.10	ACT Report Lubricant Storage Building		$578.00	$17,000	$20,550	$38,128	$7,385	$1,600	
Rubber Shop (Bldg. 605)	8.1.26	ACT Report Rubber Storage Building		$1,000.00	$30,464	$36,550	$68,014	$11,269	$5,150	
Concentrator Building and Thickeners	8.1.5 AND 8.1.25			$100,000.00	$1,248,260	$5,895,850	$7,244,110	$1,145,998	$2,141,430	
A-Lab	8.1.11			$500.00	$9,400	$14,560	$24,460	$2,940	$2,450	
Hinsdale Bridge	8.1.24			$0.00	$16,700	$616,300	$633,000	$15,200	$148,500	
Water Reservoir	8.1.12			$5,000.00		$98,100	$103,100	$914,400	$7,750	
Plant Site Water Tower	8.1.12	TG-7-005, Similar to Area 2 water tower				$30,000	$30,000	$2,500	$1,125	
Water Treatment Plant & Storage Tanks	8.1.27	TG-6-021		$1,000.00	$20,000	$72,600	$93,600	$2,250		
Colby Pump House	8.1.13				$41,000	$8,260	$49,260	$1,500		
Administration Building	8.1.17			$3,900.00		$157,935	$161,835	$18,200		
Main Gate	8.1.18			$100.00		$11,400	$11,500	$875		
Booster Pump House #1	8.1.19			$300.00		$23,500	$23,800	$9,200		
Sewage Treatment Plant	8.1.20	No ACT report		$0.00		$62,700	$62,700	$19,520		

Demo and Asbestos Abatement Cost Summary

Scope of Work Description	Demo Specification Section Number	Reference Information / Drawings	Miscellaneous	Universal Waste Collection	Galbestos Removal	Demolition	Total Demo	Site Restoration	Assets Recovery	Asbestos Lead Paint Mold
			Lakehead 2014 Updates							ACT 10/11/13
Portable Pump Houses	8.1.22	No ACM materials - See Dwg. TB-7-095		$0.00		$9,890	$9,890	$3,400		
Return Water Barge	8.1.23	No ACT report		$0.00		$44,900	$44,900			
General Infrastructure (railroads, tunnels, roadways, etc)						$4,988,921	$4,988,921	$1,504,000	$237,500	
Railroads	8.2.5	Figure 7 and Krech & Ojard Dwg. C1		$0.00		$380,000	$380,000			
Tunnels	8.2.2	TJ-63		$0.00		$1,856,000	$1,856,000			
Galleries	8.2.2	Was estimated as a portion of the concentrator								
Sanitary Systems and Wells	8.2.1					$17,500				
Pipelines				$0.00		$2,190,000	$2,190,000	$591,000		
Colby Lake water supply	8.2.2					$900,000		$98,000		
Inter pit pipeline	8.2.2					$562,000				
Natural Gas line	8.2.2					$150,000				
Tailings management above ground	8.2.2					$378,000				
Tailings management underground						$200,000				
Power Lines	8.2.3	Figures 5 & 5.1		$0.00		$97,810.00	$97,810			
Roads and Parking Lots	8.2.6	Figure 9		$0.00		$465,000	$465,000	$195,000		
New - Phase 1 - Plant Site										
Flotation Plant and Reagent Building	9.1.1			$75,000		$621,800	$696,800	$147,600	$242,500	
Concentrate Storage and Loadout Facility	9.1.2			$12,000		$273,760	$285,760	$48,100	$37,500	
Plant Site Sewage Treatment Plant	9.1.3	See Barr SOW 23 & Dwg. TL-2		$1,000.00		$118,000	$118,000	$30,000		
Railroads	9.3.3	See Barr SOW 19		$0.00		$185,000		$111,000		
Pipelines	9.3.1	SOW 12 and 14		$0.00		$1,555,000		$375,000		
Power Lines	9.3.2	SK-11-255		$0.00						
Roads and Parking Lots	9.3.4			$0.00						
Plant Site Wastewater Treatment Plant (WWTP)	9.5.2	See Barr SOW 20		$0.00		$245,000				
New - Phase 1 - Mine Site										
Maintenance Service and Fueling Facility	9.2.1			$1,100		$19,210	$20,310	$7,300	$1,200	
Rail Transfer Hopper	9.2.2	See Barr SOW 15		$1,100.00		$40,000	$41,100	$45,000	$1,200	
Rail Transfer Hopper Control Bldg	9.2.2	See Barr SOW 15		$100.00		$18,600	$18,700			
Rail Transfer Hopper Platform	9.2.2	See Barr SOW 15				$60,000	$60,000			
Central Pumping Station	9.2.3	See Barr SOW 7		$500.00		$14,000	$14,500	$1,200		
Railroads	9.2.4	See Barr SOW's 16, 17, 18		$0.00		$45,000	$45,000	$33,750		
Pipelines	9.3.1	See Barr SOW'S 05, 06, and 08		$0.00		$580,133	$580,133	$217,000		
Power Lines	9.3.2	See Barr SOW 13		$0.00		$83,900	$83,900		$7,175	
Roads and Parking Lots	9.3.4	See Barr SOW 1		$0.00		$392,000	$392,000	$132,000		
Mine Site Wastewater Treatment Facility (WWTF)	9.5.1	See Barr SOW 06		$0		$498,000	$498,000	$14,000		
New - Phase 2							$0			
Reagent Building	9.4.1	Bldg. Dims: 270' x 85' x 75' tall		$15,000.00		$820,000	$835,000	$4,100	$22,500	
Oxygen Plant	9.4.1	310' x 310' x 75' tall		$65,000.00		$4,238,600	$4,303,600	$16,600	$72,500	
Limestone Preparation	9.4.1	125' x 70' x 60' tall		$7,500.00		$345,000	$352,500	$1,750	$12,500	
Hydrometallurgical Plant	9.4.1	525' x 144' x 90' tall		$49,000.00		$4,365,000	$4,414,000	$13,500	$62,500	
Hydrometallurgical Reagents	9.4.1	144' x 90' x 90' tall		$15,000.00		$815,000	$830,000	$2,200	$17,500	
Railroads	9.4.1	Already bid, part of existing / Phase 1 infrastructure		$0.00						
Pipelines	9.4.1	Based on size of buildings and quantities in other buildings on site.		$0.00		$1,450,000				
Power Lines	9.4.1	Already bid, part of existing / Phase 1 infrastructure		$0.00						
Roads and Parking Lots	9.4.1	Based on size of buildings and quantities in other buildings on site.		$0.00		$156,000		$59,225		

NorthMet Contingency Reclamation Estimate

9/4/2014

Above Ground Storage Tanks

Name	Tank #	Fluid	Gallons	Location	Fluid Removal/ Disposal	Demolition/ Removal	Asbestos Lead Paint	Site Restoration	Assets Recovery	Notes
Legacy - Area 1 Shop					$0	$24,100	$0	$3,000		**to Demo tab**
Portable tank on skids (silver)	048	Fuel Oil	1,800	E of Area 1 Shop		$600				Out of Service - Disconnected, Labeled lube oil, Silver tank
Storage Tank	080		20,000	Area 1 - South of Rail Road Grade		$1,000				BASIS: Costs based on conceptual plan, site experience and historical knowledge.
Storage Tank	358	Used Anti-freeze		N. Side Area 1 Shop		$0				Included as part of Area 1 Shop demo
Storage Tank	420	Used Anti-freeze		N. Side Area 1 Shop		$0				Included as part of Area 1 Shop demo
Black Tank	n/a		20,000	N of Area 1 Shop		$7,500		$1,000.00	$1,500.00	
Black Tank	n/a		20,000	N of Area 1 Shop		$7,500		$1,000.00	$1,500.00	
3 Blue			20,000	N of Area 1 Shop		$7,500		$1,000.00	$1,500.00	Out of Service. Disconnected, Labeled "save for conc."
~~Locomotive Fueling~~		~~# 1,2 Fuel Oil~~		~~West end of Panel Yard~~		-				This tank is no longer on site.
Legacy - Area 2 Shop					$0	$0	$0	$0		**to Demo tab**
Locomotive Fueling		# 1,2 Fuel Oil								
Legacy - Plant Area					$0	$199,525	$0	$25,700		**to Demo tab**
Storage Tank	015	# 1,2 Fuel Oil	12,000	E. Side Concentrator		$600				
Storage Tank	032	# 2, 6 Fuel Oil	3,384,000	Tank Farm		$62,000		$8,100.00	$40,000.00	
Storage Tank	033	# 6 Fuel Oil	3,384,000	Tank Farm		$62,000		$8,100.00	$40,000.00	
Storage Tank	034	# 6 Fuel Oil	3,384,000	Tank Farm		$62,000		$8,100.00	$40,000.00	
Storage Tank	304	Mineral Oil	12,000	E. Side Concentrator		$600				
Storage Tank	305	Mineral Oil	12,000	E. Side Concentrator		$600				
Storage Tank	306	Mineral Oil	12,000	E. Side Concentrator		$600				
Storage Tank	408	Lube oil	20,000	SW of Tailings Basin Reporting Area		$0				Out of Service, but piping still in place and no signs are posted
Storage Tank	421	Alcohol	10,000	E side Concentrator		$500				
Storage Tank	506	Fuel Oil	500	Heating Plant		$25				
WTP Backwash (green)			16,000	NE of Drivehouse 1		$5,000		$700.00	$1,000.00	
Tank (white)			14,000	SE of Tailings Basin Reporting Area		$5,000		$700.00	$1,000.00	Out of Service. Disconnected, no visible labels
Dispensing Tanks at Main Gate	121	Gasoline	6,000	See gas station dwg's for reference		$600				
Dispensing Tanks at Main Gate	122	Gasoline	6,000	See gas station dwg's for reference		$600				
New - Phase 1 - Plant Site					$0	$0	$0	$0		**to Demo tab**
Storage Tank	TBD	CuSO4				$0				tanks provided by supplier
Storage Tank	TBD	Magnafloc 10	10,600			$0				tanks provided by supplier
Storage Tank	TBD	PAX	3,000			$0				tanks provided by supplier
Storage Tank	TBD	Lime	22,500			$0				tanks provided by supplier
New - Phase 1 - Mine Site					$0	$0	$0	$0		**to Demo tab**
Mine Site Truck Fueling	TBD	# 1,2 Fuel Oil		Fueling and Maintenance Facility		$0				
New - Phase 2 - Plant Site					$0	$0	$0	$0		**to Demo tab**
Storage Tank	TBD	H2SO4	40,000			$0				tanks provided by supplier
Storage Tank	TBD	HCl	60,000			$0				tanks provided by supplier
Storage Tank	TBD	Liquid SO2	21,000			$0				tanks provided by supplier
Storage Tank	TBD	Magnafloc 342/351				$0				tanks provided by supplier
Storage Tank	TBD	Mg(OH)	80,000			$0				tanks provided by supplier
Storage Tank	TBD	NaHS	13,200			$0				tanks provided by supplier
Storage Tank	TBD	NaOH	40,000			$0				tanks provided by supplier
Removed										
Day Tanks	083	# 6 Fuel Oil	20,000	Tank Farm						
Day Tanks	084	# 6 Fuel Oil	20,000	Tank Farm						
Day Tanks	085	# 6 Fuel Oil	20,000	Tank Farm						

NorthMet Contingency Reclamation Estimate

9/4/2014

Above Ground Storage Tanks

Name	Tank #	Fluid	Gallons	Location	Fluid Removal/ Disposal	Demolition/ Removal	Asbestos Lead Paint	Site Restoration	Assets Recovery	Notes
Blue		Waste oil		W side of Coarse Crusher						
Blue		Lube oil		NE cor. Fine Crusher						
White		Anti-Freeze		NW cor. Fine Crusher						

Attachment G

NTS AOC Estimates

Environmental Science
& Engineering

Via Email

March 23, 2016

Mr. Kevin Pylka
PolyMet Mining, Inc.
P.O. Box 475
Hoyt Lakes, MN 55750

RE: Cost Estimate Evaluation, PolyMet Mining, Inc. Areas of Concern, Hoyt Lakes, Minnesota

Dear Mr. Pylka:

Northeast Technical Services, Inc. (NTS) has completed an evaluation of cost estimates provided by PolyMet Mining, Inc. (PolyMet) for 23 areas of concern (AOCs) identified on PolyMet's property, Hoyt Lakes, Minnesota. The following are the results of the evaluation:

1. Average consultant rates assumed in the cost estimates were compared to NTS's current average consultant rates. The assumed rates were found to be consistent with NTS's current average consultant rates. Therefore, no changes to the AOC cost estimates are recommended based on this comparison.

2. PolyMet provided equipment (including operator) rates (i.e., union scale rates) to help NTS determine if the AOC estimated remediation costs for contractor hauling and excavating are comparable with respect to union scale rates. A direct comparison could not be completed at this time. No changes to the AOC cost estimates are recommended.

3. The only change to the AOC cost estimates that is recommended is to reduce the cost estimate for AOC 37 from $28,500 to $7,500 (updated cost estimate attached). The scope of the updated cost estimate includes completion of the Phase I Environmental Site Assessment (ESA) and submittal of the Phase I ESA to Minnesota Pollution Control Agency (MPCA) for Technical Review. It is assumed that the Phase I ESA will document completion of the land treatment site soil monitoring requirements (see attached MPCA letter dated February 24, 2006), including completion of petroleum remediation requirements, and will also document that no other recognized environmental conditions (RECs) are present at AOC 37.

Please feel free to contact me at the cell phone number below if you have questions.

Sincerely,

Dennis Schubbe
Senior Project Manager
Cell: 218-750-7316

Site Name: [redacted]
Area of Concern Number: [redacted] **Date Updated:** [redacted]
Total acres: 5 to 6 acres
Chemicals of Concern: DRO
Site Summary: This area was used as a permitted petroleum land application site. Approximately 25,000 cubic yards of soil from the Area 1 Shops Tank Farm cleanup and the Knox Fueling Station cleanup were thin spread at this site. Completion of land treatment soil monitoring documented in MPCA letter dated 02/24/2006.

Task Description	**Estimated Costs**
Phase I ESA/SAP	[redacted]
Implementation of SAP	
Consultant Costs	$ -
Laboratory Costs	$ -
Contractor Costs	$ -
Complete Phase II Investigation	
Consultant Costs	$ -
Laboratory Costs	$ -
Contractor Costs	$ -
Remediation Costs	
Consultant Costs	$ -
Laboratory Costs	$ -
Contractor Costs	$ -
TOTALS	$ 7,500

Comments:

Worksheet

Implementation of SAP

Field Work per day				
Geologist	0	100	$	-
Equip (soil)	0	300	$	-
Equip (geoprobe gw))	0		$	-
Equip (wells)	0		$	-
Daily Field Total			$	-
Number of Days	0	$ -	$	-
Limited Phase 2 Repc	0	10000	$	-
PM Time (20% of cost)			$	-
Consulting total			**$**	**-**

Complete Phase II Investigation

Field Work per day				
Geologist	0	100	$	-
Equip (soil)	0	300	$	-
Equip (geoprobe gw)	0		$	-
Equip (wells)	0		$	-
Field Total			$	-
Phase II Report	0	25000	$	-
PM Time			$	-
Consulting total			**$**	**-**

Remediation Costs
(none anticipated)

Assumptions:
No non-petroleum Recognized Environmental Conditions will be identified when completing the Phase I ESA for AOC 37.
MPCA will provide Technical Review of the Phase I ESA and agree that no additional work is necessary for AOC 37.

Depth to groundwater	greater than 20 feet
Nearest surface water	Basin 1E, approximately 800 feet NW
Identified Vapor receptors	none

Implementation of SAP
No SAP necessary.

Complete Phase II Investigation
No Phase II Investiation necessary.

Remediation Costs
Will remediation be required? No
Risk Criteria

Direct Exposure	Land treatment soil monitoring requirements met per MPCA letter dated February 24, 2006.
Groundwater	Potential pathway to surface water (see below).
Surface Water	The nearest surface water appears to be Basin 1E, approximately 800 feet to the northwest. It is unlikely that the surface water would have been impacted.
Vapor Intrusion	There do not appear to be any structures within 100 feet of the site.

Minnesota Pollution Control Agency

February 24, 2006

Mr. Bruce Gerlach
Cliffs Erie LLC
P. O. Box 900
County Road 666
Hoyt Lakes, MN 55750

RE: Completion of Land Treatment Site Soil Monitoring Requirements
Site: LTV Steel Area 5 Landfarm (from Knox Refueling Site)
Site ID#: LEAK6499

Dear Mr. Gerlach:

The MPCA staff has received and reviewed the monitoring results for soil samples collected at the above referenced land treatment site on October 14, 2005. The results indicate that the soil has been adequately treated. Therefore, no further follow-up soil monitoring and tillage is required at this land treatment site.

If you have any questions, please contact me at 651-296-7717.

Sincerely,

Amy Miller
Project Manager
Petroleum Remediation Unit 1
Petroleum Division

AM:ais

cc: Richard Bradford, Administrative City Clerk, Hoyt Lakes
Ted Troolin, St. Louis County Solid Waste Officer
Dennis Schubbe, Northeast Technical Services
Department of Commerce-Petrofund Staff

AOC 001 Detailed Estimate

Site Name:	Area 1 Shops		
Area of Concern Number:	AOC01	**Date Updated:**	06/10/14
Total acres:	3 to 5 acres		
Chemicals of Concern:	VOCs, SVOCs, GRO/DRO, RCRA metals, PCBs		
Site Summary:	Primary maintenance and storage buildings for western mining area and included locomotive and mining equipment fueling		

Yellow Highlight indicates to CRE Estimate AOC tab

Task Description	**Estimated Costs**	
Phase I ESA/SAP	$ 7,500	
Implementation of SAP		
Consultant Costs	$ 56,000	
Laboratory Costs	$ 104,615	
Contractor Costs	$ 48,000	$ 208,615
Complete Phase II Investigation		
Consultant Costs	$ 83,000	
Laboratory Costs	$ 104,615	
Contractor Costs	$ 48,000	$ 235,615
Remediation Costs		
Consultant Costs	$ 80,000	
Laboratory Costs	$ 30,000	
Contractor Costs	$ 270,000	$ 380,000
TOTALS	$ 831,730	

Comments:

AOC 001 Detailed Estimate

Assumptions:

Depth to groundwater	greater than 20-feet	
Nearest surface water	none	
Identified Vapor receptors	none	

Implementation of SAP

Consultant costs will include	Field Work	20 days
	Reporting	Limited Phase 2 Report
	Project Coordination	
Laboratory Costs		
	Soil	170 soil samples all COC
	Groundwater	75 water samples all COC
Contractor costs	Drilling	20 days

Complete Phase II Investigation

Consultant costs will include	Field Work	30 days
	Reporting	Complete Phase 2 Report
	Project Coordination	
Laboratory Costs		
	Soil	170 soil samples all COC
	Groundwater	75 water samples all COC
Contractor costs	Drilling	20 days

Remediation Costs

Will remediation be required?	yes
Risk Criteria	
Direct Exposure	Likely
Groundwater	10 to 20 feet. Groundwater contamination likely. GW discharge to wetlands/ponds nearby.
Surface Water	Ponds and wetland adjacent to site
Vapor Intrusion	Several on-site buildings

AOC 001 Detailed Estimate

Remediation Assumptions

1. Transformer areas will be excavated to 4-feet, and disposed as hazardous waste. COC is PCBs.
   Total volume is esitmated at 90 cubic yards.
2. Excavation of soils along outfall lines, and disposed as Solid waste. COC are VOCs/DRO/GO.
   Total volume is estimated at 1,500 cubic yards
3. Surface excavations, related to general industrial use exceedences
   Total volume is estimated at 1,500 cubic yards
4. Groundwater remediation may be necessary, however the need of this and the cost are unable
   to be determined at this time.

Remediation Costs

	Unit Rate	Units	Totals
Excavator	3,090	8	24720
Trucking and Disposal			
-Hazardous Waste	90	300	27000
-Solid Waste	3000	57	171000
Backfill	3090	15	46350
			269070

Site Name: Oily Waste Disposal Area
Area of Concern Number: AOC06 **Date Updated:** 06/10/14
Total acres: 3 to 5 acres
Chemicals of Concern: DRO, GRO, VOC, RCRA Metals, PAH, PCB
Site Summary:

Yellow Highlight indicates to CRE Estimate AOC tab

Oily waste from floor drains form the General Shops area was dumped at the land surface.

Task Description	Estimated Costs	
Phase I ESA/SAP	$ 7,500	
Implementation of SAP		
Consultant Costs	$ 23,550	
Laboratory Costs	$ 18,440	
Contractor Costs	$11,200	**$ 53,190**
Complete Phase II Investigation		
Consultant Costs	$ 32,450	
Laboratory Costs	$ 45,600	
Contractor Costs	$22,400	**$ 100,450**
Remediation Costs		
Consultant Costs	$ 27,530	
Laboratory Costs	$ 18,240	
Contractor Costs	$27,500	$ 73,270
TOTALS	**$ 234,410**	

Comments: Assumes that direct exposure is the only risk pathway. Remediation includes hot spot excavation and disposal.

Site Name:	Bull Gear Disposal		
Area of Concern Number:	AOC07	**Date Updated:**	06/10/14
Total acres:	~1 to 2 acres		
Chemicals of Concern:	PAH and RCRA metals		
Site Summary:	This area reportedly received a one-time disposal of bull gear grease (a heavy lubricant) in the 1970s. No visible signs of the disposal were observed during site reconnaissance in 2002 or on air photos reviewed during the initial investigation.		

Yellow Highlight indicates to CRE Estimate AOC tab

Task Description	Estimated Costs	
Phase I ESA/SAP	$ 7,500	
Implementation of SAP		
Consultant Costs	$ 18,000	
Laboratory Costs	$ 8,000	
Contractor Costs	$ 9,600	$ 35,600
Complete Phase II Investigation		
Consultant Costs	$ -	
Laboratory Costs	$ -	
Contractor Costs	$ -	
Remediation Costs		
Consultant Costs	$ -	
Laboratory Costs	$ -	
Contractor Costs	$ -	
TOTALS	$ 43,100	

Comments:

Assumptions:

Depth to groundwater	greater than 20 feet	
Nearest surface water	approximately 1300 feet SW	
Identified Vapor receptors	none	

Implementation of SAP

Consultant costs will include	Field Work	4 days
	Reporting	Limited Phase 2 Report
	Project Coordination	
Laboratory Costs		
	Soil	24 composite PAH samples, 24 composite cPAH SVOC samples, 24 composite RCRA metals samples
	Groundwater	none
Contractor costs	Drilling	4 days

Complete Phase II Investigation

Consultant costs will include	Field Work	-
	Reporting	-
	Project Coordination	
Laboratory Costs		
	Soil	-
	Groundwater	-
Contractor costs	Drilling	-

Remediation Costs

Will remediation be required?	no
Risk Criteria	
Direct Exposure	Possible.
Groundwater	The anticipated depth to groundwater is more than 20 feet below ground. Groundwater impacts are not anticipated.
Surface Water	The nearest surface water appears to be approximately 1300 feet to the southwest. It is unlikely that the surface water would have been impacted.
Vapor Intrusion	There do not appear to be any nearby structures that would be at risk for vapor intrusion.

AOC-009 Remediation

Consultant costs

	quantity		avg rate	
Field Work	150	hrs	$100	$15,000
Reporting	80	hrs	$108	$8,640
Project Managment, MPCA coordination	80	hrs	$125	$10,000
Direct Costs				$8,000
				$41,640

Laboratory Costs

	Mercury	TCLP Mercury	DRO	Lead	TCLP Lead	RCRA Metals	Total Arsenic	TCLP Arsenic
#1 Mercury Contaminated Soil	7	2						
#2 Leaded Grease Spill			10	10	2			
#3 Waste Fill Area - Ash						45		
#4 Waste Fill Area - Railroad Ties								
#5 Non-Surficial Arsenic Release							55	10
Quantity	7	2	10	10	2	45	55	10
Unit cost	$35	$60	$25	$11	$60	$70	$11	$60
Unit total	$245	$120	$250	$110	$120	$3,150	$605	$600
	Lab total				**$5,200**			

Contractor Costs

Contractor Costs Mercury Contaminated Soil						
Assumes remediation driven by field screening	Disposal	$280	ton	65	$18,200	
with Lumex,disposal as hazardous waste, and	Hauling	$4,330	roll off box	3	$12,990	Note: Transport price
mercury levels <260 ppm. Excavation size is	Roll Off Rental	$15	box, per day	21	$315	includes hauling, roll off
assumed to be 20 feet x 20 feet x 3 feet deep.	Liner Charge	$60	liner	3	$180	rental, liner charge, and
Also assumes soil will be disposed in roll off	Demurrage	$100	hour	6	$600	demurrage.
containers of 20 cubic yards each.	Add'l Fuel Surcharge	26	% of transport price		$3,662	
					$35,947	
Contractor Costs Leaded Grease Spill						
Assumes remediation is driven visually and by	Disposal	$280	ton	200	$56,000	
soils greater than 10 ppm using PID and	Hauling	$4,330	roll off box	7	$30,310	Note: Transport price
disposal as hazardous waste. Excavation size	Roll Off Rental	$15	box, per day	49	$735	includes hauling, roll off
is assumed to be 30 feet x 30 feet x 4 feet deep.	Liner Charge	$60	liner	7	$420	rental, liner charge, and
Also assumes soil will be disposed in roll off	Demurrage	$100	hour	14	$1,400	demurrage.
containers of 20 cubic yards each.	Add'l Fuel Surcharge	26	% of transport price		$8,545	
					$97,410	
Contractor Costs Waste Fill Area - Ash						
Estimate assumes excavation 450 feet x 60 feet	Mobilization	$1,500	lump	1	$1,500	
x 4 feet deep. No hazardous waste. Disposal in	Excavation	$8	cubic yard	4000	$32,000	
CE landfill. No bottom verification samples;	Hauling	$18	cubic yard	4000	$72,000	
assumed arsenic impacted soil below.	Disposal	$1,100	day	4	$4,400	
					$109,900	
Contractor Costs Waste Fill Area - Railroad Ties						
Assumes collection and disposal is necessary	Mobilization	$1,500	lump	1	$1,500	
for ~200 railroad ties. No hazardous waste.	Loading	$8	cubic yard	50	$400	
	Hauling	$18	cubic yard	50	$900	
	Disposal	$40	cubic yard	50	$2,000	
					$4,800	
Contractor Costs Non-Surficial Arsenic Release						
Assumes remediation driven by delineation	Mobilization	$1,500	lump	1	$1,500	
using soil borings. Estimate assumes	Excavation	$8	cubic yard	16000	$128,000	
excavation 500 feet x 70 feet x 12 feet deep	Hauling	$18	cubic yard	16000	$288,000	
(beneath ash). No hazardous waste.	Disposal	$40	cubic yard	16000	$640,000	
					$1,057,500	

$1,305,557

Site Name: Airport
Area of Concern Number: AOC10 **Date Updated:** 06/10/14
Total acres: 5 to 10 acres
Chemicals of Concern: DRO, GRO, VOC, RCRA Metals, PAH, PCB
Site Summary:

Yellow Highlight indicates to CRE Estimate AOC tab

Approximately 5 acres acres used for equipment teardown and salvage

Task Description	Estimated Costs	
Phase I ESA/SAP	$ 7,500	
Implementation of SAP		
Consultant Costs	$ 13,740	
Laboratory Costs	$ 15,440	
Contractor Costs	$0	**$ 29,180**
Complete Phase II Investigation		
Consultant Costs	$ 18,980	
Laboratory Costs	$ 38,600	
Contractor Costs	$0	**$ 57,580**
Remediation Costs		
Consultant Costs	$ 17,300	
Laboratory Costs	$ 15,440	
Contractor Costs	$27,500	**$ 60,240**
TOTALS	**$ 154,500**	

Comments: Assumes that direct exposure is the only risk pathway. Remediation includes hot spot excavation and disposal.

Site Name:	Stoker Coal Ash Disposal		
Area of Concern Number:	AOC11	**Date Updated:**	06/10/14
Total acres:	5 to 10 acres		
Chemicals of Concern:	B, Mn, SO4, As, Li, Mo, Th		
Site Summary:			
Yellow Highlight indicates to CRE Estimate AOC tab	Unlined landfill for coal ash generated at the heating plant between 1957 and 1989. Volume is unknown but assumed to be approximately 3000 cubic yards.		

Task Description	**Estimated Costs**	
Phase I ESA/SAP	$ 7,500	
Implementation of SAP		
Consultant Costs	$ 13,740	
Laboratory Costs	$ 3,840	
Contractor Costs	$12,600	**$ 30,180**
Complete Phase II Investigation		
Consultant Costs	$ 18,980	
Laboratory Costs	$ 2,688	
Contractor Costs	$17,200	**$ 38,868**
Remediation Costs		
Consultant Costs	$ 44,300	
Laboratory Costs	$ 4,320	
Contractor Costs	$196,500	**$ 245,120**
TOTALS	**$ 321,668**	

Comments: Assumes that groundwater is the predominant risk pathway. Remediation includes excavation disposal and groundwater monitoring

Site Name:	2001 Storage Area		
Area of Concern Number:	AOC13	**Date Updated:**	06/10/14
Total acres:	5 acres		
Chemicals of Concern:	DRO, GRO, VOC, RCRA Metals, PAH, PCB		
Site Summary:			
Yellow Highlight indicates to CRE Estimate AOC tab	Approximately 5 acres acres used for equipment storage. Assume no remediation required. Phase II Risk Assessment leads to no action.		

Task Description	**Estimated Costs**		
Phase I ESA/SAP	$	7,500	
Implementation of SAP			
Consultant Costs	$	13,740	
Laboratory Costs	$	15,440	
Contractor Costs		$0	**$ 29,180**
Complete Phase II Investigation			
Consultant Costs	$	18,980	
Laboratory Costs	$	38,600	
Contractor Costs		$0	**$ 57,580**
Remediation Costs			
Consultant Costs	$	-	
Laboratory Costs	$	-	
Contractor Costs		$0	
TOTALS	**$**	**94,260**	

Comments: Assumes that direct exposure is the only risk pathway. Risk assessment results in No action.

Site Name:	Sandblasting and large Equipment Painitng Area		
Area of Concern Number:	AOC14	**Date Updated:**	06/10/14
Total acres:	11 acres		
Chemicals of Concern:	RCRA metals, VOC, DRO, GRO, PCB, PAH,		

Areas was used sandbalsting locomotives and other large equipment and to repaint them

Yellow Highlight indicates to CRE Estimate AOC tab

Task Description	**Estimated Costs**	
Phase I ESA/SAP	$ 7,500	
Implementation of SAP		
Consultant Costs	$34,300	
Laboratory Costs	$13,896	
Contractor Costs	$9,600	**$57,796**
Complete Phase II Investigation		
Consultant Costs	$ 29,100	
Laboratory Costs	$ 360	
Contractor Costs	$0	**$ 29,460**
Remediation Costs		
Consultant Costs	$ 25,300	
Laboratory Costs	$ 270	
Contractor Costs	$18,000	**$ 43,570**
TOTALS	**$ 138,326**	

Comments: It is anticipated that osand blast waste will be required to be removed due to dermal exposure risk. No groundwater issues anticipated. The Phase II work would consist of preparing a DRAP for excavating and disposing of sand blasting media.

Recognized Environmental Conditions* that Recquire Further Investigaton	**COC**	**Viable risk pathways**	**Remediation?**
Sand blasting media	VOCs, GRO/DRO, RCRA, PCB, PAHs	Direct exposure	Yes
Sidetrack for railroad	VOCs, GRO/DRO, RCRA, PCB, PAHs	Direct exposure	No

Site Name: Dunka Water Treatment Plant Sludge
Area of Concern Number: AOC35 **Date Updated:** 06/10/14
Total acres: 3 to 5 acres
Chemicals of Concern: RCRA metals
Site Summary:

Yellow Highlight indicates to CRE Estimate AOC tab

This area was used to stage sludge generated from the Dunka Water Treatement Plant, which was used to remove metals from stockpile seep water. The sludge was shipped off-site for final disposal.

Task Description	Estimated Costs	
Phase I ESA/SAP	$ 7,500	
Implementation of SAP		
Consultant Costs	$ 15,000	
Laboratory Costs	$ 1,000	
Contractor Costs	$ 4,800	**$ 20,800**
Complete Phase II Investigation		
Consultant Costs	$ 32,000	
Laboratory Costs	$ 1,000	
Contractor Costs	$ 4,800	**$ 37,800**
Remediation Costs		
Consultant Costs	$ -	
Laboratory Costs	$ -	
Contractor Costs	$ -	
TOTALS	$ 66,100	

Comments:

Assumptions:

Depth to groundwater	greater than 20-feet	
Nearest surface water	none	
Identified Vapor receptors	none	

Implementation of SAP

Consultant costs will include	Field Work	2 days
	Reporting	Limited Phase 2 Report
	Project Coordination	
Laboratory Costs		
	Soil	10 RCRA metal composite samples
	Groundwater	none
Contractor costs	Drilling	2 days

Complete Phase II Investigation

Consultant costs will include	Field Work	2 days
	Reporting	Complete Phase 2 Report
	Project Coordination	
Laboratory Costs		
	Soil	10 RCRA metal grab samples
	Groundwater	none
Contractor costs	Drilling	2 days

Remediation Costs

Will remediation be required?	No
Risk Criteria	
Direct Exposure	Possible, however metals liley are immobilzed due to high pH. PH is below 13
Groundwater	The anticipated depth to groundwater is over 20-feet in depth, and because the metals likely are immobile, groundwater impacts are not anticipated.
Surface Water	There no surface water's identified near the site.
Vapor Intrusion	The COC are non-volatile and there are no structures within 100-feet of the site.

Site Name:	Line 9 Area 5 Petroleum Contaminated Soil
Area of Concern Number:	AOC37 **Date Updated:** 03/23/16
Total acres:	5 to 6 acres
Chemicals of Concern:	DRO
Site Summary:	This area was used as a permitted petroleum land application site. Approximately 25,000 cubic yards of soil from the Area 1 Shops Tank Farm cleanup and the Knox Fueling Station cleanup were thin spread at this site. Completion of land treatment soil monitoring documented in MPCA letter dated 02/24/2006.

Worksheet

Task Description		**Estimated Costs**
Phase I ESA/SAP	$	7,500
Implementation of SAP		
Consultant Costs	$	-
Laboratory Costs	$	-
Contractor Costs	$	-
Complete Phase II Investigation		
Consultant Costs	$	-
Laboratory Costs	$	-
Contractor Costs	$	-
Remediation Costs		
Consultant Costs	$	-
Laboratory Costs	$	-
Contractor Costs	$	-
TOTALS	$	7,500

Implementation of SAP

Field Work per day				
Geologist	0	100	$	-
Equip (soil)	0	300	$	-
Equip (geoprobe gw))	0		$	-
Equip (wells)	0		$	-
Daily Field Total			$	-
Number of Days	0	$ -	$	-
Limited Phase 2 Repo	0	10000	$	-
PM Time (20% of cost)			$	-
Consulting total			**$**	**-**

Complete Phase II Investigation

Field Work per day				
Geologist	0	100	$	-
Equip (soil)	0	300	$	-
Equip (geoprobe gw)	0		$	-
Equip (wells)	0		$	-
Field Total			$	-
Phase II Report	0	25000	$	-
PM Time			$	-
Consulting total			**$**	**-**

Comments:

Remediation Costs
(none anticipated)

Assumptions:
No non-petroleum Recognized Environmental Conditions will be identified when completing the Phase I ESA for AOC 37.
MPCA will provide Technical Review of the Phase I ESA and agree that no additional work is necessary for AOC 37.

Depth to groundwater	greater than 20 feet
Nearest surface water	Basin 1E, approximately 800 feet NW
Identified Vapor receptors	none

Implementation of SAP
No SAP necessary.

Complete Phase II Investigation
No Phase II Investiation necessary.

Remediation Costs
Will remediation be required? No
Risk Criteria

Direct Exposure	Land treatment soil monitoring requirements met per MPCA letter dated February 24, 2006.
Groundwater	Potential pathway to surface water (see below).
Surface Water	The nearest surface water appears to be Basin 1E, approximately 800 feet to the northwest. It is unlikely that the surface water would have been impacted.
Vapor Intrusion	There do not appear to be any structures within 100 feet of the site.

Site Name:	Area 2 Shops		
Area of Concern Number:	AOC38	**Date Updated:**	06/10/14
Total acres:	25 acres		
Chemicals of Concern:	RCRA metals, VOC, DRO, GRO, PCB, PAH,		
	Includes a train fueling maintenance area, light vehicle fueling, a fabrication shop, laydown areas, and storage		

Yellow Highlight indicates to CRE Estimate AOC tab

Task Description	Estimated Costs		
Phase I ESA/SAP	already completed		
Implementation of SAP	already completed		
Consultant Costs			
Laboratory Costs			
Contractor Costs		$	-
Complete Phase II Investigation			
Consultant Costs	$ 100,920		
Laboratory Costs	$ 42,190		
Contractor Costs	$99,000	**$**	**242,110**
Remediation Costs			
Consultant Costs	$ 43,460		
Laboratory Costs	$ 12,396		
Contractor Costs	$123,940	**$**	**179,796**
TOTALS	**$ 421,906**		

Comments: The Limited Phase II has confirmed groundwater contamination and surface contaminaton of metals and PAHs. The groundwater likely discharges to adjacent surface water/wetland features via underground utility line. The petroleum aspect of the contamination has been remediated under the PRP.

Recognized Environmental Conditions* that Recquire Further Investigaton	COC	Viable risk pathways	Remediation?
15A/B Building 201	VOCs, GRO/DRO, RCRA, PCB	Discharge to surface water	Yes
16A/B Building 202	VOCs, GRO/DRO	Discharge to surface water	Yes
17A/B Building 203	VOCs, GRO/DRO, RCRA, PCBs, cPAHs	Discharge to surface water	Yes
18A Building 204	PCBs	TSCA regulated area	Yes
25 New Mound System	VOCs, GRO/DRO, RCRA, PCBs, cPAHs	Discharge to surface water	Yes
27 and 28 SW laydown Area	VOCs, DRO	Discharge to surface water	No
32 South Outfall	VOCs, GRO/DRO, PCBs	Discharge to surface water	Yes
33 Burn Piles	VOCs, DRO	Direct Exposure	Yes

*Represents number assinged to REC in Ph 2 Investigation SAP, dated May 2006

Site Name:	Heavy Duty Garage
Area of Concern Number:	AOC40 **Date Updated:** 06/10/14
Total acres:	1 to 2 acres
Chemicals of Concern:	DRO/VOC/PCB/PAHs/RCRA metals

Yellow Highlight indicates to CRE Estimate AOC tab

Area was used for maintenance o f heavy equipment for approx. 10-years, and has been used as cold storage since the 1960's. One UST was removed from the facility in the 1980's.

Task Description	Estimated Costs	
Phase I ESA/SAP	$ 7,500	
Implementation of SAP		
Consultant Costs	$ 15,000	
Laboratory Costs	$ 1,200	
Contractor Costs	$ 4,800	**$ 21,000**
Complete Phase II Investigation		
Consultant Costs	$ 34,000	
Laboratory Costs	$ 1,200	
Contractor Costs	$ 4,800	**$ 40,000**
Remediation Costs		
Consultant Costs	$ -	
Laboratory Costs	$ -	
Contractor Costs	$ -	
TOTALS	$ 68,500	

Comments:

Assumptions:

Depth to groundwater	greater than 20-feet	
Nearest surface water	none	
Identified Vapor receptors	none	

Implementation of SAP

Consultant costs will include	Field Work	2 days
	Reporting	Limited Phase 2 Report
	Project Coordination	
Laboratory Costs		
	Soil	5 RCRA metal and 5 DRO/VOC samples
	Groundwater	-
Contractor costs	Drilling	2 days

Complete Phase II Investigation

Consultant costs will include	Field Work	3000
	Reporting	25000
	Project Coordination	5000
Laboratory Costs		
	Soil	10 RCRA metals/ and 5 DRO/VOC
	Groundwater	-
Contractor costs	Drilling	2 days

Remediation Costs

Will remediation be required?	No
Risk Criteria	
Direct Exposure	Possible, however only minor releases are expected
Groundwater	Due to shallow bedrock, groundwater is not anticipated
Surface Water	There is no nearby surface water.
Vapor Intrusion	There are no structures within the AOC; no vapor risk is present.

Bunker C Tank Farm Removal Estimate
October 17, 2014

Task Description	Cost
Remove tanks and lines	$400,000
Closure Sampling/Demo Coord	$15,000
Asbestos abatement	$500,000
Total	

Remove Tanks and Lines: includes remove and dispose of AST insulation (assume to be non-ACM), demolish/dispose of ASTs (assume the ASTs are clean), remove/dispose of piping (assume pipes are clean), remove/dispose of concrete vaults (assume vaults are clean), obtain necessary permits, and submit MPCA notifications

Closure Sampling/Demo Coordination: includes collecting samples every 20-feet along the piping runs and collecting 10 samples from below each tank, laboratory analyses (90 DRO samples), preparation of a closure report, oversight of demolition contractor, overall project coordination.

Asbestos Abatement: assumes two steam lines in each pipe run for a total of 3,000 lineal feet of insulated piping, and 150,000 square feet of transite siding on the tanks. Please note there has not been an asbestos inspection on this tank system, so the presence or absence of asbestos has not been confirmed.

Non-Routine Maintenance Costs: this cost included maintenance and modifications to equipment that is typically not routine. Assume 4 year lifespan.

Disposal of Recoverable Product Costs: Assume 100 gallons per month at $3 per gallon for disposal.

Since the MPCA has closed this leaksite it is assumed that no additional clean-up of the surface impacts will be required. However, if contaminated soils are encountered during development in this area then the contaminated soils would need to be properly managed.

Site Name:	Administration Building	
Area of Concern Number:	AOC43	**Date Updated:** 06/10/14
Total acres:	1 to 2 acres	
Chemicals of Concern:	DRO and VOC	
Site Summary:	An underground storage tank (UST) was abandoned in place in the Administration Building. The tank (UST 025) was used for heating oil. Domestic waste was pumped into the plant site wastewater treatment plant; a new well and septic system were installed in 2001. The Administration Building is still in use.	

Yellow Highlight indicates to CRE Estimate AOC tab

Task Description	**Estimated Costs**	
Phase I ESA/SAP	$ 7,500	
Implementation of SAP		
Consultant Costs	$ 15,000	
Laboratory Costs	$ 800	
Contractor Costs	$ 4,800	**$ 20,600**
Complete Phase II Investigation		
Consultant Costs	$ -	
Laboratory Costs	$ -	
Contractor Costs	$ -	
Remediation Costs		
Consultant Costs	$ -	
Laboratory Costs	$ -	
Contractor Costs	$ -	
TOTALS	$ 28,100	

Comments:

Assumptions:

Depth to groundwater	greater than 20 feet
Nearest surface water	approximately 1600 ft E
Identified Vapor receptors	Administration Building

Implementation of SAP

Consultant costs will include	Field Work	2 days
	Reporting	Limited Phase 2 Report
	Project Coordination	
Laboratory Costs		
	Soil	8 DRO composite samples, 8 VOC composite samples
	Groundwater	1 DRO, 1 VOC (site well)
Contractor costs	Drilling	2 days

Complete Phase II Investigation

Consultant costs will include	Field Work	-
	Reporting	-
	Project Coordination	
Laboratory Costs		
	Soil	-
	Groundwater	-
Contractor costs	Drilling	-

Remediation Costs

Will remediation be required?	no
Risk Criteria	
Direct Exposure	Surface contamination, and therefore direct exposure, are unlikely.
Groundwater	The anticipated depth to groundwater is more than 20 feet below ground. Groundwater impacts are not anticipated. Note: A domestic well is located adjacent to the Administration Building (Well ID #665923). Static water level information was not found on the well record.
Surface Water	The nearest surface water appears to be approximately 1600 feet to the east. It is unlikely that the surface water would have been impacted.
Vapor Intrusion	The Administration Building is only likely to be at risk for vapor intrusion if contamination is identified.

Site Name:	Main Gate Vehicle Fueling Area		
Area of Concern Number:	AOC44	**Date Updated:**	06/10/14
Total acres:	~0.25		
Chemicals of Concern:	GRO, DRO, VOC		
Site Summary:	This area is several hundred feet from the Administration Building. The fueling area consists of two ASTs (AST 121 and AST 122) that are used for fueling light trucks.		
Yellow Highlight indicates to CRE Estimate AOC tab			

Task Description	**Estimated Costs**	
Phase I ESA/SAP	$ 7,500	
Implementation of SAP		
Consultant Costs	$ 14,000	
Laboratory Costs	$ 600	
Contractor Costs	$ 2,400	**$ 17,000**
Complete Phase II Investigation		
Consultant Costs	$ 32,000	
Laboratory Costs	$ 500	
Contractor Costs	$ 2,400	**$ 34,900**
Remediation Costs		
Consultant Costs	$ 8,000	
Laboratory Costs	$ 1,200	
Contractor Costs	$ 15,000	**$ 24,200**
TOTALS	$ 83,600	

Comments:

Assumptions:

Depth to groundwater	greater than 20 feet	
Nearest surface water	approximately 200 ft NE	
Identified Vapor receptors	none	

Implementation of SAP

Consultant costs will include	Field Work	1 day
	Reporting	Limited Phase 2 Report
	Project Coordination	
Laboratory Costs		
	Soil	5 DRO composite samples, 5 GRO composite samples, and 5 VOC composite samples
	Groundwater	none
Contractor costs	Drilling	1 day

Complete Phase II Investigation

Consultant costs will include	Field Work	1 day
	Reporting	Complete Phase 2 Report/Limited Site Investigation Report
	Project Coordination	
Laboratory Costs		
	Soil	4 DRO grab samples, 4 GRO grab samples, and 4 VOC grab samples
	Groundwater	-
Contractor costs	Drilling	1 day

Remediation Costs

Will remediation be required?	Possible, due to the likely presence of surface contamination in the dispenser area.
Risk Criteria	
Direct Exposure	Possible, if surface contamination is present. The site is not currently listed as a leak site.
Groundwater	The anticipated depth to groundwater is more than 20 feet below ground. Groundwater impacts are not anticipated.
Surface Water	The nearest surface water appears to be approximately 200 feet to the northeast. It is unlikely that the surface water would have been impacted.
Vapor Intrusion	There appears to be a building approximately 10 feet from the western AST; however, the building is not inhabitable.

Site Name:	Plant Site and General Shops		
Area of Concern Number:	AOC46	**Date Updated:**	06/10/14
Total acres:	60 -80 acres		
Chemicals of Concern:	RCRA metals, VOC, DRO, GRO, PCB, PAH,		
Summary:			
Yellow Highlight indicates to CRE Estimate AOC tab	Includes the crushers, concentrator, general shops, rebuild garage, warehouses, associated rail, laydown areas, substations.		

Task Description	**Estimated Costs**	
Phase I ESA/SAP	$ 7,500	
Implementation of SAP		
Consultant Costs	$27,800	
Laboratory Costs	$19,544	
Contractor Costs	$12,000	**$ 59,344**
Complete Phase II Investigation		
Consultant Costs	$ 71,460	
Laboratory Costs	$ 74,700	
Contractor Costs	$43,600	**$ 189,760**
Remediation Costs		
Consultant Costs	$ 111,920	
Laboratory Costs	$ 60,960	
Contractor Costs	$471,810	**$ 644,690**
TOTALS	**$ 901,294**	

Comments: The overiding assumption within this estimate is the near surface bedrock and lack of a groundwater or surface water risk pathway. This assumption limits remediation to direct exposure and vapor wich is typicaly mitigated through engineering controls or liimited excavation rather than large scale remediation.

Recognized Environmental Conditions	**COC**	**Viable risk pathways**	**Remediation?**
#1 Concentrator Tank Farm	VOC, DRO, GRO	Vapor intrusion to conveyor tunnel and upper two feet direct exposure.	Yes
#2 Rebuild Garage UST	VOC, DRO, GRO	Upper two feet direct exposure.	Yes
#3 Substation -1	DRO, PCB	TSCA regulated vessel 1 ppm for high occupancy	Yes
#4 Substation-2	DRO, PCB	TSCA regulated vessel 1 ppm for high occupancy	Yes
#5 General Shop Perimeter and Floor Drains	VOC, DRO, GRO, PAH, RCRA Metals	Direct Exposure, Vapor intrusion	Yes
#6 Rebuild Garage Perimeter and Floor Drains	VOC, DRO, GRO, PAH, RCRA Metals	Direct Exposure, Vapor intrusion	Yes
#7 Yard Area	VOC, DRO, GRO, PAH, PCB RCRA Metals	Direct Exposure, Vapor intrusion	Yes
#8 Concentrator	VOC, DRO, GRO, PAH, PCB RCRA Metals	Direct Exposure, Vapor intrusion	No

Site Name:	Tailings Basin Reporting		
Area of Concern Number:	AOC47	**Date Updated:**	06/10/14
Total acres:	approximately 3 acres		
Chemicals of Concern:	DRO, GRO, VOC		
Site Summary: **Yellow Highlight indicates to CRE Estimate AOC tab**	This site contains a lube station fueling area, a septic tank and a drain field system. Two underground storage tanks (USTs) were removed in 1988. It is a closed leaksite.		

Task Description	**Estimated Costs**
Phase I ESA/SAP	$ 7,500
Implementation of SAP	
Consultant Costs	$ -
Laboratory Costs	$ -
Contractor Costs	$ -
Complete Phase II Investigation	
Consultant Costs	$ -
Laboratory Costs	$ -
Contractor Costs	$ -
Remediation Costs	
Consultant Costs	$ -
Laboratory Costs	$ -
Contractor Costs	$ -
TOTALS	$ 7,500

Comments: It is assumed that the leaksite will not need to be reopened due to new MPCA requirements or new site information. Reports associated with the leak site will be reviewed during the Phase I investigation.

Assumptions:

Depth to groundwater	greater than 20 feet
Nearest surface water	approximately 600 feet east
Identified Vapor receptors	none

Implementation of SAP

Consultant costs will include	Field Work	-
	Reporting	-
	Project Coordination	
Laboratory Costs		
	Soil	-
	Groundwater	-
Contractor costs	Drilling	-

Complete Phase II Investigation

Consultant costs will include	Field Work	-
	Reporting	-
	Project Coordination	
Laboratory Costs		
	Soil	-
	Groundwater	-
Contractor costs	Drilling	-

Remediation Costs

Will remediation be required?	no, unless leak site is reopened based on new information/MPCA requirements
Risk Criteria	
Direct Exposure	Unlikely.
Groundwater	The anticipated depth to groundwater is more than 20 feet below ground. Groundwater impacts are not anticipated.
Surface Water	The nearest surface water appears to be Basin 1E, approximately 600 feet to the east. Surface water impacts are not anticipated.
Vapor Intrusion	There do not appear to be any inhabitable structures within 400 feet of the site.

Site Name:	Booster Pump House with Transformer		
Area of Concern Number:	AOC48	**Date Updated:**	06/10/14
Total acres:	approximately 1 acre		
Chemicals of Concern:	PCB and DRO		
Site Summary:			
Yellow Highlight indicates to CRE Estimate AOC tab	The site consists of several pumping stations and transformers in the area of the Tailings Basin, as well as a substation on the southeast side of the basin. CE records indicated that, at the time of the original investigation in 2002, the transformers contained non-PCB mineral oil.		

Task Description	**Estimated Costs**	
Phase I ESA/SAP	$ 7,500	
Implementation of SAP		
Consultant Costs	$ 15,000	
Laboratory Costs	$ 1,100	
Contractor Costs	$ 4,800	**$ 20,900**
Complete Phase II Investigation		
Consultant Costs	$ 33,000	
Laboratory Costs	$ 900	
Contractor Costs	$ 4,800	**$ 38,700**
Remediation Costs		
Consultant Costs	$ -	
Laboratory Costs	$ -	
Contractor Costs	$ -	
TOTALS	$ 67,100	

Comments:

Assumptions:

Depth to groundwater	greater than 20 feet	
Nearest surface water	Basin 1E, approximately 250 feet SE	
Identified Vapor receptors	none	

Implementation of SAP

Consultant costs will include	Field Work	2 days
	Reporting	Limited Phase 2 Report
	Project Coordination	
Laboratory Costs		
	Soil	12 PCB composite samples and 12 DRO composite samples
	Groundwater	none
Contractor costs	Drilling	2 days

Complete Phase II Investigation

Consultant costs will include	Field Work	2 days
	Reporting	Complete Phase 2 Report
	Project Coordination	
Laboratory Costs		
	Soil	10 PCB grab samples and 10 DRO grab samples
	Groundwater	none
Contractor costs	Drilling	2 days

Remediation Costs

Will remediation be required?	no
Risk Criteria	
Direct Exposure	Direct exposure is possible if PCB-containing oil was previously used in the transformers and if PCB-containing oil contacted the soil.
Groundwater	The anticipated depth to groundwater is more than 20 feet below ground. Groundwater impacts are not anticipated.
Surface Water	The nearest surface water appears to be Basin 1E, approximately 250 feet to the southeast. Surface water impacts are not anticipated.
Vapor Intrusion	A booster pump house is located on the south side of the basin, and several smaller booster pump houses are located between Basin 2W and Basin 1E. None of these buildings appear to be inhabitable.

Site Name:	Coarse Crusher Petroleum Contaminated Soil		
Area of Concern Number:	AOC49	**Date Updated:**	06/10/14
Total acres:	approximately 1 acre		
Chemicals of Concern:	DRO		
Site Summary:	An object along the railroad track to the north of the plant/general shops punctured a locomotive's saddle tank. Approximately 300 gallons of diesel were spilled. The contaminated soil was excavated and thin spread.		

Yellow Highlight indicates to CRE Estimate AOC tab

Task Description	**Estimated Costs**	
Phase I ESA/SAP	$ 7,500	
Implementation of SAP		
Consultant Costs	$ 14,000	
Laboratory Costs	$ 300	
Contractor Costs	$ 2,400	**$ 16,700**
Complete Phase II Investigation		
Consultant Costs	$ 32,000	
Laboratory Costs	$ 700	
Contractor Costs	$ 2,400	**$ 35,100**
Remediation Costs		
Consultant Costs	$ -	
Laboratory Costs	$ -	
Contractor Costs	$ -	
TOTALS	$ 59,300	

Comments:

Assumptions:

Depth to groundwater	greater than 20 feet	
Nearest surface water	approximately 1500 feet E	
Identified Vapor receptors	building approximately 100 feet SE	

Implementation of SAP

Consultant costs will include	Field Work	1 day
	Reporting	Limited Phase 2 Report
	Project Coordination	
Laboratory Costs		
	Soil	12 DRO composite samples
	Groundwater	none
Contractor costs	Drilling	1 day

Complete Phase II Investigation

Consultant costs will include	Field Work	1 day
	Reporting	Complete Phase 2 Report/Limited Site Investigation Report
	Project Coordination	
Laboratory Costs		
	Soil	5 DRO grab samples, 5 VOC grab samples
	Soil Vapor	1 TO-15 grab sample
	Groundwater	none
Contractor costs	Drilling	1 day

Remediation Costs

Will remediation be required?	no
Risk Criteria	
Direct Exposure	Possible.
Groundwater	The anticipated depth to groundwater is more than 20 feet below ground. Groundwater impacts are not anticipated.
Surface Water	The nearest surface water is approximately 1500 feet to the east. Surface water impacts are not anticipated.
Vapor Intrusion	There are buildings located approximately 100 feet to the southeast, 400 feet to the west-northwest, and 500 feet to the southwest. Of these, the only anticipated potential vapor impact is to the nearest building.

Site Name:	Tailings Basin Salvage and Scrap Areas		
Area of Concern Number:	AOC51	**Date Updated:**	06/10/14
Total acres:	11 acres		
Chemicals of Concern:	RCRA metals, VOC, DRO, GRO, PCB, PAH,		

Surficial laydown area, and an area where general industrial waste has been incorporated into fill material on the edge of the Emergency Basin

Yellow Highlight indicates to CRE Estimate AOC tab

Task Description	**Estimated Costs**	
Phase I ESA/SAP	$ 7,500	
Implementation of SAP		
Consultant Costs	$36,200	
Laboratory Costs	$30,108	
Contractor Costs	$17,000	**$ 83,308**
Complete Phase II Investigation		
Consultant Costs	$ 22,450	
Laboratory Costs	$ -	
Contractor Costs	$0	**$ 22,450**
Remediation Costs		
Consultant Costs	$ 43,300	
Laboratory Costs	$ 1,544	
Contractor Costs	$363,400	**$ 408,244**
TOTALS	**$ 521,502**	

Comments: It is anticipated that only small surface releases will be present at this site. Negligible groundwater contamination is anticipated. The only concern is the presence of buried waste, which would constitute an unpermitted dump. Phase II would consist of preparation of a DRAP to excavate and dispose of waste from unpermitted dump.

Recognized Environmental Conditions* that Recquire Further Investigaton	**COC**	**Viable risk pathways**	**Remediation?**
Laydown areas, including various types of equi	VOCs, GRO/DRO, RCRA, PCB	Discharge to surface water Direct Exposure	No
Buried waste (approx. 2-acres in size)	VOCs, GRO/DRO, RCRA, PCB	Discharge to surface water Constitutes an unpermitted dump	Yes

Site Name:	Cell 2W Salvage Area		
Area of Concern Number:	AOC52	**Date Updated:**	06/10/14
Total acres:	1 acre		
Chemicals of Concern:	DRO/VOC/PCB/PAHs/RCRA metals		
Site Summary:			
Yellow Highlight indicates to CRE Estimate AOC tab	Area was used as a small salvage and laydown area. A mobile Chorerex AST was located here as well. No releases are anticipated.		

Task Description	**Estimated Costs**	
Phase I ESA/SAP	$ 7,500	
Implementation of SAP		
Consultant Costs	$ 15,000	
Laboratory Costs	$ 1,200	
Contractor Costs	$ 4,800	**$ 21,000**
Complete Phase II Investigation		
Consultant Costs	$ -	
Laboratory Costs	$ -	
Contractor Costs	$ -	
Remediation Costs		
Consultant Costs	$ -	
Laboratory Costs	$ -	
Contractor Costs	$ -	
TOTALS	$ 28,500	

Comments:

Assumptions:

Depth to groundwater	greater than 20-feet	
Nearest surface water	none	
Identified Vapor receptors	none	

Implementation of SAP

Consultant costs will include	Field Work	2 days
	Reporting	Limited Phase 2 Report
	Project Coordination	
Laboratory Costs		
	Soil	5 RCRA metal and 5 DRO/VOC samples
	Groundwater	5 DRO/VOC
Contractor costs	Drilling	2 days

Complete Phase II Investigation

Consultant costs will include	Field Work
	Reporting
	Project Coordination
Laboratory Costs	
	Soil
	Groundwater
Contractor costs	Drilling

Remediation Costs

Will remediation be required?	No
Risk Criteria	
Direct Exposure	Possible, however no releases are anticipated.
Groundwater	Possible, however no releases are anticipated.
Surface Water	Possible, however no releases are anticipated.
Vapor Intrusion	There are no structures within the AOC; no vapor risk is present.

Site Name:	Hornfels Burial		
Area of Concern Number:	AOC53	**Date Updated:**	06/10/14
Total acres:	~1-2 acres		
Chemicals of Concern:	sulfide minerals		
Site Summary:	This area is within Cell 2W and contains buried hornfels, a waste rock type that contains sulfide minerals. The site is surrounded by three monitoring wells, which are monitored as part of a National Pollutant Discharge Elimination System (NPDES) permit.		
Yellow Highlight indicates to CRE Estimate AOC tab			

Task Description	**Estimated Costs**
Phase I ESA/SAP	$ 7,500
Implementation of SAP	
Consultant Costs	$ -
Laboratory Costs	$ -
Contractor Costs	$ -
Complete Phase II Investigation	
Consultant Costs	$ -
Laboratory Costs	$ -
Contractor Costs	$ -
Remediation Costs	
Consultant Costs	$ -
Laboratory Costs	$ -
Contractor Costs	$ -
TOTALS	$ 7,500

Comments:

Assumptions:

Depth to groundwater	less than 5 feet	
Nearest surface water	none	
Identified Vapor receptors	none	

Implementation of SAP

Consultant costs will include	Field Work	-
	Reporting	-
	Project Coordination	
Laboratory Costs		
	Soil	-
	Groundwater	-
Contractor costs	Drilling	-

Complete Phase II Investigation

Consultant costs will include	Field Work	-
	Reporting	-
	Project Coordination	
Laboratory Costs		
	Soil	-
	Groundwater	-
Contractor costs	Drilling	-

Remediation Costs

Will remediation be required?	no
Risk Criteria	
Direct Exposure	Unlikely.
Groundwater	The depth to groundwater is anticipated to be less than 5 feet. However, three monitoring wells surround the site. The wells are sampled as part of a NPDES permit.
Surface Water	The nearest surface water appears to be more than 1,000 feet from the site. Surface water impacts are not anticipated.
Vapor Intrusion	There do not appear to be any vapor receptors in the vicinity of the site.

Site Name:	Colby Lake Pumping Station		
Area of Concern Number:	AOC59	**Date Updated:**	06/10/14
Total acres:	2 to 3 acres		
Chemicals of Concern:	DRO/VOC/PCB/RCRA metals		
Site Summary:	Remote pumping statation on Colby Lake that provided drinking water to the plant. Includes former fuel oil AST, transformer, and various mercury contaiing pressure gauges.		
Yellow Highlight indicates to CRE Estimate AOC tab			

Task Description	**Estimated Costs**	
Phase I ESA/SAP	$ 7,500	
Implementation of SAP		
Consultant Costs	$ 15,000	
Laboratory Costs	$ 1,200	
Contractor Costs	$ 4,800	**$ 21,000**
Complete Phase II Investigation		
Consultant Costs	$ -	
Laboratory Costs	$ -	
Contractor Costs	$ -	
Remediation Costs		
Consultant Costs	$ -	
Laboratory Costs	$ -	
Contractor Costs	$ -	
TOTALS	$ 28,500	

Comments:

Assumptions:

Depth to groundwater	greater than 20-feet	
Nearest surface water	none	
Identified Vapor receptors	none	

Implementation of SAP

Consultant costs will include	Field Work	2 days
	Reporting	Limited Phase 2 Report
	Project Coordination	
Laboratory Costs		
	Soil	5 RCRA metal and 5 DRO/VOC samples
	Groundwater	5 DRO/VOC
Contractor costs	Drilling	2 days

Complete Phase II Investigation

Consultant costs will include	Field Work
	Reporting
	Project Coordination
Laboratory Costs	
	Soil
	Groundwater
Contractor costs	Drilling

Remediation Costs

Will remediation be required?	No	
Risk Criteria		
	Direct Exposure	Possible, however no releases are anticipated. AST site already closed
	Groundwater	Possible, however no releases are anticipated. AST site already closed
	Surface Water	Possible, however no releases are anticipated. AST site already closed
	Vapor Intrusion	Possible, however no releases are anticipated. AST site already closed

Site Name:	Pellet Plant		
Area of Concern Number:	AOC61	**Date Updated:**	06/10/14
Total acres:	approximately 14.5 acres		
Chemicals of Concern:	GRO, DRO, PCB, VOC, SVOC, RCRA metals		
Summary:	The plant on this site was used to make iron ore pellets. The site included an electrical building, transformers, a substation system, pipelines for transformer oil and steam, and above-ground storage tanks for petroleum products. Two closed leak sites are located on adjacent properties.		

Yellow Highlight indicates to CRE Estimate AOC tab

Task Description	**Estimated Costs**	
Phase I ESA/SAP Update (in progress)	$ 7,500	
Implementation of SAP		
Consultant Costs	$ 40,300	
Laboratory Costs	$ 34,626	
Contractor Costs	$ 24,000	**$ 98,926**
Complete Phase II Investigation		
Consultant Costs	$ 36,300	
Laboratory Costs	$ 10,125	
Contractor Costs	$ 12,000	**$ 58,425**
Remediation Costs		
Consultant Costs	$ 38,300	
Laboratory Costs	$ 5,810	
Contractor Costs	$ 214,436	**$ 258,546**
TOTALS	**$ 423,397**	

Comments: This estimate assumes that the only risk is from direct exposure; it is assumed that the depth to groundwater is greater than 20 feet and that the groundwater is not impacted. There are no inhabitable buildings nearby; therefore, it is assumed that there is no risk of vapor intrusion. PCB remediation is driven by TSCA regulations rather than risk-based guidance.

Recognized Environmental Conditions	**COC**	**Viable risk pathways**	**Remediation?**
#1 Substation System	PCB, DRO	Direct Exposure	Yes
#2 Laydown Areas	VOC, SVOC, DRO, PCB, RCRA Metals	Direct Exposure	No
#3 Former Outdoor Storage Tanks	DRO, GRO, VOC, SVOC	Direct Exposure	Yes
#4 Adjacent Property to Northeast	DRO, VOC	Direct Exposure	No

Attachment H2

Ames Email

From: Michael Glissman <mglissman@polymetmining.com>
Sent: Thursday, April 27, 2017 2:49 PM
To: Jim Scott (jr.scott@frontiernet.net)
Cc: Jim Tieberg; Kevin Pylka
Subject: FW: Question on Demo Landfills
Attachments: image002.jpg; image004.jpg; image003.jpg; image004.jpg; image005.jpg; image006.jpg; image007.jpg

Jim-

See attached string from NTS on landfill demo tipping rates. I'm not exactly clear on how the fuel tax rate applies at Canyon, but overall, Canyon appears to be the worst choice (most expensive).

Just found out that freight rates to the SKB site in Cloquet would be $600 / truck load.

I am also working on obtaining what the capacity of the haul trucks are in cubic yards because we will most likely be hauling lots of air with the piping unless we come up with a way to crush it flat or grind it up so that it doesn't take up as much volume.

In summary:

<u>Dem-Con Companies General Waste in Keewatin:</u>
Clean Construction Demo - $9.40 plus $0.60 cents per cubic yard tax = $ 10.00 / cubic yard

<u>SKB Environmental Services – Shamrock Trucking in Cloquet:</u>
Clean Demo - $20 per ton (dependent on quantity)
Industrial (Contaminated) Waste - $28 per ton (dependent on quantity)

<u>Waste Management in Canyon:</u>
Please note that this is just a general special waste quote.
Disposal: $30 per ton (3 ton minimum)
Fuel: 4.8% *This percentage changes weekly
Environmental: $22 per load
Tax: All applicable taxes, $0.36 per ton
Profile: $200 (onetime fee)

Will continue to send you information as it becomes available.
Thanks
Mike

From: Kevin Pylka
Sent: Thursday, April 27, 2017 12:28 PM
To: Michael Glissman
Subject: FW: Question on Demo Landfills

Mike,

See the email and thread below detailing pricing. I can walk you through this if needed, but am headed to a 1:00-3:00 meeting. I can talk after that.
KEvin

From: Jenny Holmes [mailto:JHolmes@netechnical.com]
Sent: Tuesday, April 25, 2017 4:10 PM
To: Kevin Pylka <kpylka@polymetmining.com>
Subject: Question on Demo Landfills

Hi Kevin,

Allison was able to get some answers for you. Please see her message below and let me know if we can help with anything else. Thanks!!

Sent from my iPhone

Begin forwarded message:

> **From:** Allison Smrekar <asmrekar@netechnical.com>
> **Date:** April 25, 2017 at 3:26:44 PM CDT
> **To:** Jenny Holmes <JHolmes@netechnical.com>
> **Subject: RE: Question on Demo Landfills**
>
> Hi Jenny,
>
> To answer the first question, it is $9.40 per cubic yard plus $0.60 per cubic yard as tax.
>
> For the second question, the tax amount depends on the type of material and is usually less than $1 ($0.36 was the original estimate) so if it is $30 per ton for disposal, with tax it would be $30.36 per ton for disposal. We can disregard the $13 per ton tax as that applies for Wisconsin only (she forgot to take it out when sending the quote). The fuel and environmental charges apply, even for disposal only, so fuel tax is approximately 4.8% per load, and environmental is $22 per load.
>
> The costs listed above are for disposal only with no transportation fees included. I hope this helps – please let me know if you need me to clarify anything, or if it just doesn't make sense. Thanks!
>
> **Allison Smrekar**
> **Geological Engineer, EIT**
> **OFFICE:** (218) 741-4290 | asmrekar@netechnical.com
> **DIRECT:**(218) 742-1054 | www.netechnical.com
>
>

From: Jenny Holmes
Sent: Tuesday, April 25, 2017 12:40 PM
To: Allison Smrekar <asmrekar@netechnical.com>
Subject: Fwd: Question on Demo Landfills

Would you check on Kevin's question?

Sent from my iPhone

Begin forwarded message:

> **From:** Kevin Pylka <kpylka@polymetmining.com>
> **Date:** April 25, 2017 at 11:29:26 AM CDT
> **To:** Jenny Holmes <JHolmes@netechnical.com>
> **Subject: RE: Question on Demo Landfills**
>
> Jenny,
>
> Thanks for the info! Is the $9.40 on the Dem Con information $9.40 per load plus $0.60 cents per cubic yard, or $9.40/ton, plus 0.60 per cubic yard?
>
> Thanks
> Kevin
>
> ---
>
> **From:** Jenny Holmes [mailto:JHolmes@netechnical.com]
> **Sent:** Tuesday, April 25, 2017 10:51 AM
> **To:** Kevin Pylka <kpylka@polymetmining.com>
> **Cc:** Bruce Trebnick <BTrebnick@netechnical.com>
> **Subject:** RE: Question on Demo Landfills
>
> Good morning,
>
> Below is a cost summary for estimated waste disposal of geomembrane materials and plastic piping from the three closest demo landfills.
>
> <u>Dem-Con Companies General Waste in Keewatin:</u>
> Clean Construction Demo - $9.40 plus $0.60 cents per cubic yard
>
> <u>SKB Environmental Services – Shamrock Trucking in Cloquet:</u>
> Clean Demo - $20 per ton (dependent on quantity)
> Industrial (Contaminated) Waste - $28 per ton (dependent on quantity)
>
> <u>Waste Management in Canyon:</u>
> Please note that this is just a general special waste quote.
> Disposal: $30 per ton (3 ton minimum)
> Fuel: 4.8% *This percentage changes weekly
> Environmental: $22 per load
> Tax: All applicable taxes, $0.36 per ton, $13/ton
> Profile: $200 (onetime fee)

I hope this is what you were looking for. Please let me know if you need additional information or if you have a volume estimate so we can get better pricing for you. Thank you!

Jenny Holmes
Senior Project Manager
OFFICE: (218) 741-4290 | jholmes@netechnical.com
DIRECT:(218) 742-1033 | www.netechnical.com

From: Jenny Holmes
Sent: Friday, April 21, 2017 12:35 PM
To: 'Kevin Pylka' <kpylka@polymetmining.com>; Bruce Trebnick <BTrebnick@netechnical.com>
Subject: RE: Question on Demo Landfills

Absolutely! I will get back to you by early next week with some options. Thank you!

From: Kevin Pylka [mailto:kpylka@polymetmining.com]
Sent: Friday, April 21, 2017 11:21 AM
To: Jenny Holmes <JHolmes@netechnical.com>; Bruce Trebnick <BTrebnick@netechnical.com>
Subject: RE: Question on Demo Landfills

Jenny,

Would you or someone at NTS be able to secure pricing for demolition waste for landfills in the area, maybe the three closest? This is an exercise for cost estimating future reclamation estimates so I don't have a waste or material that is generated. We would have to assume it fits into the appropriate "demolition waste" guidelines but as mentioned previously it would be geomembrane materials and plastic piping removed from a site. Not hazardous material nor containing hazardous waste.

I realize it would have to be contingent upon acceptance of a waste profile. I just need something that can be used as a reference in a cost analysis.

Thanks,
Kevin

From: Jenny Holmes [mailto:JHolmes@netechnical.com]
Sent: Friday, April 21, 2017 10:27 AM
To: Kevin Pylka <kpylka@polymetmining.com>; Bruce Trebnick <BTrebnick@netechnical.com>
Subject: RE: Question on Demo Landfills

Hi Kevin,

Dem-Con companies General Waste located in Keewatin is likely your best bet. Disposal rates are around $21.00 or $22.00 per ton and will depend on current acceptance of the material.

If you need additional assistance, please let me know. We would be happy to coordinate any efforts for the disposal of these materials or obtain a quote based on the amount of material intended for disposal.

Thank you!

Jenny Holmes
Senior Project Manager
OFFICE: (218) 741-4290 | jholmes@netechnical.com
DIRECT:(218) 742-1033 | www.netechnical.com

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From: Kevin Pylka [mailto:kpylka@polymetmining.com]
Sent: Friday, April 21, 2017 8:50 AM
To: Bruce Trebnick <BTrebnick@netechnical.com>; Jenny Holmes <JHolmes@netechnical.com>
Subject: Question on Demo Landfills

Bruce / Jenny,

Would you or someone at NTS know the current closest demolition landfills available to dispose of waste like geomembrane liners and plastic piping. I assume it would be either the Canyon Landfill, the Carlton Landfill, or General Waste near Keewatin. If so have you obtained recent pricing for tipping fees?

Kevin

Kevin Pylka
Manager of Environmental Permitting and Compliance
Mobile: 218-750-2054 **|** Office: 218-471-2150 **|** Direct: 218-471-2162 **|** Fax: 218-471-2159
kpylka@polymetmining.com **|** **www.polymetmining.com**

Attachment I3

NTS Rate Letter

April 22, 2016

Environmental Science
& Engineering

PolyMet Mining, Inc.
Attn. Steve DeVaney
Via Email
sdevaney@polymetmining.com

RE: Cost Estimates on Several Items

Attached are the cost estimates that will be used in the Contingency Reclamation Estimate (CRE) as part of the application for the permit to mine with the State of Minnesota. Included are the following items:

1. Hourly labor rates by staff type
2. Hourly rate for surveying
3. Wetland data collection, data entry and quality assurance, per annum cost estimate
4. DMR data collection, data entry, quality assurance and report preparation, per annum cost estimate
5. Water quality report preparation, per annum cost estimate
6. SW-619 industrial landfill monitoring and maintenance, per annum cost estimate (closed state)
7. Tailings basin instrumentation inspection and data collection, per annum cost estimate (current activity)
8. Tailings basin instrumentation report preparation, per annum cost estimate (current activity)
9. Tailings basin instrumentation inspection and data collection, per annum cost estimate (operating activity)
10. Tailings basin instrumentation report preparation, per annum cost estimate (operating activity)
11. Reverse osmosis treatment plants operation, per annum cost estimate

The cost estimates for items 3-8 are based on our experience performing these duties in years past. We have a high degree of certainty in terms of level of effort and unit rates for these items. For items 9 and 10 we lack detail as to how operating conditions would affect the level of effort, therefore we roughly estimated double the level of effort of current, non-operating conditions. For Item 11 we based our cost estimate on our experience elsewhere, however with the absence of design criteria and operating requirements, we estimated what typical plants of this size may cost to operate.

Please note that all pricing is valid for the remainder of calendar year 2016. Pricing is subject to an increase not to exceed 2.5% each year thereafter, effective on Jan 1st, for a period of 10 years. If you should have any questions, please feel free to contact Mr. Bruce Trebnick at 218-742-1051 (office) or 218-780-2006 (cell).

Sincerely,

Richard H. Crum, PG

NTS, President

526 CHESTNUT STREET ▪ VIRGINIA, MINNESOTA 55792 ▪ (218) 741-4290 ▪ FAX (218) 741-4291
WWW.NETECHNICAL.COM

PRICING REQUEST FOR SEVERAL ITEMS FOR THE CONTINGENCY RECLAMATION ESTIMATE (CRE)

AS PART OF THE APPLICATION FOR THE PERMIT TO MINE WITH THE STATE OF MINNESOTA

<u>Prepared For</u>

Steve DeVaney

PolyMet Mining, Inc.

<u>Prepared By</u>

Northeast Technical Services, Inc. (NTS)

526 Chestnut Street

Virginia, Minnesota 55792

218.741.4290

April 21, 2016

Environmental Science
& Engineering

Table of Contents

1. **Hourly labor rates by staff type**

Staff Type	Hourly Rate
Entry Level Professional (I)	88
Middle Level Professional (II)	108
Senior Level Professional (III)	128
Principal Level Professional (IV)	148
WWTP Operator, Class B, C & D	58
WWTP Operator, Class A	128
Field Scientist	78
Project Support (Clerical)	58
Laborer/Intern	48

2. **Hourly rate for surveying**

$98/hour; includes Professional Engineer or EIT along with survey equipment. NTS is not permitted to survey property boundaries at this time.

3. **Wetland data collection, data entry and quality assurance, per annum cost estimate**

Item	Rate	Unit	Quantity	Subtotal
Field Equipment	2220.00	/lump	1	2220
Misc. Consumable Items	504.00	/lump	1	504
Pickup Truck 4x4	0.70	/mile	2000	1,400
Staff, Data Collection (Avg Rate)	83.00	/hour	520	43,160
			Total:	$47,284

Per annum cost estimate *per monitoring point* (21 points): $2,252

4. **DMR data collection, data entry, quality assurance and report preparation, per annum cost estimate**

Facility #1) Hoyt Lakes Tailings Basin

Item	Rate	Unit	Quantity	Subtotal
Field Equipment	7,276.00	/lump	1	7,276
Misc. Consumable Items	3,000.00	/lump	1	3,000
Pickup Truck 4x4	0.70	/mile	3400	2,380
Staff, Data Collection (Avg Rate)	83.00	/hour	560	46,480
Staff, Reporting (Avg Rate)	92.00	/hour	240	22,080
			Total:	$81,216

Facility #2) Hoyt Lakes Mining Area

Item	Rate	Unit	Quantity	Subtotal
Field Equipment	4,957.00	/lump	1	4,957
Misc. Consumable Items	648.00	/lump	1	648
Pickup Truck 4x4	0.70	/mile	1600	1,120
Staff, Data Collection (Avg Rate)	83.00	/hour	260	21,580
Staff, Reporting (Avg Rate)	92.00	/hour	264	24,288
			Total:	$52,593

Per Annum Cost Estimate, Total for *Both Facilities*: $133,809

5. **Water quality report preparation, per annum cost estimate**

Item	Rate	Unit	Quantity	Subtotal
Staff, Reporting (Avg Rate)	97.00	/hour	36	3,492
			Total:	$3,492

6. **SW-619 industrial landfill monitoring and maintenance, per annum cost estimate (closed state)**

Item	Rate	Unit	Quantity	Subtotal
Landfill Inspection	400.00	/ea	3	1,200
Cover Mowing	5327.00	/lump	1	5,327
Groundwater Monitoring	850.00	/well	7	5,950
Gas Vent Monitoring	600.00	/vent	7	4,200
Staff, Reporting (Avg Rate)	88.00	/day	60	5,280
			Total:	$21,957

Actual cost for maintenance will vary year-to-year. Costs shown are 3 year average.

NTS recommends that if the landfill leachate plume is proven to be stable, the number of groundwater sampling events/locations be reduced after five years.

7. **Tailings basin instrumentation inspection and data collection, per annum cost estimate (current activity)**

Item	Rate	Unit	Quantity	Subtotal
Field Equipment	2360.00	/lump	1	2360
Misc. Consumable Items	76.00	/lump	1	76
Pickup Truck 4x4	0.70	/mile	400	280
Staff, Data Collection (Average Rate)	113.00	/hour	112	12,656
			Total:	$15,372

Per Annum Cost Estimate, *per event* (2 events): $7,686

8. **Tailings basin instrumentation report preparation, per annum cost estimate (current activity)**

Item	Rate	Unit	Quantity	Subtotal
Staff, Reporting (Average Rate)	114.00	/hour	50	5,700
			Total:	$5,700

Per Annum Cost Estimate, *per event* (2 events): $2,850

9. **Tailings basin instrumentation inspection and data collection, per annum cost estimate (operating activity)**

Assumed Double Effort of Current Activity (Item #7)

Per Annum Cost Estimate, *per event* (2 events): $15,372

10. **Tailings basin instrumentation report preparation, per annum cost estimate (operating activity)**

Assumed Double Effort of Current Activity (Item #8)

Per Annum Cost Estimate, *per event* (2 events): $5,700

11. **Reverse osmosis treatment plants operation, per annum cost estimate**

Operation of RO treatment systems is dependent upon numerous variables. Proposed cost estimates are subject to the following variables and qualifying statements:

- Typical hours of plant operation required, assuming not continuous.
- Typical level of capacity required, assuming not maximum.
- Typical influent water quality and expected variability.
- Treatment objectives.
- Operational Strategies and SCADA Capabilities: Automation, remote monitoring, remote control capabilities, etc
- Are we to include membrane filter replacement in the estimate?
- How will reject water be stored or otherwise handled?

The following per annum cost estimate is based on this set of assumptions:

- Plants are operational 24/7 at 50% of capacity.
- Two RO plants (500gpm and 2000gpm) are both in operation; the cost estimate below is for combined operation and maintenance.
- Operator required 1 site visit per day.
- Operator scheduled 8 hours per day, 7 days a week.
- Operators are paid flat rate $40 per 8 hours "on-call".
- Not charging travel time for routine operation.
- Class A operator oversight 8 hours per week on average.
- Initial water quality is moderately impaired and moderately variable.
- Membrane filter replacement is not included.
- Potential reject water handling costs are not included.
- See Appendix A for detailed assumed design parameters.

Wastewater Treatment:

Item	**Rate**	**Unit**	**Quantity**	**Subtotal**
Energy Costs*	112,000.00	/lump	1	112,000
Chemical Costs*	599,000.00	/lump	1	599,000
Maintenance Costs*	124,000.00	/lump	1	124,000
Pickup Truck 4x4	0.70	/mi	32,000	22,400
Operator "on-call" charge	40.00	/8 hours	730	29,200
Operator, Class B, C or D	58.00	/hour	3,800	220,400
Operator, Class A	128.00	/hour	416	53,248
			Total:	$1,160,248

*See Appendix B for detailed breakdown of costs.

Wastewater Pretreatment:

Item	**Rate**	**Unit**	**Quantity**	**Subtotal**
Coagulation/Flocculation/Settling	245,000.00	/lump	1	245,000
Ultrafiltration	105,000.00	/lump	1	105,000
			Total:	$350,000

Pretreatment may be optional depending on influent water quality and effluent objectives.

Treatment costs may increase/decrease dependent on pretreatment options.

Appendix A: Assumed design parameters for WWTP's

Design Parameters:		
Percent Recovery	75%	
Design Feed Flow (Max)	3.6	mgd
Design Permeate Flow (Max)	2.70	mgd
Design Concentrate Flow (Max)	0.90	mgd
Average Feed Flow	1.80	mgd
Average Permeate Flow	1.35	mgd
Average Concentrate Flow	0.45	mgd
No. of Skids	3	skids
Size of RO Skids	0.90	mgd
RO Flux Rate	10	gfd
RO Area per Element	400	ft/elements
Number of Pressure Vessels per Skid	7	PV/skid
Number of RO Elements per Skid	231.00	elements/skid
Number of Cartridge Filters	157.00	

Appendix B: Detailed operation & maintenance costs for WWTP's

Annual Energy Cost	$112,000.00	$/year
Annual Energy Rate	$0.08	/kwh
Annual Feed Energy Cost	$97,700.24	$/year
Feed Pressure	200	psi
Interstage Boost Pressure	0	psi
Pump Motor Efficiency	78%	
Energy Consumption	3,345.90	kwh/day
Annual Concentrate Pump Energy Cost	14,000.00	$/year
Head	150.00	
Pump Horsepower	25.00	hp
Hours in Operation	24.00	hours/day
Energy Consumption	447.60	kwh/day

Annual Chemical Costs	$599,000.00	$/year
Antiscalant	$102,738.38	$/year
Dose	5.00	mg/L
Unit Cost	$3.75	$/lb
CIP Chemicals	$395,416.67	$/year
Acid CIP Frequency	30.00	days
Acid CIP Cost (2011 Cost)	$6,500.00	$/CIP
Caustic CIP Frequency	45.00	days
Caustic CIP Cost (2011 Cost)	$6,500.00	$/CIP
Miscellaneous Chemical	$99,631.01	$/year
Percentage of Non-CIP Chemicals	20%	
Final pH adjustment	$616.43	$/year
NaOH	0.25	mg/L
Strength	50%	% Concentration
Cost	$0.30	$/lb

Annual Maintenance Cost	$124,000.00	$/year
Annual Cartridge Filter Replacement Cost	$4,775.42	$/year
Filters to be Replaced	78.50	filters
Filter Replacement Frequency	90.00	days
Filter Cost	$15.00	$/filter
Annual RO Element Replacement Cost	$103,950.00	$/year
RO Elements to be Replaced	346.50	elements
RO Element Replacement Frequency	2.00	years
RO Element Cost	$600.00	$/element
Annual Maintenance Cost	$15,000.00	$/year
RO Capital Cost	$3,000,000	$
Maintenance Cost Percentage	0.50%	of capital cost/year

Attachment K2

Barr Geotechnical Letter

resourceful. naturally.
engineering and environmental consultants
BARR

April 1, 2016

Mr. Steve DeVaney
Procurement Manager
PolyMet Mining Corporation
6500 County Road 666
PO Box 475
Hoyt Lake, MN 55750

Re: Proposal for NorthMet Dam Safety Inspection

Dear Mr. DeVaney:

As requested, this letter provides the scope and cost estimate for performing onsite inspection of tailings basin dams at the NorthMet project site and providing a summary of observations and recommendations in an inspection report. Inspection is anticipated to occur under one of two primary tailings basin operating conditions:

- Tailings Basin Idle – Assumes that the basin is idle (no active tailings discharge into the basin, but discharge of water into the basin from groundwater collection system operations)
- Tailings Basin Active – Assumes that the basin is active (active tailings discharge into the basin, with discharge of water into the basin from groundwater collection system operations)

Barr Engineering Co. has performed dam safety inspections of NorthMet's dams for multiple years, beginning when the site was owned and operated by LTV Steel Mining Company. Using this long-term experience at the site, future dam safety inspections will be performed by a two-person geotechnical engineering team including a mid-level geotechnical engineer, and a senior or principal geotechnical engineer who has previously been involved with dam safety and design of these basins. One or both engineers will be registered professional engineers in the State of Minnesota. Barr's geotechnical engineers will review the integrity of the basins and evaluate field conditions. If possible, the inspection team will also meet with you while onsite to describe preliminary findings.

For 'Tailings Basin Idle' conditions we anticipate spending approximately one full day onsite to review the toe, mid-slope, and crest of the dams to review conditions. Any areas of interest noted from previous inspections, or identified during the proposed inspection, will be evaluated in greater detail. The inspection will be documented with GPS feature location confirmation, photography, and field notes. Additional time on site can be anticipated for inspections performed during 'Tailings Basin Active' conditions, to review acceptability of dam construction procedures and adequacy of dam alignment and geometry control activities.

The observations from onsite inspections will be summarized in a dam safety report, including notes on any dam modifications made since the previous inspection, and recommendations for action items necessary to improve performance of the dams or management of the basin. In addition, the instrumentation monitoring data collected during the prior year will be reviewed and discussed in the report and compared with past instrumentation data. This includes data for pneumatic and standpipe piezometers, inclinometers, and weirs. The dam safety report will also contain considerations for instrumentation repair, abandonment, or replacement based on anticipated site conditions for the following year. Supplemental surveying may be proposed if needed to confirm alignment and geometry of any existing and newly constructed dams. Table 1 provides a summary of the anticipated dam safety inspection and reporting costs.

Table 1 Tailings Basin Inspection and Reporting Cost Estimate (1)

Activity	Estimated Labor Hours	Estimated Labor Cost (2)	Estimated Expense Cost (3)	Estimated Total Cost
Tailings Basin Idle				
Inspection	40	$6,000	$1,000	$7,000
Data Analysis and Reporting	70	$10,000	$500	$10,500
			Estimated Total Cost (Tailings Basin Idle)	**$17,500**
Tailings Basin Active				
Inspection	60	$9,000	$1,000	$10,000
Data Analysis and Reporting	100	$13,000	$500	$13,500
			Estimated Total Cost (Tailings Basin Active)	**$23,500**
			Supplemental Surveying – Differential GPS, Leica, or UAV (Hourly as Needed) (4)	$200 - $300/Hour
			Supplemental Surveying – Z-Boat Bathymetry (Hourly as Needed) (4)	$350 - $450/Hour

Notes:

1) Estimated costs are valid through December 31, 2016. At the time that inspections are requested, the inspection scope will be confirmed and the estimated costs updated accordingly.
2) For estimating future labor costs, assume an annual total labor rate inflation factor on the order of 3 – 5 percent.
3) For estimating future expense costs, assume an annual total expense rate inflation factor on the order of 3 – 5 percent.
4) Hourly cost for surveying will be determined on a project-specific basis and will depend on the type and scope of survey required, the crew size required, and the equipment types and survey materials necessary. For cost estimating purposes assume single-person Differential GPS based surveys for confirmatory evaluation of alignment and geometry, and single-person Leica HDS Scan or UAV Scan for detailed topographic survey. Assume two-person crew with Z-Boat for pond bathymetry surveys.

For cases where a single-day geotechnical inspection may be required, Barr recommends the inspection be performed by a senior or principal engineer. Estimated total cost (labor and expenses) for a single-day inspection and follow-up memorandum can be predicted to be in the range of $3,000 to $4,000.

For each complete dam safety review a draft report will be submitted to PolyMet Mining Corporation for their review approximately 6 weeks after performing the inspection. Upon receipt of comments, a final report will be issued within 1 to 2 weeks.

The costs summarized herein are estimates of total cost. Work will be performed on a time and materials basis in accordance with the Barr fee schedule that is in affect at the time that the work is performed.

We appreciate the opportunity to continue working with you to review and maintain the integrity of these dams.

Sincerely,

Thomas J. Radue

Thomas J. Radue, PE
Vice President

Attachment M

PolyMet Snow Plowing Historical Cost

Attachment M

SNOW PLOWING 2013-2016

2015-2016 WINTER

DINCAU CONSTRUCTION

	DATE	AREA	HOURS*	COST
	13-Nov-15	ADMIN BLDG PARK LOT, SCALE, FUEL STA	2.0	$170.00
	2-Dec-15	ADMIN BLDG PARK LOT, SCALE, FUEL STA	2.0	$170.00
	16-Dec-15	SCALE AREA & SALT	3.5	$297.50
	17-Dec-15	ADMIN BLDG PARK LOT, SCALE, FUEL STA, ROADS, 2WX PUMP, PLANT SITE & HAUL ROADS	12.5	$1,277.50
	27-Dec-15	ADMIN BLDG PARK LOT, SCALE, FUEL STA, ROADS, 2WX PUMP, PLANT SITE & HAUL ROADS	15.0	$1,450.00
	8-Jan-16	ADMIN BLDG PARK LOT, SCALE, FUEL STA	3.5	$297.50
	12-Jan-16	ROAD TO MINE SITE BORE HOLE, ROADS TO TEST HOLES	7.5	$717.50
	15-Jan-16	ADMIN BLDG PARK LOT, SCALE, FUEL STA, ROADS, 2WX PUMP, PLANT SITE & HAUL ROADS	17.0	$1,700.00
	25-Jan-16	DUNKA ROAD, TEST HOLE ROADS	8.0	$780.00
	26-Jan-16	ADMIN BLDG PARK LOT, SCALE, FUEL STA, ROADS, 2WX PUMP, PLANT SITE & HAUL ROADS	14.0	$1,365.00
	27-Jan-16	TEST HOLE ROADS	4.5	$400.00
	28-Jan-16	ADMIN BLDG PARK LOT, SCALE, FUEL STA, ROADS, 2WX PUMP, PLANT SITE, DUNKA ROAD & TEST HOLES	21.5	$2,065.00
	29-Jan-16	TEST HOLE ROADS	5.0	$445.00
	30-Jan-16	TEST HOLE ROADS	4.5	$400.00
	1-Feb-16	TEST HOLE ROADS	3.5	$310.00
	4-Feb-16	TAILINGS BASIN	3.0	$305.00
	8-Feb-16	ADMIN BLDG PARK LOT, SCALE, FUEL STA, ROADS, DUNKA ROAD & TEST HOLES	27.0	$2,530.00
	9-Feb-16	ROADS, CLEAN UP ROADS & SCALE AREA	6.0	$545.00
	15-Feb-16	ADMIN BLDG PARK LOT, SCALE, FUEL STA, ROADS, 2WX PUMP, PLANT SITE, DUNKA ROAD & TEST HOLES	18.0	$1,645.00
	16-Feb-16	ROADS	5.0	$465.00
	20-Feb-16	ROADS & DUNKA ROAD	6.5	$772.50
	24-Feb-16	ADMIN BLDG PARK LOT, SCALE, FUEL STA, ROADS, 2WX PUMP, PLANT SITE, DUNKA ROAD & TEST HOLES	23.5	$2,322.50
TOTAL	22 CALLOUTS		213.0	**$20,430.00**

2014-2015 WINTER

C&C Winger

	8-Dec-14	NO DESCRIPTIONS OF AREAS PLOWED - SEE MAP	3.5	$483.00
	11-Dec-14		3.0	$309.00
	12-Dec-14		3.0	$504.00
	16-Dec-14		8.0	$1,239.00
	22-Dec-14		0.5	$69.00
	3-Jan-15		12.75	$1,543.25
	5-Jan-15		3.5	$483.00
	8-Jan-15		3.5	$483.00
	15-Jan-15		4.0	$572.00
	16-Jan-15		3.0	$414.00
	18-Jan-15		2.5	$345.00
	19-Jan-15		7.5	$1,035.00
	26-Jan-15		12.75	$1,322.25
	27-Jan-15		6.0	$589.50
	2-Feb-15		2.75	$393.25
	11-Feb-15		14.25	$1,822.00
	16-Feb-15		4.0	$340.00
	20-Feb-15		10.1	$1,225.50
	21-Feb-15		3.0	$255.00
	24-Feb-15		1.0	$138.00
	25-Feb-15		4.0	$552.00
	3-Mar-15		11.1	$1,501.80
	8-Apr-15		1.0	$163.00
TOTAL	23 CALLOUTS		124.7	**$15,781.55**

2013-2014 WINTER

EARTH TECH INC.

	3-Dec-13	NO DESCRIPTIONS OF AREAS PLOWED - SEE MAP	5.0	$375.00
	4-Dec-13		5.5	$412.00
	5-Dec-13		11.5	$862.50
	6-Dec-13		4.5	$337.50
	8-Dec-13		6.0	$700.00
	9-Dec-13		3.5	$262.50
	16-Dec-13		6.0	$450.00
	18-Dec-13		6.5	$487.50
	23-Dec-13		4.0	$300.00
	26-Dec-13		7.5	$562.50
	28-Dec-13		1.0	$75.00
	4-Jan-14		7.0	$525.00
	5-Jan-14		2.5	$187.50
	6-Jan-14		6.0	$450.00
	8-Jan-14		4.0	$300.00
	14-Jan-14		2.5	$212.50
	16-Jan-14		1.0	$75.00
	19-Jan-14		6.0	$480.00
	20-Jan-14		11.0	$935.00
	21-Jan-14		9.0	$765.00
	22-Jan-14		15.5	$1,417.50
	26-Jan-14		14.5	$1,207.50
	29-Jan-14		9.0	$765.00
	30-Jan-14		11.0	$935.00
	2-Feb-14		10.0	$800.00
	13-Feb-14		1.5	$112.50
	15-Feb-14		3.5	$262.50
	17-Feb-14		18.5	$1,472.50
	18-Feb-14		14.0	$1,212.50
	19-Feb-14		19.0	$1,605.00
	21-Feb-14		25.5	$2,082.50
	22-Feb-14		28.5	$2,317.50
RADOTICH ENTERPRISES				
	27-Feb-14	\		
	28-Feb-14	------------->	42.5	$4,675.00
	2-Mar-14	/		
	21-Mar-14	\		
	22-Mar-14	------------->	16.25	$1,787.50
	27-Mar-14	/		
	1-Apr-14	\		
	2-Apr-14	/	9.0	$990.00
TOTAL	40 CALLOUTS		348.3	**$30,397.00**

NOTE: HOURS* - MULTIPLE PIECES OF EQUIPMENT AT DIFFERENT RATES

Total	**$66,608.55**
Average	**$22,202.85**
Average of 2 highest	$25,413.50

Attachment O

Memorandum from MPCA to DNR on Legacy

Legacy Permitting/Financial Assurance for Change in Assignment
Former LTV Steel Mining Company (LTVSMC) Tailings Basin and Plant Site
Ann Foss, Metallic Mining Sector Director
December 12, 2017

This memo addresses MPCA's views on the State's potential liability for closure of the Cliffs Erie/NorthMet ferrous tailings basin under a very specific scenario described in detail in section II below.

I. Background/Site History

I.A. LTV Steel Mining Company (LTVSMC)

LTVSMC owned a taconite processing facility and associated tailings basin near Hoyt Lakes, mining areas near Hoyt Lakes, Dunka mine, a railroad from Hoyt Lakes to Taconite Harbor, a dock and ship loading/unloading facility at Taconite Harbor, a power plant at Taconite Harbor, and real estate. LTV Corporation, the parent company to LTVSMC, filed for bankruptcy in 2000 and in January 2001 operations at the LTVSMC facilities ceased. As a result of subsequent bankruptcy proceedings, the State of Minnesota entered into a Master Agreement with the purchasers of the property (Cliffs Natural Resources, FKA Cleveland Cliffs, and Minnesota Power) and LTV. The Bankruptcy court approved the sale and closing occurred in October 2001. One goal of the Master Agreement was to preserve the assets for future use. In addition, under the 2001 Master Agreement, Cliffs Natural Resources provided a Corporate Guarantee as financial assurance under the DNR Ferrous Permit to Mine.

Cliffs Natural Resources has successfully transferred a portion of the property to Steel Dynamics, which owns the Mesabi Nugget plant and the neighboring mine area. MPCA and DNR permits covering this portion of the property were transferred/assigned to Steel Dynamics. As part of the Ferrous Permit to Mine, Steel Dynamics provided financial assurance to cover the associated ferrous responsibilities.

I.B. Cliffs Erie, LLC (CE)

Cliffs Erie, LLC (CE), a subsidiary of Cliffs Natural Resources, holds NPDES/SDS (WQ) permits for the remainder of the former LTVSMC property near Hoyt Lakes.

One of the WQ permits covers the taconite processing plant and the tailings basin ("Basin"). The Basin is also regulated by a 2010 Consent Decree between CE and MPCA, which resolves WQ permit compliance issues involving all WQ permits for the remaining portions of the former LTVSMC property, including the Basin. CE is currently in compliance with the Consent Decree. Neither the CE Basin WQ permit nor the Basin portion of the Consent Decree anticipates requiring a treatment facility for the foreseeable future.

I.C. Transfer/Assignment of legacy permits for the Basin

CE and Poly Met Mining, Inc. (PolyMet) have indicated that PolyMet intends to purchase the former LTVSMC processing plant, Basin, and other assets from CE. A condition to closing on that purchase is that the NPDES/SDS permit and Consent Decree obligations held by CE for the Basin be assigned to PolyMet or one of its affiliates (together, "PolyMet").

To facilitate transfer/assignments, proper requests/forms would need to be submitted to the MPCA by CE and PolyMet. MPCA would process the requests and determine whether to transfer the Basin WQ permit to PolyMet. As part of the transaction, obligations related to the Basin in the 2010 Consent Decree between CE and MPCA would be assigned to PolyMet using the process provided in that document.

The Basin is also currently regulated by the DNR under the CE Ferrous Permit to Mine (PTM) along with other remaining portions of the LTVSMC lands. DNR will handle this through their permit to mine process.

The Basin is regulated by a variety of other permits as well. All of these would go through a similar process to transfer or assign to PolyMet.

II. Question

DNR has the regulatory authority for establishing financial assurance related to closure of the ferrous Basin. DNR has asked for specific information from the MPCA to assist in its financial assurance decisions related to the ferrous Basin. MPCA has been asked to address the following:

What actions would the State need to take to close the ferrous Basin in a manner that ensures compliance with Minnesota's water quality requirements under applicable law for the following situation?

- PolyMet has obtained control of the property;
- Necessary ferrous permit transfers/assignments have been made to PolyMet.
- DNR has completed the permit to mine process related to the Basin and the associated financial assurance.
- The NorthMet project has not been fully constructed and is not operational (in particular, the seepage collection system and the wastewater treatment system). It is important to note that operation of the proposed NorthMet project resolves any legacy water quality issues at the ferrous Basin.
- The state becomes responsible for closure of the Basin.

This would occur sometime after DNR and MPCA permit decisions related to the NorthMet project. It is reasonable to assume that the soonest the events above would occur is one to two years after the NorthMet permit decisions. This puts the timeframe of the State's decision related to closure somewhere in the early 2020's or later. In the interim, the Basin will be operated in compliance with the Basin WQ permit and the Basin portion of the Consent Decree.

III. MPCA Response

The Basin will continue to be regulated under the CE Basin WQ Permit and the Basin portion of the CE Consent Decree while the NorthMet project permitting process continues.

The MPCA focus, in the closure scenario described above, would be protection of surface water quality and existing uses in the area of the Basin. Specifically, surface water quality in Mud Lake Creek, Unnamed Creek, Trimble Creek, and Second Creek would be the priority. Water quality data from existing monitoring points in these streams would be used in any assessments.

It is important to note that operation of the proposed NorthMet project resolves any legacy water quality issues at the ferrous Basin.

MPCA staff recommend the following activities in the near term. MPCA will work with CE and PolyMet to ensure these activities occur using the Consent Decree work plans or some other tool. If the property transfer from CE to PolyMet occurs, the portion of the Consent Decree assigned to PolyMet will include these activities:

1. Continuation of existing monitoring of surface and groundwater
2. Addition of a groundwater monitoring well near existing well GW006 with ongoing sampling for the same parameters, at the same frequency as the existing wells. Well installation completed.
3. Redevelopment and potential eventual replacement of GW010 to eliminate well construction materials as a potential contributor to groundwater pollutant levels.
4. Installation of a shallow piezometer in the wetland area adjacent to GW010. This will assist in determining the adjacent wetland influence on groundwater pollutant levels. Piezometer installation completed.

MPCA staff recommend the following be incorporated into DNR's PTM closure plan if the State becomes responsible for closure (the scenario in II. above):

1. The State needs to consider how long to continue to preserve the Basin asset before proceeding with final closure activities, including:
   - Commencement of dewatering of the Basin (pool water in cell 2E would be pumped to cell 1E in the Basin and then pumped to SD026 to remove the pools from the top of the Basin) as soon as reasonable following a decision to proceed with closure;
   - Discontinuation of current pump-backs from SD004, SD006 and SD026 as soon as reasonable following a decision to proceed with closure;
   - Grading at the Basin to allow for proper drainage; and
   - Construction of a permanent outlet structure to allow storm water to drain off the top of the Basin.
2. Regular evaluation of the monitoring data in the context of this memo and its conclusions. In particular, this should be done upon completion of any revision to the Class 3 and 4A standards and the wild rice sulfate numeric standard.
3. Additional sampling, biological testing and/or wild rice monitoring if deemed necessary by the MPCA.

<u>No treatment/mitigation</u> for alkalinity, hardness, total dissolved solids (TDS), specific conductance, sulfate, and mercury should be required.

<u>IV. Basis for MPCA Response</u>

MPCA reviewed the October 30, 2017, Barr technical memorandum titled "Tailings Basin Legacy Permitting/Financial Assurance for Title Transfer" (PolyMet's report).

MPCA's response considers the following:

1. Timing considerations
   a. As noted above, the facility has been closed since January 2001 and the current MPCA WQ permit for the Basin prohibits operation of the ferrous facility. No additional pollutants from processing have been added since January 2001 nor will they be added under the scenario discussed in this memo.

   b. As noted above, the State Master Agreement had a goal of preserving assets for the future. This included the Basin. If the scenario above occurs, the State will need to consider how long to continue to preserve the Basin asset before proceeding with final closure.
   c. The soonest this scenario will occur is the early 2020's.
   d. If the State decides to proceed with final closure of the ferrous Basin, the MPCA will evaluate the environmental conditions at that time and the regulatory tools (see part V.C.4. of this document) available to the agency at that time to determine how to best resolve any remaining legacy water issues.

2. Groundwater
   a. Data shows groundwater quality is generally better than applicable groundwater standards at the property line. For aluminum, iron, manganese and pH, natural background exceeds the groundwater criteria. For arsenic and barium, an evaluation of tracer pollutants indicates these exceedances are not due to the Basin.
3. Mercury
   a. For mercury, in locations where surface water quality surrounding the Basin exceeds the standard, the higher concentrations are most likely due to influences from precipitation and background concentration, not from seepage from the existing Basin.

   MPCA concludes no treatment/mitigation is necessary in final closure for mercury.

4. Sulfate and wild rice
   a. Continuation of the current conditions associated with the Basin will likely not result in an exceedance of the calculated sulfate standard (or alternative sulfate standard in the proposed rule) if the MPCA's proposed rule revision goes into effect. Closure is not anticipated to change this conclusion, so no treatment/mitigation for sulfate would be required for protection of wild rice.
   b. If the wild rice rulemaking is not completed, another regulatory option available to the State would be to consider developing a site-specific standard based on the science at that time.

5. Class 3 and 4 pollutants
   a. As noted in V.C.1., MPCA is in the process of evaluating the existing water quality standards for alkalinity, hardness, TDS and specific conductance. MPCA has made this rulemaking a high priority and expects to propose revisions in 2018. Based on current information, MPCA expects that these standards will either remain unchanged or become less stringent. The rulemaking will provide clarity as to where the standards apply and how to determine whether the surface water meets the applicable standard. This clarity will be provided even in the event the numeric standards remain unchanged. This rulemaking should be complete prior to the early 2020's.
   b. Monitoring data indicates current compliance, future compliance, and uncertain compliance with the current standards using a protective compliance method.
   c. MPCA recommends regular evaluation of the monitoring data, especially upon completion of the revision to the Class 3 and 4A standards. In addition, based on evaluations, MPCA may recommend additional sampling or biological testing to support alternative regulatory approaches (see V.C.4).

   Considering the information above, MPCA concludes that if the scenario in part II. above occurred and the Basin had to be closed, no treatment/mitigation for alkalinity, hardness, TDS and specific conductance would be required.

V. Detailed Basis for Response based on Surface Water Quality

Surface water monitoring data was reviewed. The only parameters of concern identified were sulfate, mercury, alkalinity, hardness, total dissolved solids (TDS), and specific conductance. These will be discussed in the following order:

1. Mercury
2. Sulfate
3. Alkalinity, hardness, TDS and specific conductance

V.A. Mercury

- The applicable mercury standard is 1.3 ng/L.
- Monitoring data for Second Creek from 2010-2017 have been below the standard.
- Monitoring data for Mud Lake Creek, Unnamed Creek and Trimble Creek have fluctuated above and below the standard. The highest measured concentration was 6 ng/L.
- Data from four groundwater monitoring wells at the toe of the Basin indicate concentrations of mercury in Basin seepage are not increasing. Mercury levels in seepage to groundwater have generally been less than the surface water standard of 1.3 ng/L since 2013.
- Mercury levels in seepage are not expected to change (are not expected to increase). Final Basin closure will not change this.
- In addition, studies conducted by state agencies have found that taconite tailings appear to be a sink for mercury in northern Minnesota (e.g., Berndt (2003)). In particular, the sequestering of mercury through adsorption to solids in the tailings basin and subsequent burial in the sediments results in an overall permanent retention of mercury within the basin and decreases the mercury load released to receiving waters. The analysis in the NorthMet Final EIS demonstrates that mercury released to surface waters during taconite processing is insignificant with respect to mercury concentrations found in local precipitation and existing background surface waters. Surface water monitoring around the former LTVSMC tailings basin found mercury concentrations in surface water seepage around the tailings basin to be consistent with baseline levels, which confirms there is no significant addition of mercury to the environment from seepage from the existing Basin (FEIS, page 5-229, Table 4.2.2-4).
- It is important to note that, as indicated in Minnesota's Statewide Mercury TMDL, atmospheric deposition supplies almost all of the mercury reaching the environment (e.g., atmospheric deposition is the source of 99.5% of mercury in fish), and the great majority of mercury deposition in Minnesota (approximately 90%) originates from outside of the state. See https://www.pca.state.mn.us/water/statewide-mercury-reduction-plan. Concentrations of mercury in rainfall are around 10 ng/L.
- In locations where surface water quality surrounding the Basin is worse than the standard, the higher concentrations are most likely due to influences from precipitation and background influences, not from seepage from the existing Basin.

CONCLUSION: Considering all of the information above, MPCA concludes that if the scenario in II. above occurred and the Basin had to be closed, no treatment/mitigation for mercury would be required.

V.B. Wild Rice Surface Water Quality Standard

V.B.1. Background on the standard.

There is an existing surface water sulfate standard in state rule of 10 mg/L sulfate that applies to "water used for production of wild rice." The rule provides no further clarity on where the standard applies. Instead, it has been a case-by-case determination by the MPCA. In these case-by-case determinations, the MPCA staff review the available information to recommend whether the water in question was a wild rice *production* water (not simply if wild rice was present). In addition, the existing standard applies "when the rice is susceptible to damage from high sulfate levels," which is undefined. The MPCA has sometimes interpreted this to mean the wild rice growing season.

Data from groundwater monitoring wells (GW007, GW001, GW008 and GW0012) at the toe of the Basin indicate concentrations of sulfate in Basin seepage are not increasing. Following dewatering of the Basin in closure, seepage flow will decrease as the system stabilizes, so with stable concentrations in seepage, the impact on streams would not be expected to increase.

Due to issues related to implementing the existing standard and debate about the scientific details of the standard, MPCA is in the process of developing a revision to the wild rice rule. In addition, current state law prohibits MPCA from requiring expenditure of "money for design or implementation of sulfate treatment technologies or other forms of sulfate mitigation" until the current 10 mg/L sulfate wild rice rule is amended.

Recent scientific studies have found that sulfide in the sediment porewater where wild rice grows impacts wild rice; there is not a direct impact from sulfate in the surface water. Research has further shown that sulfide levels are largely controlled by three variables: surface water sulfate, sediment total carbon, and sediment total extractable iron levels. Based on this new information, the MPCA is currently pursuing a revised standard that would establish a protective sediment pore water sulfide level, then use the relationship between sediment sulfide, iron, and carbon to determine the numeric water column sulfate standard for a given wild rice water that maintains sediment pore water levels at or below the protective sulfide level. MPCA public noticed a revision to the standard in August 2017.

It is anticipated that the rule revision will be complete prior to the early 2020's.

V.B.2. Review of sulfate and sediment data

PolyMet collected sediment data from each of the waterbodies downstream of the Basin that MPCA included in the MPCA 2017 proposed rule.

In all but two instances, the calculated allowable sulfate concentrations using the proposed rule were higher than the corresponding measured surface water sulfate concentrations.

In Wynne Lake, of the nine sediment samples (4 grab samples and 5 composite) collected over three years, only one sample resulted in a calculated allowable sulfate concentration lower than the associated measured surface water sulfate concentration.

Regarding Second Creek, PolyMet's report states: "PolyMet's sampling in Second Creek downstream of the tailings basin relied on grab samples based on earlier proposed protocols rather than the composite samples required in MPCA's 2017 proposed rule." "Of the four grab sediment samples collected on Second Creek in 2015 and 2016, two of the samples had calculated allowable sulfate values higher than the associated measured surface water sulfate concentrations. The two exceptions to this outcome are with grab samples SED-92 and SED-07, which had a calculated allowable sulfate concentration of 367 mg/L and 389 mg/L, with a corresponding measured surface water sulfate concentration of 380 mg/L and 451 mg/L, respectively."

The proposed rule allows for establishment of an alternate standard for sulfate "when the ambient sulfate concentration is above the calculated sulfate standard and data demonstrates that sulfide concentrations in pore water are 120 micrograms per liter or less." An alternate standard might be based on a proportional relationship between the maximum allowable increase in porewater sulfide concentrations and an increase in ambient sulfate. MPCA's sulfide sampling in Second Creek found pore water concentrations of less than 120 micrograms per liter, even where sulfate levels were higher than the MPCA's proposed equation-based standard would allow. The proposed rule proposes 120 micrograms per liter pore water sulfide as protective of wild rice.

Continuation of the current conditions associated with the Basin will likely not result in an exceedance of the calculated allowable sulfate concentrations or alternate sulfide standard if the MPCA's proposed rule goes into effect. Closure is not anticipated to change this conclusion.

This data is representative of all potential wild rice waters downstream of the Basin and upstream of the St. Louis River.

If the rulemaking is not completed, another regulatory option available to the State would be to consider developing a site-specific standard based on the science at that time.

CONCLUSION: As a result, MPCA concludes that if the scenario in II. above occurred and the Basin had to be closed, no treatment/mitigation for sulfate would be required for protection of wild rice.

V.C. Alkalinity, Hardness, TDS and Specific Conductance

V.C.1. Background on alkalinity, hardness, TDS and specific conductance standards.

Hardness is a Class 3 standard providing protection for industrial use. When this standard was developed in the 1960s, all waters were protected for this use, whether the use existed or not.

Alkalinity, TDS and specific conductance are Class 4A standards providing protection for irrigation use. These standards were developed in the same timeframe and apply to most waters whether the use exists or not.

At the point in time when the irrigation standards and the industrial use standards were developed, neither the standards nor the background supporting documents for the standards provided guidance on how to determine surface water compliance with the standards. The standards do not include a frequency or duration. For instance, is the standard a never-to-exceed value (an "instantaneous maximum"), a monthly average, an annual average, or some other duration? Minnesota adopted the Class 4A standards to protect irrigation uses, and a longer averaging time may be appropriate since a primary intent of the standards is to protect irrigated soil from the accumulation of salts over the long term. Hardness typically is not a significant concern for industrial water appropriators since surface water appropriated for such use is almost universally treated prior to use.

MPCA is in the process of evaluating these standards, has made them a high priority, and expects to propose revisions in 2018. Based on current information, MPCA expects that the standards will either remain unchanged or become less stringent. The rulemaking will also provide clarity as to where the standards apply and how to determine surface water compliance. This clarity will be provided even in the event the numeric standards remain unchanged. This rulemaking should be complete prior to the early 2020's.

Neither irrigation nor industrial uses exist at or near the site today. The 7Q10 (low) flow in these headwater streams is zero and thus it seems unlikely someone would request to use these waters for irrigation or industrial use. The closest use for either industrial or irrigation purposes is an irrigation appropriation from Wynne Lake (located downstream in the Embarrass River) for a golf course. This is located over 10 miles downstream and there is significant watershed contribution to the river prior to reaching Wynne Lake that would result in dilution of any contributions from the Basin.

V.C.2. Review of monitoring data – Alkalinity, hardness, TDS and specific conductance

PolyMet's report evaluated the existing surface water monitoring data (2011-2016) using two statistical methods. One method uses the 95% confidence interval and one method uses the 95% prediction interval. The 95% prediction interval upper limit represents the 95% likelihood that all individual data points will be below that limit. Evaluating compliance by using the 95% prediction interval method is protective. As noted above, in V.C.1., neither the standards for these parameters nor the background supporting documents for the standards provide guidance on how to determine surface water compliance with the standards. The standards do not include a frequency or duration. For instance, is the standard a never-to-exceed value (an "instantaneous maximum"), a monthly average, an annual average, or some other duration? The current rulemaking will provide clarity as to how to determine surface water compliance. This clarity could result in a conclusion that these standards will be met.

The table below (from the PolyMet report) shows the approximate year surface water standards for these parameters will be met based on the 95% prediction interval upper limit.

Table 1 Approximate Year to Achieve Compliance with Water Quality Standards based on 95% Prediction Interval Upper Limit

Parameter	Water Quality Standard	Unnamed (Mud Lake) Creek	Trimble Creek	Unnamed Creek	Second Creek
Alkalinity, Bicarbonate as CaCO3	250 mg/L	Uncertain	Uncertain	2022	Uncertain
Hardness, as CaCO3	500 mg/L		Uncertain	2018	2024
Total Dissolved Solids	700 mg/L			2017(1)	
Specific Conductance	1,000 µmho/cm		Uncertain	2018	2018

- Prediction interval currently below standard

(1) Data used in calculations extend through December 2016; the upper limit of the 95% prediction interval reaches compliance in August 2017

- Using the 95% prediction interval upper limit, Mud Lake Creek, Unnamed Creek and Second Creek are in compliance with most of these standards or will be in compliance by the early 2020's. The exceptions are discussed below.

- Using the 95% prediction interval upper limit, it is uncertain when compliance with the alkalinity standard in Mud Lake Creek, Trimble Creek and Second Creek will occur.
- Using the 95% prediction interval upper limit, it is uncertain when compliance with the hardness and specific conductance standards will occur in Trimble Creek. However, it should be noted that individual monitoring results for hardness and specific conductance in Trimble Creek have been below the standard since 2015.
- Data from four groundwater monitoring wells (GW007, GW001, GW008 and GW0012) at the toe of the Basin indicate concentrations of alkalinity, hardness, TDS and specific conductance in Basin seepage are not increasing.
- It should be noted that data from a fifth groundwater monitoring well (GW006) is very different from the other wells. For purposes of this memo, MPCA is treating GW006 is atypical and not representative of Basin seepage. MPCA recommends that another monitoring well be placed in the same general area as GW006.
- As noted in V.C.1., the current rulemaking related to these standards will provide clarity on the numeric standards themselves, where the standards apply and how to determine whether a water complies with the applicable standard. This is expected to occur prior to the early 2020's.
- For Trimble Creek, it is uncertain whether alkalinity, hardness and specific conductance will be below the existing standard. More data and other regulatory tools may be necessary. This will be determined after the completion of the current rulemaking.

V.C.3. Expected conditions post-closure when the system has stabilized after dewatering (including removal of the pump-backs)

- Conditions will remain the same or improve in Trimble Creek and Mud Lake Creek.
- Current conditions and predictions above for Unnamed Creek and Second Creek are affected by the current operation of the Basin pump-back systems required by the existing Consent Decree.
- If closure of the ferrous Basin were required, the pump-back systems would be removed at some point to allow for dewatering of the Basin.
- PolyMet's report evaluated how the removal of the pump-backs may affect surface water quality in Unnamed Creek and Second Creek.
- PolyMet's report concludes that "continued decreases or stabilization of concentrations can be expected, even if pump-back activities are discontinued …"
- MPCA is uncertain whether the decreased impacts from dewatering the Basin will offset any increase due to cessation of the pump-backs. In particular, alkalinity could be above, below or at the existing standard following closure of the Basin. Therefore, more data and other regulatory tools may be necessary. This will be determined after the completion of the current rulemaking.

V.C.4. Other regulatory tools

At any point, the MPCA can consider other regulatory options such as site-specific standards (SSS), a use attainability analysis (UAA), a use and value demonstration (UVD), or a variance. These regulatory processes are available but are subject to various approvals including approvals by the MPCA and the United States Environmental Protection Agency (EPA). Factors that may be considered in a SSS include: consideration of specific ion concentrations as it relates to impacts to soil structure, the averaging period for determining compliance with the standards (monthly average, annual average, etc.) and the effects of seasonal applicability on the protection of designated uses. As noted above in V.C.1., there are not existing uses for industrial consumption or agricultural irrigation in the immediate vicinity of the Basin. Under these circumstances, one of these tools may be reasonable.

It is important to note that operation of the proposed NorthMet project resolves any legacy water quality issues at the Basin.

If early cessation of pump-backs has a negative effect on water quality, the pump-backs could be resumed and remain in place until standards are met and then be discontinued.

In considering all available regulatory tools, the MPCA would also need to consider the following:

1. The facility has been closed since January 2001 and the current MPCA WQ permit for the Basin prohibits operation of the ferrous facility.
2. MPCA would need to evaluate the environmental tradeoffs of all available approaches to determine the net environmental benefit. This evaluation would also consider environmental tradeoffs of the installation of a collection system to capture the Basin seepage, which could introduce additional environmental concerns (e.g., wetland impacts, hydrology impacts, etc.)

V.C.5. Conclusion

Considering all of the information above, MPCA concludes that if the scenario in II. above occurred and the Basin had to be closed, no treatment/mitigation for alkalinity, hardness, TDS and specific conductance would be required.

MPCA recommends regular evaluation of the monitoring data, especially upon completion of the revision to the Class 3 and 4A standards. In addition, based on evaluations, MPCA may recommend additional sampling or biological testing to support alternative regulatory approaches.

Appendix 15.2

Construction Phase Contingency Reclamation Plan and Estimate

NorthMet Project Construction Contingency Reclamation Plan

December 2017

Contents

List of Tables

List of Figures

1.0 Introduction

This report describes the reclamation actions that would be implemented as part of the Construction Contingency Reclamation Plan. Minnesota Rules, part 6132.1200, subpart 2, item B(2), as part of the Permit to Mine (PTM), requires a Contingency Reclamation Plan for the first year of mine activities. The Construction Contingency Reclamation Plan is defined as the scope of work required to reclaim the Project if the permittee defaults on its PTM obligations during the construction phase before Mine Year 1. The Construction Contingency Reclamation Cost Estimate (Construction CRE) for this scope of work, and the basis of the Construction CRE, are provided in this document. Capitalized terms in this report have the same meanings as the corresponding terms in the Application unless otherwise indicated.

It is anticipated that in conjunction with issuance of a PTM for the Project, DNR will terminate or otherwise dispose of the Existing PTM, currently held by Cliffs Erie, applicable to the LTV Steel Mining Company (LTVSMC) Legacy Properties that will be included in the Project. It is further anticipated that as part of the disposition of the Existing PTM, the current Cliffs Erie Closure Plan for the LTVSMC Legacy Properties, will be replaced with PolyMet's Legacy Closure Plan (Appendix 15.1). PolyMet will combine its Legacy Closure Plan and associated legacy financial assurance (discussed further in Appendix 15.1) with the Nonferrous Construction Contingency Reclamation Plan and associated nonferrous financial assurance (discussed herein) to provide the complete contingency reclamation plan and financial assurance for the pre-mining construction period. This means that there will be updated financial assurance for legacy-related reclamation costs for existing ferrous facilities, as well as all future construction-related reclamation costs for the nonferrous Project, at the time of PTM issuance.

2.0 Construction Contingency Reclamation Plan

The Construction Contingency Reclamation Plan includes those reclamation actions that would be required if PolyMet were to default on its PTM obligations during the construction phase before nonferrous mining begins. This section details the activities that would occur at the Mine Site, the Plant Site, and the Transportation and Utility Corridors during this pre-mining construction phase, and would therefore require reclamation.

In general, anticipated reclamation activities for construction would include:

- demolition and removal of nonferrous buildings and structures constructed for the Project
- reclamation of the Project stockpile footprints
- reclamation of the first lift of the Flotation Tailings Basin (FTB) dams
- reclamation of Project water management controls

2.3 Mine Site Reclamation

Mine Site construction for the Project is anticipated to take 18 to 24 months. Mine Site construction activities are listed below:

- construction of approximately 22,000 feet of haul roads
- preparation of stockpile foundations, with approximate areas as follows: 13 acres for the Category 1 Waste Rock Stockpile, 63 acres for the Category 2/3 Waste Rock Stockpile, 29 acres for the Category 4 Waste Rock Stockpile, and 32 acres for the Ore Surge Pile
- construction of stormwater ponds A, B, C, and D and related ditches and dikes
- construction of mine water management system infrastructure, including sumps, ponds, pipelines, and pumping systems
- stripping of approximately 95 acres of overburden from the East Pit - rock blasting within the pit will not occur during this period
- construction of the Mine Site power distribution system
- construction of the Mine Site Fueling and Maintenance Facility (MSFMF)

These Mine Site features are shown on Large Figure 1, and the following subsections describe how they would be reclaimed.

2.3.1 Buildings and Structures

All Project structures, including the MSFMF, would be demolished and removed from the Mine Site. Foundations and slabs at or below site final reclamation grades would be left in place. These areas would be covered with a minimum of two feet of soil, and vegetated.

2.3.2 Mine Pit and Haul Roads

Approximately 95 acres will be stripped, producing approximately 1,950,000 cubic yards of overburden material (Saturated Mineral Overburden, Unsaturated Mineral Overburden, and Peat) will be removed from the pit footprint areas during construction. For reclamation, these materials would be hauled from temporary stockpiles back to the pit footprint areas. The pit areas would be graded and vegetated. All haul roads would also be reclaimed. Because mining would not have occurred, pit rock slope grading would not be required.

2.3.3 Stockpiles

Overburden material placed in the stockpiles during construction would be returned to the mine pit areas. Under-liner systems would be removed, and the stockpile footprint areas revegetated. The Ore Surge Pile (OSP) facility would be removed and reclaimed similar to the pit footprint areas. All disturbed areas would be restored to pre-construction conditions.

2.3.4 Mine Site Water Management Systems

Mine Site water management infrastructure to be reclaimed would include mine water pipes and pumps, which could either be abandoned in place or removed and recycled. PolyMet would remove the CPS building, and would reclaim and revegetate the area. The CPS Pond could be reclaimed as a wetland or filled and revegetated.

Stormwater sedimentation ponds and the mine water ponds would be reclaimed by developing wetlands or by filling and revegetating the areas.

2.4 Plant Site Reclamation

Plant Site development for the Project is anticipated to take 18 to 24 months during the pre-mining construction phase. Plant Site construction activities that will take place are listed below:

- partial construction of Phase 1 of the WWTS
- refurbishment of the Beneficiation Plant to accommodate Project ore beneficiation processes and production schedule
- construction of the Flotation Building
- construction of the Concentrate Dewatering and Storage and Concentrate Loadout Building
- construction of the first lift of FTB dams
- construction of approximately 24,000 linear feet of the FTB Seepage Containment System, including access road, cutoff wall, piping, valves, pumps, and other mechanical and electrical systems
- construction of stormwater ponds and related ditches and dikes
- construction of the Sewage Treatment Systems
- refurbishment of raw water, potable and fire water systems for plant operations
- refurbishment of power distribution systems across the Plant Site

These Plant Site features are shown on Large Figure 2, and the following subsections describe how they would be reclaimed.

2.4.1 Buildings and Structures

All Project structures would be demolished and removed from the Plant Site. Foundations and slabs at or below site final reclamation grades would be left in place. These areas would all be covered with a minimum of two feet of soil. Building areas would be graded, have topsoil applied, and seeded.

2.4.2 Roads and Parking

Roadways not needed for future uses would be removed, and the roadway alignments graded to near surrounding site conditions. Where culverts are removed, they would be replaced with channels and the locations graded and vegetated to provide a stable restored area.

Parking areas not needed for future uses would be reclaimed as described above for roadways.

2.4.3 Flotation Tailings Basin (FTB)

The first lift of the FTB dams would be reshaped and reseeded.

2.4.4 Plant Site Water Management Systems

2.4.4.1 Wastewater Treatment System

Construction of the Waste Water Treatment System (WWTS) will begin during the pre-mining construction phase. However, because no discharge to the environment is planned for the Project during this period, the WWTS will not need to be operational. Reclamation of this facility would require its demolition and removal of all structures. Foundations and slabs at or below site final reclamation grades would be left in place. These areas would all be covered with a minimum of two feet of soil and vegetated.

2.4.4.2 Plant Site Water Management System Infrastructure

The recently installed FTB Seepage Containment System would be sealed and covered with 2 feet of soil, where possible. The FTB Seepage Containment System could be breached, if needed, for funnel and gate options for a non-mechanical water treatment system. The closure of the existing former LTVSMC tailings basin and the FTB South Seepage Management System, in this construction phase where the WWTS has not become operational, are described in the Legacy Closure Plan (Appendix 15.1).

Plant Site water management infrastructure to be reclaimed would include process water pipes and pumps, which could either be abandoned in place or removed and recycled. Ponds would be reclaimed by developing wetlands or by filling and revegetating the areas.

2.5 Corridors Reclamation

Development of the Transportation and Utility Corridors and the Colby Lake Pipeline Corridor is anticipated to take 18 to 24 months during the pre-mining construction phase. Corridor development activities during construction are listed below:

- installation of MPP in the Dunka Road and Utility Corridor, along with associated mechanical and electrical controls

- construction of approximately 11,000 linear feet of new rail and adjacent service road between the Mine and Plant Sites and refurbishment of the railroad track along the Railroad Corridor
- upgrades to Dunka Road
- refurbishment of the Colby Lake Pipeline and Colby Lake Pumphouse

The following subsections describe how these Corridor features would be reclaimed.

2.5.1 Roads and Culverts

Where roads are abandoned, the road culverts would be removed to prevent potential flow obstructions due to clogged or dammed culverts. Where culverts are removed, channels would be graded to maintain a stable restored area. Road surfaces would be regarded to similar surroundings conditions followed by topsoil placement and seeding.

2.5.2 Pipelines

The Mine to Plant Pipelines (MPP) and the Colby Lake Pipeline would be removed, recycled, disposed, or abandoned in place. Buried pipelines that are left in place would be capped off and details of pipe size, material, and purging would be documented.

Subject to the limits on reclamation described in the preceding paragraph, aboveground pipelines and other facilities (i.e., pump booster station, associated controls) would be disassembled or demolished and the material recycled or disposed. Underground pipelines would be abandoned in place. Manholes and aboveground pipeline supports and foundations would be demolished to ground level or below and covered with at least two feet of soil. All surface areas would be vegetated to achieve restoration goals.

2.5.3 Railroad Tracks

The newly installed Railroad Spur would be removed and recycled or disposed of. The rail bed would be regraded to similar surrounding conditions, followed by topsoil placement and seeding.

2.6 Ancillary Items Reclamation

2.6.1 Sanitary Systems and Wells

Construction contingency reclamation would include removal of all Project septic systems, including removing all liquids or solids from tanks and filling these tanks with either soil or crushed rock. Monitoring wells would be sealed by a licensed well driller in accordance with Minnesota Department of Health rules when no longer needed.

2.6.2 Power Lines

Power lines (poles, pole hardware, and conductors) and substations that would not remain as regional infrastructure would be removed and recycled. Foundations and anchors would be removed or demolished to at least ground elevation and covered with at least two feet of soil and seeded to achieve restoration goals.

2.6.3 Tanks

Large aboveground storage tanks would be cleaned, and painted surfaces tested for lead prior to demolition. Tanks with insulation and associated wall and/or roof covers would be evaluated for potential asbestos-containing material (ACM). Insulation and coverings would be removed and disposed of appropriately. Tank cleaning would remove remaining materials and sludge. The tanks would be cleaned, materials removed, and cleaning residues would be sent to an appropriate recycling or waste disposal facility.

Tanks would be disassembled for disposal or recycling, as appropriate. Below-grade foundations would be left in place and covered with a minimum of two feet of soil and seeded. Smaller aboveground storage tanks would be cleaned and removed without disassembly.

2.7 Waste Disposal

This section presents waste disposal plans that would be implemented during contingency reclamation activities.

2.7.1 Demolition Waste Disposal

The majority of the demolition waste from structure removal would be disposed of off site.

2.7.2 Special Material Disposal

Special materials on site at the time of construction may include ACM, partially used paint, chemical and petroleum products, fluorescent and sodium halide bulbs, certain batteries, electronic waste, lighting ballasts, small capacitors, and oil or chemical-stained concrete. All of these materials would be safely collected, removed, and properly recycled or disposed.

2.8 Watershed and Wetland Restoration

This section presents the stormwater and watershed restoration reclamation actions that would be conducted as part of Construction Contingency Reclamation.

2.8.1 Watershed Restoration

All ditches and dikes would be reclaimed and areas restored to near pre-construction site conditions. Ditches would be filled in and graded, and dikes would be removed. The reclaimed areas would have topsoil applied and would be seeded.

All ponds would either be filled or converted into wetlands. Once filled, the ponds would be covered with topsoil and seeded with the goal of restoring these areas to similar surrounding conditions.

3.0 CRE and Financial Assurance for Construction

The Construction CRE for the Project, and the basis for the cost estimates, are detailed in this Section 3.0. The legacy closure cost estimates, and the basis for those estimates, are detailed in Appendix 15.1 of the PTM Application (Application). As described in Section 16 of the Application, PolyMet plans to financially assure the total amount of the pre-mining phase (combination of construction Contingency Reclamation Plan for the Project and the Legacy Closure Plan for existing conditions) at the time of Permit to Mine issuance. Note that to avoid duplication when these Plans are combined, the long-term postclosure costs for the pre-mining phase are covered in the Legacy Closure Plan only (Appendix 15.1).

The financial assurance instruments for these combined financial assurance obligations under Minnesota Statutes, chapter 93 will be some combination of surety bond(s) and irrevocable letters of credit (ILOCs), along with a trust fund. The financial assurance package will also include commercial general liability, pollution liability, and property insurance. Insurance coverage will provide security against unknown, unanticipated, and catastrophic conditions resulting in claims against the property, should such occur.

The following sections describe how the Construction CRE was developed in accordance with the DNR nonferrous regulations. Section 3.1 describes the organization of the Construction CRE and Section 3.2 describes the basis for reclamation activities.

The remainder of this section provides information about the firms that developed costs used in the Construction CRE:

Barr Engineering Co. (Barr)

Barr is very familiar with the Project and all properties within the Project site. Barr, working with PolyMet engineers, developed scopes of work and estimates for Project reclamation for construction activities including Category 1 Waste Rock Stockpile and Groundwater Containment System, the FTB, and the Hydrometallurgical Residue Facility (HRF). Barr also provided rate estimates for reclamation project staff.

Northeast Technical Services (NTS)

NTS is very familiar with the former LTVSMC site and has been working on AOCs, monitoring and reporting on legacy tailings basin geotechnical instruments, and monitoring, maintaining and reporting with respect to the former LTVSMC site since the LTVSMC bankruptcy in 2001. NTS provided rate estimates for vehicles.

Lakehead Constructors Inc. (Lakehead)

Lakehead is a major local construction contractor and has worked with PolyMet engineers to develop estimates for building demolition, infrastructure removal, and footprint restoration for Project facilities.

Ames Construction (Ames)

Ames is national contractor with experience in mine construction and reclamation. Ames is very familiar with the Project and the properties included in the Project site. Ames, working with PolyMet and Barr engineers, developed estimates for Project construction activities. Ames provided unit cost information used for earthmoving and related reclamation activities.

D & T Landscaping, Inc. (D&T)

D&T is very familiar with the former LTVSMC site and has been providing reclamation seeding, fertilizing, and mulching services since the LTVSMC bankruptcy in 2001. D&T provided estimates for these ongoing activities.

3.1 Construction CRE Organization

The Construction CRE for the Project was developed in a standard Excel spreadsheet with no macros or user programming. All financial assurance estimates associated with the PTM Application were developed using this spreadsheet.

<u>Construction CRE</u>

The Construction CRE is attached as Appendix A. There are 10 tabs or worksheets used in the Construction CRE, which are described in Table 3-1:

Table 3-1 Construction CRE Tabs

Tab/worksheet Name	Tab/worksheet Contents	Source of Contents
Construction Tab	estimate and summary for reclamation activities	See “Note” column in tab
Unit $ Reclamation Tab	unit costs	See “Comments” column in tab
Unit $ Long Term Tab	unit costs	See “Comments” column in tab
Pipe-Liner Off Site Disposal Tab	development of unit costs for offsite disposal of pipe and liners based on local transportation and tipping fees	Dem-Con Companies General Waste in Keewatin
Ponds and Sumps Tab	number and acreage of lined and unlined ponds and sumps	Changes Over Time Memo (see Table 7-3)
SOW3 Cat 1 Grading-Seeding (Yr 0) Tab	engineering estimate for reclaiming the permanent stockpile footprint	Barr
SOW11 HRF Cover Sys (Yr 0) Tab	engineering estimate for restoration of disturbance due to HRF preconstruction activity	Barr

Tab/worksheet Name	Tab/worksheet Contents	Source of Contents
SOW14 FTB Grading and Seeding (Yr 0) Tab	engineering estimate for restoration of FTB construction disturbance	Barr
SOW21 Cat 1 Cont Sys (Yr 0) Tab	engineering estimate for breaching permanent stockpile containment system	Barr
Demo Tab	estimates for demolition, waste disposal and restoration for building, pipelines and roads	Lakehead

3.2 Reclamation Basis

This section describes the sources of information used to estimate the construction-phase reclamation costs for the Project. The Construction CRE assumes that the first year after closure of the Project during construction will be a holding year with no reclamation activities. After the holding year, construction-phase reclamation activities will occur over a three-year period.

Table 3-2 lists the sources used for the Construction CRE.

Table 3-2 Summary of Sources Uses in Construction CRE

Referenced As	Description	Used For
Attachment F	PolyMet specification (F1) and Lakehead estimates (F2)	Building and AST demolition, road, railroad, pipeline and power line removal and site restoration costs
Attachment H1	Ames letter to support Ames portion of unit $ Reclamation Tab (Ames 2016)	Unit costs for temporary stockpile footprint reclamation, pit perimeter fence, pond and sump reclamation
Attachment H2	Ames Email with new item unit $ Reclamation Tab (Ames 2017)	Unit cost for OSLA grading
Attachment I1 and Attachment I2	NTS emails used with Pipe-Liner Off Site Disposal Tab	Transport of liner and pipes to offsite landfill and tipping fees
Attachment I3	NTS letter (2016)	Rate for pickup truck
Attachment J	D&T letter (D&T 2016)	Unit costs for reclamation seeding
Attachment K1	Barr 2016 Fee Schedule	Rates for Project Manager, Project Engineer and Project Inspectors
Appendix 15.4 of the PTM Application, Changes Over Time Memo	Barr memo *NorthMet Project Feature Changes Over Time Dec 2017.pdf*	Quantities/areas for temporary stockpile material relocation and footprint reclamation, pit perimeter fence, pond and sump reclamation and reclamation seeding

Referenced As	Description	Used For
PTM Application Appendix 4	Appendix 4 Categories 1, 2/3, and 4 Stockpiles and Ore Surge Pile Design and Category 1 Stockpile Groundwater Containment System Permit Application Support Drawings	Engineering estimates for Permanent Stockpile Cover and Groundwater Containment Systems
PTM Application Appendix 6	Appendix 6 Flotation Tailings Basin and FTB Seepage Containment and Stream Augmentation Systems Permit Application Support Drawings	Engineering Estimate for FTB Bentonite Amendments
PTM Application Appendix 7	Appendix 7 Hydrometallurgical Residue Facility Permit Application Support Drawings	Engineering Estimates for HRF preload removal

3.2.1 Project Building Demolition and Infrastructure Removal

For the demolition of the Project buildings built during the construction phase, PolyMet developed a specification for demolition of all buildings (other than the Additive Building and Heating Plant), and reclamation of the associated sites footprints (Attachment F1). Lakehead submitted a proposal to cover this specification (Attachment F2).

The estimates for building demolition on the above proposal included mobilization, contractor overhead, contractor profit, and contractor supervision. These estimates are listed in the Construction CRE on the Demo Tab, and are linked to the Construction Tab under line items "Mine Site – Demo" and "Plant Site – Demo and Abatement".

3.2.2 Mine Site

The estimated costs of Project activities at the Mine Site would include demolition of buildings and removal of the pipes, pumps, power lines, roads and railroads with site restoration are included in the Construction CRE on the Construction Tab under the line items "Mine Site – Demo".

<u>Temporary Stockpile Footprint Restoration</u>

The estimated cost for separating the liner and pipes underneath Project facilities from rock and soil material is based on local contractor unit prices from the Unit $ Reclamation Tab (Ames 2016) and quantities from Changes Over Time Memo (Appendix 15.4), and is included in the Construction CRE on the Construction Tab under the line item "Mine Site - Stockpile Footprint Reclamation".

The estimated cost for disposal of liner and pipes at a local appropriate landfill is based on unit costs developed from local transport and tipping fees (Attachment I1 and Attachment I2) on the Pipe-Liner Off Site Disposal Tab and quantities from Changes Over Time Memo, and is included in the Construction CRE on the Construction Tab under the line item “Mine Site - Stockpile Footprint Reclamation”.

The estimated cost of covering Project stockpile footprints with two feet of soil and revegetating is based on local contractor unit prices from the Unit $ Reclamation Tab (Ames 2016 and D&T 2016) and quantities from Changes Over Time Memo, and is included in the Construction CRE in the Construction Tab under line item “Mine Site - Stockpile Footprint Reclamation

The estimated cost for removal of the piping, pumps and power lines associated with the temporary stockpiles with site restoration is based on the Mine Year 20 configurations, which have a liability equal to or greater than the liability at the end of the construction phase, and is included in the Construction CRE on the Construction Tab under the line items “Mine Site – Demo”.

<u>Overburden Storage and Laydown Area (OSLA)</u>

The estimated cost of grading the OSLA footprint (assuming 6” average material graded) and revegetating is based on local contractor unit prices from the Unit $ Reclamation Tab (Ames 2017 and D&T 2016) and quantity from Changes Over Time Memo, and is included in the Construction CRE on the Construction Tab under line item “Mine Site – OSLA”.

<u>Mine Pit</u>

The cost for removal of the dewatering system, in-pit pumps and piping, in-pit powerline and substation with site restoration is based on the Mine Year 20 configurations, which have a liability equal to or greater than the liability at the end of construction, and is included in the Construction CRE on the Construction Tab under the line items “Mine Site – Demo”.

<u>Pond and Sump Removal</u>

The estimated cost for cleaning out, separating the liner and pipes and revegetating the ponds and sumps is based on local contractor unit prices from the Unit $ Reclamation Tab (Ames 2016) and quantities from the Ponds and Sumps Tab, based on the Changes Over Time Memo, and is included in the Construction CRE on the Construction Tab under line item “Mine Site - Ponds and Sumps”.

The estimated cost for disposal of liner and pipes at a local appropriate landfill is based on unit costs developed from local transport and tipping fees (Attachment I1 and Attachment I2) on the Pipe-Liner Off Site Disposal Tab and quantities from the Ponds and Sumps Tab, based on the Changes Over Time Memo, and is included in the Construction CRE on the Construction Tab under line item “Mine Site - Ponds and Sumps”.

<u>Permanent Stockpile</u>

The estimated cost for breaching the containment system is developed in the engineering estimate on the SOW21 Cat 1 Cont Sys (Yr 0) Tab and is included in the Construction Tab under line item “Mine Site – Construction”. The engineering estimate is based on the containment system design shown on permit level design drawings GCS-003 and GCS-010 to 013 (Appendix 4 of the Application), and includes contractor profit/overhead, mobilization, and construction QA/QC.

The estimated cost for reclaiming the permanent stockpile footprint is developed in the engineering estimate on the SOW3 Cat 1 Grading-Seeding (Yr 0) Tab and is included in the Construction CRE on the Construction Tab under line item “Mine Site – Construction”. The engineering estimate is based on the cover system design shown on permit level design drawings SKP-011, SKP-013 and SKP-032 to 035 (Appendix 4 of the Application) and includes contractor profit/overhead, mobilization, and construction QA/QC.

3.2.3 Plant Site

The estimated cost for demolition of Plant Site buildings and structures built for the Project during the construction phase (including pipes, pumps, and roads) along with associated site restoration is included in the Construction CRE on the Construction Tab under line item “Plant Site – Demo and Abatement”.

HRF Preconstruction Disturbance

The estimated cost for reclaiming the preconstruction disturbance at the HRF is developed in the engineering estimate on the SOW11 HRF Cover Sys (Yr 0) Tab and is included in the Construction CRE on the Construction Tab under line item “Plant Site – General Reclamation”. The engineering estimate is based on permit level design drawings HRF-007 (Appendix 7 of the Application) and includes contractor profit/overhead, mobilization, and construction QA/QC.

FTB Construction Disturbance

The estimated cost for reclaiming construction disturbance at the FTB is developed in the engineering estimate on the SOW14 FTB Grading-Seeding (Yr 0) Tab and is included in the Construction CRE on the Construction Tab under the line item “Plant Site – Construction”. The engineering estimate is based on the design shown on permit level design drawings FTB-005, FTB-010 and FTB-024 (Appendix 6 of the Application) and includes contractor profit/overhead, mobilization, and construction QA/QC.

3.2.4 Project Management

Estimated costs for staff and vehicles that support Project reclamation activities during the construction phase is assumed to be for a three-year period and is based on prices from the Unit $ Reclamation Tab and is included in the Construction CRE on the Construction Tab under line item “Project Management”. All items in this section cover the short term activities associated with Project disturbances (Mine Site, new buildings and infrastructure and construction activities at the HRF and FTB). Other Project Management costs for the pre-mining period can be found in the Legacy Closure Plan.

Project Manager

Annual salary with benefits from an hourly rate is based on the average Barr rate for a top-level professional (Attachment K1). Annual cost estimate is based on assumption of 1 FTE.

Project Engineer

Annual salary with benefits from an hourly rate is based on the average Barr rate for a mid-level professional (Attachment K1). Annual cost estimate is based on assumption of 1 FTE.

Project Inspector

Annual salary with benefits from an hourly rate is based on the average Barr rate for a technician I (Attachment K1). Annual cost estimate is based on assumption of 2 FTE.

Vehicles

Vehicle $/mile is based on the NTS charge for a pickup (Attachment I3). Annual cost is based on assumption of 15,000 miles per year for each of four pickups.

3.2.5 Indirect Costs

Indirect costs are included in the Construction CRE are presented on the Construction Tab.

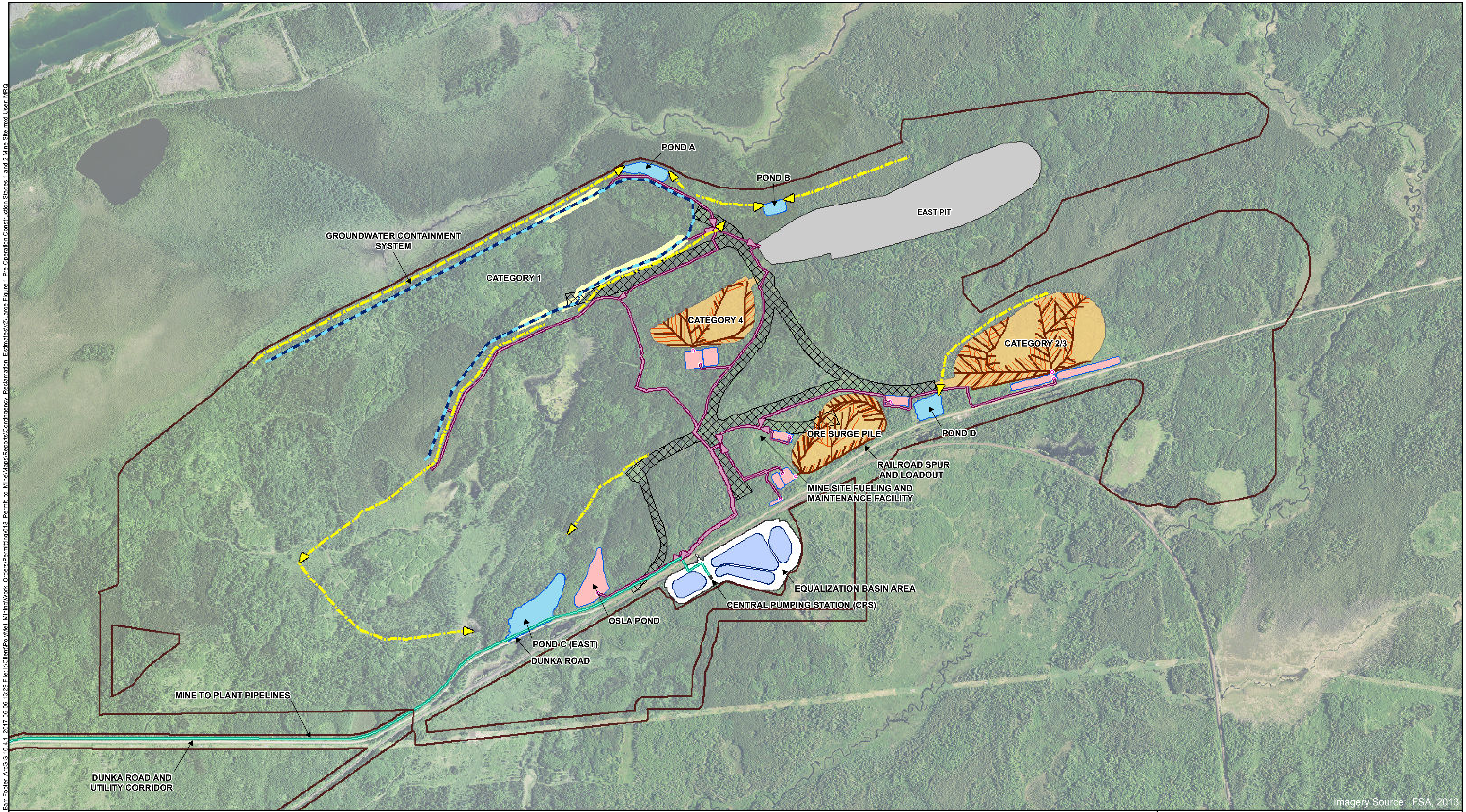
Contingency

A contingency of 10% was applied to the total direct estimated cost for Project reclamation activities during the construction phase.

Prime Contractor Markup

A prime contractor markup of 2.5% was applied to the total direct cost.

Large Figures



Mining Area
East Pit Exposed/Unblasted Rock to Reclaim
Stockpile Footprint to Reclaim
Stockpile Liner Acres to be Removed and Footprint Reclaimed
Overliner Collection Piping
Underliner Collection Piping

Haul Roads to be Reclaimed

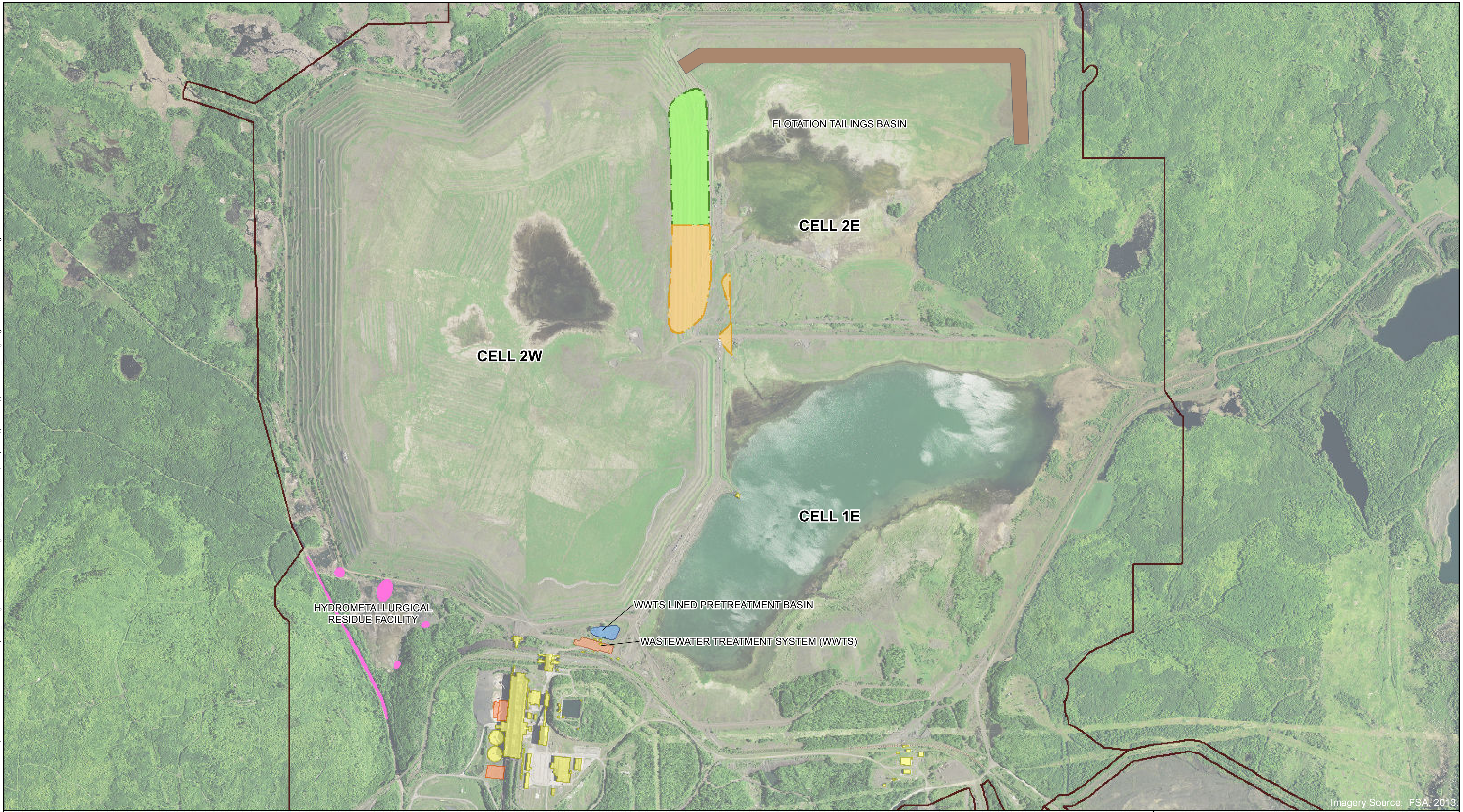
Stormwater Systems
Ditch to Reclaim
Pond Acres to Reclaim
Groundwater Containment System

Mine Water Systems
Pond/Liner to be Reclaimed (OSLA pond not lined)
Mine to Plant Pipelines
Piping to be Removed
Pumps to be Removed

0 750 1,500 3,000
Feet

CONSTRUCTION PHASE - MINE SITE
NorthMet Project
Poly Met Mining, Inc.

Large Figure 1



Mining Area
Beach Area to Reclaim
Pre-Load Distrubed Acres to Reclaim
Borrow Area to Reclaim - Stage 1
Borrow Area to Reclaim - Stage 2
Existing Buildings
Proposed Buildings

0 750 1,500 3,000
Feet

CONSTRUCTION PHASE -
TAILINGS BASIN
NorthMet Project
Poly Met Mining, Inc.

Large Figure 2

Appendix A

Construction Summary and Construction Reclamation Estimate

	Construction	
	(Reclamation)	
TOTAL CONSTRUCTION	$16,271,537	

Appendix A - Construction Reclamation Estimate **12/4/2017**

Includes Demo of Project Buildings, Project Construction Disturbances - assume added to Legacy FA

	Support Tab	Quantity	Units	Unit $	Cash $	NPV $	Note			Start of Year 01/01/18	Bankruptcy 07/01/18	07/01/19	07/01/20	07/01/21
Construction Total with Indirects					**$16,271,537**	**$14,950,953**	FA for Cash Amount		Calandar Year	2018		2019	2020	2021
Contingency	**10.0%**	Reclamation Quantities from Changes Over Time Memo Unless Noted			**$1,446,359**	**$1,328,974**								
Adaptive Management	**0.0%**				**$0**	**$0**	normal construction no water mgt					Year of Closure		
Engineering Redesign	**0.0%**				**$0**	**$0**	normal construction no water mgt				1	2	3	4
Prime Contractor Markup	**2.5%**				**$361,590**	**$332,243**		14,463,589	13,289,736					
					$0	**$0**			2.9%	**Oper**	**Hold**			
Construction Total (no Indirects)					**$14,463,589**	**$13,289,736**		**30 Yr Tot**	**NPV**		1	2	3	4
Mine Site					$8,450,657	$7,755,390								
General Reclamation														
Stockpile Relocation					$0	$0								
Cat 2/3 - rock	Unit $	0	Tons	$2.39	$0		no material in stockpile							
Cat 2/3 - sat overburden	Unit $	0	Tons	$2.39	$0		no material in stockpile							
Cat 4 - rock	Unit $	0	Tons	$1.79	$0		no material in stockpile							
Cat 4 - sat overburden	Unit $	0	Tons	$1.79	$0		no material in stockpile							
OSP - rock	Unit $	0	Tons	$2.39	$0		no material in stockpile							
Stockpile Footprint Reclamation					$3,414,499	$3,179,110								
Cat 2/3		-	-		$1,704,755	$1,587,233								
Drain Pipe Removal and Prep for Transport	Unit $ Reclamation & Pipe-Liner Off Site Disposal	45,300	LF	$15.00	$679,500	$632,657	Remove and haul to central portion of CAT 1 Stockpile. Assumes a shallow excavation with minimal backfill and cutting of pipe. [Ames 2016]	679,500	632,657	0	0	0	679,500	0
Pipe Disposal in Off Site Solid Waste Landfill	pipe-liner off site disposal	1	LS	$7,837	$7,837	$7,297	Transport and Tipping Fees [4/27/17 emails Attachments I1 and I2]	7,837	7,297	0	0	0	7,837	0
Liner Removal and Liner Prep for Transport	Unit $ Reclamation	63	Acre	$8,600	$541,800	$504,449	Remove and haul to East or West Pit. Assume avg. 9" thick soil/rock layer (1,200 CY/acre) to be included with geomembrane liner removal. Liner would be excavated with material and hauled to stockpile. Liner would then be sorted out where visible and left there. [Ames 2016]	541,800	504,449	0	0	0	541,800	0
Liner Disposal in Off Site Solid Waste Landfill	pipe-liner off site disposal	63	Acre	$152	$9,580	$8,920	Transport and Tipping Fees [4/27/17 emails Attachments I1 and I2]	9,580	8,920	0	0	0	9,580	0
Cover Area (Acres) and Depth (Inches)		63	Acres Inches	12										
Cover Volume (CY) and Haul Distance (Miles)		101,640	CY Miles	1.5										
Cover - Ovb/Soil (12" thick)	Unit $ Reclamation	101,640	CF	$4.40	$447,453	$416,606	Soil Overburden Relocation (excavate, load and dump) [Ames 2016] plus Soil Overburden Relocation (haul cost/cubic yard/mile) [Ames 2016] (1.5 mile haul)	447,453	416,606	0	0	0	447,453	0
Seeding	Unit $ Reclamation	63	Acres	$295	$18,585	$17,304	Commercial Fertilizer and Seed for Overburden – Supply/Apply/Incorporate @ 200 lb/Acre/ [D&T 4/5/16 letter]	18,585	17,304	0	0	0	18,585	0
Cat 4		-	-		$768,042	$715,094								
Drain Pipe Removal and Prep for Transport	Unit $ Reclamation & Pipe-Liner Off Site Disposal	21,590	LF	$15.00	$323,850	$301,524	Remove and haul to central portion of CAT 1 Stockpile. Assumes a shallow excavation with minimal backfill and cutting of pipe. [Ames 2016]	323,850	301,524	0	0	0	323,850	0
Pipe Disposal in Off Site Solid Waste Landfill	pipe-liner off site disposal	1	LS	$3,626	$3,626	$3,376	Transport and Tipping Fees [4/27/17 emails Attachments I1 and I2]	3,626	3,376	0	0	0	3,626	0
Liner Removal and Liner Prep for Transport	Unit $	29	Acre	$8,600	$249,400	$232,207	Remove and haul to East or West Pit. Assume avg. 9" thick soil/rock layer (1,200 CY/acre) to be included with geomembrane liner removal. Liner would be excavated with material and hauled to stockpile. Liner would then be sorted out where visible and left there. [Ames 2016]	249,400	232,207	0	0	0	249,400	0
Liner Disposal in Off Site Solid Waste Landfill	pipe-liner off site disposal	29	Acre	$152	$4,410	$4,106	Transport and Tipping Fees [4/27/17 emails Attachments I1 and I2]	4,410	4,106	0	0	0	4,410	0
Cover Area (Acres) and Depth (Inches)		29	Acres Inches	12										
Cover Volume (CY) and Haul Distance (Miles)		46,787	CY Miles	1.2										
Cover - Ovb/Soil (12" thick)	Unit $ Reclamation	46,787	CF	$3.81	$178,200	$165,916	Soil Overburden Relocation (excavate, load and dump) [Ames 2016] plus Soil Overburden Relocation (haul cost/cubic yard/mile) [Ames 2016] (1.2 mile haul)	178,200	165,916	0	0	0	178,200	0
Seeding	Unit $ Reclamation	29	Acres	$295	$8,555	$7,965	Commercial Fertilizer and Seed for Overburden – Supply/Apply/Incorporate @ 200 lb/Acre/ [D&T 4/5/16 letter]	8,555	7,965	0	0	0	8,555	0
OSP		-	-		$941,702	$876,783								
Drain Pipe Removal and Prep for Transport	Unit $ Reclamation & Pipe-Liner Off Site Disposal	30,000	LF	$15.00	$450,000	$418,978	Remove and haul to central portion of CAT 1 Stockpile. Assumes a shallow excavation with minimal backfill and cutting of pipe. [Ames 2016]	450,000	418,978	0	0	0	450,000	0
Pipe Disposal in Off Site Solid Waste Landfill	pipe-liner off site disposal	1	LS	$5,597	$5,597	$5,211	Transport and Tipping Fees [4/27/17 emails Attachments I1 and I2]	5,597	5,211	0	0	0	5,597	0
Liner Removal and Liner Prep for Transport	Unit $ Reclamation	32	Acre	$8,600	$275,200	$256,228	Remove and haul to East or West Pit. Assume avg. 9" thick soil/rock layer (1,200 CY/acre) to be included with geomembrane liner removal. Liner would be excavated with material and hauled to stockpile. Liner would then be sorted out where visible and left there. [Ames 2016]	275,200	256,228	0	0	0	275,200	0
Liner Disposal in Off Site Solid Waste Landfill	pipe-liner off site disposal	32	Acre	$152	$4,866	$4,531	Transport and Tipping Fees [4/27/17 emails Attachments I1 and I2]	4,866	4,531	0	0	0	4,866	0
Cover Area (Acres) and Depth (Inches)		32	Acres Inches	12										
Cover Volume (CY) and Haul Distance (Miles)		51,627	CY Miles	1.2										
Cover - Ovb/Soil (12" thick)	Unit $ Reclamation	51,627	CF	$3.81	$196,599	$183,046	Soil Overburden Relocation (excavate, load and dump) [Ames 2016] plus Soil Overburden Relocation (haul cost/cubic yard/mile) [Ames 2016] (1.2 mile haul)	196,599	183,046	0	0	0	196,599	0
Seeding	Unit $ Reclamation	32	Acres	$295	$9,440	$8,789	Commercial Fertilizer and Seed for Overburden – Supply/Apply/Incorporate @ 200 lb/Acre/ [D&T 4/5/16 letter]	9,440	8,789	0	0	0	9,440	0
OSLA					$98,932	$92,112								
Grade Stockpiles of Overburden and Peat	Unit $ Reclamation	41.8	Acres	$3,200	$86,601	$80,631	No hauling of material, Mid size dozer work. [Ames 2017]	86,601	80,631	0	0	0	86,601	0
Seeding	Unit $ Reclamation	41.8	Acres	$295	$12,331	$11,481	Commercial Fertilizer and Seed for Overburden – Supply/Apply/Incorporate @ 200 lb/Acre/ [D&T 4/5/16 letter]	12,331	11,481	0	0	0	12,331	0

Appendix A - Construction Reclamation Estimate **12/4/2017**

Includes Demo of Project Buildings, Project Construction Disturbances - assume added to Legacy FA

	Support Tab	Quantity	Units	Unit $	Cash $	NPV $	Note			Start of Year 01/01/18	Bankruptcy 07/01/18	07/01/19	07/01/20	07/01/21
Construction Total with Indirects					**$16,271,537**	**$14,950,953**	FA for Cash Amount		Calandar Year	2018		2019	2020	2021
Contingency	**10.0%**	Reclamation			**$1,446,359**	**$1,328,974**								
Adaptive Management	**0.0%**	Quantities			**$0**	**$0**	normal construction no water mgt				Year of Closure			
Engineering Redesign	**0.0%**	from Changes			**$0**	**$0**	normal construction no water mgt				1	2	3	4
Prime Contractor Markup	**2.5%**	Over Time			**$361,590**	**$332,243**		14,463,589	13,289,736					
		Memo Unless			**$0**	**$0**			2.9%	**Oper**	**Hold**			
Construction Total (no Indirects)		Noted			**$14,463,589**	**$13,289,736**		**30 Yr Tot**	**NPV**	1		2	3	4
Pits					$1,407,425	$1,273,469								
Prepare for Fencing	Unit $ Reclamation	$0	LF	$9.00	$0	$0	Ames 2016	0	0	0	0	0	0	0
Pit Fence - Barb Wire 4 Strand	Unit $ Reclamation	0	LF	$8.00	$0	$0	MnDOT Standard Plate 9323 Rev. D [Ames 2016]	0	0	0	0	0	0	0
Pit Fence - Non Climable	Unit $ Reclamation	0	LF	$22.00	$0	$0	MnDOT Standard Plate 9322 Rev. K [Ames 2016]	0	0	0	0	0	0	0
Gates	Unit $ Reclamation	0	EA	$5,500	$0	$0	Gate for access road / pit ramp; MnDOT Standard Plate 9322 Rev. K 20' Wide Vehicular Gate (Double Gate) [Ames 2016]	0	0	0	0	0	0	0
Reduce and Grade Overbuburden Wall		$0		$0	$0	$0	Overburden sloped and seeded as part of mining - cover of setback area not required by non-ferrous rules (FEIS WQ modeling assumed not covered)	0	0	0	0	0	0	0
Cover Area (Acres) and Depth (Inches)		95	Acres Inches	24										
Cover Volume (CY) and Haul Distance (Miles)		306,533	CY											
Cover East Pit Expose Rock	Unit $ Reclamation	306,533	CY	$4.50	$1,379,400	$1,248,112	Load, haul and place in East Pit [Ames 2016]	1,379,400	1,248,112	0	0	0	0	1,379,400
Seeding	Unit $ Reclamation	95	Acres	$295	$28,025	$25,358	Commercial Fertilizer and Seed for Overburden – Supply/Apply/Incorporate @ 200 lb/Acre/ [D&T 4/5/16 letter]	28,025	25,358	0	0	0	0	28,025
Sumps and Ponds					$434,317	$404,376								
Ponds Clean out	Ponds & Unit $ Reclamation	9	EA	$5,000	$45,000	$41,898	Break-out sumps/ clean-out ponds [Ames 2016]	45,000	41,898	0	0	0	45,000	0
Restore Pond Footprint	Ponds & Unit $ Reclamation	63	Acres	$6,000	$376,200	$350,265	Remove liner, rip-rap, grade and seed, fertilize and mulch; assume 400 CY/acre (3 in depth) of rooting soil fill [Ames 2016]	376,200	350,265	0	0	0	376,200	0
Liner Disposal in Off Site Solid Waste Landfill	Pons & pipe-liner off site disposal	56	Acres	$152	$8,470	$7,886	Transport and Tipping Fees [4/27/17 emails Attachments I1 and I2]	8,470	7,886	0	0	0	8,470	0
Pipe Disposal in Off Site Solid Waste Landfill	Ponds & pipe-liner off site disposal	4,500	LF	$1.03	$4,646	$4,326	Transport and Tipping Fees [4/27/17 emails Attachments I1 and I2]	4,646	4,326	0	0	0	4,646	0
Rail Transfer Hopper					$0	$0								
Haul RTH waste rock to East Pit, Plus Grading					$0		Construct Platform with MDNR approved rock. Cover with 2ft soil and vegetate included with Demo below							
Construction					$825,592	$747,014								
Cat 1 Stockpile Footprint Reclamation	SOW3 Cat1 Grading-Seeding(Yr 0)	1	LS	$214,255	$214,255	$193,863	Engineering estimate: Barr Engineering Estimate based on permit level design on drawing SKP-003 and SKP-007 to SKP-010 from Appendix 4 of the PTM Application - May 2016	214,255	193,863	0	0	0	0	214,255
Cat 1 Stockpile Cont Sys Breaching	SOW21 Cat 1 Cont Sys UC (Yr 0)	1	LS	$611,337	$611,337	$553,151	Engineering estimate: Barr Engineering estimate based on permit level design on drawing GCS-003, GCS-010 and GCS-011 from Appendix 4 of the PTM Application - July 2016	611,337	553,151	0	0	0	0	611,337
Demo					$2,203,893	$1,999,592	Lakehead / Rachel 2016 (Attachments E and F)							
Fueling and Maintenance Facility	Demo	1	LS	$27,610	$27,610	$25,707		27,610	25,707	0	0	0	27,610	0
Rail Transfer Hopper	Demo	1	LS	$86,100	$86,100	$80,164		86,100	80,164	0	0	0	86,100	0
Rail Transfer Hopper Control Bldg	Demo	1	LS	$18,700	$18,700	$17,411		18,700	17,411	0	0	0	18,700	0
Rail Transfer Hopper Platform	Demo	1	LS	$60,000	$60,000	$55,864		60,000	55,864	0	0	0	60,000	0
Central Pumping Station	Demo	1	LS	$15,700	$15,700	$14,618		15,700	14,618	0	0	0	15,700	0
Railroads	Demo	1	LS	$78,750	$78,750	$71,255		78,750	71,255	0	0	0	0	78,750
Pipelines	Demo	1	LS	$797,133	$797,133	$721,264		797,133	721,264	0	0	0	0	797,133
Power Lines	Demo	1	LS	$83,900	$83,900	$75,915		83,900	75,915	0	0	0	0	83,900
Roads and Parking Lots	Demo	1	LS	$524,000	$524,000	$474,127		524,000	474,127	0	0	0	0	524,000
Wasteweater Treatment Facility	Demo	1	LS	$512,000	$512,000	$463,269		512,000	463,269	0	0	0	0	512,000
Other					$66,000	$59,718								
Abandon Mine Site Wells	Unit $ Reclamation	33	wells	$2,000	$66,000	$59,718	Based on Costs from other projects, considering mobilization, permitting, and well abandonment. [Barr 11/10/17 email]	66,000	59,718	0	0	0	0	66,000
Plant Site					$4,233,931	$3,877,491								
General Reclamation		$1	LS		$31,310	$29,152								
HRF Disturbance	SOW11 HRF Cover Sys UC (Yr 0)	1	LS	$31,310	$31,310	$29,152	Engineering estimate: Barr Engineering estimate based on permit level design on drawing HRF-003, HRF-005 and HRF-007 from Appendix 7 of the PTM Application - July 2016	31,310	29,152	0	0	0	31,310	0
Construction					$405,361	$377,416								
FTB Borrow Area & Disturbed Area	SOW14 FTB Grading-Seedin (Yr 0)	1	LS	$405,361	$405,361	$377,416	Engineering estimate: Barr Engineering estimate based on permit level design on drawing FTB-003 and FTB-005 from Appendix 6 of the PTM Application - July 2016 (updated April 2017 and November 2017)	405,361	377,416	0	0	0	405,361	0
FTB Overflow		0	LS	$239,539	$0	$0		0	0	0	0	0	0	0

Appendix A - Construction Reclamation Estimate							12/4/2017							
Includes Demo of Project Buildings, Project Construction Disturbances - assume added to Legacy FA										Start of Year	Bankruptcy			
	Support Tab	Quantity	Units	Unit $	Cash $	NPV $	Note			01/01/18	07/01/18	07/01/19	07/01/20	07/01/21
Construction Total with Indirects					**$16,271,537**	**$14,950,953**	FA for Cash Amount		Calandar Year	2018		2019	2020	2021
Contingency	**10.0%**	Reclamation			**$1,446,359**	**$1,328,974**								
Adaptive Management	**0.0%**	Quantities			**$0**	**$0**	normal construction no water mgt					Year of Closure		
Engineering Redesign	**0.0%**	from Changes			**$0**	**$0**	normal construction no water mgt				1	2	3	4
Prime Contractor Markup	**2.5%**	Over Time			**$361,590**	**$332,243**		14,463,589	13,289,736					
		Memo Unless			**$0**	**$0**			2.9%	**Oper**	**Hold**			
Construction Total (no Indirects)		Noted			**$14,463,589**	**$13,289,736**		**30 Yr Tot**	**NPV**	1		2	3	4
Demo and Abatement					$3,797,260	$3,470,923								
Legacy Structure Removal														
Area 1 Shop Buildings	Demo	0	LS	$448,916	$0	$0	in Legacy Reclamation	0	0	0	0	0	0	0
Area 2 Shop Buildings	Demo	0	LS	$556,827	$0	$0	in Legacy Reclamation	0	0	0	0	0	0	0
Main Plant Area - Demoed in Construction	Demo	0	LS	$1,655,350	$0	$0	in Legacy Reclamation	0	0	0	0	0	0	0
Main Plant Area	Demo	0	LS	$19,888,937	$0	$0	in Legacy Reclamation	0	0	0	0	0	0	0
Main Gate Colby PH Ad Bldg	Demo	0	LS	$243,170	$0	$0	in Legacy Reclamation	0	0	0	0	0	0	0
Roads	Demo	0	LS	$660,000	$0	$0	in Legacy Reclamation	0	0	0	0	0	0	0
Railroads	Demo	0	LS	$380,000	$0	$0	in Legacy Reclamation	0	0	0	0	0	0	0
Power System	Demo	0	LS	$97,810	$0	$0	in Legacy Reclamation	0	0	0	0	0	0	0
Piping System	Demo	0	LS	$2,879,000	$0	$0	in Legacy Reclamation	0	0	0	0	0	0	0
Legacy Asbestos Abatement							in Legacy Reclamation							
Area 1 Shop Buildings	Demo	0	LS	$98,350	$0	$0	in Legacy Reclamation	0	0	0	0	0	0	0
Area 2 Shop Buildings	Demo	0	LS	$167,350	$0	$0	in Legacy Reclamation	0	0	0	0	0	0	0
Main Plant Area	Demo	0	LS	$5,962,607	$0	$0	in Legacy Reclamation	0	0	0	0	0	0	0
Main Gate Colby PH Ad Bldg	Demo	0	LS	$859,400	$0	$0	in Legacy Reclamation	0	0	0	0	0	0	0
Project Phase 1							Lakehead / Rachel 2016 (Attachments E and F)							
Flotation Plant and Reagent Building	Demo	1	LS	$844,400	$844,400	$786,365		844,400	786,365	0	0	211,100	422,200	211,100
Concentrate Storage and Loadout Facility	Demo	1	LS	$333,860	$333,860	$310,914		333,860	310,914	0	0	83,465	166,930	83,465
Plant Site Sewage Treatment Plant	Demo	1	LS	$148,000	$148,000	$137,828		148,000	137,828	0	0	37,000	74,000	37,000
Railroads	Demo	1	LS	$296,000	$296,000	$267,827		296,000	267,827	0	0	0	0	296,000
Pipelines	Demo	1	LS	$1,930,000	$1,930,000	$1,746,307		1,930,000	1,746,307	0	0	0	0	1,930,000
Power Lines			none constructed											
Roads and Parking Lots			none constructed											
Plant Site Wastewater Treatment Plant	Demo	1	LS	$245,000	$245,000	$221,681		245,000	221,681	0	0	0	0	245,000
Other					$0	$0								
AST Removal	AST	0	LS	$223,625	$0	$0	in Legacy Reclamation	0	0	0	0	0	0	0
AOCs	AOC	0	LS	$6,918,200	$0	$0	in Legacy Reclamation	0	0	0	0	0	0	0
Site Administration and Maintenance					$1,779,000	$1,656,855								
Legacy					$0	$0								
Site Manager - annual $ / FTE - calc from hourly rate		$0	$/yr $/hr	$ -										
Site Manager		0	FTE	$0	$0	$0	in Legacy Long Term	0	0	0	0	0	0	0
Dam Instrumentation Field Work + Report per Event		0	Event	$0										
Geotechnical Inspection and Report from Unit $		0	Year	$0										
Dam Safety Monitoring		0		$0	$0	$0	in Legacy Long Term	0	0	0	0	0	0	0
Landfill Maintenance and Monitoring SW619		0		$0	$0	$0	in Legacy Long Term	0	0	0	0	0	0	0
Landfill Mantenance and Monitoring Coal Ash		0		$0	$0	$0	in Legacy Long Term	0	0	0	0	0	0	0
Tailings Basin Maint		0		$0	$0	$0	in Legacy Long Term	0	0	0	0	0	0	0
Snow Plowing/Road Maint		0		$0	$0	$0	in Legacy Long Term	0	0	0	0	0	0	0
Vehicles (25,000 mi x $0.70/mi)		0		$0	$0	$0	in Legacy Long Term	0	0	0	0	0	0	0
Project Disturbances					$1,779,000	$1,656,855								
Project Manager - annual $ / FTE - calc from hourly rate	Unit $ Reclamation	$286,000	$/yr $/hr	$ 137.50			Barr 2016 Fee Schedule Average of Top Level Engineer [Barr 2016]							
Project Manager		1	FTE	$286,000	$858,000	$799,090		858,000	799,090	0	0	286,000	286,000	286,000
Superintendent's Light Truck - Annual Miles	Unit $ Reclamation	15,000	miles/yr	$0.70	$31,500	$29,337	NTS Letter of 4/21/16	31,500	29,337	0	0	10,500	10,500	10,500
Project Engineer - annual $ / FTE - calc from hourly rate	Unit $ Reclamation	$223,600	$/yr $/hr	$ 107.50			Barr 2016 Fee Schedule Average of Mid Level Engineer [Barr 2016]							
Project Engineer		1	FTE	$223,600	$670,800	$624,743		670,800	624,743	0	0	223,600	223,600	223,600
Engineer's Light Truck - Annual Miles	Unit $ Reclamation	15,000	miles/yr	$0.70	$31,500	$29,337	NTS Letter of 4/21/16	31,500	29,337	0	0	10,500	10,500	10,500
Road Maintenance	Unit $ Long Term	1	yr	$62,400	$187,200	$174,347	One day per week during 9 month construction season.	187,200	174,347	0	0	62,400	62,400	62,400

General Unit Costs Used in Reclamation Estimates

Source Column indicates provider and date of unit cost

Source Name	Source Location
Ames 2016	Attachment H1
Ames 2017	Attachment H2
NTS 2016	Attachment I3
D&T 2016	Attachment J
Barr 2016	Attachment K1
Barr 2017	Barr 11/10/17 email

Ames estimates include mobilization

Item	Description	Unit	Source	Basis for Quantities (drawing # or describe)	Unit Price	Comments
	Rock Moving					
1	Ore Surge Stockpile Relocation	CY	Ames 2016	Load/Haul/Dump by Contractor	$ 4.55	From OSP to floor of East Pit [Ames 2016]
		Ton	calculated	1.9 Ton/CY	$ 2.39	From OSP to floor of East Pit [Ames 2016]
2	Category 2/3 Waste Rock Relocation (used in Stockpile Relocate tab)	CY	Ames 2016	Load/Haul/Dump by Contractor	$ 4.55	From Cat 2/3 stockpile to floor of East Pit [Ames 2016]
		Ton	calculated	1.9 Ton/CY	$ 2.39	From Cat 2/3 stockpile to floor of East Pit [Ames 2016]
3	Category 4 Waste Rock Relocation (used in Stockpile Relocate tab)	CY	Ames 2016	Load/Haul/Dump by Contractor	$ 3.40	From Cat 4 stockpile to floor of East Pit [Ames 2016]
		Ton	calculated	1.9 Ton/CY	$ 1.79	From Cat 4 stockpile to floor of East Pit [Ames 2016]
4	Soil Overburden Relocation (excavate, load and dump) [Ames 2016]	CY	Ames 2016	Excavate, Load and Dump by Contractor	$ 1.60	Material for haul roads, Cat 1 etc. restoration. [Ames 2016]
5	Soil Overburden Relocation (haul cost/cubic yard/mile) [Ames 2016]	$/CY/Mile	Ames 2016	Haul by Contractor	$ 1.85	Material for haul roads, Cat 1 etc. restoration (assume 2-mile avg. haul distance; 4-mile round-trip) [Ames 2016]
	Site Removal and Restoration					
6	Remove & Dispose of Stockpile/Pond Geomembrane Liners (inc soil)	acre	Ames 2016	Cut Geomembrane into Sections/Remove	$ 8,600.00	Remove and haul to East or West Pit. Assume avg. 9" thick soil/rock layer (1,200 CY/acre) to be included with geomembrane liner removal. Liner would be excavated with material and hauled to stockpile. Liner would then be sorted out where visible and left there. [Ames 2016]
7	Remove & Dispose of Collection pipe	LF	Ames 2016	Cut-Up/Remove/Dispose	$ 15.00	Remove and haul to central portion of CAT 1 Stockpile. Assumes a shallow excavation with minimal backfill and cutting of pipe. [Ames 2016]
8	Remove Stockpile Sumps & Ponds	each	Ames 2016	Break-out sumps/ clean-out ponds	$ 5,000.00	Break-out sumps/ clean-out ponds [Ames 2016]
9	Restore Lined Sump & Pond Footprint	acre	Ames 2016	Fill/Grade	$ 6,000.00	Remove liner, rip-rap, grade and seed, fertilize and mulch; assume 400 CY/acre (3 in depth) of rooting soil fill [Ames 2016]
	Fencing, Gates, and Barricades					
10	Preparation for Fencing	LF	Ames 2016	Clearing & Grubbing for fencing	$ 9.00	Ames 2016
11	Supply & Install 4 Strand Fence	LF	Ames 2016	Gates & signage separate	$ 8.00	MnDOT Standard Plate 9323 Rev. D [Ames 2016]
12	Supply & Install Non-Climbable Fence	LF	Ames 2016	Gates & signage separate	$ 22.00	MnDOT Standard Plate 9322 Rev. K [Ames 2016]
13	Gates	each	Ames 2016	Per Gate	$ 5,500.00	Gate for access road / pit ramp; MnDOT Standard Plate 9322 Rev. K 20' Wide Vehicular Gate (Double Gate) [Ames 2016]
	Earthworks					
14	Grading uneven area for gentle contour and drainge	acre	Ames 2017	Grading for depths 6" to 16"	$ 3,200.00	No hauling of material, Mid size dozer work. [Ames 2017]
15	Load, Haul & Place Earthfill from Overburden Storage & Laydown Area	CY	Ames 2017		$ 4.50	Load, haul and place in East Pit [Ames 2016]
	General Services Reclamation					
16	Pick Up Truck	$/mi	NTS 2016		$ 0.70	NTS Letter of 4/21/16
17	Abandon Well	$/mi	Barr 2017		$ 2,000.00	Based on Costs from other projects, considering mobilization, permitting, and well abandonment. [Barr 11/10/17 email]
	Basic Labor Rates (including OH and profit)					
18	Project Manager	yr	Barr 2016		$ 137.50	Barr 2016 Fee Schedule Average of Top Level Engineer [Barr 2016]
19	Project Engineer	yr	Barr 2016		$ 107.50	Barr 2016 Fee Schedule Average of Mid Level Engineer [Barr 2016]
20	Project Inspector	yr	Barr 2016		$ 70.00	Barr 2016 Fee Schedule Average of Technician I [Barr 2016]
	Vegetation Establishment					
21	Seed and Fertilize for Vegetation Establishment - Mine Overburden Area	acre	D&T 2016	Assume typical roadway spec. seed, fertilize, mulch	$ 295.00	Commercial Fertilizer and Seed for Overburden – Supply/Apply/Incorporate @ 200 lb/Acre/ [D&T 4/5/16 letter]

General Unit Costs Used in Long Term Estimates

Source Column indicates provider and date of unit cost

Source Name	Source Location
Ames 2017	Attachment H2
NTS 2016	Attachment I3
Barr 2016	Attachment K2
DOLI 2016	Attachment L
PolyMet 2016	Attachment M

Item	Description	Unit	Source	Basis for Quantities (drawing # or describe)	Unit Price	Comments
	General Services Reclamation					
	Pick Up Truck	$/mi	NTS 2016		$ 0.70	NTS Letter of 4/21/16
	Pump Maint Truck	$/mi	NTS 2016		$ 1.05	NTS Letter of 4/21/16 x 1.5 to cover truck with lift
	Basic Labor Rates (including OH and profit)					
	Skilled Maintenance	hr	DOLI 2016		$ 68.98	Mn DOLI #707 Dec 2016 Electrician * 1.15 to cover emoloyment costs
	Skilled Labor	hr	DOLI 2016		$ 45.99	MN DOLI #102 Dec 2016 Skilled Labor * 1.15 to cover emoloyment costs
	MDNR Rate	hr	DNR		$ 116.00	Provided by DNR flat rate for all staff including overhead and expenses
	Site Manager	yr	NTS 2016		$ 108.00	NTS 4/22/16 letter Mid Level Professional
	Monitoring and Maintenance					
	Tailings Basin Geotechnical Instruments Field Work	event	NTS 2016		$ 7,686.00	NTS 4/22/16 letter inactive basin
	Tailings Basin Geotechnical Instruments Report	event	NTS 2016		$ 2,850.00	NTS 4/22/16 letter inactive basin
	Tailings Basin Geotechnical Inspection and Report	yr	Barr 2016		$ 17,500.00	Barr 4/1/16 letter inactive basin
	Landfill SW619 Maintenance and Monitoring	yr	NTS 2016		$ 21,957.00	NTS 4/22/16 letter
	Coal Ash Landfill Maintenance and Monitoring	yr	allowance		$ 2,640.00	PLM 2017 Budget
	Snow Plowing	yr	PolyMet 2016		$ 25,414.00	PolyMet Snow Plowing (average of 2 highest of 3 years)
	FTB Dam Containment System Maintenance	yr	allowance		$ 60,000.00	Allowance for maintaining flow in the drain pipe, maintaining surface water controls, repair of cutoff wall. Note most years will be much less but some could be more.
	Legacy Cell 2W Reclamation	yr	allowance		$ 1,000,000.00	Allowance for 6 years to provide stable slopes, adequate vegetation cover, and drainage provisions to resist erosion and route precipitation away from Cell 2W
	Category 1 Stockpile Cover System Maintenance	yr	allowance		$ 24,000.00	Allowance to cover (1) management of plants with deep, woody roots (2) monitoring of the soil surface cover for erosion and (3) repairing erosion damage
	Category 1 Stockpile Containment System Maintenance	yr	allowance		$ 15,000.00	Allowance to cover maintaining flow in the drain pipe, maintaining surface water controls and repairing the cutoff wall. Note that most years will be much less that this but some could be more.
	FTB Maintenance	yr	allowance		$ 10,000.00	PolyMet's experience with vegetation maintenance and erosion control at this facility indicates that $10,000 annually is sufficient for the whole facility once reclamation is complete and $60,000 a year during reclamation ramping down by $20,000 a year until $10,000 a year once reclamation has been completed.
	HRF Maintenance	yr	TBD		$ 10,000.00	Allowance
	Road Grader	hr	Ames 2017		$ 200.00	One grader with Operator Ames Email 11/13/17
	Road Maintenance	yr	calculation	one day per month	$ 19,200.00	One day per month.
	Road Maintenance (during Reclamation)	yr	calculation	one day per week for 9 months	$ 62,400.00	One day per week during 9 month construction season.

Estimate of FTE Required for Remote Alarm Response			
Shifts per week - manned	12	Day Shift Every Day + Afternoon Shift Weekdays	
Shift per week - unmanned	9		
Percent shifts unmanned	43%		
Shifts with alarms	5%	assume 5% of shifts have alarms	
Shifts with alarms requiring OT	2%		
Shifts per year	1092		
Shifts requiring OT	23.4		
Hrs per response	8	assume each OT alarm response generates 8 hrs OT	
OT hrs	187		
OT Preimum	150%	assume time and a half for overtime	
Straight Time Hr equivelent to OT	281		
Annual Hrs for 3 FTE	6240		
Percent FTE to add for Alarm Response	**5%**		

Development of Costs for Transport and Off-Site Disposal of Membrane and Pipe from Lined Facilities 04/27/17

Heavy Border with Bold Amounts are used in Reclamation Estimates

Dem-Con Companies General Waste in Keewatin:			
Truck CY	Truck $/Load	Fee /CY	source
29	$415.00	$10.00	4/27/17 emails Attachments I1 and I2

Pipe cut in 40' lengths and not crushed								Unit Cost	
Pipe Size	Pipe OD	Pipe V/ft	Load	Ft Pipe/Load	Transport	Tipping		Load	FT
In	In	CY/ft	CY	FT	Load	CY	Load	$	$
4	4.8	0.00465	29	6231	$415.00	$10.00	$290.00	$705.00	$0.11
6	6.9	0.00962	29	3015	$415.00	$10.00	$290.00	$705.00	$0.23
8	9.1	0.01673	29	1734	$415.00	$10.00	$290.00	$705.00	$0.41
10	11.4	0.02625	29	1105	$415.00	$10.00	$290.00	$705.00	$0.64
12	14.5	0.04247	29	683	$415.00	$10.00	$290.00	$705.00	$1.03

Liner assume 1" thick per acre after cutting and folding							Unit Cost	
Folded Thickness	Liner V/acre	Load	Acres/Load	Transport	Tipping		Load	acre
in/acre	CY/acre	CY	Acres	Load	CY	Load	$	$
1	134.444	29	5	$415.00	$10.00	$290.00	$705.00	**$152.07**

Mine Year 1	**Cat 2/3**		**Cat 4**		**OSP**	
	Ft*	Disposal $	Ft*	Disposal $	Ft*	Disposal $
Pipe Size	Overliner/Underdrain Piping		Underdrain Piping		Underdrain Piping	
In						
4	32,200	$3,643	14,000	$1,584	19,700	$2,229
6	9,600	$2,245	6,300	$1,473	7,400	$1,730
8	1,400	$569	1,200	$488	1,600	$651
10	2,000	$1,276	30	$19	900	$574
12	100	$103	60	$62	400	$413
Total Ft	**45,300**		**21,590**		**30,000**	
Total $	-	**$7,837**	-	**$3,626**	-	**$5,597**

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Mine Year 11	**Cat 2/3**		**Cat 4**		**OSP**	
	Ft*	Disposal $	Ft*	Disposal $	Ft*	Disposal $
Pipe Size	Underdrain Piping		Underdrain Piping		Underdrain Piping	
In						
4	84,900	$9,606	31,000	$3,508	19,700	$2,229
6	25,100	$5,869	9,400	$2,198	7,400	$1,730
8	4,200	$1,708	1,200	$488	1,600	$651
10	5,100	$3,255	30	$19	900	$574
12	200	$207	60	$62	400	$413
Total Ft	**119,500**		**41,690**		**30,000**	
Total $	-	**$20,644**	-	**$6,274**	-	**$5,597**

* Lengths from Barr Changes Over Time Memo 11/15/17

Development of Total Pond and Sump Acres

Heavy Border with Bold Amounts are used in Reclamation Estimates

Mine Year 1 - Pond and Sump Acres from Barr Changes Over Time Memo 11/15/17

Pond	Included	Count	Acres	Liner	Liner Acres	Underdrain Pipe (ft)	Note
Mine Site WWTF Pond - 1	n	1	1	y	1		used long term
Mine Site WWTF Ponds	y	1	29.8	y	29.8		
Mine Site CPS Pond	n	1	1.3	n	0		used long term
Mine Site Ponds (unlined)	y	1	7	n	0		
Mine Site Ponds (lined)	y	4	12.4	y	12.4		
Category 4 Stockpile	y	1	4.5	y	4.5		
OSP	y	1	2.3	y	2.3		
Category 2/3 Stockpile	y	1	6.7	y	6.7		
Total		**9**	**62.7**		**55.7**	**4500**	Pipe ft from Barr Changes Over Time Memo 11/15/17

Mine Year 11 - Pond and Sump Acres from Barr Changes Over Time Memo 11/15/17

Pond	Included	Count	Acres	Liner	Liner Acres	Underdrain Pipe (ft)	Note
Mine Site WWTF Pond - 1	n	1	1	y	1		used long term
Mine Site WWTF Ponds	y	1	29.8	y	29.8		
Mine Site CPS Pond	n	1	1.3	n	0		used long term
Mine Site Ponds (unlined)	y	1	7	n	0		
Mine Site Ponds (lined)	y	6	16.1	y	16.1		
Category 4 Stockpile	y	1	4.5	y	4.5		
OSP	y	1	2.3	y	2.3		
Category 2/3 Stockpile	y	1	12.2	y	12.2		
Total		**11**	**71.9**		**64.9**	**6900**	Pipe ft from Barr Changes Over Time Memo 11/15/17

Mine Year 20 - Pond and Sump Acres from Barr Changes Over Time Memo 11/15/17

Pond	Included	Count	Acres	Liner	Liner Acres	Underdrain Pipe (ft)	Note
Mine Site WWTF Pond - 1	n	1	1	y	1		used long term
Mine Site WWTF Ponds	y	1	29.8	y	29.8		
Mine Site CPS Pond	n	1	1.3	n	0		used long term
Mine Site Ponds (unlined)	y	1	7	n	0		
Mine Site Ponds (lined)	y	6	16.1	y	16.1		
Category 4 Stockpile	y	0	0	y	0		
OSP	y	1	2.3	y	2.3		
Category 2/3 Stockpile	y	0	0	y	0		
Total		**9**	**55.2**		**48.2**	**6900**	Pipe ft from Barr Changes Over Time Memo 11/15/17

SOW 3: Category 1 Cover System: Year 0 (no waste rock on pile)

Barr Enginering Estimate based on permit level design on drawing SKP-003 and SKP-007 to SKP-010 from Appendix 4 of the PTM Application - May 2016

Heavy Border with Bold Amounts are used in Reclamation Estimates

Item	Description	Unit	Quantity	Basis for Quantities (drawing # or describe)	Unit Cost	Cost Extension	Comments
1	Mobilization/Demobilization	LS	1	See Comments and Notes	$ 25,000	$ 25,000	To Be Determined By Contractor - Mob for General Earthwork, Site Grading and Vegetation Establishment
2	Environmental Protection Measures	LS	0	See Comments and Notes	$ -	$ -	Assume Environmental Protection Measures from Year 0 Site Work Remain In Place and Are Effective
3	Construction QA/QC	LS	1	See Comments and Notes	$ 5,000	$ 5,000	See Note 1.
4	Final Sloping of Category 1 Stockpile	AC	0	See Comments and Notes	$ -	$ -	Year 0 - No Waste Rock Placed; No Final Sloping
5	Furnish and Install 6-inch Geomembrane Bedding Layer	CY	0	See Comments and Notes	$ -	$ -	Year 0 - No Waste Rock Placed; No Geomembrane Bedding Layer
6	Furnish and Install 1-foot Granular Soil Cover above Geomembrane	CY	0	See Comments and Notes	$ -	$ -	Year 0 - No Waste Rock Placed; No Granular Soil Cover above Geomembrane
7	Furnish and Install 1.5-foot Rooting Zone above Granular Cover	CY	32,000	See Comments and Notes	$ 5.5	$ 176,000	Year 0 - 13 acre Area of Disturbance; assume 25% of 127,000 Cubic Yards Excavated is Replaced/Regraded to Facilitate Vegetation Establishment.
8	Furnish and Install 6-Inch Riprap Systems on Stockpile Covers	CY	0	See Comments and Notes	$ -	$ -	Year 0 - No Waste Rock Placed; Assume No Steep Slope and No Rip-Rap Required.
9	Furnish and Install 9-Inch Riprap Systems on Stockpile Covers	CY	0	See Comments and Notes	$ -	$ -	Year 0 - No Waste Rock Placed; Assume No Steep Slope and No Rip-Rap Required.
10	Furnish and Install 12-Inch Riprap Systems on Stockpile Covers	CY	0	See Comments and Notes	$ -	$ -	Year 0 - No Waste Rock Placed; Assume No Steep Slope and No Rip-Rap Required.
11	Furnish and Install 18-Inch Riprap Systems on Stockpile Covers	CY	0	See Comments and Notes	$ -	$ -	Year 0 - No Waste Rock Placed; Assume No Steep Slope and No Rip-Rap Required.
12	Furnish and Install Vegetation (grass) on Stockpile Cover Systems	Acre	13	See Comments and Notes	$ 635	$ 8,255	Commercial Fertilizer and Seed for Overburden – Supply/Apply/Incorporate @ 200 lb/Acre/ [D&T 4/5/16 letter] + Mulch – Supply and Incorporate @ 2 ton/acre of Hay or Straw Mulchs. [D&T 4/5/16 letter]
			13				
13	Reseeding 5% of Vegetation on Stockpile Cover Systems	Acre	1	See Comments and Notes	$ 635	$ 445	Commercial Fertilizer and Seed for Overburden – Supply/Apply/Incorporate @ 200 lb/Acre/ [D&T 4/5/16 letter] + Mulch – Supply and Incorporate @ 2 ton/acre of Hay or Straw Mulchs. [D&T 4/5/16 letter]
14	Procure and Install 40-mil Geomembrane - Textured	SF	0	See Comments and Notes	$ -	$ -	Year 0 - No Waste Rock Placed; No Geomembrane Cover
15	Furnish and Install Geotextile above and below Geomembrane	SF	0	See Comments and Notes	$ -	$ -	Year 0 - No Waste Rock Placed; No Geotextile Required
						$ 214,255	

Notes:

1) Limited QA/QC required. Assume limited amount of surveying for grade confirmation and site review and submittal review to confirm compliance of site restoration activities with specifications.

SOW 11: Hydroment Residue Facility: Year 0 (no residue, only grading/seeding)

Barr Engineering estimate based on permit level design on drawing HRF-003, HRF-005 and HRF-007 from Appendix 7 of the PTM Application - July 2016

Heavy Border with Bold Amounts are used in Reclamation Estimates

Item	Description	Unit	Quantity	Basis for Quantities (drawing # or describe)	Unit Cost	Cost Extension	Comments
1	Mobilization and Demobilization	LS	1	See Comments and Notes	$ 5,000.00	$ 5,000	To Be Determined By Contractor - Mob for General Earthwork and Vegetation Establishment
2	Environmental Protection Measures	LS	1	See Comments and Notes	$ 5,000.00	$ 5,000	Assume Environmental Protection Measures for Year 0 Construction Remain In Place and Are Effective
3	Construction QA/QC	LS	1	See Comments and Notes	$ 2,000.00	$ 2,000	See Note 2
4.00	General Site Grading	CY	2000	See Comments and Notes	7.75	15500.00	Assume General Grading (not soil import) of 6" Surface in Isolated Areas (assume 2.5 acres) in Prep. for Vegetion Establishment.
5.00	Furnish and Install Vegetation on Disturbed Areas	Acre	5	See Comments and Notes	635.00	3175.00	Commercial Fertilizer and Seed for Overburden – Supply/Apply/Incorporate @ 200 lb/Acre/ [D&T 4/5/16 letter] + Mulch – Supply and Incorporate @ 2 ton/acre of Hay or Straw Mulchs. [D&T 4/5/16 letter]
	Unit Cost Grade and Vegetate PreLoad Area Variable Only						
6	Reseeding 5% of Vegetation to Correct for Limited Growth	Acre	1	See Comments and Notes	$ 635.00	$ 635	Commercial Fertilizer and Seed for Overburden – Supply/Apply/Incorporate @ 200 lb/Acre/ [D&T 4/5/16 letter] + Mulch – Supply and Incorporate @ 2 ton/acre of Hay or Straw Mulchs. [D&T 4/5/16 letter]
						$ 31,310	

Notes:

1) Per Hydrometallurgical Residue Management Plan v4 DEC2014 Figure 4-1; Year 0 Activities Include Removal of Various Structures, Rock and Soil from the HRF Footprint Prior Initiation of Year 1 - Lift 1 Pre-Load. Some limited tree clearing and grubbing also anticipated. Assume 20-percent of 25-acre Pre-Load Footprint is Disturbed in Year 0 in Preparation for Access and Delivery of Preload Materials in Year 1.1

2) Limited QA/QC required. Assume limited amount of site review and submittal review to confirm compliance of site restoration activities with specifications.

SOW 14: Flotation Tailings Basin: Year 0 (without NorthMet Tailings)

Barr Engineering estimate based on permit level design on drawing FTB-003 and FTB-005 from Appendix 6 of the PTM Application - July 2016 (updated April 2017 and November 2017)

Heavy Border with Bold Amounts are used in Reclamation Estimates

Item	Description	Unit	Quantity	Basis for Quantities (drawing # or describe)	Unit Cost	Cost Extension	Comments
1	Mobilization and Demobilization	LS	1	See Comments and Notes	$ 52,000.00	$ 52,000	To Be Determined By Contractor - Mob for General Earthwork, Site Grading and Vegetation Establishment
2	Environmental Protection Measures	LS	-	See Comments and Notes	$ -	$ -	Construction is within FTB Footprint. Assume Dust Control is Ancillary to Earthwork Items and no Additional Environmental Protection Measures are Required.
3	LTVSMC Coarse Tailings Borrow Area Regrading Quantity	CY	105,000	See Comments and Notes	$ 2.50	$ 262,500	See Note 1
4	LTVSMC Coarse Tailings Borrow Area - Seed, Mulch and Fertilize	Acre	65	See Comments and Notes	$ 730.00	$ 47,450	See Note 2 [$1985 replaced by $730 D&T]
			65				
5	LTVSMC Coarse Tailings Borrow Area - Reseeding 5% of Vegetation to Correct for Limited Growth	Acre	3.25	See Comments and Notes	$ 1,985.00	$ 6,451	
6	Dam - Exterior Face Bentonite Augmentation	Acre	-	See Comments and Notes	$ -	$ -	Performed Incrementally as Routine Construction Item Through-out Year 0; Already Complete - No Additional Action Required
7	Dam - Exterior Face Seed, Mulch and Fertilize	Acre	-	See Comments and Notes	$ -	$ -	Performed Incrementally as Routine Construction Item Through-out Year 0; Already Complete - No Additional Action Required
8	Beach Area and Dam Crest - Remove and Replace 30" Tailings Cover Layer to Facilitate Bentonite Augmentation of Soil Layer 30" Below Beach Surface	Acre	-	See Comments and Notes	$ -	$ -	No Flotation Tailings Deposition at End of Year 0 - This Item Not Required
9	Beach Area and Dam Crest - Till Bentonite to 18" Depth	Acre	-	See Comments and Notes	$ -	$ -	No Flotation Tailings Deposition at End of Year 0 - This Item Not Required
10	Beach Area and Dam Crest - Compact 18" Layer of Bentonite Amended Soil	Acre	-	See Comments and Notes	$ -	$ -	No Flotation Tailings Deposition at End of Year 0 - This Item Not Required
11	Beach Area and Dam Crest - Lightly Compact Upper Cover Layer	Acre	-	See Comments and Notes	$ -	$ -	No Flotation Tailings Deposition at End of Year 0 - This Item Not Required
12	Beach Area and Dam Crest - Seed, Fertilize and Mulch (Establish Vegetation on New Dam Construction Areas (Lift 1 Crest and Interior Slope) Only - Vegetation Already In Place Elsewhere. Estimated Restoration Length is 7,000' and Estimated Restoration Width is 250'.)	Acre	40	See Comments and Notes	$ 880.00	$ 35,200	Commercial Fertilizer and Seed for Tailings Basin Slopes – Supply/Apply/Incorporate @ 200 lb/acre [D&T 4/5/16 letter] + Mulch – Supply and Incorporate @ 2 ton/acre of Hay or Straw Mulchs. [D&T 4/5/16 letter]
13	Beach Area and Dam Crest - Reseeding 5% of Vegetation to Correct for Limited Growth	Acre	2	See Comments and Notes	$ 880.00	$ 1,760	Commercial Fertilizer and Seed for Tailings Basin Slopes – Supply/Apply/Incorporate @ 200 lb/acre [D&T 4/5/16 letter] + Mulch – Supply and Incorporate @ 2 ton/acre of Hay or Straw Mulchs. [D&T 4/5/16 letter]
14	Pond Bottom - Bentonite Amended Pond Bottom	Acre	-	See Comments and Notes	$ -	$ -	No Flotation Tailings Deposition at End of Year 0 - This Item Not Required
						$ 405,361	

Notes:

1) Tailings Borrow Area Regrading Quantity Based on Assumed Borrow Area Disturbance times Average 1.0-foot Re-Grading Thickness Through-out to Facilitate Turf Establishment.

2) LTVSMC Coarse Tailings Borrow Area Disturbance Estimated from Permit Support Drawings - Flotation Tailings Basin Sheet FTB-003 and Assumed Year 0 Borrow Areas of 25% of Cell 1E/2E Splitter Dam Borrow Area and 25% of Cell 2W/2E Splitter Dam Borrow Area.

SOW 21: Category 1 Groundwater Containment System: Year 0

Barr Engineering estimate based on permit level design on drawing GCS-003, GCS-010 and GCS-011 from Appendix 4 of the PTM Application - July 2016

Heavy Border with Bold Amounts are used in Reclamation Estimates

Item	Description	Unit	Quantity	Basis for Quantities (drawing # or describe)	Unit Cost	Cost Extension	Comments
1	Mobilization and Demobilization	LS	1	See Comments and Notes	$ 15,000.00	$ 15,000	To Be Determined By Contractor - Mob for General Earthwork, Site Grading and Vegetation Establishment
2	Environmental Protection Measures	LS	0	See Comments and Notes	$ -	$ -	Assume Environmental Protection Measures from Year 0 Construction Remain in Place and Are Effective. Assume Dust Control is Ancillary to Earthwork Activities.
3	Construction QA/QC	LS	1	See Comments and Notes	$ 3,000.00	$ 3,000	Includes General Confirmatory Survey and Periodic Reclamation Review
4	Cutoff Wall Breach for CRE	CY	3400	See Comments and Notes	$ 10.00	$ 34,000	Assume 5' Thick Cutoff Wall - 8' Wide Breach at 200-Foot Spacing with Average Breach Depth of 10' and Average Trench Excavation Slopes of 1H:1V [8'x{(10'x10')+(5'x10')}] /27 Breach = 45 CY/Breach for 15,000'
5	Cutoff Wall Breach Backfill for CRE	CY	3400	See Comments and Notes	$ 10.00	$ 34,000	Assume 5' Thick Cutoff Wall - 8' Wide Breach at 200-Foot Spacing with Average Breach Depth of 10' and Average Trench Excavation Slopes of 1H:1V [8'x{(10'x10')+(5'x10')}] /27 Breach = 45 CY/Breach for 15,000'
6	Seepage Collection Pipe Modifications for CRE	LF	0	See Comments and Notes	$ -	$ -	No Seepage Collection Pipe Modifications Anticipated
7	Riser Pipe Modifications for CRE	LS	75	See Comments and Notes	$ 400.00	$ 30,000	Quantity Unconfirmed - Assume 200' Riser Pipe Spacing. Assume Risers are Cut Off Below Ground Surface, Filled with Granular Soil, and Capped with Solid Cap
8	Mine Drainage Ditch Modifications for CRE	CY	21000	See Comments and Notes	$ 10.00	$ 210,000	Assume Ditch is Backfilled Using Adjacent Berm and Roadway Soil. Quantity is [(2.5'x3') + (10'x3')]/27 Per Foot of Trench = 1.4 CY/LF for 15,000 LF
9	Berm Modifications for CRE	CY	0	See Comments and Notes	$ -	$ -	Ancillary to Mine Drainage Ditch Modifications
10	Stormwater Ditch Modifications for CRE	CY	25500	See Comments and Notes	$ 10.00	$ 255,000	Assume Ditch is Backfilled Using Adjacent Berm and Roadway Soil. Quantity is [(3'x3') + (12'x3')]/27 Per Foot of Trench = 1.7 CY/LF for 15,000 LF
11	Perimeter Dike Modifications for CRE	CY	0	See Comments and Notes	$ -	$ -	Ancillary to Perimeter Ditch Modifications
12	Sump/Manhole Modifications	LS	3	See Comments and Notes	$ 1,000.00	$ 3,000	Remove and Salvage Manhole Internals, Remove and Recycle Upper Manhole Riser Section, Fill Manhole with Granular Material and Restore to Surrounding Grade
13	Furnish and Install Vegetation on Disturbed Areas (Assume Average Width of Restoration Zone is 100' and add 20% Additional for Misc. Restoration Areas; 100'x15,000' +20% = 1,800,000 SF = 41 AcreAssume Average Width of Restoration Zone is 100' and add 20% Additional for Misc. Restoration Areas; 100'x15,000' +20% = 1,800,000 SF = 41 Acre)	AC	41	See Comments and Notes	$ 635.00	$ 26,035	Barr 2016 Fee Schedule Average of Mid Level Engineer [Barr 2016] + Commercial Fertilizer and Seed for Overburden – Supply/Apply/Incorporate @ 200 lb/Acre/ [D&T 4/5/16 letter]
14	Reseeding 5% of Vegetation to Correct for Limited Growth	AC	2	See Comments and Notes	$ 635.00	$ 1,302	Commercial Fertilizer and Seed for Overburden – Supply/Apply/Incorporate @ 200 lb/Acre/ [D&T 4/5/16 letter] + Mulch – Supply and Incorporate @ 2 ton/acre of Hay or Straw Mulchs. [D&T 4/5/16 letter]
						$ 611,337	

Demo Estimate from Lakehead/Rachel, Mavo and Arrowhead Consulting & Testing	Lakehead / Rachel 2016 (Attachments E and F)						Mavo 2016 (Attachment C)	Arrowhead Consulting & Testing 2016 (Attachment D)		
Scope of Work Description	**Universal Waste Collection**	**Galbestos Removal**	**Demolition**	**Total Demo**	**Site Restoration**	**Recovery (not used - see Summary Scrap Value tab))**	**Asbestos Lead Paint Mold**	**Pre Demo Insp**	**Demo To Rollup**	**Abatement To Rollup**
Pre-Demolition Services										
Legacy with construction				$1,650,850	$4,500	$1,125	$20,500	$4,800	$1,655,350	$25,300
Additive Building & Heating Plant				$1,593,300			Included in Lakehead's total demo			in Main Plant Area below
Bentonite silos				inc in above			n/a			
Area 2 Water Tower (price separate from Heating & Additives buildings)			$30,000	$30,000	$2,500	$1,125	n/a			
Legacy Tailings Basin Buildings - Demoed as part of construction										
Foreman's Office (Bldg. 718)			$9,350	$9,350	$400		$6,500	$1,100		
Reporting Building (Bldg. 719)			$9,900	$9,900	$400		$6,500	$1,100		
Lube House (Bldg. 720)			$2,500	$2,500	$400		$2,500	$850		
Reporting Building (Bldg. 724)			$3,300	$3,300	$400		$2,500	$900		
Lube Oil Building (Bldg. 725)			$2,500	$2,500	$400		$2,500	$850		
Legacy Area 1				$351,597	$97,319	$41,000	$97,500	$850	$448,916	$98,350
Area 1 Shop and Truck Storage (Bldg. 220)	$2,900	$106,900	$103,332	$213,132	$74,669	$37,000	$82,500			
Area 1 Cold Storage (Bldg. 221)	$400	$48,970	$10,860	$60,230	$13,400	$2,800	$5,000			
Area 1 Reporting Building (Bldg. 231)			$9,900	$9,900			$5,000	$850		
Area 1 Boiler House (Bldg. 226)	$200	$13,500	$9,875	$23,575	$3,000	$200	$2,500			
Area 1 Fire Pump House & Water Tank (Bldg. 228)	$410		$11,250	$11,660			$2,500			
Area 1 Locomotive Fueling	$500	$22,500	$10,100	$33,100	$6,250	$1,000				
Legacy Area 2				$474,042	$82,785	$18,315	$164,700	$2,650	$556,827	$167,350
Area 2 Service Shop (Bldg. 201)	$2,200	$160,900	$38,990	$202,090	$37,334	$10,940	$93,050			
Area 2 Truck Storage (Bldg. 202)	$2,000	$63,190	$9,175	$74,365	$13,988	$3,075	$3,000			
Area 2 Cold Storage (204)	$697	$42,560	$13,080	$56,337	$14,100	$1,700	$3,000			
Area 2 Shop Locomotive Service Shop (Bldg. 203)	$3,400	$20,500	$12,300	$36,200	$11,113	$1,625	$52,150			
Area 2 Locomotive Fueling	$2,000	$20,900	$11,800	$34,700	$6,250	$975	$2,500			
Hose House (Bldg. 209) Not to be used in project		$3,000	$9,150	$12,150			$2,500	$850		
Sample House (Bldg. 208) Not to be used in project		$25,400	$20,300	$45,700			$5,000	$950	main plan areas inc tunnels	
Reporting Building (Bldg. 425) Not to be used in project		$3,300	$9,200	$12,500			$3,500	$850	$19,888,937	$5,962,607

Demo Estimate from Lakehead/Rachel, Mavo and Arrowhead Consulting & Testing

	Lakehead / Rachel 2016 (Attachments E and F)						Mavo 2016 (Attachment C)	Arrowhead Consulting & Testing 2016 (Attachment D)		
Scope of Work Description	**Universal Waste Collection**	**Galbestos Removal**	**Demolition**	**Total Demo**	**Site Restoration**	**Recovery (not used - see Summary Scrap Value tab))**	**Asbestos Lead Paint Mold**	**Pre Demo Insp**	**Demo To Rollup**	**Abatement To Rollup**
Legacy Plant Area				$13,305,631	$3,223,306	$2,890,406	$3,807,340	$2,200	$16,528,937	$3,809,540
Rebuild Shop (Bldg 602)	$3,000	$70,200	$125,600	$198,800	$27,560	$13,940	$85,000			
General Shop (Bldg. 601) Includes Acetylene Building (Bldg.604)	$15,000	$199,190	$353,600	$567,790	$182,300	$113,796	$480,800			
Carpenter Shop (Bldg. 603)	$2,000	$10,200	$13,250	$25,450	$3,300	$100	$2,500			
Coarse Crusher	$10,000	$313,345	$1,551,800	$1,875,145	$593,890	$199,325	$1,070,618			
Drive House 1 conv and housings	$7,500	$165,569	$141,540	$314,609	$46,900	$41,050	incl. in above			
Drive House 2 inc conv and housings		inc in above	inc in above	inc in above	inc in above	inc in above	incl. in Fines Crusher			
Fine Crusher	$45,000	$302,430	$1,373,460	$1,720,890	$203,400	$205,250	$439,686			
Warehouse 49 (Bldg. 920)	$6,500	$27,586	$82,800	$116,886	$15,947	$5,350	$49,000			
Warehouse 45 (Bldg. 921, Electrical)	$2,500	$35,159	$72,700	$110,359	$15,947	$3,590	$13,500			
Lube House (Bldg. 926)	$578	$17,000	$20,550	$38,128	$7,385	$1,600	$52,000			
Rubber Shop (Bldg. 605)	$1,000	$30,464	$36,550	$68,014	$11,269	$5,150	$24,000			
Concentrator Building and Thickeners	$100,000	$1,248,260	$5,895,850	$7,244,110	$1,145,998	$2,141,430	$1,535,236			
A-Lab	$500	$9,400	$14,560	$24,460	$2,940	$2,450	ncluded in Concentrator			
Hinsdale Bridge	$0	$16,700	$616,300	$633,000	$15,200	$148,500	n/a			
Water Reservoir	$5,000		$98,100	$103,100	$914,400	$7,750	n/a			
Plant Site Water Tower			$30,000	$30,000	$2,500	$1,125	n/a			
Water Treatment Plant & Storage Tanks	$1,000	$20,000	$72,600	$93,600	$2,250		$45,000			
Colby Pump House (potential deduct depends on variance request)		$41,000	$8,260	$49,260	$1,500		$2,500	$1,000	$50,760	$3,500
Ad Building inc UST	$3,900		$157,935	$161,835	$18,200		$850,000		$180,035	$850,000
Main Gate	$100		$11,400	$11,500	$875		$5,000	$900	$12,375	$5,900
Booster Pump House #1	$300		$23,500	$23,800	$9,200		included in Concentrator		$243,170	$859,400
Sewage Treatment Plant	$0		$62,700	$62,700	$19,520		$5,000	$900		
Portable Pump Houses	$0		$9,890	$9,890	$3,400		n/a			
Return Water Barge	$0		$44,900	$44,900			$5,000	$1,300		
General Infrastructure (railroads, tunnels, roadways, etc)					$1,504,000	$237,500			$1,504,000	
Legacy Railroads	$0		$380,000	$380,000					$380,000	
Legacy Tunnels	$0		$1,856,000	$1,856,000			$2,127,767		$1,856,000	$2,127,767
Galleries							included in Concentrator			
Sanitary Systems and Wells			$17,500		included in associated areas					
Pipelines					$591,000				$2,879,000	
Colby Lake Pipeline (potential deduct depends on variance request)			$900,000	$900,000	$98,000					
Inter-Pit Pipeline from Reservoir to Areas 1 & 2			$562,000	$562,000						
Natural Gas Pipeline Removal			$150,000	$150,000						
Legacy PipeLines Tailings management above ground			$378,000	$378,000						
Legacy PipeLines Tailings management below ground			$200,000	$200,000						
Legacy Power Lines	$0		$97,810	$97,810					$97,810	
Legacy Roads/Parking Lots	$0		$465,000	$465,000	$195,000				$660,000	

Demo Estimate from Lakehead/Rachel, Mavo and Arrowhead Consulting & Testing

Demo Estimate from Lakehead/Rachel, Mavo and Arrowhead Consulting & Testing	Lakehead / Rachel 2016 (Attachments E and F)						Mavo 2016 (Attachment C)	Arrowhead Consulting & Testing 2016 (Attachment D)		
Scope of Work Description	**Universal Waste Collection**	**Galbestos Removal**	**Demolition**	**Total Demo**	**Site Restoration**	**Recovery (not used - see Summary Scrap Value tab))**	**Asbestos Lead Paint Mold**	**Pre Demo Insp**	**Demo To Rollup**	**Abatement To Rollup**
New - Phase 1 - Plant Site				$2,190,000	$689,000					
Flotation Plant and Reagent Building	$75,000		$621,800	$696,800	$147,600	$242,500			$844,400	
Concentrate Storage and Loadout Facility	$12,000		$273,760	$285,760	$48,100	$37,500			$333,860	
Plant Site Sewage Treatment Plant	$1,000		$118,000	$118,000	$30,000				$148,000	
Railroads	$0		$185,000	$185,000	$111,000				$296,000	
Pipelines	$0		$1,555,000	$1,555,000	$375,000				$1,930,000	
Power Lines	$0			$0	$0				$0	
Roads and Parking Lots	$0			$0	$0				$0	
Plant Site Wastewater Treatment Plant (WWTP) Ponds not included	$0		$245,000	$245,000					$245,000	used long term
New - Phase 1 - Mine Site										
Maintenance Service and Fueling Facility	$1,100		$19,210	$20,310	$7,300	$1,200			$27,610	
Rail Transfer Hopper	$1,100		$40,000	$41,100	$45,000	$1,200			$86,100	
Rail Transfer Hopper Control Bldg	$100		$18,600	$18,700					$18,700	
Rail Transfer Hopper Platform			$60,000	$60,000					$60,000	
Central Pumping Station	$500		$14,000	$14,500	$1,200				$15,700	
Railroads	$0		$45,000	$45,000	$33,750				$78,750	
Pipelines	$0		$580,133	$580,133	$217,000				$797,133	
Power Lines	$0		$83,900	$83,900	$0	$7,175			$83,900	
Roads and Parking Lots	$0		$392,000	$392,000	$132,000				$524,000	
Mine Site Wastewater Treatment Facility (WWTF)	$0		$498,000	$498,000	$14,000				$512,000	
New - Phase 2				$10,735,100	$97,375					
Reagent Building	$15,000		$820,000	$835,000	$4,100	$22,500				
Oxygen Plant	$65,000		$4,238,600	$4,303,600	$16,600	$72,500				
Limestone Preparation	$7,500		$345,000	$352,500	$1,750	$12,500				
Hydrometallurgical Plant	$49,000		$4,365,000	$4,414,000	$13,500	$62,500				
Hydrometallurgical Reagents	$15,000		$815,000	$830,000	$2,200	$17,500				
Railroads	$0									
Pipelines	$0		$1,450,000							
Power Lines	$0									
Roads and Parking Lots	$0		$156,000		$59,225					

	Lakehead	Mavo
Totals	$31,155,813	$7,087,707
Mine Site	$2,203,893	$0
less Mine Site	$28,951,920	$7,087,707

Attachments

Attachment F

PolyMet Closure and Demolition Specification and Lakehead Estimates

Attachment F1

PolyMet Closure and Demolition Specification

POLYMET
MINING

NorthMet Project

Closure and Demolition Specification (Structures and Equipment Only)

June 30, 2016
Revision 6

Table of Contents

Attachments

Figures 1-8

1.0 Background

PolyMet Mining Corporation (PolyMet) is a publicly traded mine development company with operational headquarters near the Company's mine in Hoyt Lakes, Minnesota, and executive offices in St. Paul, Minnesota. PolyMet is developing a copper-nickel-precious metals project in the established mining district of the Mesabi Iron Range in northeastern Minnesota. PolyMet controls 100% of the NorthMet ore deposit and owns a large crushing and grinding facility with extensive associated infrastructure, where it plans to process copper, nickel, gold, and platinum group metal ores from the NorthMet mine. The NorthMet Project (Project) would become the first non-ferrous ore mining operation in Minnesota. Shares are traded on the New York Stock Exchange (NYSE-A: PLM) and Toronto Stock Exchange (TSX: POM).

PolyMet is progressing with a two phased design, construction, and production plan. Phase I involves construction of the mine and related facilities, reconditioning and upgrading of the existing plant, construction of a flotation plant, and construction of a rail load-out facility for production of a dual filter cake. Products produced after Phase I construction include a copper rich concentrate and a nickel rich concentrate also holding platinum group metals.

Phase II includes the design, construction, and commissioning of a new hydrometallurgical facility and oxygen plant. Once completed, PolyMet will produce a combination of copper filter cake, nickel filter cake, nickel/cobalt hydroxide and gold/ platinum group precipitate.

PolyMet designed its facility to maximize the reuse of the LTV Steel Mining Company's Erie Plant brownfield site and existing infrastructure.

2.0 Introduction

PolyMet is in the permitting process. As part of the Minnesota Department of Natural Resources' (MDNR) Permit to Mine, PolyMet will be required to provide adequate financial assurance to the State of Minnesota for proper closure of the Project. The planned closure of the Project is 20 years after startup, however, a condition of the Permit to Mine requires that the possibility of early closure is taken into account. The Permit to Mine will require the closure plans and the instrument of financial assurance to be updated annually. The updated closure plans and instrument of financial are submitted to the MDNR for review and acceptance that the financial assurance is sufficient to meet the existing obligations of closure and remediation.

At the time that the Permit to Mine is issued, PolyMet will have entered into a financial assurance agreement with the MDNR and provided the financial instrument that will guarantee payment for the closure of the project.

There will be salvage, demolition work and asbestos removal required during the pre-construction and construction phase of the Project. That work is not part of this scope of work specification.

3.0 Request for Demolition Estimate

PolyMet is requesting an estimate for demolition of structures and equipment associated with the Project as described herein.

This document presents the specification for demolition of structures and equipment components of the Project in two parts:

- PolyMet is seeking an estimate for Year 1 demolition activities as shown in Section 8.0 of this specification.
- PolyMet is also seeking estimates for future plant closure demolition activities (i.e. Year 20) as generally described previously. These activities are described in Section 9 of this specification.

There are two components to our site that need to be considered for each portion of the estimate:

- The Plant Site components are the portions of Cliffs Erie Plant Site acquired by PolyMet (see 8.1.1 to 8.1.29, and 8.2.1 to 8.2.6) and portions of the Plant Site to be constructed as part of the Project (see 9.1.1 to 9.1.3 and 9.3.1).
- The mine components are new facilities to be constructed at the Mine Site (see 9.2.1 to 9.2.3).

Notes:

- The planned closure of the Project is 20 years after startup. . However, an unforeseen closure could occur anytime.

4.0 Specification Support Documents

This specification includes:

- This specification document
- Figures 1- 9 referenced in specification
- Plant Site drawing package per drawing index
- Plant Site asbestos and lead survey reports
- Process equipment list (see attachments)
- PolyMet demolition quantity estimates (as reference where available)
- Mine Site drawing package

- Process Flow Diagrams – Process flow diagrams are provided for the existing plants and concentrate handling areas. An entire process flow diagram is available if required. In order to obtain a copy of the entire process flow diagram including the flotation area then the Contractor must enter into a confidentiality agreement with PolyMet.

5.0 Estimate Requirements

The demolition estimates shall include the following as a minimum:

- Reclamation dirt work and seeding cost estimate by facility listed in Section 8 and 9.
- Concrete demolition cost estimate by facility listed in Section 8 and 9.
- List of assumptions from which the proposal is based. Wherever possible describe any engineering concepts or assumptions from which the proposal is based (i.e. concrete will be placed in crusher basement, siding will be placed in landfill, etc.)
- List of exceptions to requests in the proposal including reason for exception.
- Biography of Contractor including any relevant experience in relation to the Contract.
- Experience working with Governmental Agencies (i.e. MDNR, MPCA, EPA) and Owner's agents to fulfill structure and equipment demolition obligations.
- An outline describing the major aspects of the Contractor's Safety Program shall be supplied.
- A performance bond may be required with yearly Contract. Provide information regarding any bonding capability, an indication of willingness to bond, and costs associated with bonding that would be passed on to PolyMet.
- Preliminary design drawings (i.e. layouts, arrangements) are provided for the Contractor for the demolition of new facilities. Note that the drawings shown are preliminary design layouts. PolyMet will provide more information to the selected Contractor as more detailed design drawings become available. The Contractor will have the opportunity to update the Contract as more detailed information is made available regarding the new facilities to be constructed by PolyMet.

6.0 Closure Estimate Objective

The objective of the Closure Estimate is to accurately estimate the costs to place the facilities listed in Section 8 and 9 in a safe, secure, environmentally stable condition. In general, all environmental concerns will be evaluated, environmental hazards will be remediated, all buildings and structures will be demolished, and all associated sites reclaimed and vegetated.

7.0 General Demolition Requirements

The following are general demolition requirements for the Contractor:

- Asbestos containing Galbestos siding must be removed from the building in an environmentally safe manner so that no material is allowed to become airborne. Contractor must have an asbestos certified Site Supervisor oversee the removal of the Galbestos siding in accordance with all state and federal agencies. The Galbestos shall be disposed of at an off-site landfill approved by the U.S. Environmental Protection Agency which is operated in accordance with 40 CFR Section 61.154. If the landfill is operated in the state of Minnesota, ensure it is a MPCA approved solid waste facility permitted to accept the waste.
- The Contractor is responsible to obtain permits and submit all reports required by the state and federal agencies.
- Removal of hazardous materials is the responsibility of the Contractor. Contractor must have a hazardous waste subcontractor inspect, inventory, remove and dispose of all hazardous waste. The Contractor is responsible to obtain permits and submit all reports required by the state and federal agencies.
- Concrete from the building demo may go to the sites located in Figure 8 “Concrete Demolition Disposal Locations”. Concrete that is crushed and used as fill material shall be no greater than 4” in diameter.
- Roofing must be characterized as asbestos containing or asbestos free. Asbestos free roofing may be sold by the Contractor.
- Buildings must be demolished to ground level. Specific elevations are shown in Section 8 and 9. All existing floors below ground level may be left in place.
- Contractor shall provide filling of basements and the foundations will be covered with a minimum of two feet of surface overburden according to Minnesota Rules 6132.3200.
- Contractor shall plan to supply electricity from the Main Substation, water,

offices, sanitary facilities, etc. as these items may not be available at the work site.

- MSHA requirements must be met while PolyMet is in operation. At closure PolyMet's plant site will be under the jurisdiction of OSHA.
- Contractor will control, clean up and dispose of all environmental releases as no releases of soils, waters, or liquids will leave the work site area.
- Services and utilities will be severed by others prior to commencement of demolition work.
- Demolition will require a General NPDES Construction Permit.
- Contractor shall provide PolyMet or MDNR with copies of all reports and permits that are required.
- Contractor shall assume that all equipment referenced in this specification is left in place for the Contractor at time of closure and that no other entities have salvaged the equipment for value.

Notes:

- An asbestos and lead paint inventory has been performed for the Plant Site. The asbestos reports are provided as an attachment to this specification. Abatement of these materials will take place during the pre-construction phase of the project and are not considered to be part of this scope of work.
- PCB containing or contaminated items have been inventoried and removed from the PolyMet site. It is anticipated that no new PCB containing devices will be brought on site.

8.0 Year 1 Demolition Plan

Within three (3) years after closure begins, all buildings and structures will be removed and foundations razed to grade level. Provisions may be made for continued subsequent use of mine facilities that will have future benefits to the area including, pipelines, transmission lines, roads, and railroad lines. However, for the purposes of this document it shall be assumed that all of the PolyMet facilities must be removed and the facility footprints reclaimed.

All facilities listed in Sections 8.1.1 to 8.1.29 and 8.2.1 to 8.2.6 will be demolished over a maximum period of three years. Facilities described in Section 9.4 may remain in service after closure (see Section 9.4).

For building, area or equipment locations listed as headings in the following sections for the plants reference Figures 1 and 1A for details.

For major process equipment reference the Equipment List (attached) and the Process Flow Diagrams (attached).

For the new facilities preliminary design drawings (i.e. layouts, arrangements) are provided for the Contractor. Note that the drawings shown are preliminary design layouts. The layout of equipment, etc. will change throughout the design process. These drawings show equipment and building sizes that are approximate. PolyMet will provide more information to the selected Contractor as more detailed design drawings become available.

8.1 Existing Facilities

8.1.1 Coarse Crushing Facilities

The Coarse Crusher houses two stages of crushing to reduce crude ore from run-of-mine size (up to 48") to 6" size. See the process flow diagram (drawing 010-P120-001-001 Rev D and 010-P120-001-002 Rev B) for major equipment reference.

The coarse crusher contains the following large equipment in addition to many auxiliary systems:

- (2 ea) 60" x 102" gyratory crusher
- (2 ea) 900 hp motor
- (8 ea) 36" x 70" gyratory crusher
- (8 ea) 400 hp motor
- (8 ea) Apron feeders
- (2 ea) 60" conveyors
- Overhead cranes
- Dust collection systems

The site shall be left as follows:

- Demolish structure to elevation 1711-0".
- Remove all equipment, piping, wiring, ductwork, equipment structures, etc. below elevation 1711'-0".
- Utility tunnels leaving the Coarse Crushing Facility will be sealed and closed in place.
- Basement levels below elevation 1711'-0" may be used for concrete disposal per the specification.
- Place clean fill in basement below elevation 1711-0" or fill with concrete demolition materials from other plant locations before final cover is placed
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

Reference drawings for the Coarse Crusher include:

TA-556	Coarse Crushing Plant Concrete Masonry Plan at El. 1711’-0”
TA-557	Coarse Crushing Plant Concrete Masonry Plan at El. 1711’-0”
TA-558	Coarse Crushing Plant Concrete Masonry Plan at El. 1711’-0”
TA-600	Coarse Crushing Plant Concrete Masonry Reinforcing Change House Foundations
TA-690	Coarse Crushing Plant Concrete Masonry Walls Between Elev. 1668’-6 & Elev.1694-0”
TA-691	Coarse Crushing Plant Concrete Masonry Walls Between Elev. 1668’-6 & Elev.1694-0”
TA-715	Coarse Crushing Plant Concrete Reinforcing Floor @ Elev. 1668’-6 & Elev.1694-0”
TA-716	Coarse Crushing Plant Concrete Reinforcing Floor @ Elev. 1668’-6 & Elev.1694-0”
TA-717	Coarse Crushing Plant Concrete Reinforcing Floor @ Elev. 1668’-6 & Elev.1694-0”
TA-718	Coarse Crushing Plant Concrete Masonry Walls Between El. 1694’-0 & Elev.1711’-0”
TA-719	Coarse Crushing Plant Concrete Masonry Walls Between El. 1694’-0 & Elev.1711’-0”
TA-720	Coarse Crushing Plant Concrete Reinforcing Walls Between El. 1668’-6 & Elev.1694-0”
TA-1-520	Coarse Crusher Change House Locker & Lunch Room Alteration
TA-1-556	Coarse Crushing Plant Silica Assay System Piping Arrangement
TA-1-557	Coarse Crushing Plant Silica Assay System Pump & Sump @ Dust Collector 27N
TA-1-558	Coarse Crushing Plant Silica Assay System Detail 27S Sump & Tailings Sump
010-P120-001-001 Rev D	Area 10 Coarse Crushing Process Flow Diagram
010-P120-001-002 Rev B	Area 10 Coarse Crushing Process Flow Diagram

8.1.2 Drive House 1

Drive House 1 contains the transfer points and drives for the 1A, 1B, 2A, and 2B conveyors.

The drive house contains the following large equipment in addition to auxiliary systems:

- (2 ea) 60" conveyors
- (4 ea) 600 hp primary drive motors and gearcases
- (4ea) 300 hp secondary drive motors and gearcases
- Overhead crane
- Dust collection systems

The site shall be left as follows:

- Demolish the conveyor gallery leading to the Fine Crusher and drive house 1 to elevation 1711-0".
- Remove all equipment, piping, wiring, ductwork, equipment structures, etc. below elevation 1711'-0".
- Seal conveyor tunnel to the Coarse Crushing Facility and close in place.
- Place clean fill in spaces below elevation 1711-0" before final cover is placed.
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

Reference drawings for the Drive House 1 include:

TA-18	Conveyors to Sec. Cr. Plant Junction & Drive House No. 1 Dust Control System Gen. Arrg't & Bill of Material
TA-40	Conveyors to Secondary Crushing Plant 60" Belt Conveyors Nos. 2A & 2B (2nd Unit) General Arrangement and B/M
TA-41	Conveyors to Secondary Crushing Plant 60" Belt Conveyors Nos. 2A & 2B (2nd Unit) Curved Section-Horizontal to Incline Arrangement & Details
TA-42	Conveyors to Secondary Crushing Plant 60" Belt Conveyors Nos. 2A & 2B (2nd Unit) Drive & Take-Up Arrangement & Details Plan
TA-43	Conveyors to Secondary Crushing Plant 60" Belt Conveyors Nos. 2A & 2B (2nd Unit) Drive & Take-Up Long'l Elevation & Sections
TA-44	Conveyors to Secondary Crushing Plant 60" Belt Conveyors Nos. 2A & 2B (2nd Unit) Drive & Take-Up Sections & Details

TA-45	Conveyors to Secondary Crushing Plant 60" Belt Conveyors Nos. 2A & 2B (2nd Unit) Curved Section, Incline to Horizontal Arrangement and Details
TA-46	Conveyors to Secondary Crushing Plant 60" Belt Conveyors Nos. 2A & 2B (2nd Unit) Tail End Arrangement & Details
TA-47	Conveyors to Secondary Crushing Plant 60" Belt Conveyors Nos. 2A & 2B (2nd Unit) Head End Arrangement & Details
TA-48	Conveyors to Secondary Crushing Plant 60" Belt Conveyors #1A & #2A, & #1B & #2B (2nd Unit) Drive House #1 and Transfer Junction General Arrangement.
TA-49	Conveyors to Secondary Crushing Plant 60" Belt Conveyors #1A & #1B (2nd Unit) Head End, Dual Drive & Take-Up Arrangement & Sections
TA-50	Conveyors to Secondary Crushing Plant 60" Belt Conveyors #1A & #1B (2nd Unit) General Arrangement and B/M
TA-51	Conveyors to Secondary Crushing Plant 60" Belt Conveyors #1A & #1B (2nd Unit) Dual Drive Sections & Details
TA-52	Conveyors to Secondary Crushing Plant 60" Belt Conveyors #1A & #1B (2nd Unit) Gravity Take-Up Arrangement, Sections & Details
TA-53	Conveyors to Secondary Crushing Plant 60" Belt Conveyors #1A & #1B (2nd Unit) Curved Section Arrangement and Sections
TA-54	Conveyors to Secondary Crushing Plant 60" Belt Conveyors #1A & #1B (2nd Unit) Loading at 1st Unit Crushers Arrangement & Sections
TA-55	Conveyors to Secondary Crushing Plant 60" Belt Conveyors #1A & #2B (2nd Unit) Drive House #1 and Transfer Junction General Arrangement, Section BB & CC
TA-77	Conveyor Gallery – Conv. #2A & #2B Structural Steel Plans, Elevations & Sections
TA-78	Conveyor Gallery – Conv. #2A & #2B Structural Steel Details
TA-252	Conveyors to Secondary Crush. Plt. Structural Steel Drive House 1 Plans & Elevations
TA-253	Conveyors to Secondary Crush. Plt. Structural Steel Drive House 1 Sections & Details
TA-254	Conveyors to Secondary Crush. Plt.

	Structural Steel Drive House 1 Trusses T-1, T-2, T-3 & Details
TA-255	Conveyors to Secondary Crush. Plt. Structural Steel Drive House 1 Crane Girder & Col. Base Details
TA-259	Conveyors to Secondary Crush. Plant. Structural Steel Drive Hse Supports for Conv. 2A & 2B
TA-260	Conveyors to Secondary Crush. Plt. Concrete Masonry Drive House No.1
TA-261	Conveyors to Secondary Crush. Plt. Concrete Masonry Drive House No.1
TA-262	Conveyors to Secondary Crush. Plt. Concrete Masonry Drive House No.1
TA-263	Conveyors to Secondary Crush. Plt. Concrete Masonry Drive House No.1
TA-264	Conveyors to Secondary Crush. Plt. Concrete Masonry Drive House No.1
TA-265	Conveyors to Secondary Crush. Plt. Concrete Reinforcing Drive House No.1

8.1.3 Drive House 2

Drive House 2 contains the drives for the 4A and 4B conveyors. These conveyors feed ore from the Fine Crushers to the Concentrator.

The drive house contains the following large equipment:

- (2 ea) large 60” conveyors
- (2 ea) 500 hp primary drive motors and gear cases
- (2ea) 250 hp secondary drive motors and gear cases

The site shall be left as follows:

- Demolish the conveyor gallery to the concentrator and drive house 2 to elevation 1710-6”.
- Remove all equipment, piping, wiring, ductwork, equipment structures, etc. below elevation 1710’-6”.
- Seal conveyor tunnel to the Fine Crushing Facility and close in place.
- Place clean fill in spaces below elevation 1711-0” before final cover is placed.
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

Reference drawings for the Drive House 2 include:

TA-157 Conveyors to Concentrator
60" Belt Conveyors #4A & #4B
General Arrangement & B/M
TA-161 Conveyors to Concentrator
60" Belt Conveyors #4A & #4B
Drive House #2 Arrangement and Details

8.1.4 Fine Crushing Facility

The Fine Crusher houses two stages of crushing to reduce crude ore from 6" size to gravel size. See the process flow diagram (drawing 010-P120-001-001 Rev D and 010-P120-001-002 Rev B) for major equipment reference.

The fine crusher contains the following large equipment in addition to many auxiliary systems:

- (6 ea) 7' standard cone crusher
- (10 ea) 7' short head crusher
- (12 ea) 350 hp motor
- (12 ea) vibrating screen decks and feeders
- (18 ea) feeder with feed chute
- Several process support conveyors
- (3 ea) 100 ton Overhead cranes
- Dust collection systems
- (2ea) 60" conveyor and tripper

The site shall be left as follows:

- Demolish structure to elevation 1711-0".
- Remove all equipment, piping, wiring, ductwork, equipment structures, etc. below elevation 1711'-0".
- Utility tunnels leaving the Fine Crushing Facility will be sealed and closed in place.
- Place clean fill in basement below elevation 1711-0".
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

Reference drawings for the Fine Crusher include:

TA-58 Secondary Crushing Plant
Structural Steel North Elevation
TA-59 Secondary Crushing Plant

	Structural Steel South Elevation
TA-60	Secondary Crushing Plant Structural Steel Transverse Sections
TA-61	Secondary Crushing Plant Structural Steel Bin Walls Plan & Sections
TA-64	Secondary Crushing Plant Structural Steel Crane Girder Details
TA-69	Secondary Crushing Plant Structural Steel Bin Main Longitudinal Girder
TA-70	Secondary Crushing Plant Structural Steel Longitudinal Sections
TA-71	Secondary Crushing Plant Structural Steel Longitudinal Sections
TA-79	Secondary Crushing Plant Structural Steel Bin Floor Members
TA-85	Secondary Crushing Plant Structural Steel Platforms at El 1755'-91/2"
TA-86	Secondary Crushing Plant Structural Steel Tripper Floor and Platform Plans
TA-88	Secondary Crushing Plant Structural Steel Frame F-1
TA-94	Secondary Crushing Plant Structural Steel Tunnel Roof Framing @ Repair Bay Plan, Sections & Details
TA-95	Secondary Crushing Plant Structural Steel Tunnel Roof Framing @ Repair Bay Girder Details
TA-96	Secondary Crushing Plant Structural Steel Change Room, Tool Room And Offices – Framing Plan & Elevs.
TA-98	Secondary Crushing Plant Structural Steel Tunnel Roof Framing @ Repair Bay Girder Details
TA-107	Secondary Crushing Plant Structural Steel Repair Bay Bracing @ El 1782'-5" Plan & Details
TA-109	Secondary Crushing Plant Conveyor Gallery Conv. #2A & #2B Masonry & Reinforced Concrete Gallery Footings
TA-110	Secondary Crushing Plant Concrete Masonry Foundation Plan
TA-111	Secondary Crushing Plant Concrete Masonry Repair Bay North Elevation

TA-112	Secondary Crushing Plant Concrete Reinforcing Repair Bay North Elevation
TA-113	Secondary Crushing Plant Concrete Reinforcing Repair Bay North Elevation
TA-114	Secondary Crushing Plant Concrete Masonry & Reinforcing Foundations Col. Line
TA-115	Secondary Crushing Plant Concrete Masonry Longitudinal Section of Crusher Wall on “B” Line
TA-116	Secondary Crushing Plant Concrete Masonry Longitudinal Section of Crusher Wall on “B” Line
TA-117	Secondary Crushing Plant Concrete Masonry Longitudinal Section of Crusher Wall on “D” Line
TA-118	Secondary Crushing Plant Concrete Masonry East & West Crusher Walls Between Col. Lines (9) & (15)
TA-119	Secondary Crushing Plant Concrete Masonry East & West Crusher Walls Between Col. Lines (5) & (9)
TA-120	Secondary Crushing Plant Concrete Masonry South Elevation
TA-121	Secondary Crushing Plant Concrete Reinforcing South Elevation
TA-122	Secondary Crushing Plant Concrete Masonry Repair Bay East Elevation
TA-123	Secondary Crushing Plant Concrete Masonry Repair Bay West Elevation
TA-124	Secondary Crushing Plant Concrete Masonry Floor at Repair Bay
TA-125	Secondary Crushing Plant Concrete Masonry Floor at Repair Bay
TA-126	Secondary Crushing Plant Concrete Masonry Floor at Repair Bay
TA-127	Secondary Crushing Plant Concrete Masonry Standard Crusher Foundations Plans, Sections & Details

TA-128	Secondary Crushing Plant Concrete Masonry Longitudinal Section Of Crusher Wall on D Line
TA-129	Secondary Crushing Plant Concrete Reinforcing Service Tun'l at Repair Bay Sections & Bar Schedule
TA-130	Secondary Crushing Plant Concrete Reinforcing Floor at Repair Bay
TA-131	Secondary Crushing Plant Concrete Reinforcing Floor at Repair Bay
TA-132	Secondary Crushing Plant Concrete Reinforcing Floor at Repair Bay
TA-133	Secondary Crushing Plant Concrete Reinforcing Floor at Repair Bay
TA-134	Secondary Crushing Plant Concrete Masonry Tunnel for Conveyors #4A-4B Roof Plan, Sections & Details
TA-135	Secondary Crushing Plant Concrete Masonry Tunnel for Conveyors #4A-#4B North Wall – Elev. & Dets.
TA-136	Secondary Crushing Plant Concrete Masonry Tunnel for Conveyors #4A-4B South Wall – Elevs. & Dets.
TA-137	Secondary Crushing Plant Concrete Masonry Tunnel for Conveyors #4A-#4B Bottom Plan, Sections & Dets
TA-138	Secondary Crushing Plant Concrete Reinforcing Tunnel for Conveyors #4A-#4B Plan & Sections
TA-139	Secondary Crushing Plant Concrete Reinforcing Tunnel for Conveyors #4A-4B Roof Plan
TA-140	Secondary Crushing Plant Concrete Reinforcing Tunnel for Conveyors #4A-#4B North Wall – Sect. & Dets.
TA-141	Secondary Crushing Plant Concrete Reinforcing Tunnel for Conveyors #4A-#4B North Wall – Sects. & Bar Schedule
TA-142	Secondary Crushing Plant Concrete Reinforcing Tunnel for Conveyors 4A & 4B South Wall Elevs. & Dets.
TA-143	Secondary Crushing Plant Concrete Reinforcing Tunnel for Conveyors #4A & 4B

	South Wall – Sections & Bar Schedule
TA-144	Secondary Crushing Plant Concrete Reinforcing Tunnel for Conveyors #4A & #4B Bottom Plan & Sections
TA-145	Secondary Crushing Plant Concrete Reinforcing Tunnel for Conveyors #4A & #4B Bottom Plan & Sections
TA-146	Secondary Crushing Plant Concrete Reinforcing Repair Bay – East Elevation Elevation & Sections
TA-147	Secondary Crushing Plant Concrete Reinforcing Repair Bay – East Elevation Sections & Bar Schedule
TA-148	Secondary Crushing Plant Concrete Reinforcing West Elevation
TA-149	Secondary Crushing Plant Concrete Reinforcing West Elevation Sections & Bar Schedule
TA-150	Secondary Crushing Plant Concrete Reinforcing Tunnel for Conveyor 4A & 4B Footing $ Dowel Plan
TA-510	Secondary Crushing Plant Architectural Plan of Change Room Tool Room, Offices, Etc.
TA-511	Secondary Crushing Plant Architectural Change Rm, Tool Rm & Offices Elevations & Sections
TA-512	Secondary Crushing Plant Architectural Change Rm, Tool Rm & Offices Miscellaneous Details.

015-P120-001-001 Rev D Area 10 Fine Crushing Process Flow Diagram

8.1.5 Concentrator (including pipe gallery to Booster Pumphouse #1 and the Load Out)

The Concentrator houses two stages of wet grinding mills to reduce crude ore from gravel size to powder in slurry form that feeds the new flotation plant. See the process flow diagram (drawing 020-P120-001-001 Rev E) for major equipment reference.

The Concentrator contains the following large equipment in addition to many auxiliary systems:

- (29 ea) Rod mill with 800 hp motor
- (30 ea) Ball mill with 1250 hp motor
- (3 ea) Regrind mill with 1850 hp motor
- (34 ea) Ball mill cyclone cluster
- (34 ea) Ball mill cyclone feed pump
- (2 ea) 60” Conveyor and Tripper
- Fine ore bin
- Overhead cranes
- Piping and tankage
- Dust collection systems

The site shall be left as follows:

- Remove all equipment, piping, wiring, ductwork, equipment structures, etc.
- Demolish structure to elevations 1710-8”, 1688’-6”, 1665’-0”, 1651’-0” and 1617’9”. These elevations coincide with the upper elevations of the sloping finished floor in the building sections (see drawing 322-1002 for reference).
- The Contractor may leave the mill pedestals above the finished floor but must provide clean fill to bury the pedestals prior to establishment of final cover.
- Utility tunnels leaving the Concentrator and completely contained inside of the Concentrator (i.e. electrical tunnels/vaults) will be sealed and closed in place.
- Place clean fill in any basement elevations (i.e. sumps).
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.
- The final cover must be a natural slope from elevation 1710’-8” to 1616’-0” and to ensure proper water drainage.

Reference drawings for the Concentrator include:

322-1002	Concentrator General Arrangement Elevation Looking South
322-1001	Concentrator General Arrangement Plan
332-1003	Regrind Annex Gen. Arrg’t Plans
332-1004	Regrind Annex Gen. Arrg’t Elevations
332-1005	Regrind Annex Gen. Arrg’t Elevations
331-3303	Regrind Annex Structural Steel Base Details & Misc. Steel
331-3307	Regrind Annex Structural Steel

	Floor Framing at El. 1652'-71/4" Plan, Sections & Details
331-3111	Regrind Annex Concrete Masonry & Reinf'g Slab at Elevation 1666'-0" Plan, Sections & Det.
TB-81	Concentrator Concrete Masonry & Reinforcing FNDNS in Repair Area Slab at Elev. 1710'-6"
TB-84	Concentrator Concrete Masonry & Reinforcing Foundations in Repair Area Mezzanine Floor
TB-85	Concentrator Concrete Masonry & Reinforcing Foundations in Repair Area Mezzanine Floor
TB-91	Concentrator Concrete Masonry Main Pipe Tunnel Col. Lines Y to F Panel 7
TB-99	Concentrator Concrete Masonry & Reinforcing Foundations in Repair Area Mezzanine Floor
TB-301	Electric Light & Power List of Drawings "TB"
TB-811	Concentrator Architectural Plan of Change Room & Offices at Elev. 1698'-6"
TB-812	Concentrator Architectural Plan of Toilet at Elev. 1686'-6"
TB-813	Concentrator Architectural Sections Thru Change Rm. Toilets, Offices, Etc.
020-P120-001-001 Rev E	Area 20 Grinding Process Flow Diagram

8.1.6 Area 1 Buildings

Area 1 shop buildings are used for maintenance and repair of the mining equipment and include the following buildings; Shop and Truck Storage (Bldg. 220), Cold Storage (Bldg. 221), Boiler House (Bldg. 226), Fire Pump House & Water Tank (Bldg. 228), Locomotive Fueling, Reporting Station (Bldg. 231)   There is no large process equipment in this area.

The site shall be left as follows:

- Demolish the Area 1 shop buildings to elevation 1673'-0" (finished floor elevation).
- Demolish outlying cold storage, tanks and other buildings/equipment to existing grade level.
- Place clean fill in spaces below elevation 1673'-0" before final cover is placed.
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules

6132.3200.

Reference drawings for the Area 1 buildings include:

TE-8-142	Maintenance & Repair Shop Area 1 Phase 1 Fire Protection – Fire Pump & Tank
TE-8-310	Area 1 Shop Area Yard Piping System
TE-8-017	Sprinkler System for Traffic Control Center
TE-8-149	Maintenance & Repair Shop Area 1 Phase 2 Floor Plans-Existing Building

8.1.7 Area 2 Buildings

Area 2 buildings are used for reporting mining employee reporting and storage and include the following buildings; Cold Storage (Bldg. 204), Locomotive Service Shop (Bldg. 203), Maintenance Service Shop (Bldg. 201), Truck Storage Garage (Bldg. 202), Hose House (Bldg. 209), Sample House (Bldg. 208), Reporting Building (Bldg. 425), and Area 2 Locomotive Fueling.

There is no large process equipment in this area.

The site shall be left as follows:
- Demolish the Area 2 Service Shop and Truck Storage buildings to elevation 1672'-0" (finished floor elevation).
- Demolish the Area 2 Cold Storage building to elevation 1678.75' (finished floor elevation).
- Demolish Oil House to elevation 1674.58 and outlying tanks, locomotive sanding towers, and other buildings/equipment to existing grade level.
- Place clean fill in spaces below elevation 1672'-0" in Service shop before final cover is placed.
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

Reference drawings for the Area 2 buildings include:

MA-50-3	Service Area – East Pits Area Map
TE-8-008	General Revisions East Pit Service Shop
TE-8-014	Revised Shop Floor Plan

East Pit Shops Bldg

8.1.8 General Shops

The General Shops, building number 601, were and will be used for maintenance and repair of the rail fleet as well as electrical equipment repairs, welding and fabrication, and other miscellaneous repairs. The General Shops buildings include the Welding Shop, Structural Shop, Locomotive Shop, Electric Shop, Machine Shop, Tool Room, and several offices and a locker room. The Acetylene Building, number 604 is considered to be part of the General Shops. There is no large process equipment in this area except for overhead cranes.

The site shall be left as follows:

- Demolish the building, equipment, etc. to elevation 1710'-6" (finished floor elevation).
- Place clean fill in spaces below elevation 1710'-6" before final cover is placed.
  Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

Reference drawings for the General Shops include:

TE-1	General Shops General Arrangement Plan
TE-50	General Shops Structural Steel Mezz. Framing Plans & Sections
TE-51	General Shops Architectural Elevations

8.1.9 Rebuild Shop

The Rebuild Shop, building number 602, is used for drill core storage and cutting. There is no large process equipment in this area. There are overhead cranes.

The site shall be left as follows:

- Demolish the building to elevation 1711'-0" (finished floor elevation).
- Utility tunnels leaving the Rebuild Shop will be sealed and closed in place.
- Place clean fill in spaces below elevation 1711'-0" before final cover is placed.
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

Reference drawings for the Rebuild Shop include:

TE-267	Garage Building Structural Steel & Concrete Reinf. Warehouse Mezzanine and the Battery Storage Decks
TE-270	Garage Concrete Masonry Building Foundations
TE-271	Garage Concrete Masonry Building Foundations
TE-281	Garage Architectural Floor Plan and Section
TE-282	Garage Architectural Elevations
TE-284	Garage Architectural Door Schedule & Misc. Details

8.1.10 Lube House

The Lube House, building number 926, acts as storage space for lubricants and paints. The building does not contain any major pieces of equipment.

The site shall be left as follows:

- Demolish the building to elevation 1711’-0”.
- Utility tunnel under the Lube House will be sealed and closed in place.
- Place clean fill in spaces below elevation 1711’-0” before final cover is placed.
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

Reference drawings for the Lube House include:

TE-316	Lubricating Oil & Paint Storage Structural Steel Plan & Details
TE-317	Lubricating Oil & Paint Storage Structural Steel Elevations & Details
TE-318	Lubricating Oil & Paint Storage Concrete Masonry Foundation Plan & Sects.
TE-319	Lubricating Oil & Paint Storage Concrete Masonry Section & Details
TE-320	Lubricating Oil & Paint Storage Concrete Reinforcing Foundation Plan Section & Details
TE-321	Lubricating Oil & Paint Storage Concrete Reinforcing Section & Details

TE-322	Lubricating Oil & Paint Storage Concrete Reinforcing Section & Details

8.1.11 Analytical Lab

The Analytical Lab is the on-site laboratory. The building does not contain any major pieces of equipment.

The site shall be left as follows:

- Demolish the building to elevation 1618’-0” (finished floor elevation).
- Place clean fill in spaces below elevation 1618’-0” before final cover is placed.
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

Reference drawings for the Analytical Lab include:

TE-4-007	Commercial Plant Analytical Laboratory Basement Floor – Plot Plan
TE-4-008	Commercial Plant Analytical Laboratory Main Floor Plan
TE-4-009	Commercial Plant Analytical Laboratory Exterior Elevation
TE-4-010	Analytical Laboratory Sections & Details
TE-4-013	Commercial Plant Analytical Laboratory Main Floor Framing
TE-4-014	Commercial Plant Analytical Laboratory Roof Framing Plan
TE-4-015	Commercial Plant Analytical Laboratory
TE-4-016	Commercial Plant Analytical Laboratory
TE-4-017	Analytical Laboratory, Supplementary Vent. Syst. Main Floor Plan

8.1.12 Water Tower (Plant Site) and Plant Reservoir

The Plant Site Water Tower site and Reservoir shall be left as follows:

- Plant Site Water Tower would be removed to elevation 1776’-0” (top of piers) at closure.
- Utility tunnel under Water Tower for the plant reservoir will be sealed and closed in place.
- Place clean fill in spaces below elevation 1776’-0” at the Water Tower Site and

Reservoir before final cover is placed.

- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

Reference Drawings for the Water Towers include (note that the tank details could not be found at this time):

TG-162	Fire Fighting System Concrete Masonry 100,000 Gal. Elevated Tank Foundation Details
TG-163	Fire Fighting System Concrete Reinforcing 100,000 Gal. Elevated Tank Foundation Details

8.1.13 Colby Lake Pump House

The Colby Lake Pump House is located approximately 5 miles from the plant site and supplies fresh water from Colby Lake to the plant site via a 36” diameter steel buried pipeline. The Colby Lake Pump House contains the following large pieces of equipment:

- (3 ea) Vertical turbine pump w/ 600 hp motor
- Service crane

The site shall be left as follows:

- Demolish the building to elevation 1448’-6” (finished floor elevation).
- Seal intake tunnel and fill pump area with clean fill.
- Place clean fill in areas lower the 1448’-6”.
- Remove or fill pipe access manways.
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

Reference drawings for the Colby Lake Pumphouse include:

TG-18	Partridge Lake Pumping Station Plan and Pipe Line Profile Pipe Line from Pump Station to Reservoir
TG-19	Partridge Lake Pumping Station 36” Pipe Line to Plant Reservoir Details & B/M
TG-20	Partridge Lake Pumping Station 36” Pipe Line to Plant Reservoir

	Plan and Profile
TG-21	Partridge Lake Pumping Station 36" Pipe Line to Plant Reservoir Plan and Profile
TG-22	Partridge Lake Pumping Station 36" Pipe Line to Plant Reservoir Plan and Profile
TG-23	Partridge Lake Pumping Station 36" Pipe Line to Plant Reservoir Plan and Profile
TG-24	Partridge Lake Pumping Station 36" Pipe Line to Plant Reservoir Plan and Profile

8.1.14 Bentonite Silos

The Bentonite Silos were used to contain Bentonite used in tailings dam construction.

The site shall be left as follows:

- Demolish bentonite silos, these are 120 ton and 90 ton bins.
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

Reference drawings for the heating/additive plant include:

TC-641	Storage and Handling of Additives General Arrangement, Plans & Elevations

8.1.15 Warehouse Electrical

The electrical warehouse, building number 921, acts as cold storage space. The building does not contain any major pieces of equipment.

The site shall be left as follows:

- Demolish the building to elevation 1711'-0" (finished floor elevation).
- Place clean fill in spaces below elevation 1711'-0" before final cover is placed.
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200. Slope overburden to elevation 1710'-0".

Reference drawings for the electrical warehouse include:

TE-116	Warehouse General Plan
TE-117	Warehouse Elevations
TE-118	Warehouse Wall Sections
TE-5-067	Warehouse Office Edition
TE-5-069	Training Room Partitions
	Warehouse #1 – Office Area

8.1.16 Warehouse 49

Warehouse 49, building number 920, acts as cold storage space. The building does not contain any major pieces of equipment.

The site shall be left as follows:

- Demolish the building to elevation 1711'-0" (finished floor elevation).
- Place clean fill in spaces below elevation 1711'-0" before final cover is placed.
- Utility tunnels under the Warehouse will be sealed and closed in place.
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200. Slope overburden to elevation 1710'-0".

Reference drawings for the Warehouse 49 include:

TE-5-011	Erection Drawing
	Cold Storage Warehouse
TE-5-012	Exterior Sheeting & Flashing Detail
	Cold Storage Warehouse

8.1.17 Administration Building

The Administration Building houses the site administrative offices. The building does not contain any major pieces of equipment.

The site shall be left as follows:

- Demolish the building to elevation 1500'-6" (finished floor elevation).
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200. Slope overburden at 3:1 from level 1513'-6" to level 1500'-6".

Reference drawings for the Administration Building include:

TE-6-282 Elevations
TE-6-283 Building Sections
TE-6-279 Site Plan
TE-6-052 Ground Floor Plan
TE-6-053 First Floor Plan Interior Wall Elevations
TE-6-054 Second Floor Plan Room Finish Schedule
TE-6-062 Foundation Plan & Details
TE-6-264 Administration Building
Second Floor Plan Rev

8.1.18 Main Gate (Gatehouse and Gas Station)

The Main Gate consists of a Gatehouse and Gas Station. The Gatehouse is used to supply site security. The Gas Station includes tanks and pumps that supply gas to plant site vehicles during operations.

The site shall be left as follows:

- This Gatehouse building shall be demolished in total to the road way elevation.
- Gas Station tanks shall be demolished in a manner consistent with Section 9.4.4 of this specification.
- Site will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

Reference Drawings for the Main Gate include:

TE-6-001 Entrance Road Guard House
Plans, Elev. & Det.
TH-1-050 Main Gate Gasoline Refueling & Storage Facility
General Arrangement
TH-1-051 Main Gate Gas Station Details
Piping Details
TH-1-1017 Main Gate Gasoline Dispensing Station
Electrical Layout and Schematic

8.1.19 Tailings Booster Pump House #1

The Tailings Booster Pump House is used to boost pumping pressure to deliver tailings from the plant to the tailings basin. The Tailings Booster Pump House contains the following large pieces of equipment:

- (8 ea) GIW 14x39 pump w/ 500 hp motor
- Service crane

The site shall be left as follows:

- Demolish the building to elevation 1659'-0" (finished floor elevation).
- Seal floor drain pipe and fill areas below 1659'-0" with clean fill.
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

Reference Drawings for Booster Pump House include:

TB-7-101	Tailings Disposal Booster Pumping Station No. 1 Addition – General Arrangement
TB-7-102	Tailings Disposal Booster Pumping Station No. 1 Addition – General Arrangement
TB-1650	Tailings Disposal Booster Pumping Station Conc. Masonry & Reinf. Foundation Plan & Details
TB-1651	Tailings Disposal Booster Pumping Station Conc. Masonry & Reinf. Footing Details
TB-1652	Tailings Disposal Booster Pumping Station Conc. Masonry & Reinf. Footing Details
TB-1653	Tailings Disposal Booster Pumping Station Conc. Masonry & Reinf. Footing Details
TB-1654	Tailings Disposal Booster Pumping Station Conc. Masonry & Reinf. Footing Details
TB-1655	Tailings Disposal Booster Pumping Station Conc. Masonry & Reinf. Foundation Walls Elevs. & Sects.
TB-1657	Tailings Disposal Booster Pumping Station Conc. Masonry Equipment Foundations – Plans & Dets.
TB-662	Tailings Disposal Main and Auxiliary Transfer Pumps and Piping General Arrangement & B/M
TB-663	Tailings Disposal Auxiliary Transfer Pumps and Piping Plan, Elevs, Sects and Dets
TB-664-N	Tailings Disposal Main Transfer Pumps and Piping Plans. Elevs., Sects. and Dets
TB-664-S	Tailings Disposal Main Transfer Pumps and Piping Plans. Elevs., Sects. and Dets
TB-666	Tailings Disposal Booster Pumping Station No. 1 General Arrangement

8.1.20 Sewage Treatment Plant

The Sewage Treatment Plant is used to treat sewage at the plant site. This building does not contain major pieces of equipment but does have a digester and aerator.

The site shall be left as follows:

- Demolish the building to elevation 1546.35'.
- Fill areas below 1546.35' with clean fill.
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

Reference Drawings for Sewage Treatment Plant include:

TL-2-006	Sewage Treatment Plant Location & Plat Plan
TL-2-008	Sewage Treatment Plant Plan of Primary Clarifier & Right & Left Side Elevations
TL-2-009	Sewage Plant Sections
TL-2-010	Sewage Treatment Plant Details
TL-2-011	Sewage Treatment Plant Isometric Piping & Details
TL-2-012	Sewage Treatment Plant Details
TL-2-013	Sewage Treatment Plant Steel Section and Floor Plans
TL-2-014	Sewage Treatment Plant Steel Sections
TL-2-015	Sewage Treatment Plant Electrical Plan

8.1.21 Carpenter's Shop

The Carpenter's Shop acts as cold storage space. The building does not contain any major pieces of equipment.

The site shall be left as follows:

- Demolish the building to elevation 1710'-0" (finished floor elevation).
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

Reference drawings for the Carpenter's Shop do not exist. This building is a wood frame building with tin siding with dimensions of 55 ft x 101 ft.

8.1.22 Tailings Portable Pump Houses

Each Tailings Portable Pump House contains one tailing booster pumps. The pump is equipped with 500 hp motors and are used to boost line pressure to ensure proper tailings deposition. There are 29 portable pump houses located on site.

The site shall be left as follows:

- Demolish the Tailings Portable Pump Houses in entirety.

Reference Drawings for Tailings Basin Portable Pump House include:

TB-7-093	Skid & Roof Details for Booster Pumphouse with 16" SRT Pump & 300 H.P. Drive – Station #5
TB-7-094	Gen. Arrg't & Wall Elevations for Booster Pumphouse With 16" SRT Pump & 300 H.P. Drive – Station #5
TB-7-095	Typical Wall & Removable Roof Detail Booster Pumphouse Station #5

8.1.23 Return Water Barge

The Return Water Barge is used to return water from the tailings basin to the plant site reservoir. The Barge contains four water pumps each with 700 hp motors.

The site shall be left as follows:

- Demolish the Barge in its entirety.

Reference Drawings for Return Water Barge include:

TB-703	Pump Station Tailings Pond Pumping Barge General Arrangement
TB-1631	Pump Station Tailings Pond Pumping Barge Mill Water Air & Priming Piping Gen'l Arrg't & B/M

8.1.24 Hinsdale Bridge

The Hinsdale Bridge was used to deliver ore from the taconite pits located west of the plant site to the Coarse Crusher. The bridge will not be used at this time but will remain in place until closure.

The site shall be left as follows:

- Demolish the Hinsdale Bridge including concrete supports to the existing grade.
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

Reference Drawings for the Hinsdale Bridge include:

Sheet 1	D.M. & I.R.R.Y. Crossing Bridge General Plan and Elevation
Sheet 2	D.M. & I.R.R.Y. Crossing Bridge Foundation Location Plan and Log of Borings
Sheet 3	D.M. & I.R.R.Y. Crossing Bridge Abutments 1 & 6 and Pedestal for Bents 2 & 5
Sheet 4	D.M. & I.R.R.Y. Crossing Bridge Piers 3 & 4
Sheet 5	D.M. & I.R.R.Y. Crossing Bridge 96' Deck Girder Span
Sheet 6	D.M. & I.R.R.Y. Crossing Bridge 120' Deck Girder Span
Sheet 7	D.M. & I.R.R.Y. Crossing Bridge Shoes
Sheet 8	D.M. & I.R.R.Y. Crossing Bridge Bents 2 & 5
Sheet 9	D.M. & I.R.R.Y. Crossing Bridge Deck Details
Sheet 10	D.M. & I.R.R.Y. Crossing Bridge Deck Details and Inspection Walks
Sheet 13	D.M. & I.R.R.Y. Crossing Bridge Grading Details and Method of Removing Fill

8.1.25 Thickeners

The Thickeners were used in the processing of taconite and will no longer be used. Two thickeners will remain after construction.

The site shall be left as follows:

- Remove structures above grade 1616’-0” (top of concrete cone).
- Pipe tunnels under thickeners will be sealed and closed in place.
- Fill areas below 1616’-0” with clean fill.
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

Reference Drawings for Thickeners include:

TB-651	Concentrator Tailings Thickeners Excavation
TB-652	Tailings Disposal Concrete Masonry Pipe Tunnel Under R.R. Embankment Plan, Sections & Details
TB-653	Tailings Disposal Concrete Reinforcement Pipe Tunnel Under R.R. Embankment Plan, Sections & Details
TB-921	Tailings Disposal Concrete Masonry Tailings Thickeners Center Piers
TB-922	Tailings Disposal Concrete Masonry Tailings Thickeners Center Piers
TB-925	Tailings Disposal Structural Steel 255’ Dia. Tailings Thickener Tanks
TB-926	Tailings Disposal Structural Steel 255’ Dia. Tailings Thickener Tanks
TB-1040	Tailings Disposal Concrete Masonry & Reinforcing Overflow & Roof Drain Launders Plans & Sections
TB-1041	Tailings Disposal Concrete Masonry & Reinforcing 255’ Dia. Tailings Thickener Tanks Tank Slab & Ring Wall
TB-1042	Tailings Disposal Concrete Masonry & Reinforcing 255’ Dia. Tailings Thickener Tanks Ring Walls

8.1.26 Rubber Shop

The Rubber Shop, building number 605, was originally called the Untanking Tower and Emergency Diesel Generating Plant, both of those sections still exist in the building in addition to the rubber shop.

The site shall be left as follows:
- Remove structures above grade 1710’.
- Fill areas below 1710’ with clean fill.
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

Reference Drawings for the Rubber Shop include:

TD-680	Emergency Diesel Generating Plant General Arrangement Sections
TD-679	Emergency Diesel Generating Plant General Arrangement Plan
TD-698	Transformer Untanking Tower Diesel Generating Plant Structural Steel Plans & Details
TD-699	Transformer Untanking Tower Diesel Generating Plant Structural Steel Elevations & Details
TD-700	Transformer Untanking Tower Diesel Generating Plant Structural Steel Elevations & Details
TD-701	Transformer Untanking Tower Diesel Generating Plant Structural Steel Elevations & Details

8.1.27 Water Treatment Plant & Storage Tanks

The Water Treatment Plant was used to treat raw water for potable water at the plant site.

The site shall be left as follows:
- Remove structures above grade 1777’.
- Fill areas below 1777’ with clean fill.
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules

6132.3200.

Reference Drawings for the Water Treatment Plant & Storage Tanks include:

TG-6-020	Location Map & Title Page
TG-6-021	Site and Foundation Plan
TG-6-022	Floor Plans
TG-6-023	Roof Plan
TG-6-024	Sections
TG-6-025	Elevations
TG-6-026	Details
TG-6-031	Piping and Equipment Plans and Details

8.1.28 Tailings Basin Buildings

The Tailings Basin buildings are located near the southeast corner of Cell 2W and were and will be used for storage, offices, oil dispensing, and locker rooms. They include the following buildings; Foreman's Office (718), Reporting Building (719), Lube House (720), Reporting Building (724), and Lube Oil Building (725).

There are no reference drawings for the Tailings Basin Buildings. However, the following dimensions of each building are shown below:

Foreman's Office (719) – 20' x 40'
Reporting Building (718) – 20' x 40'
Lube House (720) – 12' x 22'
Reporting Building (724) – 12' x 22' w/ 6' x 12' lean-to
Lube Oil Building (725) – 12' x 21'

8.1.29 Area 2 Water Tower

The Water Tower at Area 2 is in a poor deteriorated condition and will not be used as part of the project. The Water Tower at Area 2 will be demolished prior to Phase 1 Construction, but may remain in place at the end of year 1.

The Area 2 Water Tower site shall be left as follows:

- Area 2 Water Tower would be removed to top of existing grade (top of concrete piers).
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

Reference Drawings for the Water Towers:

TG-162	Fire Fighting System Concrete Masonry 100,000 Gal. Elevated Tank Foundation Details
TG-163	Fire Fighting System Concrete Reinforcing 100,000 Gal. Elevated Tank Foundation Details

8.2 General Facilities – Existing Plant

8.2.1 Sanitary Systems and Well

The septic systems will be pumped out and the tanks filled with soil or crushed rock and backfilled. The well will be sealed by a licensed well driller in accordance with Minnesota Department of Health rules. Sanitary systems and well (See Figure 3 for locations).

- Area 1 Shops Septic System
- Area 2 Shops Septic System
- Administration Building Septic System
- Administration Building Well No. 665923
- Tailings Basin Reporting Septic System
- Booster Pumphouse #1 Septic System

Reference Drawings for the sanitary systems include:

Figure 3-1	Sanitary System Locations
MH-1-3	West Pit Service Area (Area 1) Detail of Sanitary Sewer Line
MH-22-2	Area #2 Service Area Septic Tank Details
MH-24	Area #2 Service Area Details of Sanitary Sewer & Floor Drains
TL-2-215	Wastewater Treatment System Improvements
TB-7-175	Tailings Basin Reporting Center Plot Plan
B-TB-7-202	Tailing Basin Reporting Center Alternate Sewage Disposal Method

8.2.2 Pipelines, Pipe Galleries, and Tunnels

Pipelines that will not remain as regional infrastructure will be removed, recycled or disposed, or abandoned in place. Major pipeline systems include (see Figure 4 for locations):

- Tailings Transport and Deposition- tailings transport lines from Booster Pumphouse #1 to the basin ponds reclaim water line from Barge #2 to Barge #1, water reclaim line from Barge #1 to the Concentrator
- Water Supply Pipeline from Colby Lake Pumphouse to the Plant Reservoir
- Inter-Pit Pipeline from the Plant Reservoir to the Area 1 Shop and Area 2 Shop
- Natural Gas Line from the Town Border Station to the demolished Pellet Plant

Above-ground pipelines will be disassembled or demolished and the material recycled or disposed. Underground pipelines will be abandoned in place. Manholes and above-ground pipeline supports and foundations will be demolished to ground level or below and covered with at least two feet of soil. Surface disturbances will be ripped and vegetated to achieve final reclamation.

Tunnels and Pipe Galleries (see Figure 2) shall be left in the following condition:

- Pipe Galleries shall be removed in total.
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.
- Tunnels shall have contents removed and shall be sealed in place.

Reference Drawings for the Pipe Lines, Pipe Galleries, and Tunnels include:

Figure 2 Pipe Gallery/Tunnel Detail
Figure 4 Pipeline Locations

8.2.3 Power Lines and Substations

Power lines (poles, pole hardware and conductors) and substations that will not remain as regional infrastructure will be removed and recycled. Foundations and anchors will be removed or demolished to at least ground surface and covered with at least two feet of soil and vegetated to achieve final reclamation. During Phase 1 construction, the unused power lines from Area 1 to North gate and Area 2 West Pit are to be reclaimed. In addition, due to degrading structural integrity and as preemptive fault prevention, the power line from the P1 substation to the 411 distribution line shall be reclaimed. However, for this specification, assume that these are part of Year 1 demolition.

Power lines to be removed include (See Figure 5 and 5-1 for locations):

- 13.8 Kv Line from the Main Substation to Colby Lake Pumphouse
- 13.8 Kv Lines from the Main Substation to Area 1 Shop and Area 2 Shop
- 13.8Kv and 4.16 Kv distribution lines from the Main Substation to the Tailings Basin and at the Tailings Basin (except those needed to support the Interception Wells and the Tailings Basin Waste Water Treatment Facility)
- 13.8 Kv distribution lines at the Mine Site (except those needed to support the Mine Site Waste Water Treatment Facility)
- 16,000ft of 3 conductor cable starting at Area 1 shop and heading along the north road (rd 666), ending at the North gate. (Figure 5-1)
- 21,800ft of 3 conductor cable starting at the main switch yard and heading south around Area 2 West mine pit. (Figure 5-1)
- 4,000ft of 3 conductor cable starting at the switch yard and heading east to Area 2 shop/ SD-026 pumping station. (Figure 5-1)

Reference Drawings for the Power Lines include:

Figure 5	Power Line Locations
Figure 5-1	Power Line Demo
TD-4-1308	Tailings Basin Power Distribution
TD-1	Power Distribution One Line Diagram Sheet 1 of 2
TD-2	Power Distribution One Line Diagram Sheet 2 of 2
TD-4-1259	Mine Power Distribution 13.8KV One-line Diagram

8.2.4 Tanks

The inventory of tanks that will require demolition is included in Table 2-3. See Figure 6 for locations of tanks.

Large above-ground storage tanks will be cleaned and painted surfaces tested for lead prior to demolition. Tanks with insulation and associated wall and/or roof covers will be evaluated for potential asbestos containing material. Insulation and coverings will be removed and disposed appropriately. Tank cleaning will remove remaining materials and sludge. The tanks will be cleaned and removed materials and cleaning residues will be sent to an appropriate recycling or waste disposal facility.

Tanks will be disassembled for disposal or recycling as appropriate. Where lead paint abatement is required, the disposal/recycling will be modified to accommodate the lead content. Below-grade foundations will be left in place and covered with a minimum of two feet of soil and vegetated. Smaller above-ground storage tanks will be cleaned and removed without disassembly.

Table 2-3 Inventory of Existing Tanks Requiring Demolition (See Figure 6 for Locations)

Tank Number	AST Contents (Above-Ground Storage Tanks) *All Tanks are out of service and outdoors unless stated otherwise*	Location	Storage Tank Size (gallons)
015	Fuel Oil	Concentrator	12,000
304	Mineral Oil	Concentrator	12,000
305	Mineral Oil	Concentrator	12,000
306	Mineral Oil	Concentrator	12,000
421	Waste Oil	Concentrator	
032	Fuel Oil (tanks have been cleaned)	Pellet Plant	3,384,000
033	Fuel Oil (tanks have been cleaned)	Pellet Plant	3,384,000
034	Fuel Oil (tanks have been cleaned)	Pellet Plant	3,384,000
080	Fuel Oil	Area 1 – Railroad South Grade Area	20,000
121	Gasoline (in-service)	Guard House – Entrance of County Road 666	6,000
122	Gasoline (in-service)	Guard House – Entrance off County Road 666	6,000
001	Fuel Oil (Underground)	Administration Building	

Reference Drawings for the Tanks include:

TH-67	Fuel Oil Storage & Distribution General Arrangement
TH-70	Fuel Oil Storage & Distribution Storage Tanks General Arrangement & Section
TH-81	Fuel Oil Storage & Distribution Steam Condensate & Hot Water Flow Diagram
TH-83	Fuel Oil Storage & Distribution Piping Inside of Storage Tanks
TH-134	Fuel Oil Storage & Distribution Concrete Masonry & Reinforcing Fuel Oil Storage Tank Ring Wall
TH-199	Fuel Oil Storage & Distribution Service Tanks & Misc. Tank Supports Conc. Masonry & Reinf. Plan, Sects. & Details
Figure 6	Outdoor Tank Locations

8.2.5 Railroad Tracks

Railroad track and ties controlled by PolyMet will be removed and recycled or disposed. Reclamation with overburden and subsequent vegetation will be used where roadbed is not needed for access. See Figure 7 for locations.

Railroad tracks to be grouped as follows:

- Existing track in the Plant Site area

Reference drawings include:

Figure 7	Railroad track locations
C1	Krech Ojard Drawing Ore Concentrates Handling

8.2.6 Roads and Parking Lots

Plant area roads which are deemed not necessary for access by the MDNR will be abandoned, scarified, and vegetated. Asphalt from paved surfaces will be removed and recycled. Reclamation of roads not controlled by PolyMet, such as the Dunka Road and the road from the North Gate, are not included in this plan or estimate; reclamation of these features is the responsibility of the owner of record for the roads. See Figure 9 for locations.

Building areas, roads and parking lots will be reclaimed and vegetated according to Minnesota Rules 6132.2700 by a qualified reclamation contractor. Any roads that may develop into unofficial off-road vehicle trails (Minnesota Rules 6132.3200) will require a variance to allow a 15-foot wide unpaved and un-vegetated track down the centerline of the road once reclamation is completed.

Roads and parking lots are to be grouped as follows:

- Existing roads and parking lots in the Plant Site area
- Existing roads in the Tailings Basin

Reference drawings include:

Figure 9	Road and Parking Lot Locations
Figure 9A	Road and Parking Lot Locations – Process Plant Detail
TJ-3-015	Plant site Parking Arrangement

TJ-3-026 Parking & Driveway Arrangement Administration Building

9.0 Twenty Year Demolition Plan

Within three (3) years after closure begins, all buildings and structures will be removed and foundations razed to grade level. Provisions may be made for continued subsequent use of mine facilities that will have future benefits to the area including, pipelines, transmission lines, roads, and railroad lines. However, for the purposes of this document it shall be assumed that all of the PolyMet facilities must be removed and the facility footprints reclaimed.

The timing of demolition for the individual buildings shall be suggested by the Contractor. All facilities listed in Sections 9.1 to 9.3 will be demolished over a maximum period of three years. Facilities described in Section 9.4 may remain in service after closure and will be bid separately (see Section 9.4).

For building, area or equipment locations listed as headings in the following sections for the plants reference Figures 1 and 1A for details.

For major process equipment reference the Equipment List (attached) and the Process Flow Diagrams (attached).

For the new facilities preliminary design drawings (i.e. layouts, arrangements) are provided for the Contractor. Note that the drawings shown are preliminary design layouts. The layout of equipment, etc. will change throughout the design process. These drawings show equipment and building sizes that are approximate. PolyMet will provide more information to the selected Contractor as more detailed design drawings become available.

9.1 Plant Site Facilities Constructed by PolyMet in Phase 1

9.1.1 Flotation Plant and Reagent Storage Building

A new Flotation Plant and Reagent Storage Building will be constructed as part of the Phase 1 Project operation. These buildings will be used to extract the sulfide minerals from the ore.
The flotation plant will house the following large pieces of equipment:

- Flotation Cells of varying sizes of tanks and drive systems
- Fine grinding mill
- Froth and slurry pumps
- Reagent storage tanks and mixing systems

The site shall be left as follows:

- Remove structures and equipment above grade 1616'-0".
- Fill areas below 1616'-0" with clean fill.
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

The reference drawings for the Flotation Plant and Reagent Storage Building include:

SK-11-067	Option 20 Plant Layout Plan
025-15-11-013	Northmet Project General Arrangement Flotation Area - Section
025-15-11-014	Northmet Project General Arrangement Reagent Area – Sections
025-15-11-015	Northmet Project General Arrangement Section G
025-15-11-016	Northmet Project General Arrangement Section H
025-15-11-017	Northmet Project General Arrangement Section K
E0-18-11-400	Architectural Flotation Annex – Exterior Shell Cover Sheet
E0-18-11-401	Architectural Flotation Annex – Exterior Shell Floor Plan
E0-18-11-402	Architectural Flotation Annex – Exterior Shell Roof Plan
E0-18-11-411	Architectural Flotation Annex – Exterior Shell Building Elevations
E0-18-11-412	Architectural Flotation Annex – Exterior Shell Building Elevations
E0-18-11-421	Architectural Flotation Annex – Exterior Shell Building Sections
E0-18-11-422	Architectural Flotation Annex – Exterior Shell Building Sections/Door Schedule
E0-18-11-431	Architectural Flotation Annex – Exterior Shell Wall Sections
E0-18-11-432	Architectural Flotation Annex – Exterior Shell Wall Sections
E0-18-11-461	Architectural Flotation Annex – Exterior Shell Details
E0-18-11-462	Architectural Flotation Annex – Exterior Shell Details
E0-18-11-463	Architectural Flotation Annex – Exterior Shell Details

Note that the drawings shown are preliminary design layouts. The layout of equipment, etc. will change throughout the design process. These drawings show equipment and building sizes that are approximate. PolyMet will provide more information to the selected Contractor as more detailed design drawings become available.

9.1.2 Concentrate Storage and Loadout Facility

A new Concentrate Storage and Loadout Facility will be constructed as part of the Phase 1 Project operation. The location of these facilities will be close to existing location of the existing heating/additive plant that will no longer be required. The Concentrate Storage Building will be used to store copper and nickel concentrates for shipment via rail. The Concentrate Loadout Facility will be used to load concentrate into rail cars prior to shipment. These building will house the following large pieces of equipment:

- Concentrate tanks and thickeners
- Concentrate filter press (2 ea.)
- Conveyor systems

The site shall be left as follows:

- Remove structures and equipment above grade 1581'-0" (top of finished floor).
- Fill areas below 1581'-0" with clean fill.
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

The reference drawings for the Concentrate Storage and Loadout Facility include:

SK-11-033	Preliminary Filter ISO Layout
SK-11-038	Building Layout Option 2 Elevations Conveyor Feed System
SK-11-039	Building Layout Option 2 Plan Conveyor Feed System
027-P120-001-001	Copper Concentrate Loadout Process Flow Diagram
028-P120-001-001	Nickel Concentrate Loadout Process Flow Diagram

Note: No drawings have been created for the Concentrate Storage Facility. The amount of storage capacity and thus the size of the facility are being determined.

Note that the drawings shown are preliminary design layouts. The layout of equipment, etc. will change throughout the design process. These drawings show equipment and

building sizes that are approximate. PolyMet will provide more information to the selected Contractor as more detailed design drawings become available.

9.1.3 Plant Site Sewage Treatment

A new Plant Site Sewage Treatment plant will be constructed as part of the Phase 1 Project operation. The location of this facility will be at the location of the existing Sewage Treatment Plant. The building will house the following large pieces of equipment:

- Grinder pump
- Submersible pumps (2ea.)
- Valves and piping systems

The site shall be left as follows:

- Remove structures and equipment above grade 1548’-5” (top of finished floor).
- Fill areas below 1548’-5” with clean fill.
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

The reference drawings for the Plant Site Sewage Treatment Plant include:

SWGT-001	Overall Site Plan
SWGT-002	Mechanical Treatment Site Plan
SWGT-003	Stabilized Pond Option
SWGT-004	Lift Station and Grinder Pump Details
SWGT-005	Lift Station Details Stabilization Pond Option
SWGT-006	Miscellaneous Details

Note that the drawings shown are preliminary design layouts. The layout of equipment, etc. will change throughout the design process. These drawings show equipment and building sizes that are approximate. PolyMet will provide more information to the selected Contractor as more detailed design drawings become available.

9.2 Mine Site Facilities Constructed by PolyMet in Phase 1

9.2.1 Maintenance Service and Fueling Facility

As part of the Phase 1 operation a new Maintenance Service Facility and Fueling Facility will be built at the mine site. These facilities will be used for light maintenance and fueling of mining equipment.

The site shall be left as follows:

- Maintenance Service Facility shall be removed in total.
- Fueling Facility shall be removed in total.
- Foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

Reference Drawings for the Maintenance Service and Fueling Facility include (note that there are 2 each of the building represented in the following drawings):

D93-048205-00	Cover Drawing
D93-048205-01	Specific Anchor Bolt Drawing
D93-048205-01A	Specific Reaction Drawing
D93-048205-01B	Anchor Bolt Detail Sheet
D93-048205-02	Cross Section Erection Drawing
D93-048205-02A	Cross Section Erection Drawing Detail Sheet
D93-048205-03	Wind Bracing Drawing
D93-048205-04	Roof Secondary Structural Framing Plan
D93-048205-04A	Roof Secondary Structural Detail Sheet
D93-048205-05	Wall Secondary Structural Elevation
D93-048205-05B	Wall Secondary Structural Elevation
D93-048205-05C	Wall Secondary Structural Elevation
D93-048205-05D	Wall Secondary Structural Elevation Detail Sheet
D93-048205-06	Wall Panel Drawing
D93-048205-06A	Wall Panel Drawing
D93-048205-07	Roof Panel Drawing
TH-1-066	Mobile Equipment Fueling Building Concrete Slab – Area 6, 2E, & 2WX

9.2.2 Rail Transfer Hopper

The rail transfer hopper is located at the mine site. The Rail Transfer Hopper is used to hold ore dumped via truck and subsequently fill rail cars for transport of ore to the Plant. The Rail Transfer Hopper includes a Control Building, and Platform.

The site shall be left as follows:

- Rail Transfer Hopper shall be removed in total.
- Foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

Reference Drawings for the Rail Transfer Hopper include:

Barr Engineering	SOW – 15 Rail Transfer Hopper
93909-S1	Area II East Superpocket

	Electrical & Hydraulic Room Plans & Elevations
93909-A3	Area II East Superpocket Control Room Steel Elevations
93909-A1	Area II East Superpocket Control Room Plans, Elevations & Details
93909-M3	Area II East Superpocket Discharge Chute Gate
93909-M2	Area II East Superpocket Discharge Chute
93909-M1	Area II East Superpocket Feeder Hopper Assembly
93909-3	Area II East Superpocket Section - A
93909-1	Area II East Superpocket Plot Plan

9.2.3 Central Pumping Station

The Central Pumping Station is located at the mine site. The Central Pumping Station is used to pump treated mine water back to the tailings basin for use in the plants.

The site shall be left as follows:

- Central Pumping Station shall be removed in total.
- Treated Water Pipeline from the Mine Site Central Pumping Station to the tailings basin shall be removed in total.
- Foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

Reference Drawings for the Central Pumping Station include:

Central pumping station
WWTF & CPS Plan

9.3. General Facilities – Phase 1

9.3.1 Pipelines

Pipelines that will not remain as regional infrastructure will be removed, recycled or disposed, or abandoned in place.

- Plant Site pipelines constructed by PolyMet (Phase 1)

- Mine Site pipelines constructed by PolyMet (Phase 1)

Above-ground pipelines will be disassembled or demolished and the material recycled or disposed. Underground pipelines will be abandoned in place. Manholes and above-ground pipeline supports and foundations will be demolished to ground level or below and covered with at least two feet of soil. Surface disturbances will be ripped and vegetated to achieve final reclamation.

Reference Drawings for the Pipe Lines:

Barr Engineering	SOW – 05 Process Water Systems
Barr Engineering	SOW – 06 WWTF
Barr Engineering	SOW – 08 TWP
Barr Engineering	SOW – 12 Tailings Basin Seepage Recovery
Barr Engineering	SOW – 14 Flotation Tailings Basin Dam Construction

9.3.2 Power Lines and Substations

Power lines (poles, pole hardware and conductors) and substations that will not remain as regional infrastructure will be removed and recycled. Foundations and anchors will be removed or demolished to at least ground surface and covered with at least two feet of soil and vegetated to achieve final reclamation.

Reference Drawings for the Power Lines include:

Barr Engineering	SOW – 13 Mine Site Electrical Distribution
SK-11-255	Building Layout Option 3 General Arrangement Plan

9.3.3 Railroad Tracks

Railroad track and ties controlled by PolyMet will be removed and recycled or disposed. Reclamation with overburden and subsequent vegetation will be used where roadbed is not needed for access. See Figure 7 for locations.

Railroad tracks to be grouped as follows:

- Plant Site track constructed by PolyMet for concentrate handling (Phase 1)
- Connection (CE main line to crusher feed) constructed by PolyMet (Phase 1)
- Mine Site spur for Rail Transfer Hopper (Phase 1)
- VSEP Concentrate Track (Phase 1)

Reference drawings include:

Figure 7	Railroad track locations
C1	Krech Ojard Drawing Ore Concentrates Handling
Barr Engineering	SOW – 16 Rail and Earthwork for Rail Transfer Hopper
Barr Engineering	SOW – 17 Rail Connection Track
Barr Engineering	SOW – 18 VSEP Concentrate Track
Barr Engineering	SOW – 19 Plant Site Rail

9.3.4 Roads and Parking Lots

Plant area roads which are deemed not necessary for access by the MDNR will be abandoned, scarified, and vegetated. Asphalt from paved surfaces will be removed and recycled. Reclamation of roads not controlled by PolyMet, such as the Dunka Road and the road from the North Gate, are not included in this plan or estimate; reclamation of these features is the responsibility of the owner of record for the roads. See Figure 9 for locations.

Building areas, roads and parking lots will be reclaimed and vegetated according to Minnesota Rules 6132.2700 by a qualified reclamation contractor. Any roads that may develop into unofficial off-road vehicle trails (Minnesota Rules 6132.3200) will require a variance to allow a 15-foot wide unpaved and un-vegetated track down the centerline of the road once reclamation is completed.

Roads and parking lots are to be grouped as follows:

- Plant Site roads and parking lots constructed by PolyMet (Phase 1)
- Mine Site roads and parking lots constructed by PolyMet (Phase 1)

Reference drawings include:

Barr Engineering	SOW – 01 Haul Roads
Figure 9	Road and Parking Lot Locations
Figure 9A	Road and Parking Lot Locations – Process Plant Detail
TJ-3-015	Plantsite Parking Arrangement
SK-11-255	Building Layout Option 3 General Arrangement Plan

9.4 Plant Site Facilities Constructed by PolyMet in Phase 2

9.4.1 Oxygen Plant, Limestone Preparation, Hydrometallurgical Plant, Hydrometallurgical Reagents

A Hydrometallurgical Processing Plant will be constructed as part of the Phase 2 Project operation. These buildings will be used to produce oxygen gas, process limestone, and house the Autoclave where high pressure and temperature is used to treat nickel concentrates to extract and isolate platinum group, precious metals, and base metals. At this time, no detailed engineering has been completed in regard to these buildings, therefore, only a general arrangement drawing is available.

The hydrometallurgical plant buildings will house the following large pieces of equipment:

- Autoclave
- Reagent storage tanks and mixing systems
- Cryogenic oxygen processing equipment
- Limestone processing and slurrification equipment
- Residue Transport and Deposition - residue transport lines from Booster Pumphouse #1 to the Hydrometallurgical Residue Facility
- Water reclaim line from the Hydrometallurgical Residue Facility to Booster Pumphouse #1
- Railroads
- Pipelines
- Power Lines
- Roads and Parking Lots

The site shall be left as follows:

- Remove structures and equipment above grade elevations.
- Fill areas below grade elevations with clean fill.
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.
- Railroad track and ties controlled by PolyMet will be removed and recycled or disposed. Reclamation with overburden and subsequent vegetation will be used where roadbed is not needed for access. See Figure 7 for locations.
- Above-ground pipelines will be disassembled or demolished and the material recycled or disposed. Underground pipelines will be abandoned in place. Manholes and above-ground pipeline supports and foundations will be demolished to ground level or below and covered with at least two feet of soil. Surface disturbances will be ripped and vegetated to achieve final reclamation.
- Power lines (poles, pole hardware and conductors) and substations that will not remain as regional infrastructure will be removed and recycled. Foundations and anchors will be removed or demolished to at least ground surface and covered with at least two feet of soil and vegetated to achieve final reclamation.
- Roads and parking lots will be reclaimed and vegetated according to Minnesota

Rules 6132.2700 by a qualified reclamation contractor. Any roads that may develop into unofficial off-road vehicle trails (Minnesota Rules 6132.3200) will require a variance to allow a 15-foot wide unpaved and un-vegetated track down the centerline of the road once reclamation is completed.

9.5 Facilities Needed for Closure – demolition date (To Be Determined)

9.5.1 Mine Site Waste Water Treatment Facility (Including power supply from main substation and pipelines from WWTF to East and West Pits)

There will be a Mine Site Waste Water Treatment Facility that may remain at closure for a number of years while the pits are filling with water. At the time of this writing, the length of time that the facility must remain in service has not been well defined. At this time, no detailed engineering has been completed in regard to this building, therefore, only general arrangement drawings are available. Note: For purposes of this demolition specification, assume that the equalizer basins and CPS pond and liners will be demolished and reclaimed by another party.

The Mine Site Waste Water Treatment Facility (WWTF) will house the following large pieces of equipment:

- Chemical storage tanks and mixing systems
- Reverse Osmosis water processing equipment
- Chemical precipitation thickener tanks
- Pumping systems
- Greensand filtering systems
- Filter presses

The site shall be left as follows:

- Remove structures and equipment above grade elevations.
- Fill areas below grade elevations with clean fill.
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.
- Above-ground pipelines will be disassembled or demolished and the material recycled or disposed. Underground pipelines will be abandoned in place. Manholes and above-ground pipeline supports and foundations will be demolished to ground level or below and covered with at least two feet of soil. Surface disturbances will be ripped and vegetated to achieve final reclamation.

- Railroad track and ties controlled by PolyMet will be removed and recycled or disposed. Reclamation with overburden and subsequent vegetation will be used where roadbed is not needed for access.
- Power lines (poles, pole hardware and conductors) and substations that will not remain as regional infrastructure will be removed and recycled. Foundations and anchors will be removed or demolished to at least ground surface and covered with at least two feet of soil and vegetated to achieve final reclamation.
- Roads and parking lots will be reclaimed and vegetated according to Minnesota Rules 6132.2700 by a qualified reclamation contractor. Any roads that may develop into unofficial off-road vehicle trails (Minnesota Rules 6132.3200) will require a variance to allow a 15-foot wide unpaved and un-vegetated track down the centerline of the road once reclamation is completed.

Reference drawings include:

Barr Engineering SOW – 06 WWTF

9.5.2 Tailings Basin Waste Water Treatment Plant (Including power supply from main substation, containment system, collection pumps and piping at toe of tailings basin, pipelines from collection system to WWTP, and pipelines from WWTP to discharge points)

There will be a Tailings Basin Waste Water Treatment Plant that may remain at closure for a number of years to control water at the tailings basin. At the time of this writing, the length of time that the facility must remain in service has not been well defined. At this time, no detailed engineering has been completed in regard to this building, therefore, only general arrangement drawings are available. Note: For purposes of this demolition specification, assume that the pretreatment basin and liner will be demolished and reclaimed by another party.

The Tailings Basin Waste Water Treatment Plant (WWTP) will house the following large pieces of equipment:

- Limestone storage tanks and mixing systems
- Reverse Osmosis water processing equipment
- Pumping systems
- Greensand filtering systems

The site shall be left as follows:
- Remove structures and equipment above grade elevations.
- Fill areas below grade elevations with clean fill.
- Remaining floor and/or foundations will be covered with a minimum of two feet of

surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

- Above-ground pipelines will be disassembled or demolished and the material recycled or disposed. Underground pipelines will be abandoned in place. Manholes and above-ground pipeline supports and foundations will be demolished to ground level or below and covered with at least two feet of soil. Surface disturbances will be ripped and vegetated to achieve final reclamation.
- Power lines (poles, pole hardware and conductors) and substations that will not remain as regional infrastructure will be removed and recycled. Foundations and anchors will be removed or demolished to at least ground surface and covered with at least two feet of soil and vegetated to achieve final reclamation.
- Roads and parking lots will be reclaimed and vegetated according to Minnesota Rules 6132.2700 by a qualified reclamation contractor. Any roads that may develop into unofficial off-road vehicle trails (Minnesota Rules 6132.3200) will require a variance to allow a 15-foot wide unpaved and un-vegetated track down the centerline of the road once reclamation is completed.

Reference drawings include:

Barr Engineering SOW – 20 WWTP

10.0 Demolition Waste Disposal Plan

Demolition waste from structure removal will be disposed of in an off-site landfill. Concrete from demolition will be placed in building basements where possible including coarse crusher basement, fine crusher basement and concentrator basement and the Plant Reservoir. (See Figure 2-06 for locations.)

11.0 Special Material Disposal

Surveys for Asbestos-Containing Materials (ACMs) have been completed. ACMs (i.e., pipe and electrical insulation) in utility tunnels will be sealed prior to the tunnels being sealed.

During initial closure of the Cliffs Erie facility, all PCB transformers (including sixteen large ones) and capacitors were removed and properly disposed.

During closure of the Cliffs Erie facility, all nuclear sources were inventoried and disposed.

Partially used paint, chemical and petroleum products will be collected and properly disposed.

Fluorescent and sodium halide bulbs will be removed from fixtures collected and properly disposed.

12.0 Cover and Vegetation of Building Area, Road, Parking Lots

After demolition of facilities listed in Sections 8 and 9, 2 feet of overburden material suitable for vegetation will be placed upon the facility's former footprint. Plant area roads which are not deemed necessary for access by the MDNR will also be abandoned and, if necessary, covered with 2 feet of overburden material that is suitable for vegetation. Asphalt from paved surfaces will be removed and recycled. Reclamation of roads not controlled by PolyMet, such as the Dunka Road, and the road from the North Gate are not contained within this estimate.

Building areas, roads and parking lots will be reclaimed and vegetated according to Minnesota Rules 6132.2700. Any roads that may develop into unofficial off-road vehicle trails (Minnesota Rules 6132.3200) will require a variance to allow a 15-foot wide unpaved and un-vegetated track down the centerline of the road.

Attachment F2

Lakehead Estimates

September 1, 2016

Mike Glissman
Polymet Mining

Re: 2013 Northmet Closure and Demolition Price Proposal Update

Mr. Glissman

The terms and conditions of our proposal response to the Polymet Inquiry No. PR-0027 dated 6 August 2013 remain unchanged for bid form item 1except as amended by the following;

- Subsequent pricing requests, latest of which is per the provided Closure and Demolition Specification (Structures and Equipment Only) Rev. 4 document, associated spreadsheet titled "demo data needed final adjustments 7-28-2016" and scope clarification emails and attachments provided.
- Attached version of the aforementioned spreadsheet is current as of August 15, 2016.
- The labor and equipment rates provided are no longer current and would be subject to change dependent upon final contract date.

Conditions and pricing for additional bid items found in our proposal are no longer valid or have been subsequently updated or amended by alternate pricing requests.

Sincerely,

Brad Jones

Brad Jones
Sr. Estimator
Lakehead Constructors

Demo and Asbestos Abatement Cost Summary

Scope of Work Description	Demo Specification Section Number	Reference Information / Drawings	Lakehead 2014 Updates							ACT 10/11/13
			Miscellaneous	Universal Waste Collection	Galbestos Removal	Demolition	Total Demo	Site Restoration	Assets Recovery	Asbestos Lead Paint Mold
Pre-Demolition Services			$54,400							
Legacy - demoed as part of construction										
Additive Building & Heating Plant		Galbestos removal included in ACT abatement		$7,500.00		$932,800.00	$940,300	$53,000.00		$600,000.00
Bentonite silos	8.1.14						$1,326,500			
Area 2 Water Tower (price separate from Heating & Additives buildings)	8.1.29									
Legacy Tailings Basin Buildings - Demoed as part of construction										
Foreman's Office (Bldg. 718)	8.1.28	No ACT report			~~$13,500.00~~	$9,350.00		$400.00		
Reporting Building (Bldg. 719)	8.1.28	No ACT report			~~$15,400.00~~	$9,900.00		$400.00		
Lube House (Bldg. 720)	8.1.28	No ACT report			~~$2,500.00~~	$2,500.00		$400.00		
Reporting Building (Bldg. 724)	8.1.28	No ACT report			~~$3,300.00~~	$3,300.00		$400.00		
Lube Oil Building (Bldg. 725)	8.1.28	No ACT report			~~$2,500.00~~	$2,500.00		$400.00		
							inc in above			
Legacy Area 1 - used by project										
Area 1 Shop and Truck Storage (Bldg. 220)	8.1.6	ACT Report Zone H		$2,900.00	$106,900	$103,332	$213,132	$74,669	$37,000	
Area 1 Cold Storage (Bldg. 221)	8.1.6	ACT Report Zone H		$400.00	$48,970	$10,860	$60,230	$13,400	$2,800	
Area 1 Reporting Building (Bldg. 231)	8.1.6	No ACT report				$9,900				
Area 1 Boiler House (Bldg. 226)	8.1.6	ACT Report Zone H		$200.00	$13,500	$9,875	$23,575	$3,000	$200	
Area 1 Fire Pump House & Water Tank (Bldg. 228)	8.1.6	TE-8-142 and TE-8-144, ACT Report Zone H		$410.00		$11,250	$11,660			
Area 1 Locomotive Fueling	8.1.6	ACT Report Zone H		$500.00	$22,500	$10,100	$33,100	$6,250	$1,000	
Legacy Area 2 - used by project										
Area 2 Service Shop (Bldg. 201)	8.1.7	ACT Report Zone I		$2,200.00	$160,900	$38,990	$202,090	$37,334	$10,940	
Area 2 Truck Storage (Bldg. 202)	8.1.7	ACT Report Zone I		$2,000.00	$63,190	$9,175	$74,365	$13,988	$3,075	
Area 2 Cold Storage (204)	8.1.7	ACT Report Zone I		$697.00	$42,560	$13,080	$56,337	$14,100	$1,700	
Area 2 Shop Locomotive Service Shop (Bldg. 203)	8.1.7	ACT Report Zone I		$3,400.00	$20,500	$12,300	$36,200	$11,113	$1,625	
Area 2 Locomotive Fueling	8.1.7	ACT Report Zone I		$2,000.00	$20,900	$11,800	$34,700	$6,250	$975	
Hose House (Bldg. 209) Not to be used in project	8.1.7	No ACT report			$3,000	$9,150				
Sample House (Bldg. 208) Not to be used in project	8.1.7	No ACT report			$25,400	$20,300				
Reporting Building (Bldg. 425) Not to be used in project	8.1.7	No ACT report			$3,300	$9,200				
Legacy Plant Area - used by project										
Rebuild Shop (Bldg 602)	8.1.9	ACT Report Zone A		$3,000.00	$70,200	$125,600	$198,800	$27,560	$13,940	
General Shop (Bldg. 601) Includes Acetylene Building (Bldg.604)	8.1.8	ACT Report Zone A		$15,000.00	$199,190	$353,600	$567,790	$182,300	$113,796	
Carpenter Shop (Bldg. 603)	8.1.21	ACT Report Zone A		$2,000.00	$10,200	$13,250	$25,450	$3,300	$100	
Coarse Crusher	8.1.1			$10,000.00	$313,345	$1,551,800	$1,875,145	$593,890	$199,325	
Drive House 1 conv and housings	8.1.2	Drive Houses 1 & 2 and conveyors are all considered	$133,200	$7,500.00	$165,569	$141,540	$314,609	$46,900	$41,050	
Drive House 2 inc conv and housings	8.1.3	to be one structure	inc in above		inc in above	inc in above	inc in above	inc in above	inc in above	
Fine Crusher	8.1.4			$45,000.00	$302,430	$1,373,460	$1,720,890	$203,400	$205,250	
Warehouse 49 (Bldg. 920)	8.1.16	ACT Report Zone A		$6,500.00	$27,586	$82,800	$116,886	$15,947	$5,350	
Warehouse 45 (Bldg. 921, Electrical)	8.1.15	ACT Report Zone A		$2,500.00	$35,159	$72,700	$110,359	$15,947	$3,590	
Lube House (Bldg. 926)	8.1.10	ACT Report Lubricant Storage Building		$578.00	$17,000	$20,550	$38,128	$7,385	$1,600	
Rubber Shop (Bldg. 605)	8.1.26	ACT Report Rubber Storage Building		$1,000.00	$30,464	$36,550	$68,014	$11,269	$5,150	
Concentrator Building and Thickeners	8.1.5 AND 8.1.25			$100,000.00	$1,248,260	$5,895,850	$7,244,110	$1,145,998	$2,141,430	
A-Lab	8.1.11			$500.00	$9,400	$14,560	$24,460	$2,940	$2,450	
Hinsdale Bridge	8.1.24			$0.00	$16,700	$616,300	$633,000	$15,200	$148,500	
Water Reservoir	8.1.12			$5,000.00		$98,100	$103,100	$914,400	$7,750	
Plant Site Water Tower	8.1.12	TG-7-005, Similar to Area 2 water tower				$30,000	$30,000	$2,500	$1,125	
Water Treatment Plant & Storage Tanks	8.1.27	TG-6-021		$1,000.00	$20,000	$72,600	$93,600	$2,250		
Colby Pump House	8.1.13				$41,000	$8,260	$49,260	$1,500		
Administration Building	8.1.17			$3,900.00		$157,935	$161,835	$18,200		
Main Gate	8.1.18			$100.00		$11,400	$11,500	$875		
Booster Pump House #1	8.1.19			$300.00		$23,500	$23,800	$9,200		
Sewage Treatment Plant	8.1.20	No ACT report		$0.00		$62,700	$62,700	$19,520		

Demo and Asbestos Abatement Cost Summary

			Lakehead 2014 Updates							ACT 10/11/13
Scope of Work Description	**Demo Specification Section Number**	**Reference Information / Drawings**	**Miscellaneous**	**Universal Waste Collection**	**Galbestos Removal**	**Demolition**	**Total Demo**	**Site Restoration**	**Assets Recovery**	**Asbestos Lead Paint Mold**
Portable Pump Houses	8.1.22	No ACM materials - See Dwg. TB-7-095		$0.00		$9,890	$9,890	$3,400		
Return Water Barge	8.1.23	No ACT report		$0.00		$44,900	$44,900			
General Infrastructure (railroads, tunnels, roadways, etc)						$4,988,921	$4,988,921	$1,504,000	$237,500	
Railroads	8.2.5	Figure 7 and Krech & Ojard Dwg. C1		$0.00		$380,000	$380,000			
Tunnels	8.2.2	TJ-63		$0.00		$1,856,000	$1,856,000			
Galleries	8.2.2	Was estimated as a portion of the concentrator								
Sanitary Systems and Wells	8.2.1					$17,500				
Pipelines				$0.00		$2,190,000	$2,190,000	$591,000		
Colby Lake water supply	8.2.2					$900,000		$98,000		
Inter pit pipeline	8.2.2					$562,000				
Natural Gas line	8.2.2					$150,000				
Tailings management above ground	8.2.2					$378,000				
Tailings management underground						$200,000				
Power Lines	8.2.3	Figures 5 & 5.1		$0.00		$97,810.00	$97,810			
Roads and Parking Lots	8.2.6	Figure 9		$0.00		$465,000	$465,000	$195,000		
New - Phase 1 - Plant Site										
Flotation Plant and Reagent Building	9.1.1			$75,000		$621,800	$696,800	$147,600	$242,500	
Concentrate Storage and Loadout Facility	9.1.2			$12,000		$273,760	$285,760	$48,100	$37,500	
Plant Site Sewage Treatment Plant	9.1.3	See Barr SOW 23 & Dwg. TL-2		$1,000.00		$118,000	$118,000	$30,000		
Railroads	9.3.3	See Barr SOW 19		$0.00		$185,000		$111,000		
Pipelines	9.3.1	SOW 12 and 14		$0.00		$1,555,000		$375,000		
Power Lines	9.3.2	SK-11-255		$0.00						
Roads and Parking Lots	9.3.4			$0.00						
Plant Site Wastewater Treatment Plant (WWTP)	9.5.2	See Barr SOW 20		$0.00		$245,000				
New - Phase 1 - Mine Site										
Maintenance Service and Fueling Facility	9.2.1			$1,100		$19,210	$20,310	$7,300	$1,200	
Rail Transfer Hopper	9.2.2	See Barr SOW 15		$1,100.00		$40,000	$41,100	$45,000	$1,200	
Rail Transfer Hopper Control Bldg	9.2.2	See Barr SOW 15		$100.00		$18,600	$18,700			
Rail Transfer Hopper Platform	9.2.2	See Barr SOW 15				$60,000	$60,000			
Central Pumping Station	9.2.3	See Barr SOW 7		$500.00		$14,000	$14,500	$1,200		
Railroads	9.2.4	See Barr SOW's 16, 17, 18		$0.00		$45,000	$45,000	$33,750		
Pipelines	9.3.1	See Barr SOW'S 05, 06, and 08		$0.00		$580,133	$580,133	$217,000		
Power Lines	9.3.2	See Barr SOW 13		$0.00		$83,900	$83,900		$7,175	
Roads and Parking Lots	9.3.4	See Barr SOW 1		$0.00		$392,000	$392,000	$132,000		
Mine Site Wastewater Treatment Facility (WWTF)	9.5.1	See Barr SOW 06		$0		$498,000	$498,000	$14,000		
New - Phase 2							$0			
Reagent Building	9.4.1	Bldg. Dims: 270' x 85' x 75' tall		$15,000.00		$820,000	$835,000	$4,100	$22,500	
Oxygen Plant	9.4.1	310' x 310' x 75' tall		$65,000.00		$4,238,600	$4,303,600	$16,600	$72,500	
Limestone Preparation	9.4.1	125' x 70' x 60' tall		$7,500.00		$345,000	$352,500	$1,750	$12,500	
Hydrometallurgical Plant	9.4.1	525' x 144' x 90' tall		$49,000.00		$4,365,000	$4,414,000	$13,500	$62,500	
Hydrometallurgical Reagents	9.4.1	144' x 90' x 90' tall		$15,000.00		$815,000	$830,000	$2,200	$17,500	
Railroads	9.4.1	Already bid, part of existing / Phase 1 infrastructure		$0.00						
Pipelines	9.4.1	Based on size of buildings and quantities in other buildings on site.		$0.00		$1,450,000				
Power Lines	9.4.1	Already bid, part of existing / Phase 1 infrastructure		$0.00						
Roads and Parking Lots	9.4.1	Based on size of buildings and quantities in other buildings on site.		$0.00		$156,000		$59,225		

NorthMet Contingency Reclamation Estimate

9/4/2014

Above Ground Storage Tanks

Name	Tank #	Fluid	Gallons	Location	Fluid Removal/ Disposal	Demolition/ Removal	Asbestos Lead Paint	Site Restoration	Assets Recovery	Notes
Legacy - Area 1 Shop					$0	$24,100	$0	$3,000		**to Demo tab**
Portable tank on skids (silver)	048	Fuel Oil	1,800	E of Area 1 Shop		$600				Out of Service - Disconnected, Labeled lube oil, Silver tank
Storage Tank	080		20,000	Area 1 - South of Rail Road Grade		$1,000				BASIS: Costs based on conceptual plan, site experience and historical knowledge.
Storage Tank	358	Used Anti-freeze		N. Side Area 1 Shop		$0				Included as part of Area 1 Shop demo
Storage Tank	420	Used Anti-freeze		N. Side Area 1 Shop		$0				Included as part of Area 1 Shop demo
Black Tank	n/a		20,000	N of Area 1 Shop		$7,500		$1,000.00	$1,500.00	
Black Tank	n/a		20,000	N of Area 1 Shop		$7,500		$1,000.00	$1,500.00	
3 Blue			20,000	N of Area 1 Shop		$7,500		$1,000.00	$1,500.00	Out of Service. Disconnected, Labeled "save for conc."
~~Locomotive Fueling~~		~~# 1,2 Fuel Oil~~		~~West end of Panel Yard~~		-				This tank is no longer on site.
Legacy - Area 2 Shop					$0	$0	$0	$0		**to Demo tab**
Locomotive Fueling		# 1,2 Fuel Oil								
Legacy - Plant Area					$0	$199,525	$0	$25,700		**to Demo tab**
Storage Tank	015	# 1,2 Fuel Oil	12,000	E. Side Concentrator		$600				
Storage Tank	032	# 2, 6 Fuel Oil	3,384,000	Tank Farm		$62,000		$8,100.00	$40,000.00	
Storage Tank	033	# 6 Fuel Oil	3,384,000	Tank Farm		$62,000		$8,100.00	$40,000.00	
Storage Tank	034	# 6 Fuel Oil	3,384,000	Tank Farm		$62,000		$8,100.00	$40,000.00	
Storage Tank	304	Mineral Oil	12,000	E. Side Concentrator		$600				
Storage Tank	305	Mineral Oil	12,000	E. Side Concentrator		$600				
Storage Tank	306	Mineral Oil	12,000	E. Side Concentrator		$600				
Storage Tank	408	Lube oil	20,000	SW of Tailings Basin Reporting Area		$0				Out of Service, but piping still in place and no signs are posted
Storage Tank	421	Alcohol	10,000	E side Concentrator		$500				
Storage Tank	506	Fuel Oil	500	Heating Plant		$25				
WTP Backwash (green)			16,000	NE of Drivehouse 1		$5,000		$700.00	$1,000.00	
Tank (white)			14,000	SE of Tailings Basin Reporting Area		$5,000		$700.00	$1,000.00	Out of Service. Disconnected, no visible labels
Dispensing Tanks at Main Gate	121	Gasoline	6,000	See gas station dwg's for reference		$600				
Dispensing Tanks at Main Gate	122	Gasoline	6,000	See gas station dwg's for reference		$600				
New - Phase 1 - Plant Site					$0	$0	$0	$0		**to Demo tab**
Storage Tank	TBD	CuSO4				$0				tanks provided by supplier
Storage Tank	TBD	Magnafloc 10	10,600			$0				tanks provided by supplier
Storage Tank	TBD	PAX	3,000			$0				tanks provided by supplier
Storage Tank	TBD	Lime	22,500			$0				tanks provided by supplier
New - Phase 1 - Mine Site					$0	$0	$0	$0		**to Demo tab**
Mine Site Truck Fueling	TBD	# 1,2 Fuel Oil		Fueling and Maintenance Facility		$0				
New - Phase 2 - Plant Site					$0	$0	$0	$0		**to Demo tab**
Storage Tank	TBD	H2SO4	40,000			$0				tanks provided by supplier
Storage Tank	TBD	HCl	60,000			$0				tanks provided by supplier
Storage Tank	TBD	Liquid SO2	21,000			$0				tanks provided by supplier
Storage Tank	TBD	Magnafloc 342/351				$0				tanks provided by supplier
Storage Tank	TBD	Mg(OH)	80,000			$0				tanks provided by supplier
Storage Tank	TBD	NaHS	13,200			$0				tanks provided by supplier
Storage Tank	TBD	NaOH	40,000			$0				tanks provided by supplier
Removed										
Day Tanks	083	# 6 Fuel Oil	20,000	Tank Farm						
Day Tanks	084	# 6 Fuel Oil	20,000	Tank Farm						
Day Tanks	085	# 6 Fuel Oil	20,000	Tank Farm						

NorthMet Contingency Reclamation Estimate

9/4/2014

Above Ground Storage Tanks

Name	Tank #	Fluid	Gallons	Location	Fluid Removal/ Disposal	Demolition/ Removal	Asbestos Lead Paint	Site Restoration	Assets Recovery	Notes
Blue		Waste oil		W side of Coarse Crusher						
Blue		Lube oil		NE cor. Fine Crusher						
White		Anti-Freeze		NW cor. Fine Crusher						

Attachment H

Ames Correspondence

Attachment H1

Ames Letter to Support Ames Portion of unit $ Reclamation Tab

Ames Construction, Inc.®

2000 Ames Drive
Burnsville, MN 55306
952-435-7106 • Fax 952-435-7142

To whom it may concern:

- Over the course of several weeks during the first half of 2016, Ames Construction provided to PolyMet Mining, Inc. construction cost estimates for the purpose of establishing the initial financial assurance estimate for PolyMet's Northmet Project.
- The Ames construction cost estimates are based upon information provided and quantities established by Barr Engineering on PolyMet's behalf.
- The unit costs are based on established Northern Minnesota labor and benefit rates and current fuel oil and construction material pricing. Ames' productivity rates are based on our experience working in Minnesota and across the country.
- Ames Construction is familiar with PolyMet's Northmet project, first becoming involved in 2008. At that time Ames provided project construction cost estimates for the development of the proposed mine site and tailings basin. Since 2008, Ames has worked with PolyMet and Barr personnel as the scope of the project has been refined and has provided several project construction cost estimate updates.

Sincerely,

Martin Husnik, P.E.
Midwest Chief Estimator
Ames Construction Inc.

Emil "Butch" Trebesch, P.E
Sr. VP Midwest Region
Ames Construction Inc.

Attachment H2

Ames Email with New Item Unit $ Reclamation Tab

From:	Michael Glissman <mglissman@polymetmining.com>
Sent:	Thursday, April 27, 2017 2:49 PM
To:	Jim Scott (jr.scott@frontiernet.net)
Cc:	Jim Tieberg; Kevin Pylka
Subject:	FW: Question on Demo Landfills
Attachments:	image002.jpg; image004.jpg; image003.jpg; image004.jpg; image005.jpg; image006.jpg; image007.jpg

Jim-

See attached string from NTS on landfill demo tipping rates. I'm not exactly clear on how the fuel tax rate applies at Canyon, but overall, Canyon appears to be the worst choice (most expensive).

Just found out that freight rates to the SKB site in Cloquet would be $600 / truck load.

I am also working on obtaining what the capacity of the haul trucks are in cubic yards because we will most likely be hauling lots of air with the piping unless we come up with a way to crush it flat or grind it up so that it doesn't take up as much volume.

In summary:

<u>Dem-Con Companies General Waste in Keewatin:</u>
Clean Construction Demo - $9.40 plus $0.60 cents per cubic yard tax = $ 10.00 / cubic yard

<u>SKB Environmental Services – Shamrock Trucking in Cloquet:</u>
Clean Demo - $20 per ton (dependent on quantity)
Industrial (Contaminated) Waste - $28 per ton (dependent on quantity)

<u>Waste Management in Canyon:</u>
Please note that this is just a general special waste quote.
Disposal: $30 per ton (3 ton minimum)
Fuel: 4.8% *This percentage changes weekly
Environmental: $22 per load
Tax: All applicable taxes, $0.36 per ton
Profile: $200 (onetime fee)

Will continue to send you information as it becomes available.
Thanks
Mike

From: Kevin Pylka
Sent: Thursday, April 27, 2017 12:28 PM
To: Michael Glissman
Subject: FW: Question on Demo Landfills

Mike,

See the email and thread below detailing pricing. I can walk you through this if needed, but am headed to a 1:00-3:00 meeting. I can talk after that.
KEvin

From: Jenny Holmes [mailto:JHolmes@netechnical.com]
Sent: Tuesday, April 25, 2017 4:10 PM
To: Kevin Pylka <kpylka@polymetmining.com>
Subject: Question on Demo Landfills

Hi Kevin,

Allison was able to get some answers for you. Please see her message below and let me know if we can help with anything else. Thanks!!

Sent from my iPhone

Begin forwarded message:

> **From:** Allison Smrekar <asmrekar@netechnical.com>
> **Date:** April 25, 2017 at 3:26:44 PM CDT
> **To:** Jenny Holmes <JHolmes@netechnical.com>
> **Subject: RE: Question on Demo Landfills**
>
> Hi Jenny,
>
> To answer the first question, it is $9.40 per cubic yard plus $0.60 per cubic yard as tax.
>
> For the second question, the tax amount depends on the type of material and is usually less than $1 ($0.36 was the original estimate) so if it is $30 per ton for disposal, with tax it would be $30.36 per ton for disposal. We can disregard the $13 per ton tax as that applies for Wisconsin only (she forgot to take it out when sending the quote). The fuel and environmental charges apply, even for disposal only, so fuel tax is approximately 4.8% per load, and environmental is $22 per load.
>
> The costs listed above are for disposal only with no transportation fees included. I hope this helps – please let me know if you need me to clarify anything, or if it just doesn't make sense. Thanks!
>
> **Allison Smrekar**
> **Geological Engineer, EIT**
> **OFFICE:** (218) 741-4290 | asmrekar@netechnical.com
> **DIRECT:**(218) 742-1054 | www.netechnical.com
>
>

From: Jenny Holmes
Sent: Tuesday, April 25, 2017 12:40 PM
To: Allison Smrekar <asmrekar@netechnical.com>
Subject: Fwd: Question on Demo Landfills

Would you check on Kevin's question?

Sent from my iPhone

Begin forwarded message:

> **From:** Kevin Pylka <kpylka@polymetmining.com>
> **Date:** April 25, 2017 at 11:29:26 AM CDT
> **To:** Jenny Holmes <JHolmes@netechnical.com>
> **Subject: RE: Question on Demo Landfills**
>
> Jenny,
>
> Thanks for the info! Is the $9.40 on the Dem Con information $9.40 per load plus $0.60 cents per cubic yard, or $9.40/ton, plus 0.60 per cubic yard?
>
> Thanks
> Kevin
>
> ---
>
> **From:** Jenny Holmes [mailto:JHolmes@netechnical.com]
> **Sent:** Tuesday, April 25, 2017 10:51 AM
> **To:** Kevin Pylka <kpylka@polymetmining.com>
> **Cc:** Bruce Trebnick <BTrebnick@netechnical.com>
> **Subject:** RE: Question on Demo Landfills
>
> Good morning,
>
> Below is a cost summary for estimated waste disposal of geomembrane materials and plastic piping from the three closest demo landfills.
>
> <u>Dem-Con Companies General Waste in Keewatin:</u>
> Clean Construction Demo - $9.40 plus $0.60 cents per cubic yard
>
> <u>SKB Environmental Services – Shamrock Trucking in Cloquet:</u>
> Clean Demo - $20 per ton (dependent on quantity)
> Industrial (Contaminated) Waste - $28 per ton (dependent on quantity)
>
> <u>Waste Management in Canyon:</u>
> Please note that this is just a general special waste quote.
> Disposal: $30 per ton (3 ton minimum)
> Fuel: 4.8% *This percentage changes weekly
> Environmental: $22 per load
> Tax: All applicable taxes, $0.36 per ton, $13/ton
> Profile: $200 (onetime fee)

I hope this is what you were looking for. Please let me know if you need additional information or if you have a volume estimate so we can get better pricing for you. Thank you!

Jenny Holmes
Senior Project Manager
OFFICE: (218) 741-4290 | jholmes@netechnical.com
DIRECT:(218) 742-1033 | www.netechnical.com

From: Jenny Holmes
Sent: Friday, April 21, 2017 12:35 PM
To: 'Kevin Pylka' <kpylka@polymetmining.com>; Bruce Trebnick <BTrebnick@netechnical.com>
Subject: RE: Question on Demo Landfills

Absolutely! I will get back to you by early next week with some options. Thank you!

From: Kevin Pylka [mailto:kpylka@polymetmining.com]
Sent: Friday, April 21, 2017 11:21 AM
To: Jenny Holmes <JHolmes@netechnical.com>; Bruce Trebnick <BTrebnick@netechnical.com>
Subject: RE: Question on Demo Landfills

Jenny,

Would you or someone at NTS be able to secure pricing for demolition waste for landfills in the area, maybe the three closest? This is an exercise for cost estimating future reclamation estimates so I don't have a waste or material that is generated. We would have to assume it fits into the appropriate "demolition waste" guidelines but as mentioned previously it would be geomembrane materials and plastic piping removed from a site. Not hazardous material nor containing hazardous waste.

I realize it would have to be contingent upon acceptance of a waste profile. I just need something that can be used as a reference in a cost analysis.

Thanks,
Kevin

From: Jenny Holmes [mailto:JHolmes@netechnical.com]
Sent: Friday, April 21, 2017 10:27 AM
To: Kevin Pylka <kpylka@polymetmining.com>; Bruce Trebnick <BTrebnick@netechnical.com>
Subject: RE: Question on Demo Landfills

Hi Kevin,

Dem-Con companies General Waste located in Keewatin is likely your best bet. Disposal rates are around $21.00 or $22.00 per ton and will depend on current acceptance of the material.

If you need additional assistance, please let me know. We would be happy to coordinate any efforts for the disposal of these materials or obtain a quote based on the amount of material intended for disposal.

Thank you!

Jenny Holmes
Senior Project Manager
OFFICE: (218) 741-4290 | jholmes@netechnical.com
DIRECT:(218) 742-1033 | www.netechnical.com

From: Kevin Pylka [mailto:kpylka@polymetmining.com]
Sent: Friday, April 21, 2017 8:50 AM
To: Bruce Trebnick <BTrebnick@netechnical.com>; Jenny Holmes <JHolmes@netechnical.com>
Subject: Question on Demo Landfills

Bruce / Jenny,

Would you or someone at NTS know the current closest demolition landfills available to dispose of waste like geomembrane liners and plastic piping. I assume it would be either the Canyon Landfill, the Carlton Landfill, or General Waste near Keewatin. If so have you obtained recent pricing for tipping fees?

Kevin

Kevin Pylka
Manager of Environmental Permitting and Compliance
Mobile: 218-750-2054 **|** Office: 218-471-2150 **|** Direct: 218-471-2162 **|** Fax: 218-471-2159
kpylka@polymetmining.com **|** **www.polymetmining.com**

Attachment I

NTS Correspondence

Attachment I1

NTS Tipping Fee Email

From:	Tom Radue <tradue@barr.com>
Sent:	Monday, November 13, 2017 7:34 AM
To:	'jrscotthl@gmail.com'; Jennifer Saran; Jim Tieberg
Subject:	FW: PolyMet Unit Prices for Reclamation Estimate
Attachments:	Copy of unit prices.pdf; Copy of unit prices.xlsx

Jim, Jennifer and Jim - See attached from Ames. Tom

Tom Radue, PE

Vice President
Senior Geotechnical Engineer
Minneapolis, MN office: 952.832.2871
cell: 952.240.4051
tradue@barr.com
www.barr.com

From: Martin Husnik [mailto:MartinHusnik@amesco.com]
Sent: Monday, November 13, 2017 7:29 AM
To: Tom Radue
Subject: RE: PolyMet Unit Prices for Reclamation Estimate

Tom,

See attached.

Ames Construction	**Martin Husnik, P. E.**
2000 Ames Drive	Chief Estimator
Burnsville, MN 55306	MartinHusnik@amesco.com
Midwest: 952-435-7106	Mobile: 612-919-3405

Description	Unit	Basis for Quantities (drawing # or describe)	Unit Price	Comments
Grading uneven area for gentle contour and drainge	CY or Ac	Grading for depths 6" to 16"	$3200/AC	No hauling of material, Mid size dozer work.
Abandon Monitoring or Drinling Water Well	each			No pricing requested from Ames
grader for road snow plowing or gravel road maintenance	hr		$200/hr	One grader with Operator, Assumes Ames is onsite working on other activities.
load bentonite at rail cars and spread on FTB beach	cy or t		$8/cy	26,000 ft haul using side dumps, spread and disc in 1 foot on the beach, likely a controlled spreading type machine to get the correct lb/sf.

Attachment I2

NTS Transport Email

From: Michael Glissman <mglissman@polymetmining.com>
Sent: Thursday, April 27, 2017 11:13 AM
To: Jim Scott (jr.scott@frontiernet.net)
Cc: Jim Tieberg; Kevin Pylka
Subject: FW: Pricing

Jim-

See response from Wayne Transport below.

To summarize;

Freight rates from the mine site to either Waste Management's Canyon Landfill or General Waste's Landfill by Keewatin would be $ 415.00 / load.
Non-permitted load capacity is 50,000 lbs.
Non-permitted load lengths are 40 ft.

We are still waiting for tipping fee costs from Kevin Pylka (cc'd here as friendly reminder) and estimated tonnages from Ames for the geomembrane and piping.

Thank you
Mike

From: Steve DeVaney
Sent: Thursday, April 27, 2017 10:24 AM
To: Michael Glissman ; Jim Tieberg
Subject: Fwd: Pricing

Bid on trucking

Sent from my iPhone

Begin forwarded message:

> **From:** Jeff Hill <JeffH@waynetransports.com>
> **Date:** April 27, 2017 at 9:38:20 AM CDT
> **To:** Steve DeVaney <sdevaney@polymetmining.com>
> **Subject: Re: Pricing**
>
> Hi Steve,
> Sorry I didn't get back to you sooner, I've been traveling all week and it's been pretty hectic. Anyway the rate would be the same to both places. $415.00 per load, we could haul roughly 50,000 lbs and handle lengths up to 40ft without permitting. If the lengths were longer the rate would go up considerably. I hope this helps you out. If you need more please contact me.
> Thanks and have a good day.
> Jeff

Sent from my iPhone

On Apr 24, 2017, at 10:10 PM, Steve DeVaney <sdevaney@polymetmining.com> wrote:

Hi Jeff,

PolyMet is working on a Reclamation Estimate (for permitting purposes) to dispose of geomembrane material and drain pipe from the mine stockpiles (about 6 miles east of the plant site) to either Waste Management's Canyon Landfill or General Waste's Landfill by Keewatin. Quantities are unknown at this time. Please forward a cost per truck, weight limitations and length of loads.

If you have any questions, the technical contact is Mike Glissman: (o) 218-471-2175, (c) 218-750-2991 or mglissman@polymetmining.com

Thank you,

Steve DeVaney

Procurement Manger

PolyMet Mining, Inc.

Attachment I3

NTS Rate Letter

April 22, 2016

Environmental Science
& Engineering

PolyMet Mining, Inc.
Attn. Steve DeVaney
Via Email
sdevaney@polymetmining.com

RE: Cost Estimates on Several Items

Attached are the cost estimates that will be used in the Contingency Reclamation Estimate (CRE) as part of the application for the permit to mine with the State of Minnesota. Included are the following items:

1. Hourly labor rates by staff type
2. Hourly rate for surveying
3. Wetland data collection, data entry and quality assurance, per annum cost estimate
4. DMR data collection, data entry, quality assurance and report preparation, per annum cost estimate
5. Water quality report preparation, per annum cost estimate
6. SW-619 industrial landfill monitoring and maintenance, per annum cost estimate (closed state)
7. Tailings basin instrumentation inspection and data collection, per annum cost estimate (current activity)
8. Tailings basin instrumentation report preparation, per annum cost estimate (current activity)
9. Tailings basin instrumentation inspection and data collection, per annum cost estimate (operating activity)
10. Tailings basin instrumentation report preparation, per annum cost estimate (operating activity)
11. Reverse osmosis treatment plants operation, per annum cost estimate

The cost estimates for items 3-8 are based on our experience performing these duties in years past. We have a high degree of certainty in terms of level of effort and unit rates for these items. For items 9 and 10 we lack detail as to how operating conditions would affect the level of effort, therefore we roughly estimated double the level of effort of current, non-operating conditions. For Item 11 we based our cost estimate on our experience elsewhere, however with the absence of design criteria and operating requirements, we estimated what typical plants of this size may cost to operate.

Please note that all pricing is valid for the remainder of calendar year 2016. Pricing is subject to an increase not to exceed 2.5% each year thereafter, effective on Jan 1st, for a period of 10 years. If you should have any questions, please feel free to contact Mr. Bruce Trebnick at 218-742-1051 (office) or 218-780-2006 (cell).

Sincerely,

Richard H. Crum, PG
NTS, President

Pricing Request for Several Items for the Contingency Reclamation Estimate (CRE)

As part of the Application for the Permit to Mine with the State of Minnesota

Prepared For

Steve DeVaney

PolyMet Mining, Inc.

Prepared By

Northeast Technical Services, Inc. (NTS)

526 Chestnut Street

Virginia, Minnesota 55792

218.741.4290

April 21, 2016

Environmental Science
& Engineering

Table of Contents

1. **Hourly labor rates by staff type**

Staff Type	Hourly Rate
Entry Level Professional (I)	88
Middle Level Professional (II)	108
Senior Level Professional (III)	128
Principal Level Professional (IV)	148
WWTP Operator, Class B, C & D	58
WWTP Operator, Class A	128
Field Scientist	78
Project Support (Clerical)	58
Laborer/Intern	48

2. **Hourly rate for surveying**

$98/hour; includes Professional Engineer or EIT along with survey equipment. NTS is not permitted to survey property boundaries at this time.

3. **Wetland data collection, data entry and quality assurance, per annum cost estimate**

Item	Rate	Unit	Quantity	Subtotal
Field Equipment	2220.00	/lump	1	2220
Misc. Consumable Items	504.00	/lump	1	504
Pickup Truck 4x4	0.70	/mile	2000	1,400
Staff, Data Collection (Avg Rate)	83.00	/hour	520	43,160
			Total:	$47,284

Per annum cost estimate *per monitoring point* (21 points): $2,252

4. **DMR data collection, data entry, quality assurance and report preparation, per annum cost estimate**

Facility #1) Hoyt Lakes Tailings Basin

Item	Rate	Unit	Quantity	Subtotal
Field Equipment	7,276.00	/lump	1	7,276
Misc. Consumable Items	3,000.00	/lump	1	3,000
Pickup Truck 4x4	0.70	/mile	3400	2,380
Staff, Data Collection (Avg Rate)	83.00	/hour	560	46,480
Staff, Reporting (Avg Rate)	92.00	/hour	240	22,080
			Total:	$81,216

Facility #2) Hoyt Lakes Mining Area

Item	Rate	Unit	Quantity	Subtotal
Field Equipment	4,957.00	/lump	1	4,957
Misc. Consumable Items	648.00	/lump	1	648
Pickup Truck 4x4	0.70	/mile	1600	1,120
Staff, Data Collection (Avg Rate)	83.00	/hour	260	21,580
Staff, Reporting (Avg Rate)	92.00	/hour	264	24,288
			Total:	$52,593

Per Annum Cost Estimate, Total for *Both Facilities*: $133,809

5. **Water quality report preparation, per annum cost estimate**

Item	Rate	Unit	Quantity	Subtotal
Staff, Reporting (Avg Rate)	97.00	/hour	36	3,492
			Total:	$3,492

6. **SW-619 industrial landfill monitoring and maintenance, per annum cost estimate (closed state)**

Item	Rate	Unit	Quantity	Subtotal
Landfill Inspection	400.00	/ea	3	1,200
Cover Mowing	5327.00	/lump	1	5,327
Groundwater Monitoring	850.00	/well	7	5,950
Gas Vent Monitoring	600.00	/vent	7	4,200
Staff, Reporting (Avg Rate)	88.00	/day	60	5,280
			Total:	$21,957

Actual cost for maintenance will vary year-to-year. Costs shown are 3 year average.

NTS recommends that if the landfill leachate plume is proven to be stable, the number of groundwater sampling events/locations be reduced after five years.

7. **Tailings basin instrumentation inspection and data collection, per annum cost estimate (current activity)**

Item	Rate	Unit	Quantity	Subtotal
Field Equipment	2360.00	/lump	1	2360
Misc. Consumable Items	76.00	/lump	1	76
Pickup Truck 4x4	0.70	/mile	400	280
Staff, Data Collection (Average Rate)	113.00	/hour	112	12,656
			Total:	$15,372

Per Annum Cost Estimate, *per event* (2 events): $7,686

8. **Tailings basin instrumentation report preparation, per annum cost estimate (current activity)**

Item	Rate	Unit	Quantity	Subtotal
Staff, Reporting (Average Rate)	114.00	/hour	50	5,700
			Total:	$5,700

Per Annum Cost Estimate, *per event* (2 events): $2,850

9. **Tailings basin instrumentation inspection and data collection, per annum cost estimate (operating activity)**

Assumed Double Effort of Current Activity (Item #7)

Per Annum Cost Estimate, *per event* (2 events): $15,372

10. **Tailings basin instrumentation report preparation, per annum cost estimate (operating activity)**

Assumed Double Effort of Current Activity (Item #8)

Per Annum Cost Estimate, *per event* (2 events): $5,700

11. **Reverse osmosis treatment plants operation, per annum cost estimate**

Operation of RO treatment systems is dependent upon numerous variables. Proposed cost estimates are subject to the following variables and qualifying statements:

- Typical hours of plant operation required, assuming not continuous.
- Typical level of capacity required, assuming not maximum.
- Typical influent water quality and expected variability.
- Treatment objectives.
- Operational Strategies and SCADA Capabilities: Automation, remote monitoring, remote control capabilities, etc
- Are we to include membrane filter replacement in the estimate?
- How will reject water be stored or otherwise handled?

The following per annum cost estimate is based on this set of assumptions:

- Plants are operational 24/7 at 50% of capacity.
- Two RO plants (500gpm and 2000gpm) are both in operation; the cost estimate below is for combined operation and maintenance.
- Operator required 1 site visit per day.
- Operator scheduled 8 hours per day, 7 days a week.
- Operators are paid flat rate $40 per 8 hours “on-call”.
- Not charging travel time for routine operation.
- Class A operator oversight 8 hours per week on average.
- Initial water quality is moderately impaired and moderately variable.
- Membrane filter replacement is not included.
- Potential reject water handling costs are not included.
- See Appendix A for detailed assumed design parameters.

Wastewater Treatment:

Item	**Rate**	**Unit**	**Quantity**	**Subtotal**
Energy Costs*	112,000.00	/lump	1	112,000
Chemical Costs*	599,000.00	/lump	1	599,000
Maintenance Costs*	124,000.00	/lump	1	124,000
Pickup Truck 4x4	0.70	/mi	32,000	22,400
Operator “on-call” charge	40.00	/8 hours	730	29,200
Operator, Class B, C or D	58.00	/hour	3,800	220,400
Operator, Class A	128.00	/hour	416	53,248
			Total:	$1,160,248

*See Appendix B for detailed breakdown of costs.

Wastewater Pretreatment:

Item	**Rate**	**Unit**	**Quantity**	**Subtotal**
Coagulation/Flocculation/Settling	245,000.00	/lump	1	245,000
Ultrafiltration	105,000.00	/lump	1	105,000
			Total:	$350,000

Pretreatment may be optional depending on influent water quality and effluent objectives.

Treatment costs may increase/decrease dependent on pretreatment options.

Appendix A: Assumed design parameters for WWTP's

Design Parameters:		
Percent Recovery	75%	
Design Feed Flow (Max)	3.6	mgd
Design Permeate Flow (Max)	2.70	mgd
Design Concentrate Flow (Max)	0.90	mgd
Average Feed Flow	1.80	mgd
Average Permeate Flow	1.35	mgd
Average Concentrate Flow	0.45	mgd
No. of Skids	3	skids
Size of RO Skids	0.90	mgd
RO Flux Rate	10	gfd
RO Area per Element	400	ft/elements
Number of Pressure Vessels per Skid	7	PV/skid
Number of RO Elements per Skid	231.00	elements/skid
Number of Cartridge Filters	157.00	

Appendix B: Detailed operation & maintenance costs for WWTP's

Annual Energy Cost	$112,000.00	$/year
Annual Energy Rate	$0.08	/kwh
Annual Feed Energy Cost	$97,700.24	$/year
Feed Pressure	200	psi
Interstage Boost Pressure	0	psi
Pump Motor Efficiency	78%	
Energy Consumption	3,345.90	kwh/day
Annual Concentrate Pump Energy Cost	14,000.00	$/year
Head	150.00	
Pump Horsepower	25.00	hp
Hours in Operation	24.00	hours/day
Energy Consumption	447.60	kwh/day

Annual Chemical Costs	$599,000.00	$/year
Antiscalant	$102,738.38	$/year
Dose	5.00	mg/L
Unit Cost	$3.75	$/lb
CIP Chemicals	$395,416.67	$/year
Acid CIP Frequency	30.00	days
Acid CIP Cost (2011 Cost)	$6,500.00	$/CIP
Caustic CIP Frequency	45.00	days
Caustic CIP Cost (2011 Cost)	$6,500.00	$/CIP
Miscellaneous Chemical	$99,631.01	$/year
Percentage of Non-CIP Chemicals	20%	
Final pH adjustment	$616.43	$/year
NaOH	0.25	mg/L
Strength	50%	% Concentration
Cost	$0.30	$/lb

Annual Maintenance Cost	$124,000.00	$/year
Annual Cartridge Filter Replacement Cost	$4,775.42	$/year
Filters to be Replaced	78.50	filters
Filter Replacement Frequency	90.00	days
Filter Cost	$15.00	$/filter
Annual RO Element Replacement Cost	$103,950.00	$/year
RO Elements to be Replaced	346.50	elements
RO Element Replacement Frequency	2.00	years
RO Element Cost	$600.00	$/element
Annual Maintenance Cost	$15,000.00	$/year
RO Capital Cost	$3,000,000	$
Maintenance Cost Percentage	0.50%	of capital cost/year

Attachment J

D&T Letter

D & T Landscaping, Inc.
PO Box 65
Solway, MN 56678
Office Phone & Fax 218-467-9242
Email: dntwinge@paulbunyan.net

Dave's Cell 218-556-4560
Deb's Cell 218-760-0894
Tom's Cell 218-760-3795

4/5/16

PolyMet Mining, Inc.
PO Box 475, 6500 Co Rd 666
Hoyt Lakes, MN 55750

Att: Steve DeVaney,

Below, please find some rough estimates for the Contingency Reclamation Estimate:

1.) **Commercial Fertilizer and Seed for Tailings Basin Flats – Supply/Apply/ Incorporate Unit Pricing per acre @ 500 lb/acre $390.00/Acre**
2.) **Commercial Fertilizer and Seed for Tailings Basin Slopes – Supply/Apply/Incorporate Unit Pricing per acre @ 200 lb/Acre $540.00/Acre**
3.) **Commercial Fertilizer and Seed for Overburden – Supply/Apply/Incorporate Unit Pricing per Acre @ 200 lb/Acre $295.00/Acre**
4.) **Mulch – Supply and Incorporate. Unit Pricing per Acre @ 2 ton/acre of Hay or Straw Mulch $340.00/Acre**

Thank You,

Deb Winge

Attachment K1

Barr 2016 Fee Schedule

Fee Schedule—2016

Rev. 01/01/16

Description	Rate* (U.S. dollars)
Principal	$145-295
Consultant/Advisor	$155-250
Engineer/Scientist/Specialist III	$125-150
Engineer/Scientist/Specialist II	$95-120
Engineer/Scientist/Specialist I	$65-90
Technician III	$125-150
Technician II	$95-120
Technician I	$50-90
Support Personnel II	$95-150
Support Personnel I	$50-90

Rates for litigation support services will include a 30% surcharge.

A ten percent (10%) markup will be added to subcontracts for professional support and construction services to cover overhead and insurance surcharge expenses.

Invoices are payable within 30 days of the date of the invoice. Any amount not paid within 30 days shall bear interest from the date 10 days after the date of the invoice at a rate equal to the lesser of 18 percent per annum or the highest rate allowed by applicable law.

Reimbursable expenses including, but not limited to, the actual and reasonable costs of transportation, meals, lodging, parking costs, postage, and shipping charges will be billed at actual cost. Materials and supplies charges, printing charges, and equipment rental charges will be billed in accordance with Barr's standard rate schedules. Mileage will be billed at the IRS-allowable rate.

Principal category includes consultants, advisors, engineers, scientists, and specialists who are officers of the company.

Consultant/Advisor category includes experienced personnel in a variety of fields. These professionals typically have advanced background in their areas of practice and include engineers, engineering specialists, scientists, related technical professionals, and professionals in complementary service areas such as communications and public affairs.

Engineer/Scientist/Specialist categories include registered professionals and professionals in training (e.g. engineers, geologists, and landscape architects), and graduates of engineering and science degree programs.

Technician category includes CADD operators, construction observers, cost estimators, data management technicians, designers, drafters, engineering technicians, interns, safety technicians, surveyors, and water, air, and waste samplers.

Support Personnel category includes information management, project accounting, report production, word processing, and other project support personnel.

*Rates do not include sales tax on services that may be required in some jurisdictions.

Appendix 15.3

Mine Year 1 Projected Financial Assurance Estimate

NorthMet Project

Mine Year 1 Reclamation Plan with Financial Assurance Estimate and Basis

December 2017

Table of Contents

Acronyms, Abbreviations and Units

Acronym, Abbreviation or Unit	Stands For
ACM	asbestos-containing materials
Ames	Ames Construction
AOC	Areas of Concern
Arrowhead	Arrowhead Consulting and Testing Inc.
AST	aboveground storage tank
Barr	Barr Engineering Co.
Cliffs Erie	Cliffs Erie, L.L.C.
CPS	Central Pumping Station
D&T	D & T Landscaping, Inc.
DNR	Minnesota Department of Natural Resources
ESA	Environmental Site Assessment
FAE	Financial Assurance Estimate
FTB	Flotation Tailings Basin
HRF	Hydrometallurgical Residue Facility
Lakehead	Lakehead Constructors Inc.
LTVSMC	LTV Steel Mining Company
Mavo	Mavo Systems
MPCA	Minnesota Pollution Control Agency
MPP	Mine to Plant Pipelines
NPV	Net Present Value
NTS	Northeast Technical Services
OSLA	Overburden Storage and Laydown Area
OSP	Ore Surge Pile
Pace	Pace Analytical

Acronym, Abbreviation or Unit	Stands For
PCB	polychlorinated biphenyl
PolyMet	Poly Met Mining, Inc.
PTM	Permit to Mine
QAPP	Quality Assurance Project Plan
REC	Recognized Environmental Condition
RTH	Rail Transfer Hopper
SAP	Sampling and Analysis Plan
VIC	Voluntary Inspection and Cleanup
WWTS	Waste Water Treatment System

1.0 Introduction

The Mine Year 1 Reclamation Plan and Financial Assurance Estimate are intended to facilitate an understanding of how financial assurance could change over time for the NorthMet Project (Project). PolyMet's mining operations (i.e., production blasting within the pit boundary) will begin in Mine Year 1. This reclamation plan and associated costs for Mine Year 1 are referred to as projections at this time (and are not the actual reclamation cost estimate) because PolyMet's mining operations will not begin until after construction, which is estimated to take 18 months to two years to complete. As required by the nonferrous PTM rules, the Contingency Reclamation Plan and associated cost estimate for Mine Year 1 will be updated to reflect costs at that time, and provided to the DNR for approval prior to Mine Year 1. The Mine Year 1 projections include the cost estimates for both reclamation of new activities, structures, and conditions added by the Project, and reclamation of existing legacy conditions as they relate to the Project that are currently subject to the Existing PTM. Therefore, the financial assurance that will be put in place at the time of PTM permit issuance (prior to commencement of construction) will be updated and replaced with the Mine Year 1 Contingency Reclamation Plan and financial assurance before Project operations begin. Updates to the Contingency Reclamation Plan and cost estimates will occur annually as required by Minnesota Rules, part 6132.1200, subpart 2(A) in the timeframe between PTM issuance and commencement of Project operations, as well as annually during operations.

1.1 Overview

For the purpose of the Permit to Mine Application (Application), PolyMet refers to the interim phase between Project operation and closure as the "reclamation phase," during which time any remaining activities required to reclaim the Mining Area will be accomplished prior to the start of closure. This term is used for simplicity and clarification, and is not intended to address the reclamation definition in Minnesota Rules, part 6132.0100. The various phases after the operations phase ends are defined in Minnesota Rules, part 6132.0100 as the "closure" and "postclosure maintenance" phases. In the remainder of this document, references to reclamation activities will refer to those activities that are accomplished within the first few years of operations ceasing (i.e., in the short term), and references to the closure and postclosure activities will be to those activities that are needed after reclamation and into the long term.

Mine Year 1 begins when Project mining operations (i.e., production blasting within the pit boundary) commence. The Mine Year 1 Reclamation Plan and FAE addresses the scenario where PolyMet defaults on its PTM obligations sometime during Mine Year 1, and therefore includes activities based on the assumed Project configuration at the end of Mine Year 1. There are two main components to the FAE: short-term reclamation, and long-term closure and postclosure maintenance.

Short-term reclamation activities would include:

- Investigation and remediation of legacy Areas of Concern (AOCs)

- Demolition of buildings and aboveground storage tanks (ASTs) and restoration of disturbed areas
- Removal of pipelines, power lines, roads, railroads, culverts, ponds, sumps and restoration of disturbed areas, when required
- Relocation of material in temporary stockpiles to the East Pit and restoration of stockpile footprints
- Construction of cover systems for the permanent stockpile and the FTB
- DNR management and oversight
- Site administration (i.e., third party conducting the activities)

See Sections 2.0, 3.0, 4.0, and 5.0 for more detailed information on reclamation activities.

Long term closure and postclosure maintenance activities would include:

- Operation, maintenance and replacement of water collection and treatment systems
- Water quality and dam safety monitoring and reporting
- Inspection and maintenance of permanent stockpile cover system
- Inspection and maintenance of FTB bentonite amendment
- Facility and environmental insurance
- DNR management and oversight
- Site administration (i.e., third party conducting the activities)

See Section 6.0 for more detailed information on long term closure and postclosure maintenance activities.

Section 7.0 details the basis of the FAE, and provides descriptions of the references used.

1.2 Variances

PolyMet is requesting two variances from the nonferrous mining rules related to the following activities:

- Leaving the Colby Lake Pipeline in-place rather than removing it.
- Leaving the existing Utility Tunnels at the Plant Site in-place rather than removing them.

Details on these requests can be found in Section 1.2 of the Application v3. In summary, PolyMet believes that these two items meet the requirements in Minnesota Rules, part 6132.4100, subpart 1 for variances. The resulting outcomes would be “consistent with the general public welfare, including, but not limited to, how the alternative measure proposed is equivalent to, or superior to, that prescribed in rule, and how strict compliance with the rule will impose an undue burden on the applicant.” Once the commissioner determines whether to grant the variances, PolyMet will update any information in this Mine Year 1 reclamation plan and other pertinent documents, if necessary, prior to issuance of the PTM.

1.3 Outline

The outline of this report is:

Section 1.0 Introduction, objective and overview, variances

Section 2.0 Description of the reclamation activities associated with building and AST demolition as well as pipeline, pump, power line, substation, road, railroad and culvert removal and waste disposal

Section 3.0 Description of the reclamation activities associated with remediation of relevant AOCs

Section 4.0 Description of the Mine Site reclamation activities (except for items covered in Section 2) including mine pit, temporary stockpile relocation/footprint restoration, sump/pond removal and permanent stockpile cover system

Section 5.0 Description of the Plant Site reclamation activities (except for items covered in Sections 2 and 3) including HRF preconstruction disturbance and FTB bentonite amendment

Section 6.0 Description of long term closure and postclosure maintenance activities associated with water treatment, water quality monitoring, dam safety monitoring and maintenance of cover systems

Section 7.0 Mine Year 1 FAE with supporting information (i.e., basis of estimate)

Appendices – FAE details for reclamation and long term closure and postclosure maintenance activities

Attachments – Basis of FAE documents (see complete list included after Section 7.0)

2.0 Building Demolition and Infrastructure Removal

This section describes the reclamation activities associated with building and AST demolition as well as pipeline, pump, power line, substation, road, railroad and culvert removal and waste disposal.

Minnesota Rules, part 6132.3200, subpart 2, item E(4)(c) requires that equipment, facilities and structures be removed and the foundation razed and covered with a minimum of two feet of overburden. Provisions may be made for continued subsequent use of mine facilities that will have future economic benefits to the surrounding area including buildings, pipelines, transmission lines, roads, and railroad lines.

2.1 Building and AST Demolition

All buildings and structures will be removed. Foundations above existing grade will be razed, and foundations and slabs at or below grade will be left in place. These will all be covered with a minimum of two feet of surface overburden and revegetated.

Demolition waste from structure removal will be disposed of in an off-site landfill. Concrete from demolition will be placed in building basements where possible, including the coarse crusher basement, fine crusher basement and concentrator basement and Plant Reservoir.

Surveys for asbestos-containing materials (ACMs) have been completed and most abatement is planned to be completed before the end of the Project Construction phase. Any ACM remaining in buildings after the construction phase will be abated before demolition during the reclamation phase. ACMs (hot water heating system insulation, lube system insulation, floor tile, etc.) from asbestos abatement will be removed, properly packaged, and disposed in appropriate existing off-site landfills. ACMs (i.e., pipe and electrical insulation) located in utility tunnels will also be removed and the tunnels cleaned.

Special materials on site at the time of Project closure may include nuclear sources, partially used paint, chemical and petroleum products, fluorescent and sodium halide bulbs, certain batteries, electronic waste, lighting ballasts, small capacitors, and oil- or chemical-stained concrete. These materials will be safely collected, removed, and properly recycled or disposed of according to relevant regulations.

During initial closure of the Cliffs Erie facilities in the Mining Area, all PCB transformers (including sixteen large ones) and capacitors were removed and properly disposed, and all nuclear sources were inventoried and disposed.

All legacy buildings remaining after construction, and newly constructed nonferrous structures at the Mine Site and Plant Site will be demolished in the reclamation phase. The Hydrometallurgical Plant and associated limestone and reagent handling and oxygen generation facilities will not have been constructed at the end of Mine Year 1. Buildings that will be demolished are shown in Table 2-1.

Table 2-1 Buildings to be Demolished

Building	Site
Additive Building & Heating Plant	Plant Site
Sewage Treatment Plant	Plant Site
Area 1 Shops	Area 1
Area 2 Shops	Area 2
Booster Pump House #1	Plant Site
Coarse Crusher	Plant Site
Drive House #1	Plant Site
Drive House #2	Plant Site
Fine Crusher	Plant Site
Concentrator	Plant Site
General Shops	Plant Site
Rebuild Shop	Plant Site
Rubber Shop	Plant Site
Lube House	Plant Site
A-Lab	Plant Site
Water Tower	Plant Site
Warehouse Electrical	Plant Site
Warehouse #2	Plant Site
Warehouse 49	Plant Site
Miscellaneous Buildings (not listed separately)	Plant Site
Administration Building	Plant Site
Electrical and Service Tunnels	Plant Site
Colby Lake Pumphouse	Colby Lake
Rail Transfer Hopper (RTH)	Mine Site
Fueling and Maintenance Facility	Mine Site
Flotation Plant and Reagent Building	Plant Site
Concentrate Storage and Loadout Facility	Plant Site

The Central Pumping Station (CPS) at the Mine Site and the Waste Water Treatment System (WWTS) at the Plant Site will not be demolished as long as they are required for long term water treatment in the closure and postclosure maintenance periods.

It is expected that all products produced by the Project (copper concentrate, nickel concentrate) will be shipped to customers, but no credit is taken for product value in the cost estimates under this reclamation plan. It is expected that structural steel and processing equipment will be sold as scrap but no credit is taken for scrap value in the cost estimates provided in this report.

The reagent suppliers will remove any reagents remaining at Project closure. In many cases, the suppliers of chemicals and equipment will be responsible for furnishing tanks and will therefore be required to remove and dispose of those tanks. If for some reason, the reagent suppliers could not remove remaining reagents at closure, the additional cost for this removal will be covered under the contingency provisions.

2.2 Pipeline Removal

Pipelines that will not remain as regional infrastructure (including those to be maintained under PolyMet's agreements with Cliffs Erie) will be removed, recycled or disposed, or abandoned in place. Several of the remaining pipelines will be needed through reclamation, closure, and postclosure maintenance. Major pipeline systems planned for removal or to be abandoned in place during reclamation include:

- Water reclaim line from the FTB to the Processing Plant
- Flotation Tailings pipeline
- Inter-pit pipeline from the plant reservoir to the Area 1 Shop and Area 2 Shop
- Stormwater ponds pipelines
- Water supply pipeline from Colby Lake Pumphouse to the plant reservoir
- Natural gas line from the Town Border Station to the former Pellet Plant location

Major pipeline systems that will be required to remain during reclamation, closure, and postclosure maintenance include:

- Tailings water management – tailings seepage collection pipelines from the FTB seepage capture systems, Plant Site WWTS discharge pipes to the discharge points
- Mine Site water management – East Pit dewatering pipelines and Category 1 Waste Rock Stockpile Groundwater Containment System sumps and pipelines, and Mine to Plant Pipelines (MPP)

Areas disturbed by pipelines and pump systems will be restored.

2.3 Power Line Removal

Power lines (poles, pole hardware, and conductors) and substations that will not remain as regional infrastructure will be removed and recycled. Foundations and anchors will be removed or demolished to at least ground elevation and covered with at least two feet of soil and revegetated to achieve final reclamation. Power lines to be removed during reclamation include:

- 13.8 kilovolt (kV) distribution system from the FTB to the Coarse Crusher
- 13.8 kV Lines from the Main Substation to Area 1 Shop and Area 2 Shop
- 7.20 kV distribution lines at the Mine Site

Power lines that will remain until closure begins include:

- 13.8 kV Line from the Main Substation to Colby Lake Pumphouse

Power lines that will remain through postclosure maintenance include:

- 13.8 kV Lines from the Minnesota Power Substation at the Mine Site to Mine Site facilities
- 4.16 kV distribution lines at the FTB
- 4.16 kV distribution lines at the Mine Site

Areas disturbed by power lines and substations will be restored.

2.4 Road Removal

Reclamation of roads not controlled by PolyMet, such as the Dunka Road and the road from the North Gate, are not included in this plan; reclamation of these features is the responsibility of the parties owning the road.

Minnesota Rules, part 6132.3200, subpart 2, item E(4)(a) requires that "roads, parking areas, and storage pads except those the Commissioner considers necessary for access shall be removed" within three years after closure begins. During the reclamation phase, PolyMet will reclaim mine roads that are no longer being used by flattening the roadside safety berms, scarifying the surface, and vegetating the tops of the roads.

2.5 Railroad Removal

For the Railroad Spur connecting the existing Cliffs Erie Mainline track to the existing track to meet Plant Site material movement needs, the track and ties controlled by PolyMet will be removed and recycled or disposed and the railroad bed will be reclaimed or evaluated for an approved subsequent reuse. Reclamation of railroads not controlled by PolyMet is the responsibility of the owner of the rail lines. Any areas where locomotives may have remained stationary for extended periods will be inspected for potential petroleum product release, and if necessary, remediation measures will be initiated.

A survey will be conducted along the railroad corridor between the RTH and the Plant Site to inspect for potential ore spillage along the track. If spillage is found of a quantity that could cause water quality degradation, clean up measures will be initiated. The specific details of this survey during operations, as well as in the reclamation and closure phases, will be outlined as part of the Transportation and Utility Corridors monitoring plan.

2.6 Culvert Removal

Where roads and railroads will be abandoned, culverts will be removed to prevent potential flow obstruction due to clogged or dammed culverts and to minimize impediments to access and movement in the stream by aquatic life. Any culverts requiring removal will be replaced with channels; culvert locations will be graded and vegetated to provide a stable stream bank approximating a natural channel and floodplain configuration.

2.7 Tunel Removal

PolyMet plans to remove all equipment within the Plant Site utility tunnels, including electrical lines and conduits, water lines, and sanitary lines; however, PolyMet is requesting a variance to leave the concrete tunnels themselves in-place. All entrances to the tunnels will be blocked with rock fill or concrete plugs.

The tunnels are open spaces that were blasted into the bedrock, then reinforced with poured concrete, during the mid-1950s for placement of utility lines throughout the former LTVSMC plant. The tunnels cannot be removed, per se, because they are open spaces. Collapsing or filling the tunnels would require a significant amount of material that would result in little to no change to the safety or appearance of the reclaimed Plant Site. It is possible that collapsing the tunnels could create safety concerns.

3.0 Areas of Concern (AOCs)

Cliffs Erie commissioned a Phase I Environmental Site Assessment (ESA) (Attachment A) after acquiring the former LTVSMC properties in the LTVSMC bankruptcy. The ESA identified 61 Areas of Concern (AOCs) on the entire LTVSMC site. After the ESA, two additional AOCs were identified. As part of its 2001 ferrous Closure Plan, Cliffs Erie has implemented remediation activities for some of these AOCs under the supervision of the Minnesota Pollution Control Agency (MPCA). Twenty-nine of the total of 63 AOCs are located on properties for which it is expected that PolyMet will acquire fee title in 2018 in connection with the Project. Of these 29 AOCs, one (Mill Rejects Area (AOC-12)) has received a No Further Action letter from MPCA and is considered closed. Two other AOCs (AOC 8 and 36) are closed landfills. The monitoring provisions for these landfills are discussed in Section 6.5.

The 26 open AOCs are included in this report. These AOCs may require further investigation to determine whether or not they require any further action. For these AOCs, continued participation in the Voluntary Inspection and Cleanup (VIC) program that Cliffs Erie started as part of its 2001 ferrous Closure Plan is anticipated. The AOCs will be investigated and remediated as necessary on a schedule and priority agreed to with the MPCA under the VIC program. These 26 open AOCs are summarized in Table 3-1.

Table 3-1 Areas of Potential Concern (AOC) for Remediation

AOC	Description	Activity	Contaminants of Potential Concern(1)	Status
1	Area 1 Shops and Reporting	Fueling equipment, rebuild and repair, steam cleaning, electrical shop	DRO, GRO, VOC, RCRA SVOC	Investigation at closure
6	Oily Waste Disposal Area	Oily waste from oil/water separator of the LTVSMC Plant Site Sewage Treatment Plant disposal	DRO, GRO, VOC, PAH, RCRA	Investigation pending
7	Bull Gear Disposal	One-time disposal of heavy lubricant	PAH, Pb	Investigation pending
9	RR Panel Yard	Railroad siding area, fabrication of rail panels, disposal of railroad ties, locomotive fueling	DRO, VOC, RCRA, PAH	Scrap and trash were disposed. Some items remain to be removed. Sampling and analysis plan was carried out and site report and further action plan is being generated.

AOC	Description	Activity	Contaminants of Potential Concern(1)	Status
10	Airport	Equipment salvage and tear-down area, materials storage	DRO, GRO, VOC, RCRA	Scrap sold and trash disposed. Some cleanup remains, and investigation pending.
11	Stoker Coal Ash Disposal	Coal ash industrial waste disposal	B, Sr	Investigation pending
13	2001 Storage Area	Equipment salvage, materials storage, transformer storage	DRO, GRO. VOC, PAH, PCB, RCRA Metals	Investigation pending
14	Large Equipment Paint Area	Sandblasting and painting	RCRA, VOC	Buildings sold. Scrap and trash to be removed. Investigation pending.
35	Dunka WTP Sludge	Stockpiling area for WTP sludge	RCRA Metals	Investigation pending
37	Line 9 Area 5 Petroleum Contaminated Soil	Petroleum contaminated soil landfarm	DRO	Landfarm released/closed by MPCA. Desktop study to close out AOC remains.
38	Area 2 Shops	Fueling equipment, rebuild and repair, paint shop, carpenter shop	DRO, GRO, VOC, RCRA SVOC	Site investigation complete - no solvents detected; will be handled as LUST-CAP approved(2)
40	Heavy Duty Garage	Equipment maintenance	DRO, GRO, VOC, PAH	Building removed. Investigation at closure
42	Bunker C Tank Farm	Large AST storage of #4 to #6 fuel oil	DRO	PCA shows AOC42 as closed – refers to the day tank work that is completed, including some excavation and removal of surface stains complete, pump house demolished, day tanks removed and will be scrapped. Petroleum impacted soils removed. However, further work necessary to remove tanks (AST) and some fuel lines.

AOC	Description	Activity	Contaminants of Potential Concern[(1)]	Status
43	Administration Building	Heating oil tank	DRO, BTEX	Demolition and investigation at closure
44	Main Gate Vehicle Fueling Area	Two 6,000 gallon AST	GRO/DRO/VOC	Demolition and investigation at closure
46	Plant Site Proper and General Shops	Crushing, concentrating and general maintenance facilities	DRO, GRO, VOC, PAH, PCB, RCRA	Investigation at closure; subsurface after buildings demoed
47	Tailings Basin Reporting	Lube station and fueling area	GRO, DRO	Closed MPCA LEAK site. Desktop study to close out AOC remains.
48	Transformers	Transformers associated with pumps located within the Tailings Basin	DRO, PCB	Investigation pending
49	Course Crusher	Course Crusher Petroleum Contaminated Soil	DRO	Investigation Pending
50	Emergency Basin	Drain outfall for stormwater and process water for the Plant Site	DRO, VOC, PAH, RCRA	Sampling and analysis plan was completed. Final report pending, recommending No Further Action to MPCA.
51	Salvage and Scrap Areas	Storage and salvaging various equipment. These are small areas scattered on the southwest side of the Tailings Basin.	DRO, PAH, PCB, RCRA Metals	Investigation pending
52	Cell 2W Salvage Area	Storage of materials and equipment	DRO, PAH, Pb	Investigation pending
53	Hornfels	Disposal of sulfide waste rock	RCRA, pH	Monitored via NPDES permit. Desktop study to close out AOC remains.
59	Colby Lake Pumping Station	Heating oil AST transformer	DRO, BTEX	Investigation at closure

AOC	Description	Activity	Contaminants of Potential Concern[(1)]	Status
63	General Shops Transformer	Transformer leak at General Shops	PCB	Clean up was completed. Final report pending, recommending No Further Action to MPCA.
64[(3)])	Pellet Plant	Pelletizing facilities	DRO, GRO, VOC, PAH, PCB, RCRA	AOC 61 Pellet Plant-Ditch is closed. Facilities removed. Site investigation pending at Pellet Plant.

(1) Abbreviations include: B = boron; BTEX = benzene, toluene, ethylbenzene and xylenes; DRO = Diesel Range Organics; GRO = Gasoline Range Organics; PAH = Polycyclic aromatic hydrocarbons; Pb = lead, PCB = Polychlorinated biphenyls; RCRA = Resource Conservation and Recovery Act; RCRA SVOC = RCRA Semi-Volatile Organic Compounds; Sr = strontium; VOC = Volatile Organic Compounds
(2) LUST-CAP = leaking underground storage tank corrective action plan
(3) referred to as AOC 61 in NTS documents

MPCA will oversee any necessary remediation activities for these AOC sites. The VIC process for clearing and closing an AOC beyond the Phase I ESA is documented in the Quality Assurance Project Plan (QAPP) (Attachment B) that has been prepared and which is incorporated into this report. Within the QAPP, a process for preparing a Sampling and Analysis Plan (SAP) is included. Record searches to confirm the presence or absence of a recognized environmental condition (REC) within applicable MPCA requirements will be completed during preparation of a SAP for each open AOC. If a REC is identified, a SAP will also be used to detail the scope of any required Phase II ESA investigation work that will help determine if a release to the environment has occurred. A Phase II ESA investigation is also intended to define the nature, magnitude, and extent of the release (if found). The results of the Phase II ESA will be used to perform an MPCA VIC Program Risk Based Site Evaluation based on intended land use, to determine if remediation is required under the applicable law to mitigate risk.

4.0 Mine Site Reclamation

Mine Site building demolition and pipeline/pump systems, power line, substation, road and railroad removal discussions are included in Section 2.0.

4.1 Mine Pit

Only the East Pit will be active, and no other Duluth Complex rock will be exposed at the end of Mine Year 1. The East Pit lake level at that time is estimated to be at 1,592 ft-MSL, allowing for sub-aqueous storage of material from the temporary stockpiles. Required pit wall sloping and revegetation will be done as the pit is developed. Reclamation activities will include:

- Construct the pit perimeter fence
- Construct a gate to provide access to the pit lake via an existing pit access ramp

4.2 Temporary Stockpile Relocation and Footprint Restoration

The temporary stockpiles are the Category 2/3 Waste Rock Stockpile, the Category 4 Waste Rock Stockpile and the Ore Surge Pile (OSP). The stockpiles are expected to contain materials at the end of Mine Year 1. Reclamation activities will include:

- Relocate (load and haul to bottom of pit) material in the temporary stockpiles to the East Pit
- Remove membrane liner and piping from the stockpile foundations and disposal at an off-site landfill
- Relocate (load and haul to bottom of pit) soil liner material from the stockpile foundations to the East Pit
- Cover stockpile footprints with two feet of soil
- Seed stockpile footprints

4.3 Ponds and Sumps

Lined and unlined ponds and sumps will have been constructed and in use at the end of Mine Year 1. Reclamation activities will include:

- Relocate (load and haul to bottom of pit) sediments in the lined ponds and sumps to the East Pit
- Remove membrane liner and piping from the lined ponds and sumps and disposal at an off-site landfill
- Relocate (load and haul to bottom of pit) soil liner material from the lined ponds and sumps to the East Pit
- Cover sump and pond footprints with two feet of soil
- Seed sump and pond footprints

4.4 Overburden Storage and Laydown Area (OSLA)

The majority of the material stored at the OSLA should be reused for reclamation of the Mine Site. Any remaining material will be contoured and the OSLA's footprint revegetated.

4.5 Permanent Stockpile

The Category 1 Waste Rock Stockpile is planned to be a permanent stockpile. The stockpile will contain material at the end of Mine Year 1. Reclamation activities will be:

- Construct the cover system (an engineered cover system to reduce percolation into the stockpile)
- Complete the Category 1 Stockpile Groundwater Containment System

Before the start of Project operations, the Category 1 Stockpile Groundwater Containment System will be installed to capture drainage and surface runoff from the stockpile. To allow for planned growth of the stockpile, the containment system would not be fully completed until Mine Year 4. In a Mine Year 1 default closure scenario, this system would require completion by connecting the northern and southern portions on the western end of the stockpile.

5.0 Plant Site Reclamation

5.1 Hydrometallurgical Residue Facility (HRF)

Although the HRF will not have been constructed, pre-construction activities will have occurred at the HRF by the end of Mine Year 1. Reclamation activities will be:

- Grading and seeding of the area disturbed by preconstruction activity using soils at the site.

5.2 Flotation Tailings Basin (FTB)

At the end of Mine Year 1, it is expected that Flotation Tailings will have been deposited in the FTB, a portion of Lift 1 will have been constructed, and the dam crest will be at elevation of approximately 1590 (+ 5) feet. The Transfer Pump Raft and Tailings Disposal Diffuser Raft will be operational. The FTB area requiring bentonite amendment will consist of approximately two-thirds to three-quarters of the exposed beaches, with the remainder consisting of pond area. Exterior slope areas will have previously been reclaimed as part of dam construction. Reclamation activities will be:

- Grade interior portions to provide a gently sloping surface that effectively routes stormwater runoff to the interior of the FTB, accommodates future differential settlement of the underlying Flotation Tailings, and maximizes ponding of water in the reclaimed FTB Pond.
- Seed and mulch upland areas. Vegetation types will be selected to limit root penetration to within the top 24-inches of the Flotation Tailings to minimize the potential for root penetration into the underlying bentonite-amended Flotation Tailings layer planned for 30-inches below the Flotation Tailings surface. Fertilizer may be used but care will be taken to minimize carry-over into pond areas, which would encourage algae growth.
- Place rip rap along the pond perimeter where wave action and freeze-thaw cycles occur to protect the bentonite layer.
- Construct the FTB Closure Overflow. It is expected that this structure will be modified to serve as a stormwater overflow or non-mechanical treatment system discharge. Because there is a net positive water balance in the region, it is anticipated that in the closure phase there will be occasional overflow (stormwater or non-mechanical treatment discharge) via the Closure Overflow outlet to the adjacent wetlands if operation of the WWTS is discontinued.
- Amend beaches and pond bottom with bentonite, as discussed below

5.2.1 FTB Beach Bentonite Amendment

Exposed beach areas will be amended in the reclamation phase with bentonite to limit oxygen infiltration into the Flotation Tailings. Granulated bentonite (approximately 3% by dry weight) will be added to an 18-inch thick layer of Flotation Tailings, overlain by an additional 30- inch layer of Flotation Tailings. The upper layer of tailings will be removed, and equipment will be utilized to facilitate bentonite application and thorough mixing. The bentonite will be placed and tilled via agricultural equipment. The removed tailings will then be replaced and vegetated.

5.2.2 FTB Pond Bottom Bentonite Amendment

The pond bottom will be amended with bentonite during the reclamation phase. Granular or pelletized bentonite will be systematically fed through a barge mounted broadcast spreader system to uniformly distribute the bentonite across the area of the pond. The bentonite will subsequently settle to the pond bottom where it will hydrate, swell, and due to its inherently low hydraulic conductivity, reduce percolation from the pond bottom.

The bentonite-amended pond bottom will reduce the percolation from the FTB Pond, thereby maintaining a permanent pond that will provide an oxygen barrier above the Flotation Tailings to reduce oxidation and resultant production of chemical constituents. It will also reduce the amount of water collected by the FTB seepage capture systems.

6.0 Long-Term Activities

The following long-term care activities that would continue during the closure and postclosure maintenance phases are included in the Mine Year 1 FAE:

- Water management (FTB and permanent stockpile containment systems, and water treatment)
- Permanent stockpile cover system inspection and maintenance
- FTB and other reclaimed areas inspection and maintenance
- Water quality and dam safety monitoring and reporting
- Legacy landfill monitoring and reporting

6.1 Water Management

Although the ultimate goal is to transition from mechanical treatment to non-mechanical treatment systems, this reclamation plan assumes that excess East Pit, FTB seepage capture system, and excess FTB pond water will continue to be pumped to the WWTS and the WWTS will continue operate during the long term. The transition from mechanical to non-mechanical treatment will occur only after the site-specific designs for non-mechanical systems have been proven and approved by the appropriate regulatory agencies.

6.1.1 Mine Site

The relocation of the materials in the temporary stockpiles to the East Pit will result in a flushing of oxidation products into the East Pit water. As the East Pit floods with water, oxidation products that have accumulated on the pit wall rock will be flushed into the pit as the water level rises. The flushed oxidation products will be removed from the East Pit by pumping the pit water to the WWTS for treatment and returning the treated water to the pit.

Once the flushing load has been removed, the pit will be flooded with groundwater inflow, surface water runoff and water collected by the permanent stockpile groundwater containment system.

When the water elevation in the pit no longer allows the water from the permanent stockpile groundwater containment system to flow by gravity to the pit, that water will be pumped to the pit.

When the East Pit water reaches its designed long-term elevation, that level will be managed by pumping pit water to the CPS and then to the WWTS via the MPP to prevent pit overflow. This is expected to continue until the pit water quality reaches an acceptable level. For purposes of this reclamation plan, it is assumed that the WWTS will be operated and maintained until DNR issues a release of the permittee under Minnesota Rules, chapter 6132.

6.1.2 Plant Site

At the start of reclamation, the volume of water treated by the WWTS will increase relative to operations while the FTB’s water balance stabilizes. WWTS influent sources will include water collected by the FTB seepage capture systems, excess FTB pond water and water from the Mine Site as described above. WWTS discharge will continue to augment stream headwaters to replace flow collected by the containment system.

6.2 Cover System Maintenance

The permanent stockpile cover system at the Mine Site will require annual maintenance. Annual maintenance will consist of repair of erosion, removal of deep-rooted woody plant species (as permits require), repair of impacts from burrowing animals, and any other conditions that, if left unresolved, could impair performance of the cover. Periodic inspections (typically each spring and fall and after rainfall events approaching or exceeding the design event) will be conducted to identify any areas requiring repair.

6.3 Dam Safety Maintenance and Monitoring

Annual maintenance (e.g., erosion repairs) of the FTB will be required. For purposes of this reclamation plan, it is assumed that this maintenance will continue until DNR issues a release of the permittee under Minnesota Rules, chapter 6132.

The bentonite amendment will require periodic inspection early in the life of the reclaimed pond to confirm that the selected erosion control and freeze-thaw protection method (typically well graded rip rap) is effective and to repair and upgrade riprap in any areas showing signs of erosion and/or freeze-thaw impacts.

Inspection, monitoring and reporting with respect to the FTB dams will continue as required by the Dam Safety Permits for the Project. For purposes of this reclamation plan, it is assumed that this monitoring will continue until DNR issues a release of the permittee under Minnesota Rules, chapter 6132.

6.4 Water Quality Monitoring

For purposes of this reclamation plan, it is assumed that the water quality sampling locations, frequency, and analytes tested that are defined by the Project NPDES/SDS permit will continue. This monitoring will continue until MPCA or DNR, as applicable, issues the necessary release of permittee under the relevant statutes and rules. Water quality monitoring will be included for the following:

- East Pit lake water
- Ground water and surface water around permanent stockpile and East Pit
- FTB pond water
- Ground water and surface water downstream of FTB pond
- WWTS influent and effluent

6.5 Legacy Landfills

6.5.1 Coal Ash Landfill

Coal ash from LTVSMC's Taconite Harbor facility was disposed at the Hoyt Lakes' Coal Ash Landfill located southeast of the Tailing Basin. As part of a Compliance Agreement with the MPCA, LTVSMC agreed to close the Coal Ash Landfill. Cliffs Erie currently is responsible for postclosure activities concerning the Coal Ash Landfill, and PolyMet expects to become responsible for those activities when the Project receives its PTM. PolyMet intends to continue implementing the plans described below.

A Closure Plan and Postclosure Plan were subsequently submitted to the MPCA during May 2000. That plan indicated that LTVSMC would stop accepting coal ash at the disposal area by approximately August 1, 2000. The Closure Plan was prepared in accordance with Minnesota Rules, part 7035.2815, subpart 5, items D and E, subpart 6 and subpart 16 and specified that closure activities be completed by September 2000.

The Postclosure Plan for the Coal Ash Landfill indicates that the postclosure care period will continue for 30 years from the final closure certification which certifies that the Coal Ash Landfill has been closed in accordance with approved plans and specifications as required by Minnesota Rules, part 7035.2610. Final closure was approximately 2000.

Until 2030, inspections of the final cover system and surface water control system will be performed three times a year (spring, summer and fall), maintenance will be performed as necessary and an annual report describing the inspection(s), conditions observed, corrective actions, maintenance activities, and monitoring activities will be submitted to MPCA. PolyMet has included costs to perform these activities in its FAE.

6.5.2 Industrial Landfill SW-619

Cliffs Erie's Industrial Landfill operates under MPCA Solid Waste Management Permit 619 (SW-619). A groundwater monitoring system and a methane ventilation system were already present at the closed LTVSMC industrial waste landfill and are currently used to monitor conditions at Industrial Landfill SW- 619. Groundwater and methane monitoring is performed annually during October each year. PolyMet expects to become responsible for landfill permit when the Project receives its PTM. PolyMet has included costs to perform these activities in its FAE.

The postclosure care period will continue for 30 years from the final closure certification, which certifies that the disposal area has been closed in accordance with approved plans and specifications as required by Minnesota Rules, part 7035.2610. Current plans are to close this landfill in 2018.

7.0 Financial Assurance Estimate (FAE)

The following sections describe how the FAE was developed. Section 7.1 describes the organization of the FAE, which includes two parts: short-term activities in the reclamation phase, and long-term activities during the closure and postclosure maintenance phases. Section 7.2 describes the basis for short-term reclamation activities and Section 7.3 describes the basis for long-term activities.

The remainder of this section provides information about the firms that developed costs used in the FAE:

Barr Engineering Co. (Barr)

Barr is very familiar with the former LTVSMC site and Project and, working with PolyMet engineers, developed scopes of work and estimates for Project reclamation including the Category 1 Waste Rock Stockpile Cover and Groundwater Containment Systems, and FTB Bentonite Amendments and Emergency Overflow.

Barr has done Project water modeling for environmental review and permitting and designed the water management systems. Barr has also designed the WWTS and developed detailed operating and maintenance costs for the WWTS.

Barr has provided dam safety geotechnical services for the tailings basin while LTVSMC was in operation, ongoing services since the basin was closed, and designed the FTB dams for the Project. Barr provided cost estimates for dam safety geotechnical services as well as project staff during reclamation.

Northeast Technical Services (NTS)

NTS is very familiar with the former LTVSMC site, and has been working on AOCs, monitoring and reporting on legacy tailings basin geotechnical instrument, and monitoring, maintaining and reporting other site conditions since the LTVSMC bankruptcy in 2001. NTS provided cost estimates for these activities as well as rate information for site manager and vehicles.

Lakehead Constructors Inc. (Lakehead)

Lakehead is a major local construction contractor, and has worked with PolyMet engineers to develop cost estimates for building demolition, infrastructure removal, and footprint restoration for legacy and Project facilities. Lakehead personnel have been on site to inspect legacy buildings.

Mavo Systems (Mavo)

Mavo is a Minnesota-based specialist contractor providing environmental services, and has worked with PolyMet engineers to develop cost estimates for asbestos, lead paint and mold abatement for legacy facilities. Mavo personnel have been on site to inspect legacy buildings.

Arrowhead Consulting & Testing Inc (Arrowhead)

Arrowhead is a Minnesota-based specialist consultant providing environmental inspection and testing services, and has worked with PolyMet engineers to develop inventories of ACMs for legacy facilities and cost estimates for additional tests where required. Arrowhead personnel have been on site to inspect legacy buildings.

Ames Construction (Ames)

Ames is national contractor with experience in mine construction and reclamation. Ames is very familiar with the former LTVSMC site and Project and, working with PolyMet and Barr engineers, has developed estimates for Project construction. Ames provided unit cost information used for earthmoving and related reclamation activities.

D & T Landscaping, Inc. (D&T)

D&T is very familiar with the former LTVSMC site, and has been providing reclamation seeding, fertilizing and mulching services since the LTVSMC bankruptcy in 2001. D&T provided cost estimates for these ongoing activities.

Pace Analytical (Pace)

Pace is a nationwide provider of laboratory services headquartered in Minneapolis, Minnesota with a laboratory in Virginia, Minnesota. Pace rates were used to develop water quality analysis costs.

7.1 FAE Organization

The FAE was developed in a standard Excel spreadsheet with no macros or user programming. All financial assurance estimates associated with the PTM Application were developed using this spreadsheet.

<u>Mine Year 1 Reclamation FAE</u>

The Mine Year 1 Reclamation FAE is attached as Appendix A-1. There are 13 tabs or worksheets used in the Mine Year 1 Reclamation FAE, which are described in Table 7-1:

Table 7-1 Mine Year 1 Reclamation FAE Tabs

Tab/worksheet Name	Tab/worksheet Contents	Source of Contents
MY1 Reclamation Tab	estimate and summary for reclamation activities	See "Note" column in tab
Unit $ Reclamation Tab	unit costs	See "Comments" column in tab

Tab/worksheet Name	Tab/worksheet Contents	Source of Contents
Pipe-Liner Off Site Disposal Tab	development of unit costs for offsite disposal of pipe and liners based on local transportation and tipping fees	Dem-Con Companies General Waste in Keewatin
Ponds and Sumps Tab	number and acreage of lined and unlined ponds and sumps	Changes Over Time Memo (see Table 7-3)
SOW3 Cat 1 Cover Sys (Yr 1) Tab	engineering estimate for permanent stockpile cover system	Barr
SOW11 HRF Cover Sys (Yr 1) Tab	engineering estimate for restoration of disturbance due to HRF preconstruction activity	Barr
SOW14 FTB Cover Sys (Yr 1) Tab	engineering estimate for FTB bentonite amendment	Barr
FTB Emerg OFlow CONCEPT Tab	concept for Mine Year 1 1 FTB Emergency Overflow	Barr
SOW14 FTB Emerg OFlow (Yr 1) Tab	engineering estimate FTB emergency overflow	Barr
SOW21 Cat 1 Cont Sys (Yr 1) Tab	engineering estimate for completion of permanent stockpile containment system	Barr
AoC Tab	summary of engineering estimates for remediation of AOCs	NTS
Demo Tab	estimates for abatement, demolition, waste disposal and restoration for building, pipelines, power lines, roads and railroads	Lakehead, Mavo, Arrowhead
AST Tab	estimates for abatement, demolition, waste disposal and restoration ASTs	Lakehead

Mine Year 1 Long Term FAE

The Mine Year 1 Long Term FAE is attached as Appendix A-2. There are three tabs or worksheets used for the Mine Year 1 Long Term FAE, which are described in Table 7-2:

Table 7-2 Mine Year 1 Long Term FAE Tabs

Tab/worksheet Name	Tab/worksheet Contents	Source of Contents
MY1 Long Term Tab	estimate and summary for long term activities	See “Note” column in tab
Unit $ Reclamation Tab	unit costs	See “Comments” column in tab
Water Quality Samp-Anal-Rep Tab	development of water quality sampling, analysis and reporting costs	Pace

7.2 Reclamation Basis

This section describes the sources of information used to estimate the reclamation costs. The FAE assumes that the first year after closure of the Project will be a holding year with no reclamation activities. After the holding year, reclamation activities will occur over a three-year period.

Table 7-3 lists the sources used for the Mine Year 1 Reclamation FAE.

Table 7-3 Summary of Sources Uses in Mine Year 1 Reclamation FAE

Referenced As	Description	Used For
Attachment C	PolyMet specifications (C1) Mavo estimates (C2 and C3)	Legacy building asbestos abatement costs
Attachment D	PolyMet specifications Arrrowhead estimates (D1 and D2)	Legacy building asbestos inspection costs
Attachment E Attachment F	PolyMet specification (E1 and F1) and Lakehead estimates (E2 and F2)	Building and AST demolition, road, railroad, pipeline and power line removal and site restoration costs
Attachment G	NTS estimates for AOC remediation	AOC Remediation costs
Attachment H1	Ames letter to support Ames portion of Unit $ Reclamation Tab (Ames 2016)	Unit costs for temporary stockpile material relocation and footprint reclamation, pit perimeter fence, pond and sump reclamation
Attachment H2	Ames Email with new item Unit $ Reclamation Tab and update for SOW14 FTB Cover Sys (Yr 1) Tab (Ames 2017)	Unit cost for OSLA grading and bentonite transport/spreading
Attachment I1 and Attachment I2	NTS emails used with Pipe-Liner Off Site Disposal Tab	Transport of liner and pipes to offsite landfill and tipping fees

Referenced As	Description	Used For
Attachment I3	NTS letter (2016)	Rate for pickup truck
Attachment J	D&T letter (D&T 2016)	Unit costs for reclamation seeding
Attachment K1	Barr 2016 Fee Schedule	Rates for Project Manager, Project Engineer and Project Inspectors
Appendix 15.4 of PTM Application Changes Over Time Memo	Bar Engineering memo *NorthMet Project Feature Changes Over Time Dec 2017.pdf*	Quantities/areas for temporary stockpile material relocation and footprint reclamation, pit perimeter fence, pond and sump reclamation and reclamation seeding
Appendix 4 of PTM Application	Appendix 4 Categories 1, 2/3, and 4 Stockpiles and Ore Surge Pile Design and Category 1 Stockpile Groundwater Containment System Permit Application Support Drawings	Engineering estimates for Permanent Stockpile Cover and Groundwater Containment Systems
Appendix 6 of PTM Application	Appendix 6 Flotation Tailings Basin and FTB Seepage Containment and Stream Augmentation Systems Permit Application Support Drawings	Engineering Estimate for FTB Bentonite Amendments
Appendix 7 of PTM Application	Appendix 7 Hydrometallurgical Residue Facility Permit Application Support Drawings	Engineering Estimates for HRF

7.2.1 Asbestos Abatement, Building Demolition and Infrastructure Removal

PolyMet developed a specification for the ACM abatement needs for legacy buildings, except the Main Plant buildings (Attachment C1). Mavo submitted a proposal (Attachment C2) to implement that ACM abatement scope of work. Mavo submitted a second proposal (Attachment C3) for the Main Plant buildings. Arrowhead submitted estimates for the inspections and sampling of the ACM (Attachment D1 and Attachment D2).

For the demolition of buildings, PolyMet developed two separate specifications. The first specification was for demolition of the Additive Building and Heating Plant, and reclamation of the associated site footprint (Attachment E1). Lakehead submitted a proposal for the costs under this specification (Attachment E2).

The second specification for demolition of all buildings (other than the Additive Building and Heating Plant), and reclamation of the associated sites footprints (Attachment F1). Lakehead submitted a proposal to cover this specification (Attachment F2).

The cost estimates for building demolition on the above proposals included mobilization, contractor overhead, contractor profit, and contractor supervision. These estimates are listed in the FAE on the Demo Tab, and are linked to the MY1 Reclamation Tab under line items “Mine Site – Demo” and “Plant Site – Demo and Abatement”.

The cost estimates for AST removal (Attachment F2) on the above proposals included mobilization, contractor overhead, contractor profit, and contractor supervision. These estimates are listed in the FAE on the AST Tab, and are linked to the MY1 Reclamation Tab under the line item “Plant Site – Other”.

7.2.2 Areas of Concern (AOCs)

NTS provided cost estimates for investigating and/or remediating 24 of the 26 open AOCs (Attachment G). The two AOCs that do not have cost estimates associated with them, AOC50 and AOC63, are open, but do not have any costs associated with them as the only action needed is a final report (see Table 3-1).

NTS did the original ESA and has worked on all AOC site sampling and remediation that has occurred to date. NTS anticipates that some sites may be closed based on desk-top analysis while others may require sampling, and based on the results of the sampling, some may require remediation.

The cost estimates for the AOC work included mobilization, contractor overhead, and contractor supervision. These estimates are listed in the FAE on the AoC Tab, and are linked to the MY1 Reclamation Tab under the line item “Plant Site – Other”.

The NTS cost estimates assume the AOC work will be completed over a three-year period. This timing is consistent with the work to-date under the MPCA VIC process.

7.2.3 Mine Site

The costs for demolition of Mine Site buildings and removal of the pipes, pumps, power lines, roads and railroads with site restoration are included in the FAE on the MY1 Reclamation Tab under the line items “Mine Site – Demo”.

<u>Temporary Stockpile Relocation and Footprint Restoration</u>

The cost estimate for relocating the material in the temporary stockpiles the East Pit is based on local contractor unit prices from the Unit $ Reclamation Tab (Ames 2016) and quantities from Changes Over Time Memo. This estimate is included in the FAE on the MY1 Reclamation Tab under the line item “Mine Site - Stockpile Relocation”.

The cost estimate for separating the liner and pipes underneath the facility from rock and soil material is based on local contractor unit prices from the Unit $ Reclamation Tab (Ames 2016) and quantities from Changes Over Time Memo, and is included in the FAE on the MY1 Reclamation Tab under the line item “Mine Site - Stockpile Footprint Reclamation”.

The cost estimate for disposal of liner and pipes at a local appropriate landfill is based on unit costs developed from local transport and tipping fees (Attachment I1 and Attachment I2) on the Pipe-Liner Off Site Disposal Tab and quantities from Changes Over Time Memo, and is included in the FAE on the MY1 Reclamation Tab under the line item “Mine Site - Stockpile Footprint Reclamation”.

The cost estimate for covering stockpile footprints with two feet of soil and revegetating is based on local contractor unit prices from the Unit $ Reclamation Tab (Ames 2016 and D&T 2016) and quantities from Changes Over Time Memo, and is included in the FAE in the MY1 Reclamation Tab under line item “Mine Site - Stockpile Footprint Reclamation.”

The cost estimate for removal of the piping, pumps and power lines associated with the temporary stockpiles with site restoration is based on the Mine Year 20 configurations, which have a liability equal to or greater than the liability at the end of Mine Year 1, and is included in the FAE on the MY1 Reclamation Tab under the line items “Mine Site – Demo”.

<u>Overburden Storage and Laydown Area (OSLA)</u>

The estimated cost of grading the OSLA footprint (assume 6” average material graded) and revegetating is based on local contractor unit prices from the Unit $ Reclamation Tab (Ames 2017 and D&T 2016) and quantity from Changes Over Time Memo, and is included in the FAE on the MY1 Reclamation Tab under line item “Mine Site – OSLA”.

<u>Mine Pit</u>

The estimated cost for removal of the dewatering system, in-pit pumps and piping, in-pit powerline and substation with site restoration is based on the Mine Year 20 configurations, which have a liability equal to or greater than the liability at the end of Mine Year 1, and is included in the FAE on the MY1 Reclamation Tab under the line items “Mine Site – Demo”.

The cost estimate for the pit perimeter fence and pit lake access gate is based on local contractor unit prices from the Unit $ Reclamation Tab (Ames 2016) and quantities from Changes Over Time Memo and is included in the FAE on the MY1 Reclamation Tab under the line items “Mine Site – Pit.”

<u>Pond and Sump Removal</u>

The cost for cleaning out, separating the liner and pipes and revegetating the ponds and sumps is based on local contractor unit prices from the Unit $ Reclamation Tab (Ames 2016) and quantities from the Ponds and Sumps Tab, based on the Changes Over Time Memo, and is included in the FAE on the MY1 Reclamation Tab under line item “Mine Site - Ponds and Sumps”.

The cost estimate for disposal of liner and pipes at a local appropriate landfill is based on unit costs developed from local transport and tipping fees (Attachment I1 and I2) on the Pipe-Liner Off Site Disposal Tab and quantities from the Ponds and Sumps Tab, based on the Changes Over Time Memo, and is included in the FAE on the MY1 Reclamation Tab under line item “Mine Site - Ponds and Sumps”.

<u>Permanent Stockpile</u>

The cost estimate for completing the containment system is developed in the engineering estimate on the SOW21 Cat 1 Cont Sys (Yr 1) Tab and is included in the MY1 Reclamation Tab under line item “Mine Site – Construction”. The engineering estimate is based on the containment system design shown on permit level design drawings GCS-003 and GCS-010 to 013 which are attached to the Application Appendix 4, and includes contractor profit/overhead, mobilization, and construction QA/QC.

The cost estimate for constructing the cover system is developed in the engineering estimate on the SOW3 Cat 1 Cover Sys (Yr 1) Tab and is included in the FAE on the MY1 Reclamation Tab under line item “Mine Site – Construction”. The engineering estimate is based on the cover system design shown on permit level design drawings SKP-011, SKP-013 and SKP-032 to 035 which are attached to the Application Appendix 4 and includes contractor profit/overhead, mobilization, and construction QA/QC.

7.2.4 Plant Site

The cost estimate for demolition of Plant Site buildings including abatement and removal of the pipes, pumps, power lines, roads and railroads with site restoration is included in the FAE on the MY1 Reclamation Tab under line item “Plant Site – Demo and Abatement”.

The cost estimate for removal of ASTs with site restoration is included in the FAE on the MY1 Reclamation Tab under line item “Plant Site – Other”.

The cost estimate for remediation of AOCs is included in the FAE on the MY1 Reclamation Tab under line item “Plant Site – Other”.

HRF Preconstruction Disturbance

The cost estimate for reclaiming the preconstruction disturbance at the HRF is developed in the engineering estimate on the SOW11 HRF Cover Sys (Yr 1) Tab and is included in the FAE on the MY1 Reclamation tab under line item “Plant Site – General Reclamation”. The engineering estimate is based on permit level design drawings HRF-007 which is attached to the PTM Application Appendix 7, and includes contractor profit/overhead, mobilization, and construction QA/QC.

FTB

The cost for constructing the beach and pond bottom bentonite amendment is developed in the engineering estimate on the SOW14 FTB Cover Sys (Yr 1) Tab and is included in the FAE on the MY1 Reclamation Tab under the line item “Plant Site – Construction”. The engineering estimate is based on the design shown on permit level design drawings FTB-005, FTB-010 and FTB-024 which are attached to the Application Appendix 6, and includes contractor profit/overhead, mobilization, and construction QA/QC.

The estimated cost for constructing the emergency overflow is developed in the engineering estimate on the SOW14 FTB Emerg OFlow (Yr 1) Tab and is included in the FAE on the MY1 Reclamation Tab under line item “Plant Site – Construction”. The engineering estimate is based on the conceptual design shown on FTB Emerg OFlow CONCEPT Tab and includes contractor profit/overhead and mobilization.

7.2.5 Project Management

Cost estimates for staff and vehicles that support reclamation activities are assumed to be for a three-year period and are based on prices from the Unit $ Reclamation Tab and is included in the FAE on the MY1 Reclamation Tab under line item "Project Management".

Project Manager

Annual salary with benefits from an hourly rate is based on the average Barr rate for a top-level professional (Attachment K1). Annual cost estimate is based on the assumption of 1 FTE.

Project Engineer

Annual salary with benefits from an hourly rate is based on the average Barr rate for a mid-level professional (Attachment K1). Annual cost estimate is based on the assumption of 1 FTE.

Project Inspector

Annual salary with benefits from an hourly rate is based on the average Barr rate for a technician I (Attachment K1). Annual cost estimate is based on the assumption of 2 FTE.

Vehicles

Vehicle $/mile is based on NTS charge for a pickup (Attachment I3). Annual cost estimate is based on the assumption of 15,000 miles per year for each of four pickups.

7.2.6 Indirects

Indirect costs of reclamation are included in the FAE on the MY1 Reclamation Tab.

Contingency

A contingency of 10% was applied to the total direct cost estimate for the reclamation activities.

Adaptive Management

An allowance for adaptive management of 2% was applied to the total direct cost less Project Management.

Engineering Redesign

An allowance for engineering redesign of 2% was applied to the total direct cost less Project management for the reclamation activities.

Performance Bond

A performance bond charge of 1% was applied to the total direct cost.

Prime Contractor Markup

A prime contractor markup of 2.5% was applied to the total direct cost for reclamation activities.

7.3 Long Term Basis

Long term cost estimates include ongoing activities that start in the first year after the Project is closed and continue into the closure and postclosure maintenance periods. Some long-term activities change once reclamation is complete and the site is safe and stable. Based on the activities described above, a 100-year cash flow with financial assurance put into place in 2018 and expenses starting in 2019 was developed. An NPV was calculated using an effective discount rate of 2.9%. Table 7-4 lists the sources used for the Mine Year 1 Long Term FAE.

Table 7-4 Summary of Sources Used in MY1 Long Term FAE

Referenced As	Description	Used For
Attachment H2	Ames Email with update item Unit $ Long Term Tab (Ames 2017)	Rate for road grader
Attachment I3	NTS letter	Rates for dam safety instrumentation services, landfill SW-619 monitoring, Site Manager, pickup truck and pump maintenance truck
Attachment K2	Barr letter	Rates for dam safety geotechnical services
Attachment L	MN DOLI Prevailing Wage List	Rates for Water Treatment Operator and Repairman
Attachment M	PolyMet Historical Snow Plowing	Snow plowing cost
Attachment N	Pace Price List	Water sample analysis cost
Water Treatment Memo	Barr memo *Technical Memo O&M for Water Treatment after Mine Year 1 Closure Dec2017*	Costs for water treatment and facility replacement
Non-Mechanical Treatment Memo	Barr memo *Non-Mechanical Treatment Memo Barr Summary of Non-Mechanical Treatment Plans for PolyMet May 2016*	Cost for development of non-mechanical water treatment systems

7.3.1 Water Management

Water management systems include:

- Pumps and piping from the permanent stockpile containment system to the CPS
- Pumps and piping from Mine Site to WWTS (CPS and MPP)
- Pumps and piping from the FTB containment system to the WWTS

- WWTS and pumps and piping to discharge points

The Water Treatment Memo describes the plan for operation of water management systems and develops the operating, maintenance, replacement, and expansion costs to implement that plan (Appendix 15.4).

Table 1 of the Water Treatment Memo has an annual cost for OPEX for the Mine Site and Plant Site for several time periods. These are used in the FAE on the MY1 Long Term Tab under line items "Water Treatment Plant Site - Treatment O&M Less Labor" and "Water Treatment Mine Site - Treatment O&M Less Labor" for the corresponding periods.

Table 1 of the Water Treatment Memo has an annual cost for Equipment Replacement for the Mine Site and Plant Site. The cost estimates for water treatment equipment replacement are based on the operating life and initial cost for all equipment (with buildings and supporting systems) and assumes the equipment is replaced at its original cost at the end of its life. The result is an annual cost for each type of equipment which is the original cost divided by the operating life. The annual equipment replacement cost is the sum of the individual equipment costs. This is explained in detail in the Water Treatment Memo. These costs are used in the FAE on the MY1 Long Term Tab under line items "Water Treatment Plant Site - Facility Replacement" and "Water Treatment Mine Site - Facility Replacement".

Table 1 of the Water Treatment Memo has a cost estimate for Equipment Addition (CAPEX) for the Plant Site. The cost estimates for water treatment equipment addition are based on the required additional WWTS capacity and cost for equipment (with supporting systems) to provide that capacity. This is explained in detail in the Water Treatment Memo. This cost is used in the FAE on the MY1 Long Term Tab under line item "Water Treatment Plant Site - Facility Expansion".

The water management system will be designed for remote monitoring and automated operation. In addition to operating the system, operators will perform routine maintenance, inspections and collect water quality samples site wide. Water management system labor hourly rate is Skilled Labor from Minnesota Department of Labor and Industry prevailing wage charts (Attachment L) multiplied by 1.15 to account for employment costs. Annual cost is based on the rate from the Unit $ Long Term Tab (DOLI 2016) and the assumption of 3.14 FTE, and is included in the FAE on the MY1 Long Term Tab under line item "Water Treatment Plant Site – Labor".

The water management system will require some specialized maintenance in addition to the routine maintenance done by operators and equipment replacement covered under facility replacement. The water management system specialized maintenance rate is Electrician from Minnesota Department of Labor and Industry prevailing wage charts (Attachment L) multiplied by 1.15 to account for employment costs. Annual cost is based on the rate from the Unit $ Long Term Tab (DOLI 2016) and the assumption of 0.1 FTE, and is included in the FAE on the MY1 Long Term Tab under line item "Water Treatment Plant Site – Specialized Maintenance".

To further the ultimate goal of transitioning from mechanical treatment to non-mechanical treatment, the estimate for water management includes cost to develop the site-specific designs. The cost for this development is from the Non-Mechanical Treatment Memo and is included in the FAE on the MY1 Long Term Tab under line item “Other – NMT Development”.

7.3.2 Maintenance

Snow Plowing and Road Maintenance

The annual estimated cost for snow plowing is based on historical PolyMet costs (Attachment M) for the site from the Unit $ Long Term Tab (PolyMet 2016) and is included in the FAE on the MY1 Long Term Tab under line item “Maintenance and Monitoring – Maintenance”.

The annual estimated cost for road maintenance is based on an estimate for a grader on an as needed basis from the Unit $ Long Term Tab (Ames 2017) and is included in the FAE on the MY1 Long Term Tab under line item “Maintenance and Monitoring – Maintenance”. During the 3-year reclamation period, road maintenance is increased due to reclamation activity.

Permanent Stockpile Maintenance

The annual cost estimate for permanent stockpile cover maintenance covers management of plants with deep, woody roots, monitoring of the soil surface cover for erosion and repairing erosion damage. The annual amount is from the Unit $ Long Term Tab and is included in the FAE on the MY1 Long Term Tab under line item “Maintenance and Monitoring – Maintenance”.

The annual cost estimate for permanent stockpile containment system maintenance covers maintaining flow in the drain pipe, maintaining surface water controls, repairing the cutoff wall. The annual amount is from the Unit $ Long Term Tab and is included in the FAE on the MY1 Long Term Tab under line item “Maintenance and Monitoring – Maintenance”.

FTB Maintenance

The annual cost estimate for FTB erosion maintenance is based on PolyMet’s experience with vegetation maintenance and erosion control at this facility from the Unit $ Long Term Tab and is included in the FAE on the MY1 Long Term Tab under line item “Maintenance and Monitoring – Maintenance”. Annual cost is based on historic annual expense during reclamation ($60,000) and then reduced until an ongoing annual amount of $10,000 is reached.

The annual cost estimate for FTB containment system maintenance includes maintaining flow in the drain pipe, maintaining surface water controls, and repairing the cutoff wall. The annual amount is from the Unit $ Long Term Tab and is included in the FAE on the MY1 Long Term Tab under line item “Maintenance and Monitoring - Maintenance”.

The annual estimated cost for achieving closure of the legacy portion of the FTB (Cell 2W) assumes a 6-year period to provide stable slopes, adequate vegetation cover, and drainage provisions to resist erosion and route precipitation away from Cell 2W. The cost estimate is from the Unit $ Long Term Tab and is included in the FAE on the MY1 Long Term Tab under line item “Maintenance and Monitoring – Maintenance”.

7.3.3 Water Quality Monitoring

The cost estimate for water quality monitoring is developed in the Water Quality Samp-Anal-Rep Tab and is included in the FAE on the MY1 Long Term Tab under line item “Maintenance and Monitoring – Monitoring”. The cost estimate assumes samples collected by water management system operators, number of samples analyzed, and results reported by a local laboratory and reports prepared and submitted by the Site Manager. The cost for sample analysis, QA/QC and results reporting is based on Pace prices (Attachment N).

7.3.4 Dam Safety Monitoring

In 2016 NTS prepared estimates (Attachment I3) for biannual inspection and data collection of tailings basin instrumentation and preparation of an instrumentation report. In 2016 Barr prepared estimates (Attachment K2) for inspection and preparation of an annual geotechnical report. Barr and NTS have been doing this work at the former LTVSMC site since the LTVSMC bankruptcy in 2001. Dam safety monitoring will occur two times per year.

The annual cost estimate for dam safety monitoring is based on annual costs from the Unit $ Long Term Tab (NTS 2016 and Barr 2016) and is included in the FAE on the MY1 Long Term Tab under line item “Maintenance and Monitoring – Monitoring”.

7.3.5 Legacy Landfill Monitoring

<u>Landfill SW-619</u>

Landfill SW-619 is planned to be closed in 2018. In 2016 NTS prepared estimates (Attachment I3) for annual inspection, monitoring, and reporting associated with the landfill.

The annual estimated cost for Landfill SW-619 monitoring is based on annual costs from the Unit $ Long Term Tab (NTS 2016) and is included in the FAE on the MY1 Long Term Tab under line item “Maintenance and Monitoring – Monitoring”.

<u>Coal Ash Landfill</u>

The current MPCA-approved closure plan for the closed Coal Ash Landfill includes various activities through 2030. The annual cost estimate for its inspection, monitoring and reporting is based on PolyMet’s FY2018 budget. The annual cost for Coal Ash Landfill monitoring from the Unit $ Long Term Tab and is included in the FAE in the MY1 Long Term Tab under line item “Maintenance and Monitoring – Monitoring”.

7.3.6 Site Administration and Management

Estimated costs for staff, vehicles, engineering and insurance that support long term activities are included in the FAE on the MY1 Long Term Tab under line item “Administration and Management”.

<u>Site Manager</u>

Annual salary with benefits from an hourly rate is based on the NTS rate for mid-level professional (Attachment I3). Annual cost estimate is based on the assumption of 1 FTE during holding and reclamation and 0.5 FTE in the long term. The rate is from the Unit $ Long Term Tab (NTS 2016).

DNR Oversight

Annual cost estimate is based on the assumptions of 6 FTE during holding (2 FTE are for legal assistance to secure financial assurance funds), 4 FTE in reclamation and 2 FTE in the long-term period. Cost estimates were provided by DNR as a flat rate (that includes overhead and expenses) for all FTEs. The rate is from the Unit $ Long Term Tab (DNR).

Engineering Service

An annual cost estimate of $25,000 for engineering service is included in the long-term phase.

Facility Insurance

The annual cost estimate of $150,00 for insurance on facilities needed for water management was provided by PolyMet's insurance broker.

Environmental Insurance

An annual estimated cost of $100,00 for a $10,000,000 environmental insurance policy is included in the long-term phase.

Vehicles

Vehicle $/mile estimate is from the NTS charge for a pickup truck (Attachment I3). Annual cost is based on the assumption of 25,000 miles per year. The rate is from the Unit $ Long Term Tab (NTS 2016).

Vehicle $/mile estimate is from the NTS charge for a pump maintenance truck (Attachment I3). Annual cost based on assumption of 15,000 miles per year. The rate is from the Unit $ Long Term Tab (NTS 2016).

7.3.7 Indirects

Indirect costs for the long-term period are included in the FAE on the MY1 Long Term Tab.

Contingency

A contingency of 15% was applied to the total direct costs for the long-term period.

Adaptive Management

An allowance for adaptive management of 2% was applied to the total direct cost less administration and management costs.

Contractor Supplies Markup

An allowance for contractor supplies markup of 2.5% was applied to contractor supplies included in the FAE.

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Appendix A

Mine Year 1

	Mine Year 1 Projection			
	Reclamation		Long Term	
	(Appendix A-1)		(Appendix A-2)	
Discount Rate (Cash Flow starts year before expenses start and expenses occur mid year)	0.0%			2.9%
PolyMet Estimate	$133,621,573			$410,101,543
TOTAL MY1 PROJECTION	**543,723,116**			

Appendix A-1 Mine Year 1 Reclamation Estimate

12/7/2017

Includes Demo of Legacy Buildings (less Abatement and buildings demoed during Construction), Project Buildings, AOCs, Project Construction and Project Operational Disturbances as of the end of MY1

										01/01/18	07/01/19	07/01/20	07/01/21	07/01/22
											Year of Closure			
								$112,869,961	$102,973,571		1	2	3	4
									2.9%		MY			
	Support Tab	**Quantity**	**Units**	**Unit $**	**Cash $**	**NPV $**	**Note**	**6 Yr Tot**	**NPV**	**Operating**	**Hold**	3	4	5
Reclamation Total with Indirects		Quantities from Barr Changes Over Time Memo Unless Noted			**$133,621,573**	**$121,898,444**	FA for Cash Amount							
Contingency	**10.0%**				**$11,380,656**	**$10,382,126**								
Adaptive Management	**2.0%**				**$2,225,563**	**$2,030,658**								
Engineering Redesign	**2.0%**				**$2,225,563**	**$2,030,658**								
Performance Bond	**1.0%**				**$1,138,066**	**$1,038,213**								
Prime Contractor Markup	**2.5%**				**$2,845,164**	**$2,595,531**								
Mobilization	**4.0%**				**$0**	**$0**								
Reclamation Total (no Indirects)					**$113,806,561**	**$103,821,258**								
Mine Site					$48,879,815	$44,999,799								
General Reclamation														
Stockpile Relocation					$21,462,374	$19,982,800								
Cat 2/3 - rock	Unit $ Reclamation	5,238,766	Tons	$2.39	$12,545,466	$11,680,606	From Cat 2/3 stockpile to floor of East Pit [Ames 2016]	12,545,466	11,680,606	0	0	12,545,466	0	0
Cat 2/3 - sat overburden	Unit $ Reclamation	192,150	Tons	$2.39	$460,149	$428,427	From Cat 2/3 stockpile to floor of East Pit [Ames 2016]	460,149	428,427	0	0	460,149	0	0
Cat 4 - rock	Unit $ Reclamation	1,489,201	Tons	$1.79	$2,664,886	$2,481,174	From Cat 4 stockpile to floor of East Pit [Ames 2016]	2,664,886	2,481,174	0	0	2,664,886	0	0
Cat 4 - sat overburden	Unit $ Reclamation	192,150	Tons	$1.79	$343,847	$320,143	From Cat 4 stockpile to floor of East Pit [Ames 2016]	343,847	320,143	0	0	343,847	0	0
OSP - rock	Unit $ Reclamation	2,275,000	Tons	$2.39	$5,448,026	$5,072,450	From OSP to floor of East Pit [Ames 2016]	5,448,026	5,072,450	0	0	5,448,026	0	0
Stockpile Footprint Reclamation					$4,236,751	$3,833,506								
Cat 2/3		-	-		$2,152,208	$1,947,365								
Drain Pipe Removal and Prep for Transport	Unit $ Reclamation & Pipe-Liner Off Site Disposal	45,300	LF	$15.00	$679,500	$614,827	Remove and haul to central portion of CAT 1 Stockpile. Assumes a shallow excavation with minimal backfill and cutting of pipe. [Ames 2016]	679,500	614,827	0	0	0	679,500	0
Pipe Disposal in Off Site Solid Waste Landfill	Pipe-Liner Off Site Disposal	1	LS	$7,837	$7,837	$7,091	Transport and Tipping Fees [4/27/17 emails Attachments I1 and I2]	7,837	7,091	0	0	0	7,837	0
Liner/Soil Cover Removal and Liner Prep for Transport	Unit $ Reclamation	63	Acre	$8,600	$541,800	$490,233	Remove and haul to East or West Pit. Assume avg. 9" thick soil/rock layer (1,200 CY/acre) to be included with geomembrane liner removal. Liner would be excavated with material and hauled to stockpile. Liner would then be sorted out where visible and left there. [Ames 2016]	541,800	490,233	0	0	0	541,800	0
Liner Disposal in Off Site Solid Waste Landfill	Pipe-Liner Off Site Disposal	63	Acre	$152	$9,580	$8,669	Transport and Tipping Fees [4/27/17 emails Attachments I1 and I2]	9,580	8,669	0	0	0	9,580	0
Cover Area (Acres) and Depth (Inches)		63	Acres Inches	24			to calculate CY							
Cover Volume (CY) and Haul Distance (Miles)		203,280	CY Miles	1.5										
Cover - Ovb/Soil (24" thick)	Unit $ Reclamation	203,280	CY	$4.40	$894,906	$809,730	Soil Overburden Relocation (excavate, load and dump) [Ames 2016] plus Soil Overburden Relocation (haul cost/cubic yard/mile) [Ames 2016]	894,906	809,730	0	0	0	894,906	0
Seeding	Unit $ Reclamation	63	Acres	$295	$18,585	$16,816	Commercial Fertilizer and Seed for Overburden – Supply/Apply/Incorporate @ 200 lb/Acre/ [D&T 4/5/16 letter]	18,585	16,816	0	0	0	18,585	0
Cat 4		-	-		$946,242	$856,181								
Drain Pipe Removal and Prep for Transport	Unit $ Reclamation & Pipe-Liner Off Site Disposal	21,590	LF	$15.00	$323,850	$293,027	Remove and haul to central portion of CAT 1 Stockpile. Assumes a shallow excavation with minimal backfill and cutting of pipe. [Ames 2016]	323,850	293,027	0	0	0	323,850	0
Pipe Disposal in Off Site Solid Waste Landfill	Pipe-Liner Off Site Disposal	1	LS	$3,626	$3,626	$3,281	Transport and Tipping Fees [4/27/17 emails Attachments I1 and I2]	3,626	3,281	0	0	0	3,626	0
Liner/Soil Cover Removal and Liner Prep for Transport	Unit $ Reclamation	29	Acre	$8,600	$249,400	$225,663	Remove and haul to East or West Pit. Assume avg. 9" thick soil/rock layer (1,200 CY/acre) to be included with geomembrane liner removal. Liner would be excavated with material and hauled to stockpile. Liner would then be sorted out where visible and left there. [Ames 2016]	249,400	225,663	0	0	0	249,400	0
Liner Disposal in Off Site Solid Waste Landfill	Pipe-Liner Off Site Disposal	29	Acre	$152	$4,410	$3,990	Transport and Tipping Fees [4/27/17 emails Attachments I1 and I2]	4,410	3,990	0	0	0	4,410	0
Cover Area (Acres) and Depth (Inches)		29	Acres Inches	24			to calculate CY							
Cover Volume (CY) and Haul Distance (Miles)		93,573	CY Miles	1.2										
Cover - Ovb/Soil (24" thick)	Unit $ Reclamation	93,573	CY	$3.81	$356,401	$322,479	Ames 2016 - Soil Overburden Relocation (excavate, load and dump) [Ames 2016] plus Soil Overburden Relocation (haul cost/cubic yard/mile) [Ames 2016]	356,401	322,479	0	0	0	356,401	0
Seeding	Unit $ Reclamation	29	Acres	$295	$8,555	$7,741	Commercial Fertilizer and Seed for Overburden – Supply/Apply/Incorporate @ 200 lb/Acre/ [D&T 4/5/16 letter]	8,555	7,741	0	0	0	8,555	0
OSP		-	-		$1,138,301	$1,029,960								0
Drain Pipe Removal and Prep for Transport	Unit $ Reclamation & Pipe-Liner Off Site Disposal	30,000	LF	$15.00	$450,000	$407,170	Remove and haul to central portion of CAT 1 Stockpile. Assumes a shallow excavation with minimal backfill and cutting of pipe. [Ames 2016]	450,000	407,170	0	0	0	450,000	0
Pipe Disposal in Off Site Solid Waste Landfill	Pipe-Liner Off Site Disposal	1	LS	$5,597	$5,597	$5,064	Transport and Tipping Fees [4/27/17 emails Attachments I1 and I2]	5,597	5,064	0	0	0	5,597	0
Liner/Soil Cover Removal and Liner Prep for Transport	Unit $ Reclamation	32	Acre	$8,600	$275,200	$249,007	Remove and haul to East or West Pit. Assume avg. 9" thick soil/rock layer (1,200 CY/acre) to be included with geomembrane liner removal. Liner would be excavated with material and hauled to stockpile. Liner would then be sorted out where visible and left there. [Ames 2016]	275,200	249,007	0	0	0	275,200	0
Liner Disposal in Off Site Solid Waste Landfill	Pipe-Liner Off Site Disposal	32	Acre	$152	$4,866	$4,403	Transport and Tipping Fees [4/27/17 emails Attachments I1 and I2]	4,866	4,403	0	0	0	4,866	0
Cover Area (Acres) and Depth (Inches)		32	Acres Inches	24			to calculate CY							
Cover Volume (CY) and Haul Distance (Miles)		103,253	CY Miles	1.2										
Cover - Ovb/Soil (24" thick)	Unit $ Reclamation	103,253	CY	$3.81	$393,198	$355,774	Soil Overburden Relocation (excavate, load and dump) [Ames 2016] plus Soil Overburden Relocation (haul cost/cubic yard/mile) [Ames 2016]	393,198	355,774	0	0	0	393,198	0
Seeding	Unit $ Reclamation	32	Acres	$295	$9,440	$8,542	Commercial Fertilizer and Seed for Overburden – Supply/Apply/Incorporate @ 200 lb/Acre/ [D&T 4/5/16 letter]	9,440	8,542	0	0	0	9,440	0

Appendix A-1 Mine Year 1 Reclamation Estimate

12/7/2017

Includes Demo of Legacy Buildings (less Abatement and buildings demoed during Construction), Project Buildings, AOCs, Project Construction and Project Operational Disturbances as of the end of MY1

	Support Tab	Quantity	Units	Unit $	Cash $	NPV $	Note			01/01/18	07/01/19	07/01/20	07/01/21	07/01/22
Reclamation Total with Indirects		Quantities from Barr Changes Over Time Memo Unless Noted			**$133,621,573**	**$121,898,444**	FA for Cash Amount							
Contingency	**10.0%**				**$11,380,656**	**$10,382,126**								
Adaptive Management	**2.0%**				**$2,225,563**	**$2,030,658**								
Engineering Redesign	**2.0%**				**$2,225,563**	**$2,030,658**								
Performance Bond	**1.0%**				**$1,138,066**	**$1,038,213**					Year of Closure			
Prime Contractor Markup	**2.5%**				**$2,845,164**	**$2,595,531**		$112,869,961	$102,973,571		1	2	3	4
Mobilization	**4.0%**				**$0**	**$0**			2.9%			MY		
Reclamation Total (no Indirects)					**$113,806,561**	**$103,821,258**		**6 Yr Tot**	**NPV**	**Operating**	**Hold**	3	4	5
OSLA					$146,091	$128,461								
Grade Stockpiles of Overburden and Peat	Unit $ Reclamation	41.8	Acres	$3,200	$133,760	$117,618	No hauling of material, Mid size dozer work. [Ames 2017]	133,760	117,618	0	0	0	0	133,760
Seeding acres	Unit $ Reclamation	41.8	Acres	$295	$12,331	$10,843	Commercial Fertilizer and Seed for Overburden – Supply/Apply/Incorporate @ 200 lb/Acre/ [D&T 4/5/16 letter]	12,331	10,843	0	0	0	0	12,331
Pit					$365,200	$330,441								
Prepare for Fencing	Unit $ Reclamation	12,100	LF	$9.00	$108,900	$98,535	Ames 2016	108,900	98,535	0	0	0	108,900	0
Pit Fence - Barb Wire 4 Strand	Unit $ Reclamation	1,100	LF	$8.00	$8,800	$7,962	MnDOT Standard Plate 9323 Rev. D [Ames 2016]	8,800	7,962	0	0	0	8,800	0
Pit Fence - Non Climable	Unit $ Reclamation	11,000	LF	$22.00	$242,000	$218,967	MnDOT Standard Plate 9322 Rev. K [Ames 2016]	242,000	218,967	0	0	0	242,000	0
Gates	Unit $ Reclamation	1	EA	$5,500	$5,500	$4,977	Gate for access road / pit ramp; MnDOT Standard Plate 9322 Rev. K 20' Wide Vehicular Gate (Double Gate) [Ames 2016]	5,500	4,977	0	0	0	5,500	0
Reduce and Grade Overbuburden Wall				$0			Overburden sloped and seeded as part of mining - cover of setback area not required by non-ferrous rules (FEIS WQ modeling assumed not covered)							
Plant Seed Mix				$0										
Ponds and Sumps					$434,317	$392,979								
Ponds Clean out	Ponds and Sumps	9	EA	$5,000	$45,000	$40,717	Break-out sumps/ clean-out ponds [Ames 2016]	45,000	40,717	0	0	0	45,000	0
Restore Pond Footprint	Ponds and Sumps	63	Acres	$6,000	$376,200	$340,394	Remove liner, rip-rap, grade and seed, fertilize and mulch; assume 400 CY/acre (3 in depth) of rooting soil fill [Ames 2016]	376,200	340,394	0	0	0	376,200	0
Liner Disposal in Off Site Solid Waste Landfill	Ponds and Sumps & Pipe-Liner Off Site Disposal	56	Acres	$152	$8,470	$7,664	Transport and Tipping Fees [4/27/17 emails Attachments I1 and I2]	8,470	7,664	0	0	0	8,470	0
Pipe Disposal in Off Site Solid Waste Landfill	Ponds and Sumps & Pipe-Liner Off Site Disposal	4,500	LF	$1.03	$4,646	$4,204	Transport and Tipping Fees [4/27/17 emails Attachments I1 and I2]	4,646	4,204	0	0	0	4,646	0
Rail Transfer Hopper					$0	$0								
Haul RTH waste rock to East Pit, Plus Grading					$0		Construct Platform with MDNR approved rock. Cover with 2ft soil and vegetate included with Demo below							
Construction					$20,558,890	$18,852,792								
Cat 1 Stockpile Cover	SOW3 Cat 1 Cover Sys UC (Yr 1)	1	LS	$19,104,918	$19,104,918	$17,537,207	Engineer estimate: Barr Enginering Estimate based on permit level design on drawing SKP-011, SKP-013 and SKP-032-035 from Appendix 4 of the PTM Application - May 2016	19,104,918	17,537,207	0	0	9,552,459	9,552,459	0
Cat 1 Stockpile Cont Sys Ext	SOW21 Cat 1 Cont Sys UC (Yr 1)	1	LS	$1,453,972	$1,453,972	$1,315,586	Engineer estimate: Barr Engineering estimate based on permit level design on drawing GCS-003 and GCS-010 to 013 from Appendix 4 of the PTM Application - July 2016	1,453,972	1,315,586	0	0	0	1,453,972	0
Demo					$1,676,193	$1,478,819	Lakehead / Rachel 2016 (Attachments E and F)							
Fueling and Maintenance Facility	Demo	1	LS	$27,610	$27,610	$24,982		27,610	24,982	0	0	0	27,610	0
Rail Transfer Hopper	Demo	1	LS	$86,100	$86,100	$77,905		86,100	77,905	0	0	0	86,100	0
Rail Transfer Hopper Control Bldg	Demo	1	LS	$18,700	$18,700	$16,920		18,700	16,920	0	0	0	18,700	0
Rail Transfer Hopper Platform	Demo	1	LS	$60,000	$60,000	$54,289		60,000	54,289	0	0	0	60,000	0
Central Pumping Station	Demo	0	LS	$15,700	$0	$0	used long term	0	0	0	0	0	0	0
Railroads	Demo	1	LS	$78,750	$78,750	$69,247		78,750	69,247	0	0	0	0	78,750
Pipelines	Demo	1	LS	$797,133	$797,133	$700,936		797,133	700,936	0	0	0	0	797,133
Power Lines	Demo	1	LS	$83,900	$83,900	$73,775		83,900	73,775	0	0	0	0	83,900
Roads and Parking Lots	Demo	1	LS	$524,000	$524,000	$460,765		524,000	460,765	0	0	0	0	524,000
Wasteweater Treatment Facility	Demo	0	LS	$512,000	$0	$0	Not constructed under WWTS plan	0	0	0	0	0	0	0

Appendix A-1 Mine Year 1 Reclamation Estimate

12/7/2017

Includes Demo of Legacy Buildings (less Abatement and buildings demoed during Construction), Project Buildings, AOCs, Project Construction and Project Operational Disturbances as of the end of MY1

	Support Tab	Quantity	Units	Unit $	Cash $	NPV $	Note	6 Yr Tot	NPV	Operating	Hold	3	4	5
										01/01/18	07/01/19	07/01/20	07/01/21	07/01/22
											Year of Closure			
								$112,869,961	$102,973,571		1	2	3	4
									2.9%		MY			
Reclamation Total with Indirects					**$133,621,573**	**$121,898,444**	FA for Cash Amount							
Contingency	**10.0%**	Quantities from Barr Changes Over Time Memo Unless Noted			**$11,380,656**	**$10,382,126**								
Adaptive Management	**2.0%**				**$2,225,563**	**$2,030,658**								
Engineering Redesign	**2.0%**				**$2,225,563**	**$2,030,658**								
Performance Bond	**1.0%**				**$1,138,066**	**$1,038,213**								
Prime Contractor Markup	**2.5%**				**$2,845,164**	**$2,595,531**								
Mobilization	**4.0%**				**$0**	**$0**								
Reclamation Total (no Indirects)					**$113,806,561**	**$103,821,258**								
Plant Site					$62,398,345	$56,533,084								
General Reclamation		$1	LS		$249,669	$232,457								
HRF Disturbance	SOW11 HRF Cover Sys UC (Yr 1)	1	LS	$249,669	$249,669	$232,457	Engineer Estimate: Barr Engineering estimate based on permit level design on drawing HRF-007 from Appendix 7 of the PTM Application - July 2016	249,669	232,457	0	0	249,669	0	0
Construction					$26,299,932	$23,978,818								
FTB Bentonite Ammendment (pond, beach, dam top)	SOW14 FTB Cover Sys UC (Yr 1)	1	LS	$26,060,393	$26,060,393	$23,755,792	Engineer Estimate: Barr Engineering estimate based on permit level design on drawing FTB-005, FTB010 and FTB-024 from Appendix 6 of the PTM Application - July 2016 (updated April 2017 and November 2017)	26,060,393	23,755,792	0	0	13,030,196	6,515,098	6,515,098
FTB Overflow	SOW 14 FTB Emerg Oflow (Yr 1)	1	LS	$239,539	$239,539	$223,026	Engineer Estimate: Barr Engineering estimate based on permit level design on drawing FTB-xxx to FTB-xxx - April 2017	239,539	223,026	0	0	239,539	0	0
Demo and Abatement					$28,706,920	$25,852,155								
Legacy Structure Removal							Lakehead / Rachel 2016 (Attachments E and F)							
Area 1 Shop Buildings	Demo	1	LS	$448,916	$448,916	$417,969		448,916	417,969	0	0	448,916	0	0
Area 2 Shop Buildings	Demo	1	LS	$556,827	$556,827	$518,440		556,827	518,440	0	0	556,827	0	0
Main Plant Area - Demoed in Construction	Demo	0	LS	$1,655,350	$0	$0		0	0	0	0	0	0	0
Main Plant Area	Demo	1	LS	$19,888,937	$19,888,937	$17,999,627		19,888,937	17,999,627	0	0	4,972,234	9,944,469	4,972,234
Main Gate Colby PH Ad Bldg	Demo	1	LS	$243,170	$243,170	$226,406		243,170	226,406	0	0	243,170	0	0
Roads	Demo	1	LS	$660,000	$660,000	$580,352		660,000	580,352	0	0	0	0	660,000
Railroads	Demo	1	LS	$380,000	$380,000	$334,142		380,000	334,142	0	0	0	0	380,000
Power System	Demo	1	LS	$97,810	$97,810	$86,006		97,810	86,006	0	0	0	0	97,810
Piping System	Demo	1	LS	$2,879,000	$2,879,000	$2,531,567		2,879,000	2,531,567	0	0	0	0	2,879,000
Legacy Asbestos Abatement							Arrowhead Consulting & Testing 2016 (Attachment D) and Mavo 2016 (Attachment C)							
Area 1 Shop Buildings	Demo	0	LS	$98,350	$0	$0		0	0	0	0	0	0	0
Area 2 Shop Buildings	Demo	0	LS	$167,350	$0	$0		0	0	0	0	0	0	0
Main Plant Area	Demo	0	LS	$5,962,607	$0	$0		0	0	0	0	0	0	0
Main Gate Colby PH Ad Bldg	Demo	0	LS	$859,400	$0	$0		0	0	0	0	0	0	0
Project Phase 1							Lakehead / Rachel 2016 (Attachments E and F)							
Flotation Plant and Reagent Building	Demo	1	LS	$844,400	$844,400	$764,188		844,400	764,188	0	0	211,100	422,200	211,100
Concentrate Storage and Loadout Facility	Demo	1	LS	$333,860	$333,860	$302,146		333,860	302,146	0	0	83,465	166,930	83,465
Plant Site Sewage Treatment Plant	Demo	1	LS	$148,000	$148,000	$133,941		148,000	133,941	0	0	37,000	74,000	37,000
Railroads	Demo	1	LS	$296,000	$296,000	$260,279		296,000	260,279	0	0	0	0	296,000
Pipelines	Demo	1	LS	$1,930,000	$1,930,000	$1,697,091		1,930,000	1,697,091	0	0	0	0	1,930,000
Power Lines			none constructed											
Roads and Parking Lots			none constructed											
Plant Site Wastewater Treatment Plant	Demo	0	LS	$245,000	$0	$0	used long term	0	0	0	0	0	0	0
Other					$7,141,825	$6,469,654								
AST Removal	AST	1	LS	$223,625	$223,625	$208,209	Lakehead / Rachel 2016 (Attachments E and F)	223,625	208,209	0	0	223,625	0	0
AOCs	AOC	1	LS	$6,918,200	$6,918,200	$6,261,445	Legacy Remediation - Areas of Concern (AOC) - costs from detailed spreadsheets by NTS [2016] (see Attachment G)	6,918,200	6,261,445	0	0	2,306,067	2,306,067	2,306,067
Project Management					$2,528,400	$2,288,375								
Project Manager - annual $ / FTE - calc from hourly rate	Unit $ Reclamation	$286,000	$/yr $/hr	$137.50			Barr 2016 Fee Schedule Average of Top Level Engineer [Barr 2016]							
Project Manager		1	FTE	$286,000	$858,000	$776,549		858,000	776,549	0	0	286,000	286,000	286,000
Project Managers Light Truck	Unit $ Reclamation	15,000	miles	$0.70	$31,500	$28,510	NTS Letter of 4/21/16	31,500	28,510	0	0	10,500	10,500	10,500
Project Engineer - annual $ / FTE - calc from hourly rate	Unit $ Reclamation	$223,600	$/yr $/hr	$107.50			Barr 2016 Fee Schedule Average of Mid Level Engineer [Barr 2016]							
Project Engineers		1	FTE	$223,600	$670,800	$607,120		670,800	607,120	0	0	223,600	223,600	223,600
Engineer's Light Truck	Unit $ Reclamation	15,000	miles	$0.70	$31,500	$28,510	NTS Letter of 4/21/16	31,500	28,510	0	0	10,500	10,500	10,500
Project Inspector - annual $ / FTE - calc from hourly rate	Unit $ Reclamation	$145,600	$/yr $/hr	$70.00			Barr 2016 Fee Schedule Average of Technician I [Barr 2016]							
Project Inspectors		2	FTE	$291,200	$873,600	$790,668		873,600	790,668	0	0	291,200	291,200	291,200
Inspectors's Light Truck	Unit $ Reclamation	30,000	miles	$0.70	$63,000	$57,019	NTS Letter of 4/21/16	63,000	57,019	0	0	21,000	21,000	21,000

General Unit Costs Used in Reclamation Estimates

Source Column indicates provider and date of unit cost

Source Name	Source Location
Ames 2016	Attachment H1
Ames 2017	Attachment H2
NTS 2016	Attachment I3
D&T 2016	Attachment J
Barr 2016	Attachment K1
Barr 2017	Barr 11/10/17 email

Ames estimates include mobilization

Item	Description	Unit	Source	Basis for Quantities (drawing # or describe)	Unit Price	Comments
	Rock Moving					
1	Ore Surge Stockpile Relocation	CY	Ames 2016	Load/Haul/Dump by Contractor	$ 4.55	From OSP to floor of East Pit [Ames 2016]
		Ton	calculated	1.9 Ton/CY	$ 2.39	From OSP to floor of East Pit [Ames 2016]
2	Category 2/3 Waste Rock Relocation (used in Stockpile Relocate tab)	CY	Ames 2016	Load/Haul/Dump by Contractor	$ 4.55	From Cat 2/3 stockpile to floor of East Pit [Ames 2016]
		Ton	calculated	1.9 Ton/CY	$ 2.39	From Cat 2/3 stockpile to floor of East Pit [Ames 2016]
3	Category 4 Waste Rock Relocation (used in Stockpile Relocate tab)	CY	Ames 2016	Load/Haul/Dump by Contractor	$ 3.40	From Cat 4 stockpile to floor of East Pit [Ames 2016]
		Ton	calculated	1.9 Ton/CY	$ 1.79	From Cat 4 stockpile to floor of East Pit [Ames 2016]
4	Soil Overburden Relocation (excavate, load and dump) [Ames 2016]	CY	Ames 2016	Excavate, Load and Dump by Contractor	$ 1.60	Material for haul roads, Cat 1 etc. restoration. [Ames 2016]
5	Soil Overburden Relocation (haul cost/cubic yard/mile) [Ames 2016]	$/CY/Mile	Ames 2016	Haul by Contractor	$ 1.85	Material for haul roads, Cat 1 etc. restoration (assume 2-mile avg. haul distance; 4-mile round-trip) [Ames 2016]
	Site Removal and Restoration					
6	Remove & Dispose of Stockpile/Pond Geomembrane Liners (inc soil)	acre	Ames 2016	Cut Geomembrane into Sections/Remove	$ 8,600.00	Remove and haul to East or West Pit. Assume avg. 9" thick soil/rock layer (1,200 CY/acre) to be included with geomembrane liner removal. Liner would be excavated with material and hauled to stockpile. Liner would then be sorted out where visible and left there. [Ames 2016]
7	Remove & Dispose of Collection pipe	LF	Ames 2016	Cut-Up/Remove/Dispose	$ 15.00	Remove and haul to central portion of CAT 1 Stockpile. Assumes a shallow excavation with minimal backfill and cutting of pipe. [Ames 2016]
8	Remove Stockpile Sumps & Ponds	each	Ames 2016	Break-out sumps/ clean-out ponds	$ 5,000.00	Break-out sumps/ clean-out ponds [Ames 2016]
9	Restore Lined Sump & Pond Footprint	acre	Ames 2016	Fill/Grade	$ 6,000.00	Remove liner, rip-rap, grade and seed, fertilize and mulch; assume 400 CY/acre (3 in depth) of rooting soil fill [Ames 2016]
	Fencing, Gates, and Barricades					
10	Preparation for Fencing	LF	Ames 2016	Clearing & Grubbing for fencing	$ 9.00	Ames 2016
11	Supply & Install 4 Strand Fence	LF	Ames 2016	Gates & signage separate	$ 8.00	MnDOT Standard Plate 9323 Rev. D [Ames 2016]
12	Supply & Install Non-Climbable Fence	LF	Ames 2016	Gates & signage separate	$ 22.00	MnDOT Standard Plate 9322 Rev. K [Ames 2016]
13	Gates	each	Ames 2016	Per Gate	$ 5,500.00	Gate for access road / pit ramp; MnDOT Standard Plate 9322 Rev. K 20' Wide Vehicular Gate (Double Gate) [Ames 2016]
	Earthworks					
14	Grading uneven area for gentle contour and drainge	acre	Ames 2017	Grading for depths 6" to 16"	$ 3,200.00	No hauling of material, Mid size dozer work. [Ames 2017]
15	Load, Haul & Place Earthfill from Overburden Storage & Laydown Area	CY	Ames 2017		$ 4.50	Load, haul and place in East Pit [Ames 2016]
	General Services Reclamation					
16	Pick Up Truck	$/mi	NTS 2016		$ 0.70	NTS Letter of 4/21/16
17	Abandon Well	$/mi	Barr 2017		$ 2,000.00	Based on Costs from other projects, considering mobilization, permitting, and well abandonment. [Barr 11/10/17 email]
	Basic Labor Rates (including OH and profit)					
18	Project Manager	yr	Barr 2016		$ 137.50	Barr 2016 Fee Schedule Average of Top Level Engineer [Barr 2016]
19	Project Engineer	yr	Barr 2016		$ 107.50	Barr 2016 Fee Schedule Average of Mid Level Engineer [Barr 2016]
20	Project Inspector	yr	Barr 2016		$ 70.00	Barr 2016 Fee Schedule Average of Technician I [Barr 2016]
	Vegetation Establishment					
21	Seed and Fertilize for Vegetation Establishment - Mine Overburden Area	acre	D&T 2016	Assume typical roadway spec. seed, fertilize, mulch	$ 295.00	Commercial Fertilizer and Seed for Overburden – Supply/Apply/Incorporate @ 200 lb/Acre/ [D&T 4/5/16 letter]

Development of Costs for Transport and Off-Site Disposal of Membrane and Pipe from Lined Facilities 04/27/17

Heavy Border with Bold Amounts are used in Reclamation Estimates

Dem-Con Companies General Waste in Keewatin:			
Truck CY	Truck $/Load	Fee /CY	source
29	$415.00	$10.00	4/27/17 emails Attachments I1 and I2

Pipe cut in 40' lengths and not crushed								Unit Cost	
Pipe Size	Pipe OD	Pipe V/ft	Load	Ft Pipe/Load	Transport	Tipping		Load	FT
In	In	CY/ft	CY	FT	Load	CY	Load	$	$
4	4.8	0.00465	29	6231	$415.00	$10.00	$290.00	$705.00	$0.11
6	6.9	0.00962	29	3015	$415.00	$10.00	$290.00	$705.00	$0.23
8	9.1	0.01673	29	1734	$415.00	$10.00	$290.00	$705.00	$0.41
10	11.4	0.02625	29	1105	$415.00	$10.00	$290.00	$705.00	$0.64
12	14.5	0.04247	29	683	$415.00	$10.00	$290.00	$705.00	$1.03

Liner assume 1" thick per acre after cutting and folding							Unit Cost	
Folded Thickness	Liner V/acre	Load	Acres/Load	Transport	Tipping		Load	acre
in/acre	CY/acre	CY	Acres	Load	CY	Load	$	$
1	134.444	29	5	$415.00	$10.00	$290.00	$705.00	**$152.07**

Mine Year 1	**Cat 2/3**		**Cat 4**		**OSP**	
	Ft*	Disposal $	Ft*	Disposal $	Ft*	Disposal $
Pipe Size	Overliner/Underdrain Piping		Underdrain Piping		Underdrain Piping	
In						
4	32,200	$3,643	14,000	$1,584	19,700	$2,229
6	9,600	$2,245	6,300	$1,473	7,400	$1,730
8	1,400	$569	1,200	$488	1,600	$651
10	2,000	$1,276	30	$19	900	$574
12	100	$103	60	$62	400	$413
Total Ft	**45,300**		**21,590**		**30,000**	
Total $	-	**$7,837**	-	**$3,626**	-	**$5,597**

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Mine Year 11	**Cat 2/3**		**Cat 4**		**OSP**	
	Ft*	Disposal $	Ft*	Disposal $	Ft*	Disposal $
Pipe Size	Underdrain Piping		Underdrain Piping		Underdrain Piping	
In						
4	84,900	$9,606	31,000	$3,508	19,700	$2,229
6	25,100	$5,869	9,400	$2,198	7,400	$1,730
8	4,200	$1,708	1,200	$488	1,600	$651
10	5,100	$3,255	30	$19	900	$574
12	200	$207	60	$62	400	$413
Total Ft	**119,500**		**41,690**		**30,000**	
Total $	-	**$20,644**	-	**$6,274**	-	**$5,597**

* Lengths from Barr Changes Over Time Memo

Development of Total Pond and Sump Acres
Heavy Border with Bold Amounts are used in Reclamation Estimates

Mine Year 1 - Pond and Sump Acres from Barr Changes Over Time Memo

Pond	Included	Count	Acres	Liner	Liner Acres	Underdrain Pipe (ft)	Note
Mine Site WWTF Pond - 1	n	1	1	y	1		used long term
Mine Site WWTF Ponds	y	1	29.8	y	29.8		
Mine Site CPS Pond	n	1	1.3	n	0		used long term
Mine Site Ponds (unlined)	y	1	7	n	0		
Mine Site Ponds (lined)	y	4	12.4	y	12.4		
Category 4 Stockpile	y	1	4.5	y	4.5		
OSP	y	1	2.3	y	2.3		
Category 2/3 Stockpile	y	1	6.7	y	6.7		
Total		**9**	**62.7**		**55.7**	**4500**	Pipe ft from Barr Changes Over Time Memo

Mine Year 11 - Pond and Sump Acres from Barr Changes Over Time Memo

Pond	Included	Count	Acres	Liner	Liner Acres	Underdrain Pipe (ft)	Note
Mine Site WWTF Pond - 1	n	1	1	y	1		used long term
Mine Site WWTF Ponds	y	1	29.8	y	29.8		
Mine Site CPS Pond	n	1	1.3	n	0		used long term
Mine Site Ponds (unlined)	y	1	7	n	0		
Mine Site Ponds (lined)	y	6	16.1	y	16.1		
Category 4 Stockpile	y	1	4.5	y	4.5		
OSP	y	1	2.3	y	2.3		
Category 2/3 Stockpile	y	1	12.2	y	12.2		
Total		**11**	**71.9**		**64.9**	**6900**	Pipe ft from Barr Changes Over Time Memo

Mine Year 20 - Pond and Sump Acres from Barr Changes Over Time Memo

Pond	Included	Count	Acres	Liner	Liner Acres	Underdrain Pipe (ft)	Note
Mine Site WWTF Pond - 1	n	1	1	y	1		used long term
Mine Site WWTF Ponds	y	1	29.8	y	29.8		
Mine Site CPS Pond	n	1	1.3	n	0		used long term
Mine Site Ponds (unlined)	y	1	7	n	0		
Mine Site Ponds (lined)	y	6	16.1	y	16.1		
Category 4 Stockpile	y	0	0	y	0		
OSP	y	1	2.3	y	2.3		
Category 2/3 Stockpile	y	0	0	y	0		
Total		**9**	**55.2**		**48.2**	**6900**	Pipe ft from Barr Changes Over Time Memo

Estimate for SOW 3: Category 1 Cover System: End of Year 1

Barr Enginering Estimate based on permit level design on drawing SKP-011, SKP-013 and SKP-032-035 from Appendix 4 of the PTM Application - May 2016

Heavy Border with Bold Amounts are used in Reclamation Estimates

Item	Description	Unit	Quantity	Basis for Quantities (drawing # or describe)	Unit Cost	Cost Extension	Comments
1	Mobilization/Demobilization	LS	1	See Comments and Notes	$ 1,345,000.00	$ 1,345,000	
2	Environmental Protection Measures	LS	1	See Comments and Notes	$ 10,000.00	$ 10,000	
3	Construction QA/QC	LS	1	See Comments and Notes	$ 275,000.00	$ 275,000	See Note 1
4	Final Sloping of Category 1 Stockpile	CY	260,000	See Comments and Notes	$ 2.50	$ 650,000	Estimated as 15,000' Stockpile Perimeter by 1.4H:1V Slope Flattened to 3.75H:1V Slope for 40' High Pile (ref. Golder Stockpile Design Drawings for Typical Section).
4a	Working with Blasted Rock	LS	1	Allowance	$ 300,000.00	$ 300,000	
4b	Import Soil to Fill Voids	LS	1	Allowance	$ 1,000,000.00	$ 1,000,000	
5	Subgrade Grading	AC	213	See Comments and Notes	$ 2,100.00	$ 447,300	Estimate of Area Covered by CAT 1 Waste Rock at End of Year 1
6	Furnish and Install 6-inch Geomembrane Bedding Layer	CY	170,000	See Comments and Notes	$ 8.00	$ 1,360,000	
7	Furnish and Install 1-foot Granular Soil Cover above Geomembrane	CY	340,000	See Comments and Notes	$ 8.00	$ 2,720,000	
7a	Process Drain Layer Material	LS	1	Allowance	$ 500,000.00	$ 500,000	
7b	Slotted Drain Pipe	LS	1	Allowance	$ 200,000.00	$ 200,000	
8	Furnish and Install 1.5-foot Rooting Zone above Granular Cover	CY	510,000	See Comments and Notes	$ 5.50	$ 2,805,000	
9	Furnish and Install 9-Inch Riprap Systems on Stockpile Covers	CY	1,000	See Comments and Notes	$ 65.00	$ 65,000	See Note 2
10	Furnish and Install 12-Inch Riprap Systems on Stockpile Covers	CY	2,000	See Comments and Notes	$ 77.00	$ 154,000	See Note 2
11	Furnish and Install 18-Inch Riprap Systems on Stockpile Covers	CY	400	See Comments and Notes	$ 89.00	$ 35,600	See Note 2
12	Furnish and Install Vegetation (grass) on Stockpile Cover Systems	AC	213	See Comments and Notes	$ 635.00	$ 135,255	Commercial Fertilizer and Seed for Overburden – Supply/Apply/Incorporate @ 200 lb/Acre/ [D&T 4/5/16 letter] + Mulch – Supply and Incorporate @ 2 ton/acre of Hay or Straw Mulchs. [D&T 4/5/16 letter]
12a	Surface Runoff Drainage	LS	1	Allowance	$ 600,000.00	$ 600,000	
13	Reseeding 5% of Vegetation on Stockpile Cover Systems	AC	11	See Comments and Notes	$ 635.00	$ 6,763	Commercial Fertilizer and Seed for Overburden – Supply/Apply/Incorporate @ 200 lb/Acre/ [D&T 4/5/16 letter] + Mulch – Supply and Incorporate @ 2 ton/acre of Hay or Straw Mulchs. [D&T 4/5/16 letter]
14	Procure and Install 40-mil Geomembrane - Textured	SF	9,280,000	See Comments and Notes	$ 0.40	$ 3,712,000	Assume LLDPE Geomembrane for Improved Interface Friction Angle.
15	Furnish and Install Geotextile above and below Geomembrane	SF	18,560,000	See Comments and Notes	$ 0.15	$ 2,784,000	Requirement for Geotextile Dependent on Gradation and Particle Shape for Materials Above and Below Geomembrane.
					total	**$ 19,104,918**	

	est Unit Cost/AC for Other Mine Years		
Flat	$ 86,642.81	$ 14,209,420	deduct final sloping and apply flat % for MY1 from below
Slope	$ 99,908.11	$ 4,895,498	deduct final sloping and apply flat % for MY1 from below + final sloping

Notes:

1) Assume surveying for grade and cover layer thickness confirmation, material testing to confirm that materials comply with specifications, and site review and submittal review to confirm compliance of site restoration activities with specifications.

2) Per Document Referenced in Note 1; Entire CAT 1Stockpile Footprint is 526 Acres. Portion Constructed by End of Year 1 is Estimated and Riprap System Needs are Taken as Proportion of (Total Riprap x Year 1 Acreage/Total Acreage) x (Year 1 Height/Total Height) to Account for Stockpile Footprint and Height at End of Year 1.
3) D&T letter is Attachment K

Development of Category 1 Stockpile based on Mine Year 1 Flat and Slope per Acre Costs and Flat and Sloped Acres from Barr Changes Over Time Memo

Heavy Border with Bold Amounts are used in Reclamation Estimates

	Units	Quanitiy	Percent	Unit Cost	Cost	
MY1 Flat	AC	164	77%	$ 86,643	$ 14,209,420	
MY1 Slope	AC	49	23%	$ 99,908	$ 4,895,498	
MY1 Total		213			$ 19,104,918	method check
MY2 Flat	AC	120	56%	$ 86,643	$ 10,397,137	
MY2 Slope	AC	96	44%	$ 99,908	$ 9,591,179	
MY2 Total		216			**$ 19,988,316**	to MY2 Reclamation Tab
MY11 Flat	AC	196	36%	$ 86,643	$ 16,981,990	
MY11 Slope	AC	341	64%	$ 99,908	$ 34,068,666	
MY11 Total		537			**$ 51,050,656**	to MY11 Reclamation Tab
MY20 Flat	AC	65	100%	$ 86,643	$ 5,631,782	
MY20 Slope	AC	0	0%	$ 99,908	$ -	
MY20 Total					**$ 5,631,782**	to MY20 reclamation Tab

Estimate for SOW 11: Hydromet Residue Facility: End of Year 1 (no residue, only grading/seeding)

Barr Engineering estimate based on permit level design on drawing HRF-007 from Appendix 7 of the PTM Application - July 2016

Heavy Border with Bold Amounts are used in Reclamation Estimates

Item	Description	Unit	Quantity	Basis for Quantities (drawing # or describe)	Unit Cost	Cost Extension	Comments
1	Mobilization and Demobilization	LS	1	See Comments and Notes	$ 25,000.00	$ 25,000	To Be Determined By Contractor - Mob for General Earthwork and Vegetation Establishment
2	Environmental Protection Measures	LS	0	See Comments and Notes	$ -	$ -	Assume Environmental Protection Measures for One-Third (assume northwest segment where discharge from site could occur) Perimeter of 25-acre Disturbed Area Associated with Future HRF Area Pre-Load
3	Construction QA/QC	LS	1	See Comments and Notes	$ 5,000.00	$ 5,000	See Note 2
4	Regrade Pre-Load Fill	CY	62,000	See Comments and Notes	$ 2.50	$ 155,000	Assumes 25-percent of Year 1 Pre-load Fill Requires Regrading to Flatten Perimeter Slopes Prior to Restoration.
5	Common Borrow for Pre-Load Fill Area Restoration	CY	6,000	See Comments and Notes	$ 8.00	$ 48,000	Assume 6,000 CY of Misc. Earthwork/Common Borrow for Miscellaneous Restoration.
6	Furnish and Install Vegetation on Disturbed Areas	Acre	25	See Comments and Notes	$ 635.00	$ 15,875	Commercial Fertilizer and Seed for Overburden – Supply/Apply/Incorporate @ 200 lb/Acre/ [D&T 4/5/16 letter] + Mulch – Supply and Incorporate @ 2 ton/acre of Hay or Straw Mulchs. [D&T 4/5/16 letter] - acres from Changes Over Time Memo
7	Reseeding 5% of Vegetation to Correct for Limited Growth	Acre	1.25	See Comments and Notes	$ 635.00	$ 794	Commercial Fertilizer and Seed for Overburden – Supply/Apply/Incorporate @ 200 lb/Acre/ [D&T 4/5/16 letter] + Mulch – Supply and Incorporate @ 2 ton/acre of Hay or Straw Mulchs. [D&T 4/5/16 letter]
					total	**$ 249,669**	

Notes:

1) Quantity Estimates by TJR based in part on May 9, 2016 using "2013 Updated Bid Form Quantities Combined 18NOV2013 with All Costs 12-3-2013v7.xlsx" in Barr File "2369C29 PolyMet NorthMet Engineering_Work Authorization 13_Bid Form_Jan 2014 percent of Ames"; amended as needed to include CRE scope not addressed by previous estimates.
2) Limited QA/QC required. Assume limited amount of surveying for grade confirmation and site review and submittal review to confirm compliance of site restoration activities with specifications.
3) D&T letter is Attachment K

Barr Enginering estimates for FTB Bentonite Amendment Based On Mine Year 1 Beach and Pond Unit Costs with Dam Top added at Beach Unit Cost and Cell 2W Wall Rip Rap - Acres from Barr Changes Over Time Memo

Heavy Border with Bold Amounts are used in Reclamation Estimates

	Units	Quantity		Unit Cost	Cost	
MY1 Beach	AC	95		$ 37,286	$ 3,542,179	unit cost from per acre cost development below
MY1 Pond	AC	421		$ 49,448	$ 20,817,794	unit cost from per acre cost development below
MY1 Top of Dam	AC	41.9		$ 37,286	$ 1,562,287	use beach $/acre
MY1 Cell 2W Rip Rap (from above)	LS	1		$ 138,133	$ 138,133	$ from Cell 2W Wall estimate below - year 1 to 7
MY1 Total					**$ 26,060,393**	To MY1 Reclamation Tab
MY2 Beach	AC	95		$ 37,286	$ 3,542,179	unit cost from per acre cost development below
MY2 Pond	AC	424		$ 49,448	$ 20,966,139	unit cost from per acre cost development below
MY2 Top of Dam	AC	52		$ 37,286	$ 1,938,877	use beach $/acre
MY2 Cell 2W Rip Rap (from above)	LS	1		$ 138,133	$ 138,133	$ from Cell 2W Wall estimate below - year 1 to 7
MY2 Total					**$ 26,585,328**	To MY2 Reclamation Tab
MY11 Beach	AC	212		$ 37,286	$ 7,904,652	unit cost from per acre cost development below
MY11 Pond	AC	1,124		$ 49,448	$ 55,580,047	unit cost from per acre cost development below
MY11 Top of Dam	AC	90.6		$ 37,286	$ 3,378,120	use beach $/acre
MY11 Cell 2W Rip Rap (from above)	LS	1		$ 296,000	$ 296,000	$ from Cell 2W Wall estimate below - year 8 to 20
MY11 Total					**$ 67,158,819**	To MY11 Reclamation Tab
MY20 Beach	AC	428		$ 37,286	$ 15,958,448	unit cost from per acre cost development below
MY20 Pond	AC	905		$ 49,448	$ 44,750,839	unit cost from per acre cost development below
MY20 Top of Dam	AC	81.4		$ 37,286	$ 3,035,088	use beach $/acre
MY20 Cell 2W Rip Rap (from above)	LS	1		$ 296,000	$ 296,000	$ from Cell 2W Wall estimate below - year 8 to 20
MY20 Total					**$ 64,040,374**	To MY20 Reclamation Tab

Development of per Acre Costs for Beach and Pond Bentonite Amendment using SOW 14: Flotation Tailings Basin: End of Year 1 (with NorthMet Tailings)

Barr Engineering estimate based on permit level design on drawing FTB-005, FTB010 and FTB-024 from Appendix 6 of the PTM Application - July 2016 (updated April 2017 and November 2017)

	Bentonite price per ton FOB Plant	$65		Shipping 98 ton car	$5,650	$125.90	shipping by rail to Mesaba MN 5% margin applied to bentonite price (price and shipping from 4/17/17 quote)
Item	**Description**	**Unit**	**Quantity**	**Basis for Quantities (drawing # or describe)**	**Unit Cost**	**Cost Extension**	**Comments**
1	Mobilization and Demobilization	LS	1	See Comments and Notes	$ 1,225,000	$ 1,225,000	To Be Determined By Contractor - Mob for General Earthwork, Bentonite Placement, Site Grading and Vegetation Establishment
2	Environmental Protection Measures	LS	0	See Comments and Notes	$ -	$ -	Construction is within FTB Footprint. Assume Dust Control is Ancillary to Earthwork Items and no Additional Environmental Protection Measures are Required.
3	LTVSMC Coarse Tailings Borrow Area Regrading Quantity	CY	72,000	See Comments and Notes	$ 2.50	$ 180,000	See Note 1
4	LTVSMC Coarse Tailings Borrow Area - Seed, Mulch and Fertilize	Acre	44.7	See Comments and Notes	$ 730.00	$ 32,631	Commercial Fertilizer and Seed for Tailings Basin Flats – Supply/Apply/ Incorporate @ 500 lb/acre.[D&T 4/5/16 letter] + Mulch – Supply and Incorporate @ 2 ton/acre of Hay or Straw Mulchs. [D&T 4/5/16 letter] - Acres from Changes Over Time Memo
5	LTVSMC Coarse Tailings Borrow Area - Reseeding 5% of Vegetation to Correct for Limited Growth	Acre	2	See Comments and Notes	$ 730.00	$ 1,635	Commercial Fertilizer and Seed for Tailings Basin Flats – Supply/Apply/ Incorporate @ 500 lb/acre.[D&T 4/5/16 letter] + Mulch – Supply and Incorporate @ 2 ton/acre of Hay or Straw Mulchs. [D&T 4/5/16 letter]
	Borrow Area Reclamation Unit Cost Variable Only	**Acre**	44.7		**$ 4,793.43**	$ 214,266	
6	Beach Area and Dam Crest - Remove and Replace 30" Tailings Cover Layer to Facilitate Bentonite Augmentation of Soil Layer 30" Below Beach Surface	Acre	95.0	See Comments and Notes	$ 13,000.00	1,235,000	
7	Procure Bentonite - 108 tons/acre (3% by weight)	Tons	10,260	See Comments and Notes	$125.90	$1,291,765	See Bentonite price per ton FOB Plant above
8	On-Site: Transport and Spread Bentonite (load bentonite at rail cars and spread on FTB beach)	CY	12,667	See Comments and Notes	$ 8.00	$101,333	26,000 ft haul using side dumps, spread and disc in 1 foot on the beach, likely a controlled spreading type machine to get the correct lb/sf. (Attachment H2)
9	Beach Area and Dam Crest - Till Bentonite to 18" Depth	Acre	95.0	See Comments and Notes	$ 1,750.00	$166,250	Beach and Dam Crest Area at End of Year 1 is Estimated
10	Beach Area and Dam Crest - Compact 18" Layer of Bentonite Amended Soil	Acre	95.0	See Comments and Notes	$ 800.00	$76,000	Beach and Dam Crest Area at End of Year 1 is Estimated
11	Beach Area and Dam Crest - Lightly Compact Upper Cover Layer	Acre	95.0	See Comments and Notes	$ 800.00	$76,000	Beach and Dam Crest Area at End of Year 1 is Estimated
12	Beach Area and Dam Crest - Seed, Fertilize and Mulch	Acre	95.0	See Comments and Notes	$ 880.00	$83,600	Beach and Dam Crest Area at End of Year 1 is Estimated [Commercial Fertilizer and Seed for Tailings Basin Slopes – Supply/Apply/Incorporate @ 200 lb/acre [D&T 4/5/16 letter] + Mulch – Supply and Incorporate @ 2 ton/acre of Hay or Straw Mulchs. [D&T 4/5/16 letter]]
13	Beach Area and Dam Crest - Reseeding 5% of Vegetation to Correct for Limited Growth	Acre	5	See Comments and Notes	$ 880.00	$4,180	Commercial Fertilizer and Seed for Tailings Basin Slopes – Supply/Apply/Incorporate @ 200 lb/acre [D&T 4/5/16 letter] + Mulch – Supply and Incorporate @ 2 ton/acre of Hay or Straw Mulchs. [D&T 4/5/16 letter]
	Beach Bentonite Ammendment Unit Cost Variable Only	**Acre**	95.0		**$ 31,938.20**	$3,034,129	
14	- Barge delivery/return	LS	1		$45,569.00	$45,569	
15	Equipment						
16	- Barge Rental	ea	2		$107,500.00	$215,000	
17	- Broadcasters	ea	4		$10,000.00	$40,000	
18	- loader, skidsteers(2), end dump trucks(3), pickup	lot	1		$195,000.00	$195,000	Not Purchased Items - Temporary use from Contractor's Fleet
19	- loading dock	ea	1		$55,000.00	$55,000	
20	- bin and chute for truck to barge transfer	LS	1	See Comments and Notes	$100,000.00	$100,000	Amount is an Assumed Allowance for this Item
21	- pop-up shelter for temporary PondSeal storage	LS	1	See Comments and Notes	$100,000.00	$100,000	Amount is an Assumed Allowance for this Item Incl. Site Prep, Set-Up and Disposal
22	Labor						All labor at 2016 rates
23	- foreman (1)	manhr	877			$76,090	Supervision
24	- laborer (1)	manhr	1,300			$87,580	$67.37/hr
25	- barge operator (included below)		0				Included in Equip Operator
26	- equipment operators (5)	manhr	6,500			$491,660	placement 375 Ton/barge = 750 ton/shift; 2 shifts = 1,500 ton/day $75.64/hr
27	Haul PondSeal from Mobile Plant to Barge	ton	68,607		$4.36	$299,127	Ames price
28	Material						
29	- PondSeal (Delivered by Train, Mixing at Site)	ton	68,607		$213.18	$14,625,682	9 lbs/sq.ft. * 43,560 sq.ft./acre / 2,000 lbs/ton * 350 = 68,607 ton ; See PondSeal Price Adjustment Below
30	**Pond Bentonite Amendment Unit Cost Variable Only**	**acre**	350		**46,659.17**	$16,330,708	Bid Based on 350 Acres - Adjusted Yr 1 Acres is 421 Based on Changes Over Time memo
31	Beach Area Rip Rap	CY	7,222	See Comments and Notes	$22.00	$158,889	Beach at Cell 2E North Dam - Assume 6,500' * 40' Rip Rap Zone * 9" Thickness
32	Construct Surface Drainage System	LS	1	Allowance	$80,000.00	$80,000	

PondSeal Price Adjustment		
Old PondSeal Price	$/ton	$200
Bentonite in PondSeal	%	20%
Tons bentonite in a ton of PondSeal	tons	0.2
Old Bentonite Price	$/ton	$60
Old Bentonite Price per Ton PondSeal	$/ton	$12
New Bentonite Price	$/ton	$125.90
New Bentonite Price per Ton PondSeal	$/ton	$25.18
New PondSeal Price	$/ton	$213.18

total		$21,042,992
del 350A pond	pond acres	$16,330,708
add 421A pond	421	19,643,509
adj total		$24,355,792
	Unit Cost	
Beach	$37,286	
Pond	$49,448	

Notes:

1) Tailings Borrow Area Regrading Quantity Based on Assumed Borrow Area Disturbance times Average 1.0-foot Re-Grading Thickness Through-out to Facilitate Turf Establishment.
2) LTVSMC Coarse Tailings Borrow Area Disturbance Estimated from Permit Support Drawings - Flotation Tailings Basin Sheet FTB-003 and Assumed Year 1 Borrow Areas of 25% of Cell 1E/2E Splitter Dam Borrow Area and 25% of Cell 2W/2E Splitter Dam Borrow Area.
3) Bentonite tonnage based on 3% bentonite by weight with tailkings weight assumed at 110 pounds/cubic foot.
4) Wyo-Ben processed unit weight per product literature is on the order of 60 pcf.
5) D&T letter is Attachment K

Truck Count: 1,500 ton/day / 15 tons per load = 100 loads per day. If we assume 15 minutes per load, then a single truck can take 30 to 40 loads per day. Therefore – 3 end dump trucks.

Labor Hours: 6 Operators (loader, 3 trucks, general laborer, barge operator) x 10/hrs per shift x 5 days/week x 26 weeks/year = 7,800 hours + 877 (foreman) = 8,677 hrs vs. the 5,911 hrs currently estimated.

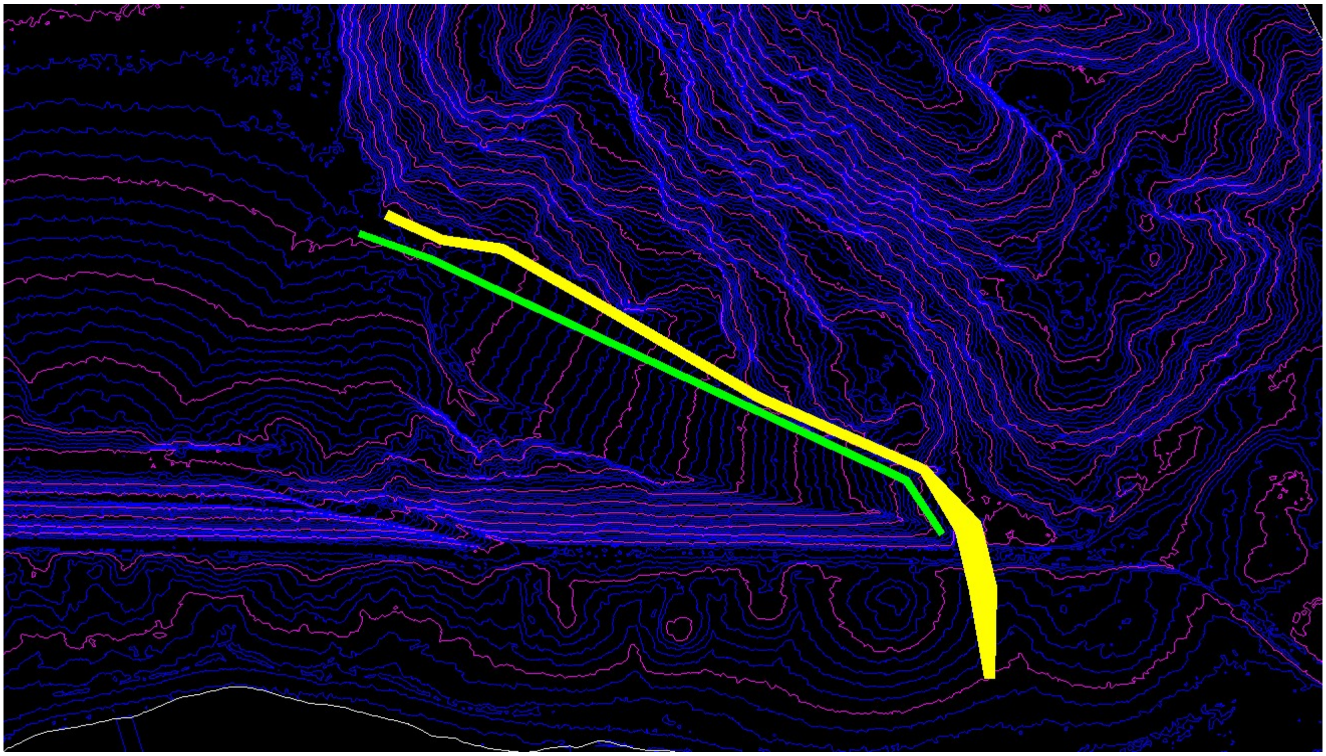
Estimate for Rip Rap along Cell 2W Wall (TJR 10/12/17)

33a	Applicable to Closure in MY 1 through MY 7: Cell 2W/Cell 2E Dam Slope Rip Rap at 4' above and 4' Below Water Line (Tentative)	CY	3,733	See Comments and Notes	$22.00	$82,133	Assume 4,200' * 32' Rip Rap Zone * 9" Thickness. 32' Rip Rap Zone is on assumed 4H:1V Cell 2W dam slope.
33b	Allowance for Geotextile (with 25% overage) below Rip Rap and Miscellaneous Slope Prep.	SY	18,667	See Comments and Notes	$3.00	$56,000	Assume slope prep. and geotextile below rip rap.
33c	Item 33 Estimate Total - MY1	N/A				$138,133	
34a	Applicable to Closure in MY 8 through MY 20: Cell 2W/Cell 2E + 1E Dam Slope Rip Rap at 4' Above and 4' Below Water Line (Tentative)	CY	8,000	See Comments and Notes	$22.00	$176,000	Assume 9,000' * 32' Rip Rap Zone * 9" Thickness. 32' Rip Rap Zone is on assumed 4H:1V Cell 2W dam slope.
34b	Allowance for Geotextile (with 25% overage) below Rip Rap and Miscellaneous Slope Prep.	SY	40,000	See Comments and Notes	$3.00	$120,000	Assume slope prep. and geotextile below rip rap.
34c	Item 34 Estimate Total - MY20	N/A				$296,000	

Year 1 closure
emergency overflow from Cells 1E and 2E
conceptual design only

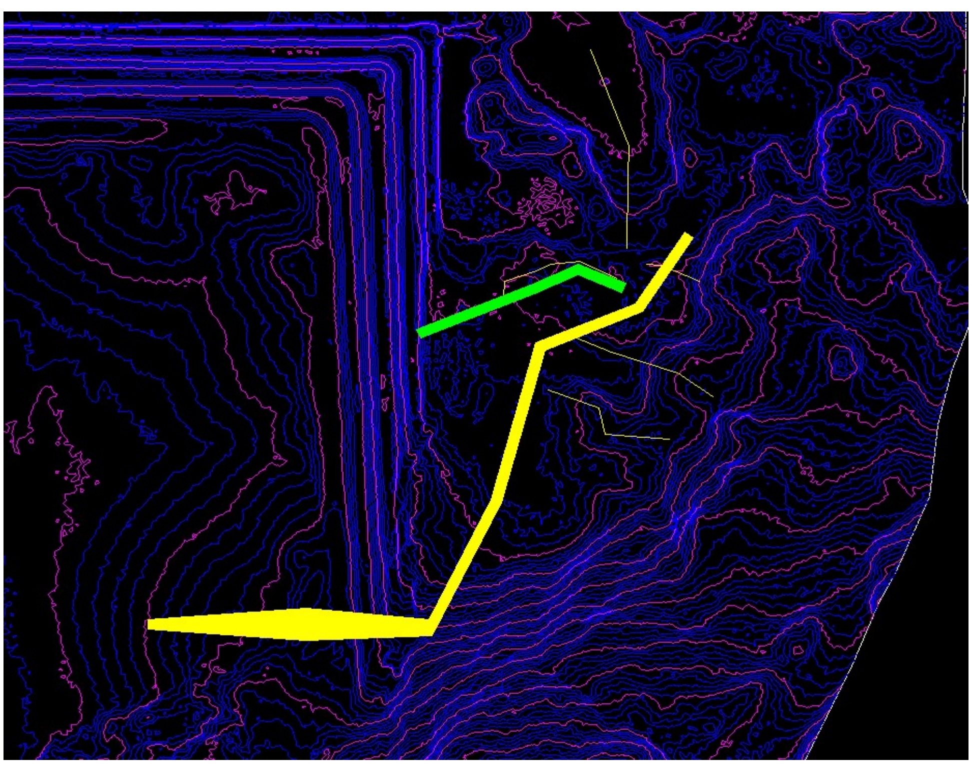
Cell 1E overflow flows into 2E

	length	width	depth	CF	CY	
excavate through Dike at elevation 1660	670	50	8	268000	9,926	Common Excavation
excavate channel adjacent to bedrock knob	1800	20	4	144000	5,333	common Excavation
rip rap south side of channel Assume invert and north side is on bedrock	2000	10	4	80000	2,963	Riprap and filter



Cell 2E overflow

	length	width	depth	CF	CY	
excavate through Dike at elevation 1570	800	70	10	560000	20,741	Common Excavation
excavate channel adjacent to bedrock knob	1800	20	4	144000	5,333	common Excavation
rip rap and filter side of channel to protect the embankment toe Assume invert andeast side is on bedrock	500	10	4	20000	741	Riprap and filter
dike to direct flow away from embankment toe	636	20	3	38160	1,413	granular borrow
bedrock excavation for channel	200	20	4	16000	593	bedrock drill and blast



Soil excavation	41,333	CY				
riprap	3,704	cy	100000	cf	2.2956841	AF

SOW 14: Flotation Tailings Basin: Year 1 Emergency Overfflow

Barr Engineering estimate based on permit level design on drawing FTB-xxx to FTB-xxx - April 2017

Heavy Border with Bold Amounts are used in Reclamation Estimates

Item	**Description**	**Unit**	**Quantity**	**Basis for Quantities (drawing # or describe)**	**Unit Cost**	**Cost Extension**	**Comments**
1	Mobilization and Demobilization	LS	1	See Comments and Notes	$ 20,000.00	$ 20,000	To Be Determined By Contractor - Mob for General Earthwork, Site Grading and Vegetation Establishment
2	Environmental Protection Measures	LS	1	See Comments and Notes	$ 10,000.00	$ 5,000	about 1/2 of the Construction is within FTB Footprint.
3	Soil Excavation	CY	41,333	See Comments and Notes	$ 1.60	$ 66,133	soil spread inside FTB
4	Rock Excavation	CY	593	See Comments and Notes	$ 11.25	$ 6,671	rock spread inside FTB
5	Rip-Rap Erosion Protection	Acre	2.30	See Comments and Notes	$ 58,000.00	$ 133,400	
6	Granular fill	CY	1,413	See Comments and Notes	$ 5.00	$ 7,065	Unsure of unit cost and description
7	Seed, Fertilize and Mulch for Vegetation Establishment	Acre	2	See Comments and Notes	$ 635.00	$ 1,270	Commercial Fertilizer and Seed for Overburden – Supply/Apply/Incorporate @ 200 lb/Acre/ [D&T 4/5/16 letter] + Mulch – Supply and Incorporate @ 2 ton/acre of Hay or Straw Mulchs. [D&T 4/5/16 letter]
8		Acre	0	See Comments and Notes		`	
9		Acre	-	See Comments and Notes	$ -	$ -	
					Total	**$ 239,539**	

Notes:
1) D&T letter is Attachment K

Estimate for SOW 21: Category 1 Groundwater Containment System: End of Year 1

Barr Engineering estimate based on permit level design on drawing GCS-003 and GCS-010 to 013 from Appendix 4 of the PTM Application - July 2016

Heavy Border with Bold Amounts are used in Reclamation Estimates

Item	Description	Unit	Quantity	Basis for Quantities (drawing # or describe)	Unit Cost	Cost Extension	Comments
1	Mobilization and Demobilization	LS	1	See Comments and Notes	$ 125,000	$ 125,000	To Be Determined By Contractor - Mob for General Earthwork, Site Grading and Vegetation Establishment
2	Environmental Protection Measures	LS	1	See Comments and Notes	$ 10,000	$ 10,000	Assume Environmental Protection Measures from Year 0 Construction Remain in Place and Are Effective. Assume Dust Control is Ancillary to Earthwork Activities.
3	Construction QA/QC	LS	1	See Comments and Notes	$ 45,000	$ 45,000	Includes General Confirmatory Survey, Construction Observation, Material Testing, Test Data and Submittal Review, and Construction Documentation
4	Grubbing	AC	3	See Comments and Notes	$ 2,500	$ 7,500	
5	Temporary Dewatering and Pumping	LS	1	See Comments and Notes	$ 75,000	$ 75,000	
6	Common Excavation and Stockpile	N/A	0	See Comments and Notes	$ -	$ -	
7	Portion that is Assumed to be Peat Excavation	CY	7,200	See Comments and Notes	$ 8	$ 54,000	
8	Portion that is Assumed to be Saturated Overburden Excavation	CY	14,100	See Comments and Notes	$ 5	$ 70,500	
9	Portion that is Assumed to be Unsaturated Overburden Excavation	CY	11,400	See Comments and Notes	$ 5	$ 57,000	
10	Portion that is Assumed to be Rock Excavation	CY	3,200	See Comments and Notes	$ 46	$ 147,200	
11	Clay Borrow, Backfill and Compaction	CY	6,300	See Comments and Notes	$ 12	$ 75,600	
12	Common Borrow Backfill and Compaction	CY	5,200	See Comments and Notes	$ 5	$ 26,000	
13	1-Inch Minus Rock	CY	7,500	See Comments and Notes	$ 20	$ 150,000	
14	Surface Runoff and Seepage Collection Trench	N/A	0	See Comments and Notes	$ -	$ -	
15	Furnish and Install 36-inch Dia. Perforated HDPE Pipe	LF	2,800	See Comments and Notes	$ 150	$ 420,000	quantity from Changes Over Time Memo
16	Furnish and Install 12-inch Dia. Solid HDPE Pipe	LF	60	See Comments and Notes	$ 36	$ 2,160	
17	Furnish and Install 12-inch Dia. Perforated HDPE Pipe	LF	35	See Comments and Notes	$ 45	$ 1,575	
18	Furnish and install 12-inch HDPE end cap	EA	12	See Comments and Notes	$ 275	$ 3,300	
19	Furnish and install 12x36-inch HDPE Tee	EA	12	See Comments and Notes	$ 2,600	$ 31,200	
20	Furnish and install 12-inch HDPE connection	EA	12	See Comments and Notes	$ 200	$ 2,400	
21	Granular Drainage Material	CY	5,700	See Comments and Notes	$ 16	$ 91,200	
22	Furnish and install 60-inch I.D. precast manhole	LS	2	See Comments and Notes	$ 16,000	$ 32,000	Assume Total Manhole Height of 16' Each with Concrete Base, Steps, Concrete Top and Cast/Locking Manway Hatch.
23	Furnish and Install Vegetation on Disturbed Areas	AC	41	See Comments and Notes	$ 635	$ 26,035	Assume Average Width of Restoration Zone is 100' and add 20% Additional for Misc. Restoration Areas; 100'x15,000' +20% = 1,800,000 SF = 41 Acre [Commercial Fertilizer and Seed for Overburden – Supply/Apply/Incorporate @ 200 lb/Acre/ [D&T 4/5/16 letter] + Mulch – Supply and Incorporate @ 2 ton/acre of Hay or Straw Mulchs. [D&T 4/5/16 letter]]
24	Reseeding 5% of Vegetation to Correct for Limited Growth	AC	2	See Comments and Notes	$ 635	$ 1,302	Commercial Fertilizer and Seed for Overburden – Supply/Apply/Incorporate @ 200 lb/Acre/ [D&T 4/5/16 letter] + Mulch – Supply and Incorporate @ 2 ton/acre of Hay or Straw Mulchs. [D&T 4/5/16 letter]
					total	**$ 1,453,972**	

Notes

3) D&T letter is Attachment K

Legacy Remediation - Areas of Concern (AOC) - costs from detailed spreadsheets by NTS [2016] (see Attachment G)

Heavy Border with Bold Amounts are used in Reclamation Estimates

		Cost Per Phase/Task (see separate sheet for details and assumptions)					
AoC No.	**WBS No.**	**Site Name**	**Phase I ESA/ SAP**	**Implement SAP**	**Complete Phase II**	**Remediation**	**Total Cost**
01	731-1	Area 1 Shops	$7,500	$208,615	$235,615	$380,000	$831,730
06	731-2	Oily Waste Disposal Area	$7,500	$53,190	$100,450	$73,270	$234,410
07	731-3	Bull Gear Disposal	$7,500	$35,600	$0	$0	$43,100
09	731-4	Railroad Panel Yard	$0	$0	$23,010	$1,352,397	$1,375,407
10	731-5	Airport	$7,500	$29,180	$57,580	$60,240	$154,500
11	731-6	Stoker Coal Ash Disposal	$7,500	$30,180	$38,868	$245,120	$321,668
13	731-7	2001 Storage Area	$7,500	$29,180	$57,580	$0	$94,260
14	731-8	Sandblasting and large Equipment Painitng Area	$7,500	$57,796	$29,460	$43,570	$138,326
35	731-9	Dunka Water Treatment Plant Sludge	$4,000	$20,800	$37,800	$0	$62,600
37	731-10	Line 9 Area 5 Petroleum Contaminated Soil	$7,500	$0	$0	$0	$7,500
38	731-11	Area 2 Shops	$0	$0	$242,110	$179,796	$421,906
40	731-12	Heavy Duty Garage	$7,500	$21,000	$40,000	$0	$68,500
42	731-13	Bunker C Tank Farm (inc asbestos abatement)	$0	$0	$0	$915,000	$915,000
43	731-14	Administration Building	$7,500	$20,600	$0	$0	$28,100
44	731-15	Main Gate Vehicle Fueling Area	$7,500	$17,000	$34,900	$24,200	$83,600
46	731-16	Plant Site and General Shops	$7,500	$59,344	$189,760	$644,690	$901,294
47	731-17	Tailings Basin Reporting	$7,500	$0	$0	$0	$7,500
48	731-18	Booster Pump House with Transformer	$7,500	$20,900	$38,700	$0	$67,100
49	731-19	Coarse Crusher Petroleum Contaminated Soil	$7,500	$16,700	$35,100	$0	$59,300
51	731-20	Tailings Basin Salvage and Scrap Areas	$7,500	$83,308	$22,450	$408,244	$521,502
52	731-21	Cell 2W Salvage Area	$7,500	$21,000	$0	$0	$28,500
53	731-22	Hornfels Burial	$7,500	$0	$0	$0	$7,500
59	731-23	Colby Lake Pumping Station	$7,500	$21,000	$0	$0	$28,500
61	731-24	Pellet Plant	$7,500	$98,926	$58,425	$258,546	$423,397
	Totals		$154,000	$844,319	$1,241,808	$4,585,073	$6,825,200
		MPCA Coordination Trans 1			$4,024,183	1.5%	$62,000
		MPCA Coordination Trans 2			$2,801,017	1.1%	$31,000
							$6,918,200

Demo Estimate from Lakehead/Rachel, Mavo and Arrowhead Consulting & Testing	Lakehead / Rachel 2016 (Attachments E and F)						Mavo 2016 (Attachment C)	Arrowhead Consulting & Testing 2016 (Attachment D)		
Scope of Work Description	Universal Waste Collection	Galbestos Removal	Demolition	Total Demo	Site Restoration	Recovery (not used - see Summary Scrap Value tab))	Asbestos Lead Paint Mold	Pre Demo Insp	Demo To Rollup	Abatement To Rollup
Pre-Demolition Services										
Legacy with construction				$1,650,850	$4,500	$1,125	$20,500	$4,800	$1,655,350	$25,300
Additive Building & Heating Plant				$1,593,300			Included in Lakehead's total demo			in Main Plant Area below
Bentonite silos				inc in above			n/a			
Area 2 Water Tower (price separate from Heating & Additives buildings)			$30,000	$30,000	$2,500	$1,125	n/a			
Legacy Tailings Basin Buildings - Demoed as part of construction										
Foreman's Office (Bldg. 718)			$9,350	$9,350	$400		$6,500	$1,100		
Reporting Building (Bldg. 719)			$9,900	$9,900	$400		$6,500	$1,100		
Lube House (Bldg. 720)			$2,500	$2,500	$400		$2,500	$850		
Reporting Building (Bldg. 724)			$3,300	$3,300	$400		$2,500	$900		
Lube Oil Building (Bldg. 725)			$2,500	$2,500	$400		$2,500	$850		
Legacy Area 1				$351,597	$97,319	$41,000	$97,500	$850	$448,916	$98,350
Area 1 Shop and Truck Storage (Bldg. 220)	$2,900	$106,900	$103,332	$213,132	$74,669	$37,000	$82,500			
Area 1 Cold Storage (Bldg. 221)	$400	$48,970	$10,860	$60,230	$13,400	$2,800	$5,000			
Area 1 Reporting Building (Bldg. 231)			$9,900	$9,900			$5,000	$850		
Area 1 Boiler House (Bldg. 226)	$200	$13,500	$9,875	$23,575	$3,000	$200	$2,500			
Area 1 Fire Pump House & Water Tank (Bldg. 228)	$410		$11,250	$11,660			$2,500			
Area 1 Locomotive Fueling	$500	$22,500	$10,100	$33,100	$6,250	$1,000				
Legacy Area 2				$474,042	$82,785	$18,315	$164,700	$2,650	$556,827	$167,350
Area 2 Service Shop (Bldg. 201)	$2,200	$160,900	$38,990	$202,090	$37,334	$10,940	$93,050			
Area 2 Truck Storage (Bldg. 202)	$2,000	$63,190	$9,175	$74,365	$13,988	$3,075	$3,000			
Area 2 Cold Storage (204)	$697	$42,560	$13,080	$56,337	$14,100	$1,700	$3,000			
Area 2 Shop Locomotive Service Shop (Bldg. 203)	$3,400	$20,500	$12,300	$36,200	$11,113	$1,625	$52,150			
Area 2 Locomotive Fueling	$2,000	$20,900	$11,800	$34,700	$6,250	$975	$2,500			
Hose House (Bldg. 209) Not to be used in project		$3,000	$9,150	$12,150			$2,500	$850		
Sample House (Bldg. 208) Not to be used in project		$25,400	$20,300	$45,700			$5,000	$950	main plan areas inc tunnels	
Reporting Building (Bldg. 425) Not to be used in project		$3,300	$9,200	$12,500			$3,500	$850	$19,888,937	$5,962,607

Demo Estimate from Lakehead/Rachel, Mavo and Arrowhead Consulting & Testing

Scope of Work Description	Lakehead / Rachel 2016 (Attachments E and F)						Mavo 2016 (Attachment C)	Arrowhead Consulting & Testing 2016 (Attachment D)		
	Universal Waste Collection	**Galbestos Removal**	**Demolition**	**Total Demo**	**Site Restoration**	**Recovery (not used - see Summary Scrap Value tab))**	**Asbestos Lead Paint Mold**	**Pre Demo Insp**	**Demo To Rollup**	**Abatement To Rollup**
Legacy Plant Area				$13,305,631	$3,223,306	$2,890,406	$3,807,340	$2,200	$16,528,937	$3,809,540
Rebuild Shop (Bldg 602)	$3,000	$70,200	$125,600	$198,800	$27,560	$13,940	$85,000			
General Shop (Bldg. 601) Includes Acetylene Building (Bldg.604)	$15,000	$199,190	$353,600	$567,790	$182,300	$113,796	$480,800			
Carpenter Shop (Bldg. 603)	$2,000	$10,200	$13,250	$25,450	$3,300	$100	$2,500			
Coarse Crusher	$10,000	$313,345	$1,551,800	$1,875,145	$593,890	$199,325	$1,070,618			
Drive House 1 conv and housings	$7,500	$165,569	$141,540	$314,609	$46,900	$41,050	incl. in above			
Drive House 2 inc conv and housings		inc in above	inc in above	inc in above	inc in above	inc in above	incl. in Fines Crusher			
Fine Crusher	$45,000	$302,430	$1,373,460	$1,720,890	$203,400	$205,250	$439,686			
Warehouse 49 (Bldg. 920)	$6,500	$27,586	$82,800	$116,886	$15,947	$5,350	$49,000			
Warehouse 45 (Bldg. 921, Electrical)	$2,500	$35,159	$72,700	$110,359	$15,947	$3,590	$13,500			
Lube House (Bldg. 926)	$578	$17,000	$20,550	$38,128	$7,385	$1,600	$52,000			
Rubber Shop (Bldg. 605)	$1,000	$30,464	$36,550	$68,014	$11,269	$5,150	$24,000			
Concentrator Building and Thickeners	$100,000	$1,248,260	$5,895,850	$7,244,110	$1,145,998	$2,141,430	$1,535,236			
A-Lab	$500	$9,400	$14,560	$24,460	$2,940	$2,450	included in Concentrator			
Hinsdale Bridge	$0	$16,700	$616,300	$633,000	$15,200	$148,500	n/a			
Water Reservoir	$5,000		$98,100	$103,100	$914,400	$7,750	n/a			
Plant Site Water Tower			$30,000	$30,000	$2,500	$1,125	n/a			
Water Treatment Plant & Storage Tanks	$1,000	$20,000	$72,600	$93,600	$2,250		$45,000			
Colby Pump House (potential deduct depends on variance request)		$41,000	$8,260	$49,260	$1,500		$2,500	$1,000	$50,760	$3,500
Ad Building inc UST	$3,900		$157,935	$161,835	$18,200		$850,000		$180,035	$850,000
Main Gate	$100		$11,400	$11,500	$875		$5,000	$900	$12,375	$5,900
Booster Pump House #1	$300		$23,500	$23,800	$9,200		included in Concentrator		$243,170	$859,400
Sewage Treatment Plant	$0		$62,700	$62,700	$19,520		$5,000	$900		
Portable Pump Houses	$0		$9,890	$9,890	$3,400		n/a			
Return Water Barge	$0		$44,900	$44,900			$5,000	$1,300		
General Infrastructure (railroads, tunnels, roadways, etc)					$1,504,000	$237,500			$1,504,000	
Legacy Railroads	$0		$380,000	$380,000					$380,000	
Legacy Tunnels	$0		$1,856,000	$1,856,000			$2,127,767		$1,856,000	$2,127,767
Galleries							included in Concentrator			
Sanitary Systems and Wells			$17,500		included in associated areas					
Pipelines					$591,000				$2,879,000	
Colby Lake Pipeline (potential deduct depends on variance request)			$900,000	$900,000	$98,000					
Inter-Pit Pipeline from Reservoir to Areas 1 & 2			$562,000	$562,000						
Natural Gas Pipeline Removal			$150,000	$150,000						
Legacy PipeLines Tailings management above ground			$378,000	$378,000						
Legacy PipeLines Tailings management below ground			$200,000	$200,000						
Legacy Power Lines	$0		$97,810	$97,810					$97,810	
Legacy Roads/Parking Lots	$0		$465,000	$465,000	$195,000				$660,000	

Demo Estimate from Lakehead/Rachel, Mavo and Arrowhead Consulting & Testing

	Lakehead / Rachel 2016 (Attachments E and F)						Mavo 2016 (Attachment C)	Arrowhead Consulting & Testing 2016 (Attachment D)		
Scope of Work Description	**Universal Waste Collection**	**Galbestos Removal**	**Demolition**	**Total Demo**	**Site Restoration**	**Recovery (not used - see Summary Scrap Value tab))**	**Asbestos Lead Paint Mold**	**Pre Demo Insp**	**Demo To Rollup**	**Abatement To Rollup**
New - Phase 1 - Plant Site				$2,190,000	$689,000					
Flotation Plant and Reagent Building	$75,000		$621,800	$696,800	$147,600	$242,500			$844,400	
Concentrate Storage and Loadout Facility	$12,000		$273,760	$285,760	$48,100	$37,500			$333,860	
Plant Site Sewage Treatment Plant	$1,000		$118,000	$118,000	$30,000				$148,000	
Railroads	$0		$185,000	$185,000	$111,000				$296,000	
Pipelines	$0		$1,555,000	$1,555,000	$375,000				$1,930,000	
Power Lines	$0			$0	$0				$0	
Roads and Parking Lots	$0			$0	$0				$0	
Plant Site Wastewater Treatment Plant (WWTP) Ponds not included	$0		$245,000	$245,000					$245,000	used long term
New - Phase 1 - Mine Site										
Maintenance Service and Fueling Facility	$1,100		$19,210	$20,310	$7,300	$1,200			$27,610	
Rail Transfer Hopper	$1,100		$40,000	$41,100	$45,000	$1,200			$86,100	
Rail Transfer Hopper Control Bldg	$100		$18,600	$18,700					$18,700	
Rail Transfer Hopper Platform			$60,000	$60,000					$60,000	
Central Pumping Station	$500		$14,000	$14,500	$1,200				$15,700	
Railroads	$0		$45,000	$45,000	$33,750				$78,750	
Pipelines	$0		$580,133	$580,133	$217,000				$797,133	
Power Lines	$0		$83,900	$83,900	$0	$7,175			$83,900	
Roads and Parking Lots	$0		$392,000	$392,000	$132,000				$524,000	
Mine Site Wastewater Treatment Facility (WWTF)	$0		$498,000	$498,000	$14,000				$512,000	
New - Phase 2				$10,735,100	$97,375					
Reagent Building	$15,000		$820,000	$835,000	$4,100	$22,500				
Oxygen Plant	$65,000		$4,238,600	$4,303,600	$16,600	$72,500				
Limestone Preparation	$7,500		$345,000	$352,500	$1,750	$12,500				
Hydrometallurgical Plant	$49,000		$4,365,000	$4,414,000	$13,500	$62,500				
Hydrometallurgical Reagents	$15,000		$815,000	$830,000	$2,200	$17,500				
Railroads	$0									
Pipelines	$0		$1,450,000							
Power Lines	$0									
Roads and Parking Lots	$0		$156,000		$59,225					

	Lakehead	Mavo
Totals	$31,155,813	$7,087,707
Mine Site	$2,203,893	$0
less Mine Site	$28,951,920	$7,087,707

Demo Estimate for Above Ground Storage Tanks from Lakehead Rachel

Heavy Border with Bold Amounts are used in Reclamation Estimates						Lakehead / Rachel 2016 (Attachments E and F)				
Name	Tank #	Fluid	Gallons	Location	Fluid Removal/ Disposal	Demolition/ Removal	Site Restoration	Asbestos Lead Paint	Assets Recovery	Notes
Legacy - Area 1 Shop					$0	$24,100	$3,000	$0		
Portable tank on skids (silver)	048	Fuel Oil	1,800	E of Area 1 Shop		$600				Out of Service - Disconnected, Labeled lube oil, Silver tank
Storage Tank	080		20,000	Area 1 - South of Rail Road Grade		$1,000				BASIS: Costs based on conceptual plan, site experience and historical knowledge.
Storage Tank	358	Used Anti-freeze		N. Side Area 1 Shop		$0				Included as part of Area 1 Shop demo
Storage Tank	420	Used Anti-freeze		N. Side Area 1 Shop		$0				Included as part of Area 1 Shop demo
Black Tank	n/a		20,000	N of Area 1 Shop		$7,500	$1,000.00		$1,500.00	
Black Tank	n/a		20,000	N of Area 1 Shop		$7,500	$1,000.00		$1,500.00	
3 Blue			20,000	N of Area 1 Shop		$7,500	$1,000.00		$1,500.00	Out of Service. Disconnected, Labeled "save for conc."
Locomotive Fueling		# 1,2 Fuel Oil		West end of Panel Yard		-				This tank is no longer on site.
Legacy - Area 2 Shop					$0	$0	$0	$0		
Locomotive Fueling		# 1,2 Fuel Oil								
Legacy - Plant Area					$0	$199,525	$25,700	$0		
Storage Tank	015	# 1,2 Fuel Oil	12,000	E. Side Concentrator		$600				
Storage Tank	032	# 2, 6 Fuel Oil	3,384,000	Tank Farm		$62,000	$8,100.00		$40,000.00	
Storage Tank	033	# 6 Fuel Oil	3,384,000	Tank Farm		$62,000	$8,100.00		$40,000.00	
Storage Tank	034	# 6 Fuel Oil	3,384,000	Tank Farm		$62,000	$8,100.00		$40,000.00	
Storage Tank	304	Mineral Oil	12,000	E. Side Concentrator		$600				
Storage Tank	305	Mineral Oil	12,000	E. Side Concentrator		$600				
Storage Tank	306	Mineral Oil	12,000	E. Side Concentrator		$600				
Storage Tank	408	Lube oil	20,000	SW of Tailings Basin Reporting Area		$0				Out of Service, but piping still in place and no signs are posted
Storage Tank	421	Alcohol	10,000	E side Concentrator		$500				
Storage Tank	506	Fuel Oil	500	Heating Plant		$25				
WTP Backwash (green)			16,000	NE of Drivehouse 1		$5,000	$700.00		$1,000.00	
Tank (white)			14,000	SE of Tailings Basin Reporting Area		$5,000	$700.00		$1,000.00	Out of Service. Disconnected, no visible labels
Dispensing Tanks at Main Gate	121	Gasoline	6,000	See gas station dwg's for reference		$600				
Dispensing Tanks at Main Gate	122	Gasoline	6,000	See gas station dwg's for reference		$600				
New - Phase 1 - Plant Site					$0	$0	$0	$0		**to Demo tab**
Storage Tank	TBD	CuSO4				$0				tanks provided by supplier
Storage Tank	TBD	Magnafloc 10	10,600			$0				tanks provided by supplier
Storage Tank	TBD	PAX	3,000			$0				tanks provided by supplier
Storage Tank	TBD	Lime	22,500			$0				tanks provided by supplier
New - Phase 1 - Mine Site					$0	$0	$0	$0		**to Demo tab**
Mine Site Truck Fueling	TBD	# 1,2 Fuel Oil		Fueling and Maintenance Facility		$0				
New - Phase 2 - Plant Site					$0	$0	$0	$0		**to Demo tab**
Storage Tank	TBD	H2SO4	40,000			$0				tanks provided by supplier
Storage Tank	TBD	HCl	60,000			$0				tanks provided by supplier
Storage Tank	TBD	Liquid SO2	21,000			$0				tanks provided by supplier
Storage Tank	TBD	Magnafloc 342/351				$0				tanks provided by supplier
Storage Tank	TBD	Mg(OH)	80,000			$0				tanks provided by supplier
Storage Tank	TBD	NaHS	13,200			$0				tanks provided by supplier
Storage Tank	TBD	NaOH	40,000			$0				tanks provided by supplier
Removed										
Day Tanks	083	# 6 Fuel Oil	20,000	Tank Farm						
Day Tanks	084	# 6 Fuel Oil	20,000	Tank Farm						
Day Tanks	085	# 6 Fuel Oil	20,000	Tank Farm						
Blue		Waste oil		W side of Coarse Crusher						
Blue		Lube oil		NE cor. Fine Crusher						
White		Anti-Freeze		NW cor. Fine Crusher						
					Total	$223,625				

Appendix A-2 Mine Year 1 Long Term

12/7/2017

Includes 100 Years of MDNR Administration,Site Mgr,Water Treatment,Cover System Maintenance, Monitoring/Reporting (Dam Safety and Landfill) , Snowplowing/Road Maint and Vehicles

	Support Tab	Quantity	Units	Unit $	Cash $	NPV $	Note		Calendar Year	Start of Year 01/01/18	Bankruptcy 07/01/18 2018	07/01/19 2019	07/01/20 2020	07/01/21 2021	07/01/22 2022	07/01/23 2023	07/01/24 2024	07/01/25 2025	07/01/26 2026	07/01/27 2027	07/01/28 2028
Long Term Total with Indirects					**$1,181,141,669**	**$410,101,543**	FA for NPV Amount														
Contingency	**15.0%**				**$148,891,223**	**$51,700,321**															
Adaptive Management	**2.0%**				**$17,930,987**	**$6,218,365**															
Contractor Supplies Markup	**2.5%**				**$21,711,307**	**$7,514,049**					7.953										**Year 11**
								992.608	344.669												**Continues to Year 100**
Long Term Total (no Indirects)					**$992,608,152**	**$344,668,807**			2.9%	**Operating**	**Hold**	Backfilling		Flushing			Flooding			Pit Oflow	
								100 Yr Tot	**NPV**		1	2	3	4	5	6	7	8	9	10	11
Water Treatment					**$859,066,077**	**$293,489,498**															
Plant Site					$752,055,909	$252,187,506															
Treatment O&M less Labor (Years 1 to 3)		1	Annual	$2,910,240	$8,730,720	$8,367,299		8.731	8.367	0	2.910	2.910	2.910	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Treatment O&M less Labor (Years 4 to 5)		1	Annual	$5,804,160	$11,608,320	$10,355,456	Annual $ from Barr Water Treatment Memo	11.608	10.355	0	0.000	0.000	0.000	5.804	5.804	0.000	0.000	0.000	0.000	0.000	0.000
Treatment O&M less Labor (Years 6 to 9)		1	Annual	$6,543,329	$26,173,316	$21,437,039		26.173	21.437	0	0.000	0.000	0.000	0.000	0.000	6.543	6.543	6.543	6.543	0.000	0.000
Treatment O&M less Labor (Years 10 to 100)		1	Annual	$5,315,501	$483,710,591	$133,011,153		483.711	133.011	0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	5.316	5.316
Labor - annual $ / FTE - calc from hourly rate	Unit $ Long Term	$95,653	$/yr $/hr	$45.99			MN DOLI #102 Dec 2016 Skilled Labor * 1.15 to cover emoloyment costs														
Factor for off shift alarm response	Unit $ Long Term	105%	factor				Estimate of FTE Required for Remote Alarm Response														
Labor - annual $ from annual FTE		3.14	FTE	$299,873	$29,987,333	$9,883,433		29.987	9.883	0	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300
Facility Replacement (Year 2 to 100)		1	Annual	$1,804,316	$178,627,284	$57,688,978	Annual $ from Barr Water Treatment Memo	178.627	57.689	0	0.000	1.804	1.804	1.804	1.804	1.804	1.804	1.804	1.804	1.804	1.804
Facility Expansion		1	LS	$11,783,623	$11,783,623	$10,971,283		11.784	10.971	0	0.000	0.000	11.784	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Labor - annual $ / FTE - calc from hourly rate	Unit $ Long Term	$143,472	$/yr $/hr	$ 68.98			Mn DOLI #707 Dec 2016 Electrician * 1.15 to cover emoloyment costs														
Specialized Maintenance		0.1	Annual	$14,347	$1,434,722	$472,865		1.435	0.473	0	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014
Mine Site					$107,010,168	$41,301,992															
Treatment O&M less Labor (Years 1 to 3)		1	Annual	$2,452,740	$7,358,220	$7,051,930		7.358	7.052	0	2.453	2.453	2.453	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Treatment O&M less Labor (Years 4 to 6)		1	Annual	$1,237,709	$3,713,127	$3,265,923	Annual $ from Barr Water Treatment Memo	3.713	3.266	0	0.000	0.000	0.000	1.238	1.238	1.238	0.000	0.000	0.000	0.000	0.000
Facility Replacement (Year 2 to 100)		1	Annual	$969,079	$95,938,821	$30,984,139		95.939	30.984	0	0.000	0.969	0.969	0.969	0.969	0.969	0.969	0.969	0.969	0.969	0.969
Maintencne and Monitoring					$37,483,275	$16,332,881															
Maintenance					$21,504,000	$10,545,235															
Snow Plowing	Unit $ Long Term	1	Annual	$25,414	$2,541,400	$837,612	PolyMet Snow Plowing (average of 2 highest of 3 years)	2.541	0.838	0	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025
Road Maintenance - After Reclamation	Unit $ Long Term	1	Annual	$19,200	$1,862,400	$579,162	One grader with Operator Ames Email 11/13/17 One day per month.	1.862	0.579	0	0.019	0.000	0.000	0.000	0.019	0.019	0.019	0.019	0.019	0.019	0.019
Road Maintenance - During Reclamation	Unit $ Long Term	1	Annual	$62,400	$187,200	$174,347	One grader with Operator Ames Email 11/13/17 One day per week during 9 month construction season.	0.187	0.174	0	0.000	0.062	0.062	0.062	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Category 1 Stockpile Cover Maintenance	Unit $ Long Term	1	Annual	$24,000	$2,328,000	$722,006	Allowance to cover (1) management of plants with deep, woody roots (2) monitoring of the soil surface cover for erosion and (3) repairing erosion damage	2.328	0.722	0	0.000	0.000	0.000	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024
Category 1 Stockpile Containment System Maintenance	Unit $ Long Term	1	Annual	$15,000	$1,455,000	$451,254	Allowance to cover maintaining flow in the drain pipe, maintaining surface water controls and repairing the cutoff wall. Note that most years will be much less that this but some could be more.	1.455	0.451	0	0.000	0.000	0.000	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015
FTB Erosion Maintenance	Unit $ Long Term	1	Annual	$10,000	$1,190,000	$504,213	PolyMet's experience with vegetation maintenance and erosion control at this facility indicates that $10,000 annually is sufficient for the whole facility once reclamation is complete and $60,000 a year during reclamation ramping down by $20,000 a year until $10,000 a year once reclamation has been completed.	1.190	0.504	0	0.010	0.060	0.060	0.060	0.040	0.020	0.010	0.010	0.010	0.010	0.010
FTB Seepage Containtainment System Maintenance	Unit $ Long Term	1	Annual	$60,000	$5,940,000	$1,918,366	Allowance for maintaining flow in the drain pipe, maintaining surface water controls, repair of cutoff wall. Note most years will be much less but some could be more.	5.940	1.918	0	0.000	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060
Legacy Cell 2W Reclamation	Unit $ Long Term	1	Annual	$1,000,000	$6,000,000	$5,358,275	Allowance for 6 years to provide stable slopes, adequate vegetation cover, and drainage provisions to resist erosion and route precipitation away from Cell 2W	6.000	5.358	0	0.000	1.000	1.000	1.000	1.000	1.000	1.000	0.000	0.000	0.000	0.000
Monitoring					$15,979,275	$5,787,647															
Water Quality Monitoring - first 5 years	Water Quality Samp-	1	Annual	$202,193	$1,010,965	$942,071	12/yr surface water & 4/yr groundwater	1.011	0.942	0	0.202	0.202	0.202	0.202	0.202	0.000	0.000	0.000	0.000	0.000	0.000
Water Quality Monitoring - long term	Anal-Rep	1	Annual	$109,664	$10,418,080	$3,103,428	9/yr surface water & 1/yr groundwater	10.418	3.103	0	0.000	0.000	0.000	0.000	0.000	0.110	0.110	0.110	0.110	0.110	0.110
Dam Safety Monitoring	Unit $ Long Term	1	Annual	$38,572	$3,857,200	$1,271,283	NTS estimate for annual instrumentation data collection and report (2 events) - Barr estimate for geotectnical inspection and report	3.857	1.271	0	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039
Landfill Monitoring and Maintenance SW619 (30yrs)	Unit $ Long Term	1	Annual	$21,957	$658,710	$442,201	NTS 4/22/16 letter	0.659	0.442	0	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022
Landfill Monitoring and Maintenance Coal Ash (13yrs)	Unit $ Long Term	1	annual	$2,640	$34,320	$28,663	PLM 2017 Budget	0.034	0.029	0	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
Other					$2,871,400	$2,351,796															
NMT Development		1	Total	$2,871,400	$2,871,400	$2,351,796	From Non-Mechanical Treatment Memo - adjusted (-$75,000) for work already done	2.871	2.352	0	0.000	0.000	0.000	0.000	0.000	0.718	0.718	0.718	0.718	0.000	0.000
Site Administration and Management					$93,187,400	$32,494,632															
Site Manager - Holding and Reclamation	Unit $ Long Term	1.0	FTE	$224,640	$1,123,200	$1,046,658	NTS 4/22/16 letter Mid Level Professional	1.123	1.047	0	0.225	0.225	0.225	0.225	0.225	0.000	0.000	0.000	0.000	0.000	0.000
Site Manager -Long Term	Unit $ Long Term	0.5	FTE	$112,320	$10,670,400	$3,178,591	NTS 4/22/16 letter Mid Level Professional	10.670	3.179	0	0.000	0.000	0.000	0.000	0.000	0.112	0.112	0.112	0.112	0.112	0.112
DNR - Holding	Unit $ Long Term	4.0	FTE	$965,120	$965,120	$951,535		0.965	0.952	0	0.965	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
DNR - Reclamation	Unit $ Long Term	4.0	FTE	$965,120	$2,895,360	$2,696,566	Provided by DNR flat rate for all staff including overhead and expenses	2.895	2.697	0	0.000	0.965	0.965	0.965	0.000	0.000	0.000	0.000	0.000	0.000	0.000
DNR - Long Term	Unit $ Long Term	2.0	FTE	$482,560	$46,325,760	$14,080,496		46.326	14.080	0	0.000	0.000	0.000	0.000	0.483	0.483	0.483	0.483	0.483	0.483	0.483
DNR - Legal	Unit $ Long Term	2.0	FTE	$482,560	$482,560	$475,767		0.483	0.476	0	0.483	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Misc Engrg Services		1.0	Annual	$25,000	$2,400,000	$729,469	allowance	2.400	0.729	0	0.000	0.000	0.000	0.000	0.025	0.025	0.025	0.025	0.025	0.025	0.025
Facility Insurance		1.0	Annual	$150,000	$15,000,000	$4,943,804	estimate from insurance broker	15.000	4.944	0	0.150	0.150	0.150	0.150	0.150	0.150	0.150	0.150	0.150	0.150	0.150
Environmental Insurance		1.0	Annual	$100,000	$10,000,000	$3,295,869	$10M coverage with 1% preimum	10.000	3.296	0	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100
Pickup Truck (25,000 mi x $0.70/mi)	Unit $ Long Term	25,000	Annual	$17,500	$1,750,000	$576,777	NTS Letter of 4/21/16	1.750	0.577	0	0.018	0.018	0.018	0.018	0.018	0.018	0.018	0.018	0.018	0.018	0.018
Pump Maint Truck (15,000 mi x $1.05/mi)	Unit $ Long Term	15,000	Annual	$15,750	$1,575,000	$519,099	NTS Letter of 4/21/16 x 1.5 to cover truck with lift	1.575	0.519	0	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016

General Unit Costs Used in Long Term Estimates

Source Column indicates provider and date of unit cost

Source Name	Source Location
Ames 2017	Attachment H2
NTS 2016	Attachment I3
Barr 2016	Attachment K2
DOLI 2016	Attachment L
PolyMet 2016	Attachment M

Item	Description	Unit	Source	Basis for Quantities (drawing # or describe)	Unit Price	Comments
	General Services Reclamation					
	Pick Up Truck	$/mi	NTS 2016		$ 0.70	NTS Letter of 4/21/16
	Pump Maint Truck	$/mi	NTS 2016		$ 1.05	NTS Letter of 4/21/16 x 1.5 to cover truck with lift
	Basic Labor Rates (including OH and profit)					
	Skilled Maintenance	hr	DOLI 2016		$ 68.98	Mn DOLI #707 Dec 2016 Electrician * 1.15 to cover emoloyment costs
	Skilled Labor	hr	DOLI 2016		$ 45.99	MN DOLI #102 Dec 2016 Skilled Labor * 1.15 to cover emoloyment costs
	MDNR Rate	hr	DNR		$ 116.00	Provided by DNR flat rate for all staff including overhead and expenses
	Site Manager	yr	NTS 2016		$ 108.00	NTS 4/22/16 letter Mid Level Professional
	Monitoring and Maintenance					
	Tailings Basin Geotechnical Instruments Field Work	event	NTS 2016		$ 7,686.00	NTS 4/22/16 letter inactive basin
	Tailings Basin Geotechnical Instruments Report	event	NTS 2016		$ 2,850.00	NTS 4/22/16 letter inactive basin
	Tailings Basin Geotechnical Inspection and Report	yr	Barr 2016		$ 17,500.00	Barr 4/1/16 letter inactive basin
	Landfill SW619 Maintenance and Monitoring	yr	NTS 2016		$ 21,957.00	NTS 4/22/16 letter
	Coal Ash Landfill Maintenance and Monitoring	yr	allowance		$ 2,640.00	PLM 2017 Budget
	Snow Plowing	yr	PolyMet 2016		$ 25,414.00	PolyMet Snow Plowing (average of 2 highest of 3 years)
	FTB Dam Containment System Maintenance	yr	allowance		$ 60,000.00	Allowance for maintaining flow in the drain pipe, maintaining surface water controls, repair of cutoff wall. Note most years will be much less but some could be more.
	Legacy Cell 2W Reclamation	yr	allowance		$ 1,000,000.00	Allowance for 6 years to provide stable slopes, adequate vegetation cover, and drainage provisions to resist erosion and route precipitation away from Cell 2W
	Category 1 Stockpile Cover System Maintenance	yr	allowance		$ 24,000.00	Allowance to cover (1) management of plants with deep, woody roots (2) monitoring of the soil surface cover for erosion and (3) repairing erosion damage
	Category 1 Stockpile Containment System Maintenance	yr	allowance		$ 15,000.00	Allowance to cover maintaining flow in the drain pipe, maintaining surface water controls and repairing the cutoff wall. Note that most years will be much less that this but some could be more.
	FTB Maintenance	yr	allowance		$ 10,000.00	PolyMet's experience with vegetation maintenance and erosion control at this facility indicates that $10,000 annually is sufficient for the whole facility once reclamation is complete and $60,000 a year during reclamation ramping down by $20,000 a year until $10,000 a year once reclamation has been completed.
	HRF Maintenance	yr	TBD		$ 10,000.00	Allowance
	Road Grader	hr	Ames 2017		$ 200.00	One grader with Operator Ames Email 11/13/17
	Road Maintenance	yr	calculation	one day per month	$ 19,200.00	One day per month.
	Road Maintenance (during Reclamation)	yr	calculation	one day per week for 9 months	$ 62,400.00	One day per week during 9 month construction season.

Estimate of FTE Required for Remote Alarm Response			
Shifts per week - manned	12	Day Shift Every Day + Afternoon Shift Weekdays	
Shift per week - unmanned	9		
Percent shifts unmanned	43%		
Shifts with alarms	5%	assume 5% of shifts have alarms	
Shifts with alarms requiring OT	2%		
Shifts per year	1092		
Shifts requiring OT	23.4		
Hrs per response	8	assume each OT alarm response generates 8 hrs OT	
OT hrs	187		
OT Preimum	150%	assume time and a half for overtime	
Straight Time Hr equivelent to OT	281		
Annual Hrs for 3 FTE	6240		
Percent FTE to add for Alarm Response	**5%**		

Water Quality Sampling, Analysis and Reporting

Task					Performed by
Collect surface and well sample					Water Treatment/Utility Staff
Perform water quality analysis, QA/QC and report to Site Manager					local laboratory (see Pace Analytical below)
Complete and submit DMR					Site Manager
Prepare and submit NPDES report					Site Manager

Cost Development for Sample Analysis - QA/QC - Reporting					
Heavy Border with Bold Amounts are used in Long Term Estimates					
Mine Site	**$/samp**	**locations**	**samples/year**	**$**	**Note**
Monthly	$428.38	9	12	$46,265	first 5 years
Quarterly	$428.38	33	4	$56,546	first 5 years
Total		42		$102,810	first 5 years
Monthly (non feezing)	$428.38	9	9	$34,698	long term
Annual	$428.38	33	1	$14,136	long term
Total		42		$48,835	long term
Plant Site	**$/samp**	**locations**	**samples/year**	**$**	**Note**
Monthly	$428.38	14	12	$71,967	first 5 years
Quarterly	$428.38	16	4	$27,416	first 5 years
Total		30		$99,383	first 5 years
Monthly (non feezing)	$428.38	14	9	$53,975	long term
Annual	$428.38	16	1	$6,854	long term
Total				$60,829	long term
Mine Site and Plant Site				**$**	**Note**
Total				**$202,193**	first 5 years
Total				**$109,664**	long term

Water Analysis for Typical Sample - From Pace Analytical 2016 Price List (Attachment N)					
Analyte	**Price**	**Qty/sample**	**Sample Cost**		**Note**
Alkalinity	$18.75	1	$18.75		
Arsenic	$20.00	1	$20.00		
Calcium	$20.00	1	$20.00		
Copper	$20.00	1	$20.00		
Cobalt	$20.00	1	$20.00		
Iron	$20.00	1	$20.00		
Hardness Calc	$12.50	1	$12.50		
Magnesium	$20.00	1	$20.00		
Mercury Low Level	$112.50	1	$112.50		
Nickel	$20.00	1	$20.00		
pH	$6.25	1	$6.25		
Specific Conductance	$12.50	1	$12.50		
Sulfate	$25.00	1	$25.00		
Total Dissolved Solids	$12.50	1	$12.50		
Total Suspended Solids	$12.50	1	$12.50		
Zinc	$20.00	1	$20.00		
SubTotal			$372.50		
Level 3 QC		15%	$55.88		Data Reporting, Complete Quality Control plus QC Limits and Batch Cross reference
Total			$428.38		

Assumed Water Quality Monitoring – Mine Site					
Location/ID	**Media**	**Qty**	**Recl Samp/Yr**	**LT Samp/Yr**	**Note**
East Pit	WS	1	12	9	
Category 1 Waste Rock Stockpile Groundwater Containment System	WS	1	12	9	
to WWTS	WS	1	12	9	
MW-05-02	GW	1	4	1	
MW-05-08	GW	1	4	1	
MW-05-09	GW	1	4	1	
MW-1	GW	1	4	1	
MW-2	GW	1	4	1	
MW-3	GW	1	4	1	
MW-4	GW	1	4	1	
MW-5	GW	1	4	1	
MW-6S	GW	1	4	1	
MW-6D	GW	1	4	1	
MW-7	GW	1	4	1	
MW-8S	GW	1	4	1	
MW-8D	GW	1	4	1	
MW-9	GW	1	4	1	
MW-10S	GW	1	4	1	
MW-10D	GW	1	4	1	
MW-11	GW	1	4	1	
MW-12	GW	1	4	1	
MW-13	GW	1	4	1	
MW-14	GW	1	4	1	
MW-15	GW	1	4	1	
MW-16	GW	1	4	1	
MW-17	GW	1	4	1	
MW-18	GW	1	4	1	
OB-1	GW	1	4	1	
OB-2	GW	1	4	1	
OB-3	GW	1	4	1	
OB-4	GW	1	4	1	
OB-5	GW	1	4	1	
P-1	GW	1	4	1	
P-2	GW	1	4	1	
P-3	GW	1	4	1	
P-4	GW	1	4	1	
SW002 (PM-2)	SW	1	12	9	
SW003 (PM-3)	SW	1	12	9	
SW004 (PM-16)	SW	1	12	9	
SW004a	SW	1	12	9	
SW005 (PM-4)	SW	1	12	9	
Colby Lake	SW	1	12	9	
Total Sampling Points		42			
Monthly Sampling Points		9	12		first 5 years
Quarterly Sampling Points		33	4		first 5 years
Monthly (non freezing) Sampling Points		9		9	long term
Annual Sampling Points		33		1	long term

Assumed Water Quality Monitoring – Plant Site					
Location/ID	**Media**	**Qty**	**Recl Samp/Yr**	**LT Samp/Yr**	**Note**
FTB Pond	WS	1	12	9	
FTB Seepage	WS	4	12	9	
WS009	WS	1	12	9	
WWTS Effluent	SW	1	12	9	
PM-12 (existing NPDES station SW004)	SW	1	12	9	
PM-12.2	SW	1	12	9	
PM-13 (existing NPDES station SW005)	SW	1	12	9	
MLC-2	SW	1	12	9	
PM-19	SW	1	12	9	
PM-11 (existing NPDES station SW003)	SW	1	12	9	
PM-7	SW	1	12	9	
GW001	GW	1	4	1	
GW002	GW	1	4	1	
GW003	GW	1	4	1	currently dry and have been dry for a number of years.
GW004	GW	1	4	1	currently dry and have been dry for a number of years.
GW005	GW	1	4	1	
GW006	GW	1	4	1	
GW007	GW	1	4	1	
GW008	GW	1	4	1	
GW009	GW	1	4	1	
GW010	GW	1	4	1	
GW011	GW	1	4	1	
GW012	GW	1	4	1	
GW013	GW	1	4	1	
GW014	GW	1	4	1	
GW015	GW	1	4	1	
GW016	GW	1	4	1	
Total Sampling Points		30			
Monthly Sampling Points		14	12		first 5 years
Quarterly Sampling Points		16	4		first 5 years
Monthly (non freezing) Sampling Points		14		9	long term
Annual Sampling Points		16		1	long term

Attachments

Attachment A

ESA Cliffs Erie 2003

PHASE I - ENVIRONMENTAL SITE ASSESSMENT

CLIFFS ERIE PROPERTIES INCLUDING; THE HOYT LAKES FACILITY, DUNKA PROPERTY, TACONITE HARBOR AND RAILROAD CORRIDORS

September, 2002
NTS Project # 5796.08

Prepared for:

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DISCLAIMER

All information presented in this Phase I Environmental Site Assessment is based on reviews of available literature, records, and informal discussions with various governmental agencies, contractors, and other personnel involved with the property. Conclusions presented are a result of interpretations of the information collected by Northeast Technical Services, (NTS).

Since several conclusions reached in this evaluation were based on information from others or readily available documentation, newly documented or changed verbal information discovered after submittal of this report could result in reinterpretation and alteration of conclusions presented. No soil or water samples were collected or submitted for laboratory analysis as part of the Phase I ESA to verify or confirm the implied quality.

This report does not constitute an assurance or guarantee by NTS that the subject property is presently, nor will it necessarily remain free, from environmental impairment. However, NTS has made every effort to conduct a thorough and complete evaluation of the subject property before submitting this report.

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INTRODUCTION

The former LTV Steel Mining Company (LTVSMC) ceased mining operations in 2001 and subsequently Cliffs Erie, L.L.C. (CE) acquired portions of the facility directly related to mining and ore processing. Minnesota Power (MP) acquired portions not directly associated with the mine and processing. Minnesota Rules 6130 require a Mine Closure Plan for the facility. The CE Closure Plan (May 23, 2002) provides a framework for work to be conducted as part of the closure process. In general, closure work falls into two categories:

1. Work that falls under regulatory oversight by the Minnesota Department of Natural Resources (MDNR) Including:
   - Plans for pit to watercourse discharges.
   - Mineland reclamation.
   - Plans for tailings basin drainage.
2. Work that falls under regulatory oversight by the Minnesota Pollution Control Agency (MPCA) including:
   - Investigation and potential cleanup of contaminants in soil or groundwater related to the mining operations.
   - Protection of overall water quality.

CE retains the responsibility for closure of the mine (areas not currently owned by MP) and entered the Voluntary Investigation and Cleanup (VIC) Program of the MPCA on April 4, 2002. Conducting closure work as a volunteer in the VIC Program will result in legal or administrative assurances, issued by the Commissioner of the MPCA, that apply either to CE as an entity, or to specific legally described lands. These assurances are intended to streamline re-use or redevelopment of the idled facility. In essence, the facility is viewed as brownfield that must undergo routine Phase I assessment, Phase II investigation, and risk based decision making that incorporates planned land use regarding identified releases that arise from the Phase I and Phase II process.

Northeast Technical Services, Inc. (NTS) was retained by CE to conduct a Phase I Environmental Site Assessment (ESA) of the CE owned facility which consists of the following general land descriptions:

1. Mining areas at Hoyt Lakes and Dunka.
2. Plant area at Hoyt Lakes.
3. Railroad Corridor including Murphy City.
4. Taconite Harbor including the Pellet Dock, Marine Fueling, and Coal Ash Landfill.

METHODOLOGY AND LIMITATIONS

The purpose of this Phase I ESA is to provide the appropriate level of inquiry to delineate Areas of Concern (AOC) which will require Phase II investigation. An AOC is defined as a discrete area of the property where a known release, or a material threat of a release is identified by the level of inquiry provided by this document. Sampling and Analysis Plans (SAPs) will be developed for each of the areas of concern and will contain sufficient details regarding the practices and contaminants of concern to identify individual Recognized Environmental Conditions (RECs).

The scope of this Phase I ESA generally follows the 2000 version of ASTM Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process (Designation: E 1527-97) and is consistent with the MPCA VIC Guidance Document #8.

Due to the large land area and the unique use of the property, several limitations are noted:

1. Record searches did not designate a specific address. Rather, Environmental Data Resources (EDR) provided an "Area Search" for the Hoyt Lakes Facility and Taconite Harbor. Environmental record searches were not obtained for Murphy City, Dunka or the Railroad Corridor.
2. The historical land use was developed primarily from information obtained from interviews. Drawings, plans, and air photographs archived by CE Mine and Plant Engineering, were used to verify historical information.
3. Questions presented in the ASTM Owner Questionnaire are very difficult for one individual to answer given size of the facility and the recent change in ownership. Therefore, an owner questionnaire was not completed for the facility.
4. The entire facility was accessible for performance of the ESA. However, the very large land area made inspection of all land area practicably unascertainable.

Historical land use, development of the property and description of the mining process is presented for the property as a whole. Site descriptions (physiographic, geologic and hydrogeologic), standard environmental records searches, and interviews and site reconnaissance are presented separately for the following;

1. Hoyt Lakes (mining areas and plant) and Dunka,
2. Taconite Harbor
3. Railroad Corridor

GENERAL HISTORICAL BACKGROUND

The CE "Facility" consists of major portions of former LTVSMC. The historical development of the whole facility is important in understanding the overall property use.

The Erie Mining Company (EMC) was formed in 1940 to pursue a process for economic recovery of iron from taconite. The research culminated in the construction and operation of the Erie Experimental Taconite Plant (Pre-Tac) which operated between 1948 and 1957. Pre-Tac was located in the SW ¼, of the SE ¼ of Section 28, Township 59 North, Range 15 West, or near the western extent of the current Hoyt Lakes mine area.

The decision to proceed with construction of a full scale commercial taconite plant was largely based on the estimated reserves on lands controlled by EMC. The reserves would need to yield a minimum of 10.5 million long tons annually of agglomerated concentrate with an average dry iron content of 64% over a period of 40 years; or a total of 420 million long tons of concentrate. In 1951 EMC held lands were divided into the following areas:

1. Area 1 with a minimum yield of 83 million long tons of concentrate.
2. Area 2 with a minimum yield of 142 million long tons of concentrate.
3. Area 3 with a minimum yield of 83, million long tons of concentrate.
4. Area 3X with a minimum yield of 90 million long tons of concentrate.
5. Area 4 with a minimum yield of 92 million long tons of concentrate.

These yields exceeded the 420 million long ton requirement and EMC initiated construction of a full scale facility in 1954.

The EMC full scale facility was originally constructed and owned by Bethlehem Steel Corporation (45%), Youngstown Sheet and Tube Company (35%), Interlake Iron Corporation (10%) and Steel Company of Canada Limited (10%). The facility consisted of a 7.5 million ton annual capacity taconite processing plant at Hoyt Lakes, a coal fired steam electric generating plant in Taconite Harbor, and approximately 75 miles of railroad and power lines connecting the Hoyt Lakes plant to the generating plant. The facility was placed into production in September, 1957 with the first load of pellets shipped in December of 1957. Pickands Mather Company (PM) was the original managing agent for the mine.

The Taconite Tax Amendment, passed in November, 1964, provided tax structure for taconite producers. Consequently, in 1965, PM announced an expansion program for EMC which would bring it's pellet producing capacity to 10.6 million tons annually. Construction began in the same year and by 1967 EMC was meeting the new production rate. Additional mining areas were permitted over the years as production requirements dictated.

Ling-Temco-Vought Corporation (LTV Corporation) of Dallas Texas acquired 100% ownership of EMC in May, 1986 and renamed the facility LTV Steel Mining Company (LTVSMC) in 1987. Also in 1986, Cleveland Cliffs, Inc. (CCI) purchased PM and became managing agent for the facility.

On May 24, 2000, LTV Steel Corporation announced it would close LTVSMC in the summer of 2001. On December 6, 2000, the closure date was moved up to February 24, 2001. On January 3, 2001, it was announced that LTVSMC's Hoyt Lakes mine and processing plant would close immediately. The last product left the plant site, by railcar, on July 19, 2001 and the last ore boat departed Taconite Harbor Docks on July 22, 2001.

On October 30, 2001, CE, a subsidiary of CCI and MP purchased the facility and assets. MP now owns the Power Plant, former Taconite Harbor Village and some related lands. CE owns the mine sites, taconite processing plant, Pellet Dock, Marine Fueling, and Railroad Corridor.

GENERAL OVERVIEW OF THE TACONITE PROCESS

Unlike sulfide ore mining, the process of mining and processing taconite does not generate hazardous waste or hazardous substances as a result of the process. The process waste is overburden, waste rock, and tailings. These materials alone are not considered to lead to a release of contaminants of concern. One exception to this "benign waste rock and tailings rule" exists at Dunka where some sulfide minerals exist within some of the waste rock. This condition is discussed in a later section. In general, waste containing contaminants of concern are generated as a result of using materials related to the process such as fuels, lubricants, hydraulic fluids, etc. Therefore, this Phase I ESA was conducted by identifying areas where materials other than process waste where used or disposed. Locating these areas was largely dependent upon use of existing drawings and interviews with current and former employees.

The general taconite process is divided into the following categories; mining, crushing, concentrating, agglomerating, railroad, dock, and power plant.

MINING

Mining operations were conducted at the Hoyt Lakes location and the Dunka location. Mining included drilling, blasting and loading ore to an in-mine railroad. The mining lands are divided into the following areas which are shown on Figure 2 in Appendix A:

1. Area 1
2. Areas 2, 2 E, and Area 3
3. Area 2 W
4. Area 2 WX
5. Area 5
6. Area 6
7. Area 8 (Dunka)
8. Area 9 N

9. Area 9 S

One additional mine area, generally referred to as the McKinley Extension, exists near Area 6 and Area 9. The McKinley Extension is owned and was mined by US Steel Corporation except for a period of time during which the Northwest Ore Division leased the area. The McKinley Extension has been formally “closed” in accordance with Minnesota Rules 6130 and is not included in this Phase I.

In general, each mine area contains the following infrastructure:

- Fueling – Fueling in the mine areas consisted of above ground storage tanks (ASTs) containing fuel oil or gasoline for in-mine heavy equipment (haul trucks, loaders and rubber tired dozers). Early in development of the mining areas, fueling was accomplished with mobile ASTs which were either skid mounted, or consisted of a semi trailer transport tank. During the 1980s and 1990s ,fueling stations were installed that consisted of ASTs meeting standard construction specifications. The dispensers are located within large shelters with concrete floors. Any spills that occurred within the shelters during fueling were contained and drained to holding tanks that are pumped periodically. In-pit locomotive fueling was accomplished with Locomotive Fueling Stations located near the Area 1 and Area 2 Shops. Fueling for the mainline railroad locomotives was done at the Knox Locomotive Fueling Station which is discussed later. Tables 2 though 5 summarize the AST and underground storage tank (UST) inventory at the entire facility.
- Loading Pockets – Initially, shovels loaded rail cars directly. As the mine pits became deeper, the grade became too great for rail transport of crude ore directly to the plant. Therefore, shovels loaded crude ore into haul trucks for transport out of the pit. Loading Pockets provided a means of transferring the ore from the haul trucks into rail cars for the remaining transport to the processing plant. The pockets were generally in close proximity to the Truck Fueling Stations. The Loading Pockets used two types of feeders; the vibratory type and the Superpocket. The vibratory pockets were electrically powered and the only waste stream was small amounts of lubricant for wear surfaces. The Superpocket type was electric/hydraulic powered and therefore used hydraulic fluids.
- Reporting Area – A set of buildings where mine employees reported for work and general operations within the area were controlled was called the Reporting Area. The buildings contained locker rooms, showers, offices, lunch rooms, etc. Septic systems and drinking water systems (wells or holding tanks) were associated with each Reporting Area. The septic systems were connected to domestic type sewage only and are not considered a concern. Table 6 presents an inventory of wells and septic systems.

Other mine infrastructure that is not specific to all mine areas is the following:

- Area 1 Shops, Area 2 Shops and Dunka Shops –The shops were constructed during the original plant construction and upgraded in 1967 during the overall plant expansion. The reason for upgrading was primarily to accommodate the increasing size of equipment used. The Area 1 and Area 2 Shops provided general maintenance of in-mine equipment while Dunka shops provided only light maintenance such as brakes, lubrication etc.

CRUSHING

Ore delivered to the plant site was offloaded to the Coarse Crusher which used 60 inch and 36 inch gyratory crushers to reduce the crude ore size to six inches. The coarse crushed ore was delivered to the Fine Crusher which used a series of standard and shorthead crushers to reduce the crude ore to ¾ inch. Various heavy lubricants were used on the bearing surfaces of the crushers.

CONCENTRATING

Concentrating (a separation of the iron containing minerals from the rest of the crude ore) included the following components:

- Rod mill – A rotating drum filled with metal rods. The rotation pulverized the crushed ore to finer material. Water was added at this point and the concentrate was carried through the rest of the process as a slurry.
- Magnetic separators – Magnetite grains in the concentrate slurry was separated from the pulverized ore by rotating magnetic drums.
- Ball mill – Same as a rod mill except that metal balls rotating in a drum pulverized the ore.
- Floatation – final finishing separation step. Two reagents referred to as Frother (alcohol) and Collector (amines) were added to the concentrate slurry.

The process of concentrating used large amounts of water with tailings discharged to the Tailings Basin as a slurry. Once solids settled out of the slurry, water was recycled back to the plant in a closed system.

AGGLOMERATING

Agglomerating produced finished taconite pellets and included the following:

- Thickener - The concentrate slurry was delivered to the thickner were settling increased the concentrate to water ratio.
- Filter – The thickened slurry was filtered to provide a filter cake with acceptable moisture content for the balling step.
- Balling – Bentonite and concentrate were added to a rotating drum. The right mixture of moisture, bentonite and concentrate formed “green pellets”.
- Furnace - Furnaces fired the green pellets to form finished “hard” pellets. The original plant furnace was fired with #6 fuel oil stored in three large ASTs. The fuel was offloaded by railcar. The furnaces were converted to natural gas between 1965 and 1968 with #6 fuel oil used as backup.

RAILROAD

Railroad – Provides transport of finished pellets to the Pellet Dock at Lake Superior. The railroad consisted of the following:

- Rail corridor – Originally constructed concurrent with the original plant, the corridor was constructed with ballast (crushed rock), rail ties and rail lines. Switches are manual with the exception of several electric switches near the Taconite Harbor end of the rail line. Power for crossing signs and switches was provided by several battery houses (Photograph 5, Appendix D) with solar panels to recharge the batteries. Prior to solar panels the batteries were changed out periodically by railroad maintenance crews.
- Knox Locomotive Fueling Station - Located on the south edge of the plant and processing area. Locomotives were diverted off the mainline through the facility.
- Murphy City was originally a location from which the rail line construction was coordinated. Susequent use of the facility was for maintenance of way and consists of several buildings including a Minor Repair Building, Storage Building, and Reporting Building. Locomotives were not fueled at Murphy City but several ASTs exist for light vehicle fueling.

DOCK

Dock and Marine Fueling Facility – Provided unloading of finished taconite pellets from the railcars and loading to ore boats. The Marine Fueling Facility consisted of two large ASTs which were originally filled from rail cars. The filling since approximately 1968 was from truck transport. Above ground piping delivered fuel to the loading dock for marine traffic.

POWER PLANT

Power Plant and power line – provides electric power to operate the Hoyt Lakes plant. The Power Plant is not a portion of CE owned lands and is not included in this Phase I.

OTHER INFRASTRUCTURE

Infrastructure of the whole facility not described above includes the following:

1. Pellet Storage Area.
2. Administration Building.
3. General Shops – contained a weld shop, blacksmith shop, car shop, locomotive shop, electric shop, machine shop, rebuild shop, and carpenters shop.
4. Domestic Waste Water Treatment Plant (WWTP) - treated only sanitary sewage
5. Water Treatment Plant – provided potable water for the Hoyt Lakes facility.
6. Emergency Basin – received storm water and process overflow from the Coarse Crusher, Fine Crusher and Concentrator.
7. Red Water Basin – received storm water and process overflow from the Agglomerator and storm water from the Pellet Storage Area.
8. Colby Lake Pumping Station – provided water to the reservoir through a 36 inch line for plant process water and the Water Treatment Plant.
9. Dunka Constructed Wetland Treatment System and water treatment plant – provides metal reduction in water from waste rock stockpile seeps.
10. Heating Plant – provided hot water heat for the plant area buildings. Originally coal fired, the Heating Plant was converted to natural gas in 1994.

The primary buildings of the plant site are constructed into bedrock. Therefore, the lowermost portion of the building is well below grade. Floor drains and sump pumps discharge to the Emergency Basin or Red Water Basin.

UST AND AST INVENTORY

USTs were removed during the late 1980s and early 1990s and as a result there are currently no known USTs at the entire facility except for tank 001. Tank 001 is located at the Administration Building and was abandoned in place in the late 1970s to avoid building damage.

CE records provide documentation of existing ASTs and removed USTs. An attempt was made to inventory both existing and historical tanks using the following resources:

1. The AST Permit for the Hoyt Lakes Facility (AST Permit #5297).
2. The AST Permit for the Marine Fueling Facility (AST Permit # 51740).
3. The MPCA list of registered tanks (TABS site database) for Hoyt Lakes, Dunka, Murphy City, Marine Fueling Facility, and Taconite Harbor.
4. CE internal records.

5. Interviews with former LTVSMC Staff.
6. Site reconnaissance.

Tables 2 through 5 present existing outdoor ASTs, indoor ASTs, Removed ASTs and Removed USTs . The TABS database, and AST Permits are contained in Appendix E. It should be noted that the TABS site ID for Taconite Harbor applies to the Power Plant which is owned by MP and is not a part of this Phase I. However the Taconite Harbor database is presented in Appendix E to demonstrate apparent inaccuracies between the Power Plant tanks and tanks that existed at the Pellet Dock and Marine Fueling Facility. Some ASTs are listed under both databases and as result are listed in the AST permits. In addition, both databases contain several ASTs of approximately 180,000 gallon capacity. Review of air photos and interviews with former staff do not support the existence of these tanks. The only known tanks at the Marine Fueling Facility include the existing ASTs listed in Table 2 and one removed AST listed in Table 3. The removed AST stored #2 fuel oil used for heating the lines for the heavier #4 and #6 fuel oil.

The TABS databases listing for the Hoyt Lakes facility includes multiple listings for ASTs that cannot be accounted for through historical records reviewed to date. In addition, these ASTs are not included in the AST permit for Hoyt Lakes and are not included in Tables 2 through 5. The additional listings on the TABS database are either tanks that are accounted for under a different ID in Tables 2 through 5 or were mobile AST that no longer exist.

PROJECT BOUNDARIES AND OWNERSHIP

Lands that comprise the operating mine are those formerly owned or leased by LTVSMC. The purchase of the facility by CE and MP resulted in two parties owning lands within the mine area in addition to the leased lands. This Phase I applies to all lands that belonged to the operating mine that are not currently under ownership by MP.

Figure 1 presents a GIS map prepared by the MDNR, Minerals Division, that shows lands owned by CE, owned by MP and lands divided between CE and MP. It should be noted that the smallest land unit recognized by the map is a 40 acre parcel, although actual ownership may be less than the entire 40 acres.

MINE AND PLANT AREAS

REGIONAL GEOLOGY AND HYDROGEOLOGY

Bedrock geology underlying the entire mine and plant area consists of a sequence of, from oldest to youngest, (1) undifferentiated Archean volcanic and volcanogenic rocks, (2) the Pokegama Quartizite, (3) the Biwabik Iron Formation and (4) Virginia Formation. The sequence of the Pokegama, Biwabik and Virginia formations are gently folded and dip to the southwest at approximately 10 degrees. However, dips within localized areas of the mine may be very erratic with some dipping to the north. The Geologic Map of the Mesabi Iron Range (Meineke et.al.) is attached in Appendix F and contains descriptions of each geologic unit and shows the location of the mining areas and the plant site with respect to the various bedrock units. Notice that Area 6 (Dunka) lies at eastern extent of the Biwabik Iron Formation. Additional description of the bedrock geology can be found in Morey, D.G. (1993).

During the Pleistocene glacial event, the Biwabik Formation and associated bedrock provided an area more resistant to glacial erosion than bedrock to the north and south. The result is an east-west trending ridge that forms a watershed divide. Glacial deposits are distinctly different north of the divide from the deposits on the south side of the divide. North of the divide glacial sediments are associated with the Rainy Lobe and consist of thin patchy deposits of sandy, stony till overlying the scoured bedrock. Glacial deposits south of the divide are thicker, the uppermost associated with the DesMoine Lobe. These sediments are generally gray or red-brown silty to clayey tills. Most of the glacial sediments (overburden) have been stripped from the mine areas of the CE facility. In addition, other areas where overburden has not been stripped, contain overburden and waste rock stockpiles or tailings over the original ground surface.

The Hoyt Lakes Mine and plant area lies at the northern edge of the St. Louis River Watershed. Surface water from the Tailings Basin area flows north to the Embarrass River which drains south to a confluence with the St. Louis River. Surface water drainage from the most of the plant area and the mine area at Hoyt Lakes flows either south to Colby Lake, or east to the Partridge River which ultimately drains to the St. Louis River, via Colby Lake.

Local groundwater flow systems occur within the glacial overburden where it remains in sufficient thickness, and within overburden and waste rock stockpiles. These small local flow systems tend to be hydraulically isolated from other local flow, with discharge to small intermittent streams, wetlands or leakage to intermediate and regional flow systems within the Biwabik Iron Formation and Virginia Formation. The Virginia Formation and the Biwabik Iron Formation contain fracture systems sufficient to be considered as aquifers.

Mine dewatering over the years has produced enough drawdown around active mine pits that the water table lies within the fractured bedrock. Therefore, local groundwater elevations and flow directions are very complex across the entire facility.

The Dunka mine area lies within the Rainy Lake Watershed. Surface water drainage is easterly to the Dunka River which discharges to Birch Lake. Very little glacial overburden existed over the bedrock surface and mine dewatering has depressed the water table within the fractured bedrock. Local groundwater flow occurs within the overburden and waste rock stockpiles. Discharge from the these stockpiles occurrs as seeps to small streams and wetlands. Due to the geology of much of the waste rock from the Dunka mine, these seeps contain elevated concentrations of metals. Constructed Wetland Treatment Systems and an active Water Treatment Plant have been constructed to reduce the metal concentrations to acceptable levels prior to discharge to the Dunka River.

ENVIRONMENTAL RECORDS REVIEW

An Area Study Report was received from Environmental Data Resources, Inc. (EDR) and is attached in Appendix C. The Area Study Report differs from a Radius Report in that lands surrounding the subject property are not included. The ASTM criteria for minimum search radius surrounding the CE lands is not met. File evaluations included review of both federal and state records. The list of databases is included in the EDR report.

There were no reported sites, under any of the databases, that had sufficient location information for mapping. The Orphan Summary in the EDR Report lists all sites that may be within the area search boundaries based upon common location descriptions, but cannot be absolutely located. Review of the orphan listings yields the following sites that may be within the project boundary:

1. Former Monsanto Plant was obtained from the UST database with location information only as HWY 110. The listing contains two gasoline USTs and one fuel oil UST, all of which have been removed. The Tank owner was Viking Explosive. This site was not within the project boundary of this Phase I and is not considered an AOC.
2. Erie Mining Dump #2 was obtained from the MN LS database. Information within the listing states that the site is located approximately 2.5 miles north of CSAH 110. The MPCA ID is MNODIOOO1125. This is the same as site as the CE Private Landfill discussed elsewhere in this document.
3. Monsanto Co. was obtained from the RCRIS SQG-FINDS database. No violations were listed in the information and this site is not within the boundary of this Phase I.
4. Hoyt Lakes Demolition Landfill was obtained from the MN LS database. The location is listed as 2 miles north of 110. this is likely the same site as the closed Hoyt Lakes Landfill which is not a portion of this Phase I project area.
5. LTV Steel Mining Company was listed under FINDS, MN Spills, RCRIS-LQG, and MLTS databases. Most listings were related to specific waste generator manifest, record keeping violations, not necessarily related to a release. Eleven spill reports were included.
6. The USX Corp. McKinley Mine was obtained from the RCRIS-SQG database. No violations were reported in the listing and this property is not part of the CE property.

INTERVIEWS, ON SITE RECONNAISANCE AND ARIAL PHOTO REVIEW

One primary site reconnaissance of the Hoyt Lakes Facility was conducted on June 19, 2002. Several follow up visits occurred on July 24, 2002 and July 29, 2002. Jim Stanhope accompanied NTS on the primary reconnaissance. In addition, the following table summarizes the persons interviewed.

TABLE 1: SUMMARY OF VERBAL CONTACTS

Contact	Relationship to the facility	Title	Interview Date	Number
Jim Stanhope	EMC, LTVSMC employee 1968 to 2001	Environmental Engineering Supervisor	Various	218/225-4242
Richard Erchul	EMC, LTVSMC employee 1967 to 2001	Staff Services Coordinator	5/02 – 7/02	218/225-4263
Jim Scott	EMC and CCI employee 1970 to present	Manager of Operations	Various	218/225-4217
Bruce Gerlach	CCI employee	Facility Manager	7/25/02	218/225-4261
Dave Youngman	EMC, LTVSMC employee 1968 to 2001	Lands Supervisor	Various	218/225-4223

EMC and LTVSMC performed areal surveys of various portions of the facility routinely. The following photographs were reviewed:

1. Chronoflex photos of the plant and tailings basin areas for the years 1979 through 2000 (scale of the photos are 1" = 1500' to 1' = 200'.
2. Photomosaics for the Hoyt Lakes and Taconite Harbor areas for the years 1948 and 1955.
3. Regular air photos for the years 1980 though 1996.

The air photos were reviewed to determine if AOCs exist that were not identified through other data sources. The air photos were not necessarily used to document changing conditions of the AOCs already identified. It is anticipated that air photos will be an important resource in preparation of Sampling and Analysis Plans (SAPs).

Figure 2 presents the locations of each area within the Hoyt Lakes facility and Figures 3 through 12 provide details of each area along with locations of AOCs.

AREA 1

Area 1 is located at the northwest portion of the mine areas contains one of the largest open pits of the facility. The open pit was actively dewatered until 1987. The pit is currently overflowing through road grade at the southeast side of the area.

The Area 1 Shops (AOC-1, Figure 3) were visited during the reconnaissance. Figure 6 presents detail drawing of the Area 1 Shops. This area provided the mining service support mentioned earlier in this report. Domestic waste water is connected to a septic tank and drain field system. Floor drains and other industrial waste water was contained and reused with residuals from oil water separators disposed of through outside services. A closed leak site exists for the fueling portions of the shops.

The Area1 W petroleum contaminated soil land application site (AOC-2, Figure 3) was visited and appears in good condition, no odors or staining were apparent. An area near the western extent of Area 1 where municipal waste water treatment plant sludge from Aurora and Hoyt Lakes was land applied (AOC-3, Figure 3) has no discernable impacts. The land application site has heavy brush and is located on a north facing slope. Sludge application was discontinued during 1988.

The 1004 Material and Equipment Storage Area (AOC-4, Figure 3) is a lay-down area containing cable equipment, salvaged equipment and other materials. The area is on top of a waste rock stockpile. Several areas with soil staining were observed. The heaviest soil staining was observed in a portion of the area was used for salvaging equipment. A deep ravine borders the west edge of the 1004 area and contains large amounts of demolition debris, scrap metal and several barrels.

Several hundred feet east of the 1004 storage area is a demolition debris disposal area containing asphalt and rubber roofing material removed from various plant buildings (AOC-5, Figure 3). The roofing material was compacted with a loader or dozer during placement and buried with waste rock boulders. The material was observed commingled with the waste rock.

Interviews identified two areas that are not a portion of the Private Landfill, but are very close to the footprint. The first is an area were oily waste from floor drains in the General Shops area was dumped at the land surface (AOC-6, Figure 3). This disposal was discontinued in 1980 when Berg Oil (currently OSI Environmental, Inc.) was contracted to accept the waste. The second area near the landfill reportedly received a one time disposal of heavy lubricant (bull gear grease) in the 1970s (AOC-7, Figure 3). No visible signs of the disposal were evident during the site inspection or on air photos reviewed.

The Private Landfill (AOC-8, Figure 3) was a permitted (SW-17) industrial waste landfill that operated until 1993. The landfill has gone through routine hydrogeologic investigation as required by Minnesota Solid Waste Rules. Five monitoring wells installed around the perimeter of the landfill are currently monitored once per year with routine quarterly inspections of the cover. Hydrogeologic evaluation documents as well as annual monitoring reports are available for the landfill. During the site reconnaissance, the cover and vegetation appeared to be in good condition.

The Panel Yard (AOC-9, Figure 3) is located near the northeast portion of Area 1 and originally was an area where railroad panels were constructed. Railroad panels are sections of rail and ties prefabricated to allow temporary rail lines to be constructed. Areas near the perimeter of the panel yard contain large volumes of railroad ties. The ties are typically buried with waste rock. Several of the disposal areas contain co-mingled waste including scrap metal, wood, and other demolition and industrial waste. The Panel Yard has also been used as a general laydown area with equipment in various stages of demolition. Areas of soil staining are evident.

The Airport (AOC-10, Figure 3) is an area immediately south of the Panel Yard. The name Airport was adopted because it is where abundant equipment and materials “landed” after they were no longer serviceable. Currently most of the materials and equipment have been salvaged. However, several pieces remain. Areas of soil staining are evident throughout the Airport.

Several hundred feet south of the Airport is a Coal Ash Disposal Area (AOC-11, Figure 3). The ash was generated from the old stoker coal fired Heating Plant. The disposal was discontinued in the 1980s when ash was used to cover the Private Landfill. The Heating Plant was converted to natural gas in 1994. The coal ash has only marginal cover.

An area containing large volumes of mill rejects (hard rock fragments) and scrap material generated from various rebuild and improvement projects is located at the extreme northeast boundary of Area 1 (AOC-12, Figure 3).

AREA 2, 2E AND 3

This area lies near the eastern extent of the Hoyt Lakes facility and contains significantly less infrastructure and areas of potential concern than Area 1. The Dunka Road and the Taconite Harbor Railroad Corridor exit the Hoyt Lakes facility through this area.

At the far northern boundary of this area is the 2001 Material and Equipment Storage Area (AOC-13, Figure 4). Various types of equipment and materials, including transformers, were observed in this area with several areas of soil staining.

Near the northwest boundary of Area 2, 2E and 3 is a facility for sandblasting and painting locomotives and railcars (AOC-14, Figure 4). The facility consists of an open sided roofed structure with rail line entering, a sand hopper, and several storage buildings and compressor building. A buildup of blasting sands is evident.

Near the western boundary of Area 2, 2E and 3 is a railroad siding that is a designated railroad equipment storage area (AOC-15, Figure 4). Several locomotives and various other small equipment were observed in this area. Soil staining appeared to be limited to the siding tracks.

The Area 2 Loading Pckets were observed. One pocket is a vibratory type (AOC-16, Figure 4) and one pocket is a Superpocket (AOC-18, Figure 4). Small amounts of hydraulic oil stained soil was observed near the Superpocket. A Truck Fueling Station, constructed with a roof and containment system, is also located in this area.

A building for storage of solid blasting materials is located near the east end of this area. However, materials were containerized and no evidence of a release was identified.

AREA 2W

Very little infrastructure exists in Area 2W and no AOCs were identified. Reporting, truck fueling and loading for Area 2W was done at Area 2. The mainline Rail Corridor forms the eastern and northern boundary.

The Missabe Location existed in Area 2W but is not considered an AOC since large volumes of overburden and rock have been mined from the former location.

AREA 2WX

This is the most recently developed mining area and contains both a vibratory Loading Pocket (AOC-22, Figure 6) and a Superpocket (AOC-23, Figure 6). Both were observed during the site reconnaissance. A small lube station exists near the Superpocket. A Truck Fueling Station is located immediately south of the loading pockets and is constructed with a roof and containment system (AOC-21, Figure 6). The Reporting Area (AOC-19, Figure 6) includes an area for materials and equipment storage where several patches of soil staining were observed. A well, septic tank and drain field system remain in place. Finally, a shovel was dismantled in an area west of the loading pockets (AOC-20, Figure 6) where soil staining was observed.

AREA 5

This area is the most northern of the mining areas at the Hoyt Lakes Facility and contains the headwaters of Wyman Creek. Most of the eastern half of the area has undergone mine land reclamation and is covered with vegetation. Truck fueling in Area 5 was accomplished with mobile ASTs.

The Reporting Area (AOC-24, Figure 7) includes a scrap and salvage area where some stained soil was observed. Most of the scrap has been removed. A well, septic tank and drain field system remain in place.

The Area 5 vibratory Loading Pocket was observed (AOC-25, Figure 7). No soil staining was apparent in this area. However, the rail line to the Loading Pocket contains a siding where rail cars and locomotives have been stored. Some stained soils was observed along the siding.

AREA 6, AREA 9N AND AREA 9S

These areas comprise the southwest portion of the mining areas and are discussed here collectively. Of most significance is the location of Pre-Tac (AOC-30, Figure 9) which was located on the western edge of Area 9N. The plant was demolished in the late 1950s and the only observable evidence of the plant today is some concrete slabs and foundations. Figure 19 shows a drawing of the plant, although features on the drawing are not labeled. The location is currently only accessible by ATV or foot.

The former Area 1W Reporting Area was actually located in the northern section of Area 9N. This area is also only accessible by a ATV or foot. No observable environmental conditions were noted at this site however, a septic system was associated with this Reporting Area.

The Area 9 Loading Pocket (AOC-31, Figure 10) is a vibratory type. The Area 6 and Area 9 Reporting Area has a septic tank and drain field system in place. The former Aurora City Dump (AOC-28, Figure 8) was located at the west boundary of Area 9S. The majority of the dump was reported as removed during mining of Area 9S to Stockpile #9021(AOC-29, Figure 8). However some scrap wood, cans and litter are observable today.

A misfired blast (AOC – 27, Figure 8) occurred in Area 6 on March 8, 1999. Approximately 95, of 220 blast holes were undetonated. The blasting material consists primarily of 25% ammonium nitrate and 75% mineral oil.

The Evergreen Trailer Park was located within this area. The trailer park contained mobile homes and presumably had wells and septic systems. The only evidence of the trailer park today are remnants of roads and non-indigenous shrubbery.

<u>PLANT AND PROCESSING AREA</u>

The Tailings Basin portion of the plant and processing area is a large dike constructed of tailings with road access along the top of the lifts. Tailings were discharged as a slurry with process water. The design of the dikes allows the tailings to settle and the process water to be recycled back to the plant. The Colby Lake Pumping Station provided process water to offset any losses due to seepage, evaporation and water loss up the furnace stacks. Several pumping stations are located in the Tailings Basin and several transformers exist (AOC-48, Figure 12). CE records indicate that these transformers currently contain non-PCB mineral oil. An area within Cell 2W contains buried hornfels (AOC-53, Figure 12). Hornfels is a waste rock type containing sulfide minerals. Monitoring wells are installed surrounding the hornfels burial site and are monitored as part of the NPDES permit. The Tailings Basin Reporting Area (AOC-47, Figure 12) is located at the road access point. This Reporting Area contains a lube station. In addition, two USTs were removed in 1988 and a septic tank and drain field system remain in place.

Several other notable features surround the tailings basin dikes. An area immediately west of the Tailings Basin Reporting Area contains several small equipment and materials storage locations (AOC-51, Figure 12). Most of the salvageable materials are gone. However several soil stained areas were observed. The Cell 2W salvage area (AOC-52, Figure 12) is located along the western edge of the Tailings Basin. Salvage operations are evident with several small soil stained areas as well the remains of a mobile AST containing Choherex, a petroleum based dust suppressant.

The eastern margins of the Tailings Basin contain an area where WTP sludge from the Dunka Water Treatment Plant was staged (AOC-35, Figure 12). The sludge has been shipped offsite and little evidence of it’s existence were observed.

The Coal Ash Landfill (AOC-34, Figure 11) is located south of the sludge staging area. The coal ash was generated at the Taconite Harbor power plant and shipped back to Hoyt Lakes on rail cars. The landfill cover appears in good condition. Inspection of the cover is conducted as part of NPDES requirements.

The Line 9, Area 5 permitted petroleum land application site (AOC-36, Figure 12) is located adjacent east of the Tailings Basin. This land application site contains approximately 25,000 cubic yards of soil from the Area 1 Shops Tank Farm cleanup and the Knox Fueling Station cleanup. The site appears in good condition. Monitoring data is available.

The Area 2 Shops (AOC-38, Figure 12) were visited, this area was the primary shop for the eastern mining areas and currently contains a Locomotive Fueling Station for the in-mine locomotives. A septic tank and drain field remain in place.

The Knox Fueling Station (AOC-39, Figure 12) contains one AST. Containment structures are provided below the dispenser lines.

The Heavy Duty Garage (AOC-40, Figure 12) is located on a hill adjacent to the plant site proper. The facility has been used only for cold storage since approximately 1960. However, it was previously used for equipment maintenance and one UST has been removed near the facility.

The Oxygen Plant (AOC-41, Figure 12) produced oxygen through a series of ambient air compressions. The oxygen was used in drilling. With the introduction of more modern drilling methods the oxygen use was phased out. Several USTs have been removed from the Oxygen Plant.

The Bunker C Tank Farm (AOC-42, Figure 12) is currently being investigated under the LUST program (Leak #12254). The finished pellet storage and loadout area (AOC-45, Figure 12) is a large flat surface with little notable features. However, the rail line that access the loadout facility contains appreciable soil staining and heavy oil residue in an adjacent ditch.

The Administration Building (AOC-43, Figure 12) did not have any notable features. However, one heating oil UST was abandoned in place. Domestic waste was pumped to the plantsite WWTP. The Administration Building is still active. Therefore, a new well and septic system were installed in 2001. Several hundred feet from the Administration Building is the Main Gate Fueling Station (AOC-44, Figure 12). The station consists of two ASTs used for fueling light trucks.

The plant site proper (AOC-46, Figure 12) is considered the core of the plant and processing area where the taconite process was conducted. Figure 15 provides detail of the infrastructure of the plant itself.

The Colby Lake Pump Station (AOC-59) is located distant from the plant area but provides process and drinking water to the plant and therefore is considered part of the plant infrastructure. The pumps and associated equipment are located within a large block and metal sided building. One heating oil AST was removed in approximately 1970 when natural gas became available. The concrete pedestals for the AST remain. The pumps are electric and an associated transformer is located adjacent to the building.

AREA 8 (DUNKA MINE)

The Dunka Mine is remote from the other mining areas and the plant. A rail line provided shipping of ore back to the plant site. Since the mine was remote from the rest of the facility, a shops area (AOC-32, Figure 11) was constructed as previously mentioned. The shops were demolished in 1998 and the area has been covered and seeded. A closed leaksite exists in association with the Dunka Shops.

The North and South Loading Pockets (AOC-33 and AOC-34, Figure 11) existed at Dunka, each had a fueling system. The Reporting Area had well and septic systems which were abandoned.

The geology of the Dunka mine is different from the remaining mining areas in that the taconite is in close proximity to the Duluth Complex. This association produced a zone of sulfide rich rocks. Some of the sulfide mineral containing rocks have been removed and placed in stockpiles. Groundwater seeps that discharge from the stockpiles have elevated concentrations of several meals and low pH. A full scale metals water treatment system has been constructed. In addition, Constructed Wetland Treatment Systems have been built at each of the identified seeps. Since this condition is regulated through the NPDES permit, no addition scrutiny of the seeps is recommended as part of this Phase I. The Water Treatment Plant is powered by electricity. No fuel tanks were identified associated with the plant building.

TACONITE HARBOR

REGIONAL GEOLOGY AND HYDROGEOLOGY

A very thin layer of glacial drift may overlie volcanic bedrock, although bedrock is exposed at the ground surface throughout much of the Taconite Harbor Area. The drift is a red-brown, clay to silty clay. The volcanic bedrock is part of the Northshore Volcanic Group; a thick sequence of southeast dipping lava flows. The local members of the lava flows are named the Schroeder Basalt.

Taconite harbor lies within the Lake Superior Water shed where surface water flow is southeast toward Lake Superior. The thin drift may support a local groundwater flow system over the bedrock. If local flow occurs, discharge is typically at creeks, seeps or leakage to the bedrock flow system. Groundwater flow within bedrock occurs in fractured basalt or within inter-flow sediments. The fracture flow systems tend to be somewhat isolated from one another, often with dead-end flow (no discharge). Where, fracture zones are hydraulically connected, intermediate groundwater flows is southeast, toward Lake Superior.

ENVIRONMENTAL RECORDS REVIEW

An Area Study Report was received from EDR and is attached in Appendix D. There were seven sites listed in the report that had sufficient information to locate on a map of the search area.

1. The Taconite Harbor Power Plant was listed under the Emergency Response Notification System (ERNS) records. This site is not within the boundaries of this Phase I and is currently owned by MP.
2. The Taconite Harbor Power plant was listed under the state LUST database. This site is not within the boundaries of this Phase I and is currently owned by MP.
3. Three listings were found under the MN Spills database that contain sufficient information to attribute the spill to the power plant.
4. Two listings were found under the MN Spills database that did not have sufficient information to determine where the spill occurred.

The Orphan summary in the EDR report lists all sites that may be within the area search boundaries based upon common location descriptions, but cannot be adequately located. Review of the Orphan Summary did not find any sites attributable to the CE facility.

INTERVIEWS, ON-SITE RECONNAISSANCE AND ARIAL PHOTO REVIEW

The Taconite Harbor Pellet Dock and a Marine Fueling Facility were inspected on July 25, 2002. The Marine Fueling Facility consists of two Large ASTs (AOC-54, Figure 13) and associated lines and pump house are currently being addressed under the LUST program (Leak #12252).

The “Oil Track” (AOC-55, Figure 13) is a siding off the main rail line where fuel oil was off loaded from rail cars to the ASTs. The Oil Track was not used for off loading oil after approximately 1970. However, some buildup of heavy lubricants and oil was observed along the track grade. In addition, one mobile AST, used for fueling light track vehicles existed adjacent to the grade and some demolition debris and waste soils piles were observed adjacent to the track grade.

RAILROAD CORRIDOR AND MURPHY CITY

REGIONAL GEOLOGY AND HYDROGEOLOGY

The Railroad Corridor transects a remote portion of Northeast Minnesota and three seperate watersheds. The Corridor begins at Hoyt Lakes which lies within the St. Louis River Watershed and enters the Rainy Lake Watershed in T.59N, R.11W. Finally the railroad enters the Lake Superior Watershed in about T.58N, R.9W. Murphy City lies within the Lake Superior Watershed.

Bedrock geology at the western end of the corridor is shown on Appendix G and consists of the Animikie Group which contacts the Duluth Gabbro several miles east of the Hoyt Lakes facility. This contact between the Duluth Gabbro Complex and the Animikie Group has been extensively explored for non-ferrrous metal reserves. The corridor is underlain by the gabbro as it extends eastward. The Northshore Volcanic sequence as previously described, underlies the eastern sections of the corridor.

Glacial drift varies in thickness accross the corridor ranging from several feet on the eastern end to more than 100 feet on the mid sections of the corridor. The deposits tend to be sandy to stony till ranging in color from brown on the western end to red-brown on the eastern end. Peat and sandy glacial outwash is common on the western portions of the railroad

ENVIRONMENTAL RECORDS REVIEW

A database search of standard environmental records was not obtained for the railroad corridor or Murphy City.

INTERVIEWS, ON-SITE RECONNAISSANCE AND ARIAL PHOTO REVIEW

The entire corridor from the Hoyt Lakes facility to Taconite Harbor was inspected on July 25, 2002. In general, the Railroad Corridor contained few notable environmental conditions. Occasional railroad ties are discarded along the corridor and switches contain small areas with lubricant build-up on the ballast. However, this material is limited to the area immediately surrounding the switches. Near the Taconite Harbor end of the corridor, large curves exists in the track with rail lubricators installed at each curve (AOC-58, Figure 12). Rail lubricators also exist along the rail corridor east of Murphy city in the general vicinity of mile marker 55. Some buildup of the grease on the ballast was observed at these locations. Several Battery Houses were observed with all batteries removed. These are small structures containing batteries that operate signals, detectors and electrical switches. The batteries are recharged with solar panels. No indications of a release were observed around the battery houses.

Murphy City (AOC-57, Figure 17) consists of four main buildings; a Repair Building, Storage Building, Lubricant Oil Storage and Reporting Building. The Repair Building was used for light service on track maintenance equipment, soil staining was evident along the tracks leading into the Repair Building. A well and septic system are associated with the Reporting Building. The Oil Storage Building has a wood floor and contains some surrounding stained soil. Two USTs were removed from the Murphy City facility in the 1990s and replaced with two ASTs. These tanks are listed in Table 2 and 5. A laydown area for various wood, scrap metal, rails and railroad ties is located adjacent to the rail siding entering the facility, In addition a small pile of general demolition waste is located in the laydown area. Figure 17 presents a detail drawing of Murphy City.

CONCLUSIONS

NTS has performed this Phase I Environmental Site Assessment of the CE Facility in general conformance with the scope and limitations of ASTM Practice E 1527-00 as well as VIC Guidance document # 8. Uniqueness' in the methodology are described in the Limitations and Methodology section of this report. This report uses the term Area of Concern (AOC) as a discrete area of the property where a known release, or a material threat of a release is identified by the level of inquiry provided by this document. The term is not intended to include de minimis conditions that generally do not present a material risk of harm to public health or the environment and that generally would not be the subject or an enforcement action if brought to the attention of appropriate governmental agencies.

NTS has identified 59 AOCs which are summarized in Table 6. NTS recommends that CE determine a prioritization of the AOCs and prepare a Quality Assurance Plan (QAP) which outlines the Phase II methods and decision process. Following VIC Staff approval of the QAP Sampling and Analysis Plans (SAPs) should be prepared to address the AOCs. Each SAP should contain sufficient detail on the process and waste stream associated with the AOC. This detail should be used to develop a sampling strategy in accordance with the MPCAs Draft Risk Base Site Characterization and Sampling Guidance.

REFERENCES

Meinike, D.G., Buchheit, R.L., Dahlberg, E.H., Morey, G. B., Warren, L.E., 1999, Geologic Map Mesabi Iron Range, Minnesota, Second Edition.

Morey G.B., 1993, Geology of the Mesabi Iron Range: Institute on Lake Superior Geology Procedings, 39 Annual Meeting, Eveleth, MN, 1993, v.39, part 2, p1-18.

Attachment B

QAPP Cliffs Erie 2003

QUALITY ASSURANCE PROJECT PLAN TITLE SIGNITURE PAGE

Prepared by: Northeast Technical Services, Inc.

Prepared for: Cliffs Erie L.L.C.

Jim Scott, Cliffs Erie L.L.C., Manager Operations (CE Project Manager)	Date
Rick Crum, P.G., Northeast Technical Services, Inc. (NTS Project Manager/QA Officer)	Date
Dennis Schubbe, P.G., Northeast Technical Services, Inc. (Project Hydrogeologist)	Date
Donald Downs, Northeast Technical Services, Inc. (Project Engineer)	Date
Amy Miller, MPCA (MPCA - VIC Project Manager)	Date
Jonathan Smith, MPCA (MPCA - VIC North District Coordinator)	Date

QUALITY ASSURANCE PROJECT PLAN DISTRIBUTION LIST

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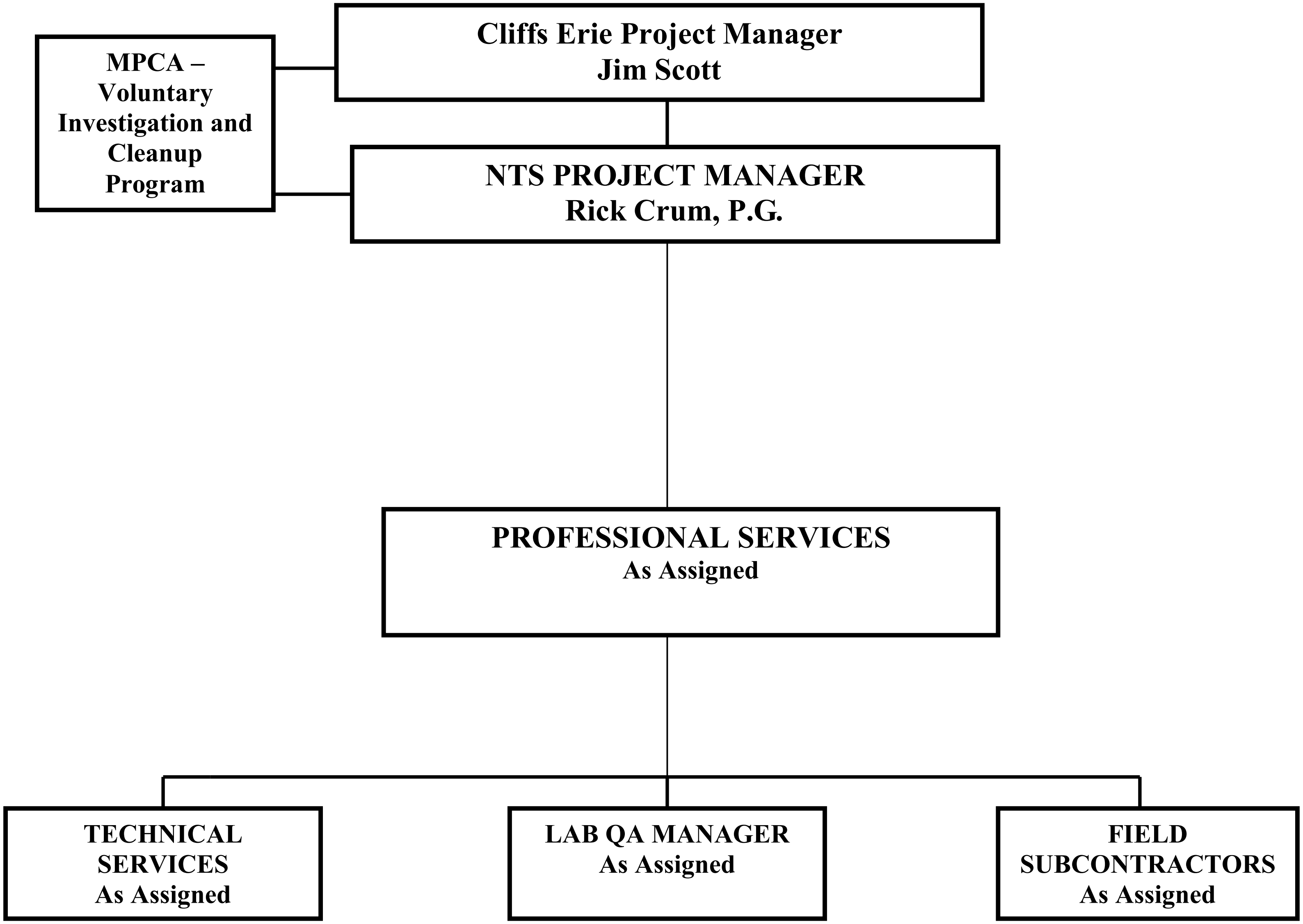
CLIFFS ERIE VIC ORGANIZATIONAL CHART



OVERVIEW

Cliffs Erie L.L.C. (CE) purchased the assets of LTV Steel Mining Company (LTVSMC), including LTVSMC's Hoyt Lakes Facility, Dunka Property, Taconite Harbor, and Railroad Corridors (the property) during 2001. CE has subsequently retained Northeast Technical Services, Inc. (NTS) as their consultant to assist in completing tasks that will allow CE to reuse, develop, or sell portions of the property. In order to obtain these objectives a process to "clear" the property was designed that would support closure of the property per the Mine Closure Plan (May 23, 2002) for the property and will allow CE to obtain legal or administrative assurances, issued by the Commissioner of the Minnesota Pollution Control Agency (MPCA), to limit environmental liability that may be associated with the property. The assurances may apply to CE and/or specific legally described lands.

The process to clear the property was initiated by performing a Phase I Environmental Site Assessment (<u>Phase I Environmental Site Assessment (ESA), Cliffs Erie Properties Including; The Hoyt Lakes Facility, Dunka Property, Taconite Harbor, and Railroad Corridors</u> (NTS, September 2002). The property consists of approximately 58,000 acres, including lands used by LTVSMC for mining activities or that were used to support mining activities. The Phase I ESA was performed per American Society for Testing and Materials (ASTM) Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process (E 1527-00). However, the size of the property, volume of information within LTVSMC records and the standard environmental records database search was not reasonably ascertainable and/or practicably reviewable. Specific tasks and decision making had to be defined in order for the process to clear the property to continue and ensure that due diligence per ASTM 1527-00 was performed. The purpose of this Quality Assurance Project Plan (QAPP) is to define the tasks and decision making process, as well as data quality objectives that will allow the process of clearing the property to continue.

The Phase I ESA for the property (September 2002) identified fifty-nine separate Areas of Concern (AOCs) on the property. The AOCs have been grouped into Sites. The Phase I ESA was submitted by CE to the MPCA along with an application for CE's inclusion in the MPCA's Voluntary Investigation and Cleanup (VIC) Program. Sites have been prioritized by CE and MPCA for further investigation (Phase II ESA Investigations) and eventual closure. Phase II ESA Investigations will be performed in accordance with the MPCA's Risk Based Site Evaluation (RBSE) process (MPCA Draft Guidelines-Risk Based Site Characterization and Sampling Guidance). Sampling and Analysis Plans (SAPs) will be prepared and submitted for MPCA approval for each Site and/or AOC based upon this QAPP and MPCA RBSE guidance.

Closure of a Site and/or AOC will be obtained upon justification of No Further Action with or without exceptions (e.g. groundwater not investigated) or successful implementation of a Response Action for cleanup. Response Action Plans will be based on the results of Phase II Investigations and planned property use.

As agreed upon by MPCA VIC staff and CE, this QAPP in conjunction with the SAPs for each Site will represent the workplan. The objectives of the workplan follow:

QAPP

- Defines the decision process.
- Specifies the Data Quality Objectives (DQO).
- Defines the data verification and usability process.
- Outlines potential sampling strategies

SAP

- Identifies Recognized Environmental Concerns (RECs) within each Site and/or AOC that have a reasonable probability to exist.

If a REC exists, the following additional objectives of the SAP are:

- Identifies Chemicals of Potential Concern (COPC) that have a reasonable probability to be present at each Site AOC.
- Determines the sample locations and quantities to be taken and analyses to be performed that will show that a REC exists or COPCs are present at each Site AOC.
- Defines the sampling protocol to be used.

TABLE OF CONTENTS

I. INTRODUCTION

A. PROBLEM DEFINITION/BACKGROUND

Cliffs Erie L.L.C. (CE) purchased the assets of LTV Steel Mining Company (LTVSMC), including LTVSMC's Hoyt Lakes Facility, Dunka Property, Taconite Harbor, and Railroad Corridors (the property) during 2001. CE has subsequently retained Northeast Technical Services, Inc. (NTS) as their consultant to assist in completing tasks that will allow CE to reuse, develop, or sell portions of the property. In order to obtain these objectives a process to "clear" the property was designed that would support closure of the property per the Mine Closure Plan (May 23, 2002) for the property and will allow CE to obtain legal or administrative assurances, issued by the Commissioner of the Minnesota Pollution Control Agency (MPCA), to limit environmental liability that may be associated with the property. The assurances may apply to CE and/or specific legally described lands.

CE acquired portions of the LTVSMC's facility directly related to mining and ore processing. Minnesota Rules 6130 require a Mine Closure Plan for the facility. The CE Closure Plan (May 23, 2002) provides a framework for work to be conducted as part of the closure process. In general, closure work falls into two categories:

1. Work that falls under regulatory oversight by the Minnesota Department of Natural Resources (MDNR) Including:
   - Plans for pit to watercourse discharges;
   - Mineland reclamation; and,
   - Plans for tailings basin drainage.

2. Work that falls under regulatory oversight of the MPCA including:
   - Investigation and potential cleanup of contaminants in soil or groundwater related to the mining operations; and,
   - Protection of overall water quality.

The purpose of this QAPP is to define the process to clear property with respect to potential environmental liability and that will address work that may fall under the regulatory oversight of the MPCA. CE retains the responsibility for closure of the mine and entered the MPCA Voluntary Investigation and Cleanup (VIC) Program on April 4, 2002. Conducting closure work as a volunteer in the VIC Program will result in legal or administrative assurances, issued by the Commissioner of the MPCA, that apply either to CE as an entity, or to specific legally described lands. These assurances are intended to streamline re-use or redevelopment of the idled facility. In essence, the facility is viewed as brownfield that must undergo routine Phase I assessment, Phase II investigation, and risk based decision making that incorporates planned land use regarding identified releases that arise from the Phase I and Phase II process. The process was initiated by performing a Phase I Environmental Site Assessment (Phase I Environmental Site Assessment (ESA), Cliffs Erie Properties Including; The Hoyt Lakes Facility, Dunka Property, Taconite Harbor, and Railroad Corridors (NTS, September 2002).

The property consists of approximately 58,000 acres, including lands used by LTVSMC for mining activities or that were used to support mining activities. The Phase I Environmental Site Assessment (ESA) was performed per American Society for Testing and Materials (ASTM) Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process (E 1527-00). However, the size of the property, volume of information within LTVSMC records and the standard environmental records database search was not reasonably ascertainable and/or practicably reviewable. The Phase I ESA for the property identified fifty-nine separate Areas of Concern (AOCs) on the property. The AOCs have been grouped into Sites where potential or identified recognized environmental concerns (RECs) exist.

Specific tasks and decision making had to be defined in order for the process to clear the property (i.e., clear the identified AOCs and/or Sites) to continue and ensure that due diligence per ASTM 1527-00 was performed. The purpose of this QAPP is to define the tasks and decision making process, as well as data quality objectives that will allow the process of clearing the property to continue.

II. PROJECT MANAGEMENT AND ORGANIZATION

A. PROJECT ORGANIZATION

Communication, management activities, and technical direction with the CE VIC project team will follow organization and arrangement protocol. Any directions or communications from the MPCA will flow from the MPCA Project Manager to the NTS Project Manager, who will keep the CE Project Manager apprised of developments. All written correspondence will be distributed according to the project distribution list. Overall organization and personnel for the project are depicted on the Organizational Chart following the Signature Page of this QAPP.

The NTS Project Manager will provide overall direction for project implementation utilizing professional and technical resources. These resources may be drawn from various sources as cost and availability dictate.

The specific responsibilities of the project team are described below.

1. CE Project Manager

1. Review and approve technical work and associated documents including the QAPP and SAPs.
2. See that work performed is consistent with the ultimate objectives of CE.
3. Approve and authorize project budgets prepared by the NTS Project Manager.
4. Approve subcontractors.

2. NTS Project Manager

1. Manage project scope, schedule, and cost.
2. Direct approval and review of QAPP and SAPs.
3. Provide technical consultation services to the CE Project Manager, and to project professional and technical staff.
4. Prepare progress reports detailing work accomplished.
5. Implement SAPs, provide direct supervision of assigned resources to meet schedule.
6. Review all project deliverables, project strategies, and decision making.
7. Review Data Review Checklist (Appendix L) and comparability assessment to determine usability of data (See Section V.A.).

3. Professional Services

1. Develop QAPP and SAPs under the direction of the NTS Project Manager.
2. Provide project schedule updates to the NTS Project Manager.
3. Prepare the Project Health and Safety Plan (HASP).
4. Review the HASP with appropriate field personnel and subcontractors.
5. Oversee site investigative activities.
6. Review field and laboratory data to assess the status and adequacy of the SAPs.
7. Develop and review Response Action Plans (RAP).
8. Prepare Phase II site investigation reports.
9. Complete Laboratory Data Checklist (Appendix L) and perform data comparability assessment per Section V.A. on individual data sets.

4. Lab QA Manager

1. Maintain records of laboratory QA/QC procedures as outlined in the laboratory's QA/QC Manual and Standard Operating Procedures.
2. Perform laboratory data verification per Section V.A.

5. Technical Services

1. Read and be familiar with the HASP.
2. Provide status updates to the NTS Project Manager.
3. Conduct sampling events in accordance with the Standard Operating Procedures (SOP) contained within Appendix F. Before sampling, discuss with NTS Project Manager and Project Hydrogeologist the sampling purposes, sampling methodology, number of samples, sample preservation methods, chain-of-custody requirements, analyses required, use of field forms, equipment decontamination procedures, and which samples will be duplicated in the field.
4. Be responsible for collection of equipment needed for site work, and inspect all field equipment prior to site use to verify that equipment is in proper working condition, has been decontaminated, batteries (if needed) have been properly charged, and properly calibrated.
5. Perform soil borings, push-probes, monitoring well installations, and test pitting.

Proposed NTS personnel and associated resumes are provided as Appendix C.

The project will be conducted within the MPCA-VIC program. Therefore, this QAPP and subsequent documentation produced will be supplied to VIC Staff for approval purposes.

All site personnel shall have completed applicable training as required by state and/or federal regulations. Also, all NTS professional staff shall be degreed environmental professionals with working knowledge of this QAPP and the HASP.

Any subcontractors used for the purpose of obtaining environmental media samples shall have completed OSHA training, in accordance with applicable regulations. Additionally, subcontractors will be required to comply with all site safety requirements addressed in the site-specific HASP, provided under a separate cover to this QAPP.

B. PROJECT DESCRIPTION AND SCHEDULE

Investigation of environmental conditions on the facility is contained in four steps. The steps along with resulting documentation and appropriate guidance or standards are summarized in the table below.

STEPS	RESULTING DOCUMENTS	APPROPRIATE GUIDANCE OR STANDARDS
PHASE I ESA	Phase I ESA Report (September 2002)	ASTM E 1527-00
ADDITIONAL PHASE I ESA	Multiple Phase I ESA	ASTM E 1527-00 and ASTM 1528-00
PHASE II ESA	One Project inclusive HASP	NIOSH/OSHA /EPA – Occupational Safety and Health Guidance for Hazardous Waste Site Activities. NIOSH Publ. # 85-115.
	One Project inclusive QAPP	EPA Requirements for Quality Assurance Project Plans (EPA QA/R-5).
	Multiple Separate SAPs	MPCA Draft Guidelines-Risk Based Site Characterization and Sampling Guidance.
	Multiple Separate Phase II Investigation Reports	MPCA VIC Guidance Document #12 MPCA VIC Risk-Based Site Evaluation Manual
RESPONSE ACTION PLAN	Multiple Separate Response Action Plan (RAP) Reports as required	MPCA VIC Risk Based Evaluation Manual
ASSURANCE	Multiple Separate Letters of Assurance	MPCA VIC Guidance Document #4

<u>Additional Phase I ESA</u>
A Phase I ESA for the project has been completed. However, it is anticipated that potential REC and/or potential AOC may be identified in the future that are not listed in the Phase I ESA completed during September 2002. The potential REC will be identified as an AOC on the current list included in the September 2002 Phase I ESA (reference Appendix B) and a Phase I assessment will be completed in accordance with the established decision process.

As indicated above, the standard environmental database search was not practicably reviewable and/or reasonably ascertainable per ASTM E 1527-00. Standard environmental database search results are provided for a given zip code. However, the location is typically given as a post office box number for the LTVSMC administrative offices and the records do not specifically identify locations. Given the size of the property (approximately 58,000 acres) a zip code location alone causes environmental database search results to not be practicably reviewable. Therefore, additional standard environmental database searches will not be performed for the property as part any additional AOC and/or Site work, and will not be performed during future Phase I ESA that may be conducted as part of the process outlined in this QAPP.

Phase II ESA Investigations

Phase II ESA Investigations may comprise the actual collection and analysis of various media and may consist of one or more of the following tasks:

1. Collection and analysis of soil samples.
2. Collection and analysis of sediment samples.
3. Collection and analysis of groundwater samples.
4. Collection and analysis of surface water samples.
5. Installation of temporary and/or permanent groundwater monitoring wells.
6. Performance of aquifer tests and evaluation of aquifer characteristics.
7. If required, risk based site evaluation.
8. If required, an evaluation of cleanup technologies and associated costs.
9. Assessment and usability of resulting data.

Health and Safety Plan (HASP) provides specific health and safety requirements for personnel involved in data collection on the property. This QAPP defines objectives of the project and documents procedures and practices that will allow quality assurance required by EPA QA/R-5. The SAPs are intended to be companion documents to this QAPP and provide details on the quantity, locations and intent, of any required sampling at each Site. The Phase II Reports present the results of the Phase II Investigation for a Site, including risk evaluation. Finally, the RAP is a plan for reducing or eliminating the risk at a Site, if the risk evaluation fails.

The inclusive results of all steps listed above are intended to provide CE and the MPCA with data of sufficient quality and quantity to:

1. determine if further action is required; and,
2. determine appropriate reuse of the project Sites.

C. PROBLEM STATEMENT

CE is in the process of mine closure of properties identified as idled mine land brownfields. An evaluation will characterize the environmental conditions present within each Site to the extent that it may be determined if the site may be reused for a specific purpose or identify the risk mitigation required to achieve an appropriate risk evaluation as documented within a RAP. A tiered evaluation of risk through direct exposure, soil leaching, groundwater, and surface water will be utilized.

Within this framework of evaluation, it is essential that the set of legal or administrative assurances provided by the MPCA also satisfy the CE Mine Closure Plan.

1. Decision Identification

CE and MPCA will use information resulting from an evaluation of each site or newly identified Site to make the following decisions:

1. Is a newly identified Site an AOC?
2. Will the Site require a cleanup or can an appropriate assurance be issued in accordance with Phase II information and RBSE criteria?
3. If cleanup is required and it is not cost effective based on the intended use, can the Site be developed for another use under assurance while satisfying all other regulatory requirements regarding environmental conditions?

Phase I ESA(s) will be performed for potential AOC(s) that are not included in a Site listed in the September 2002 Phase I ESA, in order to determine if a new AOC should be included on the list. As indicated above, a standard environmental database search will not be performed for future Phase I ESA since the search results are not practicably reviewable and/or reasonably ascertainable.

2. Decision Inputs

In assessing the AOCs and/or Sites, the presence of a Recognized Environmental Conditions (REC) will be determined. If required to assess the level of soil, sediment, surface water, and/or groundwater contamination present at the site, samples of these media will be collected for analysis as described in the specific SAPs. These samples will be collected for the purpose of answering the following decision inputs as diagramed in Figure 1:

Examples of specific questions related to the decision inputs associated with each AOC are the following:

1. What has been the historical mine related land use at the AOC and to what extent did these uses occur?
2. Have past uses of the AOC impacted the soil, sediment, surface water, or groundwater?
3. Did past hazardous substance handling/housekeeping activities (if any) impact the AOC?

4. If any former Underground Storage Tanks (USTs) existed on the AOC, does contamination exist near the area of the identified tank(s) or tank system components?
5. Have former Aboveground Storage Tanks (ASTs) (if any) impacted the surrounding media at an AOC?
6. Have uncontrolled dumping / landfilling activities occurred at the AOC? If so, have those activities impacted the environmental media?
7. Considering the planned Site use, what is the level of potential exposure to potentially contaminated media that exists at the Site?

3. Investigation Boundaries

A plan showing physical boundaries of the AOC will accompany each SAP. Within each investigation area, data may be collected from the ground surface, or at depth in order to assess all exposure pathways.

CE currently owns or leases all the properties and right to access does not affect physical boundaries of on-site investigation. If characterization of site conditions requires off-site sampling, right to access will be obtained prior to sampling.

Seasonal constraints on the investigation are limited. Sampling may be conducted during most weather conditions other than surface soil sampling during the winter.

4. CE's Decision Process

Tier-1 SRVs and SLVs as defined in the MPCA September, 1998 Working Draft-Risk Based Site Evaluation Manual (RBSE) and. Similarly, the Minnesota Department of Health (MDH) Health Risk Limits (HRLs) for drinking water will be used for decision and response action criteria.

With data of adequate quantity and quality, an assurance will be requested from MPCA if no release is identified. If a release is identified an assurance will be requested from MPCA if:

1. Soil sample results collected as part of this investigation are all below the applicable SRVs and SLVs.
2. The hydrogeologic conceptual model has been defined to the extent that SLV criteria indicate minimal risk to the aquifer.
3. The aquifer is encountered, physical parameters adequately measured, and groundwater chemistry defined with contaminant concentrations less than HRLs.

Occasionally, the soils and groundwater of Northeastern Minnesota contain background concentrations of analytes that exceed Tier-1 SRVs, SLVs or MDH HRLs. Background soil concentrations contained in the Tier-2 SRV calculation spreadsheet within the MPCA Risk Based Site Evaluation Manual will be used to establish standard background soil concentrations. Similarly 'Baseline Water Quality of Minnesota's Principal Aquifers, MPCA, 1998" will be referenced for groundwater background concentrations.

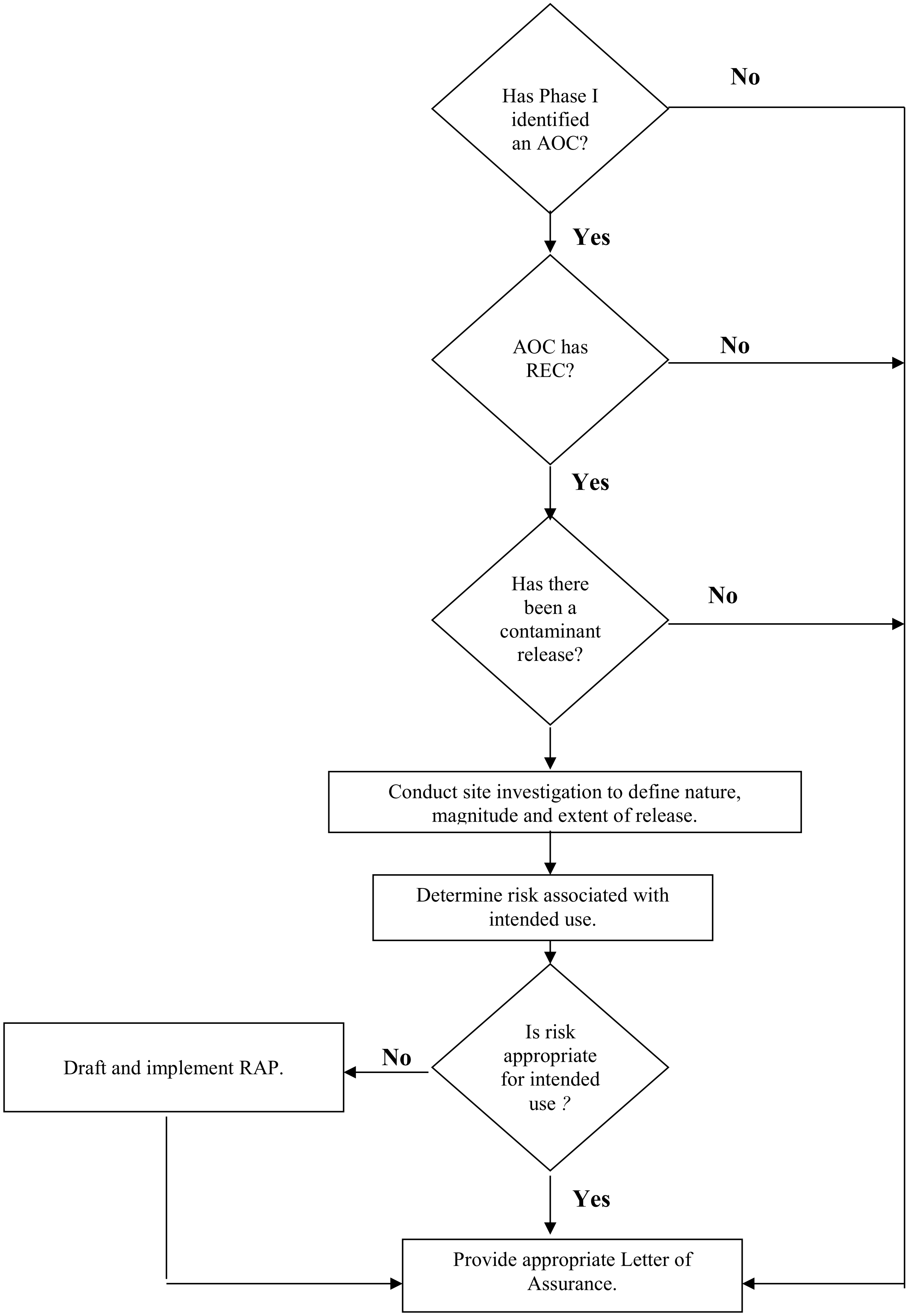


Figure 1 – AOC Decision Tree

If any of these criteria are not satisfied, CE will consider the following Response Action options:

1. If contaminant concentrations exceeding SRV/SLV/HRL are limited to less than 10% of the total number of soil and/or groundwater samples analyzed, then CE may resample specific locations indicating elevated contaminant levels. If resampling supports the original data, CE will proceed to the second option discussed below.
2. Can a cleanup strategy be developed to achieve contaminant concentrations less than the SRV/SLV/HRL for the proposed use of the site?

Can institutional controls or changes in planned site use achieve acceptable risk evaluation criteria?

D. DATA QUALITY OBJECTIVES

Data Quality Objectives (DQOs) are qualitative and quantitative statements that specify the quality of the data required to support the following;

1. Decisions made during the investigation and,
2. The ultimate conclusions produced from the data.

Different data uses require different levels of quality.

1. Data Acquisition Design

The purpose of the QAPP is to produce reliable data that will be generated throughout the investigation by:

1. Ensuring data validity and integrity;
2. Assuring and providing mechanisms for ongoing control of data quality;
3. Evaluating data quality in terms of precision, accuracy, reproducibility, and data recovery; and
4. Providing usable, quantitative data for analysis, interpretation, and decision making.

E. DOCUMENTATION REVISION CONTROL

The control of documentation revisions for documents generated during the course of the project is essential to the integrity of the document. Incorporation of agreed upon changes made during the document review and approval cycle are to be accomplished in an efficient manner in view of the voluminous nature of the documentation generated. Therefore, documentation changes will be noted in red within the margin of the affected page(s) of the original document, referring the reader to the project correspondence by date and subject. Any other copies of the document will be marked as "Copy" on the title page. The decision to release a revision of the document will remain with the responsible party. Documents generated by NTS will undergo Peer Review. All project correspondence held by NTS will be maintained per company policy.

III. MEASUREMENT DATA ACQUISITION

A. SAMPLING SRATEGY

SAPs developed for each project area will present rationale for proposed sampling and be in accordance with the MPCA 1998 Draft Guidelines – Risk Based Characterization and Sampling Guidance. Specifically the SAPs will address the following:

1. Media types that will be sampled.
2. Analytical parameters and associated methods for each media sample correlated to a COPC.
3. Quantities of samples.
4. Horizontal and vertical locations (UTM coordinates) for each proposed sample correlated to an AOC.
5. How CE's Decision Process is supported by the sampling and analysis plan.
6. Use of EPA SW-846, method 5035 for soil volatiles sampling.
7. Order of sample bottle filling to minimize volatiles loss.

In general, soil sampling is conducted to assess human and ecological risk associated with direct exposures to the soil and to assess the transport potential for soil contaminants to groundwater. Composite soil sampling will not be used unless an acceptable rationale is provided in the SAP. Locations of samples may be based on two strategies;

1. A *grid pattern* where the samples are collected at shallow depth. Grid sampling is used typically to assess the direct exposure pathway and field screening data is generally not used to make decisions regarding locations of other grid samples.
2. A *random pattern* where samples are collected at a specific point of potential release and radially out from the point of release. Random sampling is used to characterize, and determine extent and magnitude of the release. Therefore, samples are typically collected at various depths of the subsurface. Field screening data is very important for determining location for additional samples. The random pattern may be used to assess either direct exposure or transport to groundwater risks. However, follow up grid sampling may be required to adequately address direct exposure.

Groundwater sampling is divided into preliminary sampling and extensive groundwater monitoring.

1. *Preliminary sampling* is conducted to determine if a potential release has impacted groundwater, to determine the nature and extent of the impact, and for general characterization of the aquifer. Samples may be obtained from temporary (e.g., Geoprobe) well points or permanent monitoring wells. Generally, preliminary sampling is used to determine if extensive monitoring is required. In addition, if a legal or administrative assurance, inclusive of groundwater, is sought from the VIC program, preliminary sampling is required.
2. *Extensive monitoring* is conducted if preliminary sampling indicates groundwater contamination exists. The extensive monitoring consists of rigid characterization of aquifer parameters, extent of the groundwater plume, and monitoring of plume transport controls. The groundwater exposure pathway is evaluated using extensive monitoring data. In addition, remedy selections for groundwater conditions are determined through extensive monitoring data.

QA/QC samples will be submitted in accordance with the QAPP protocols presented in the following sections. Requirements for QA/QC samples are identified on Table 1, Appendix D.

B. ANALYTICAL METHODS REQUIREMENTS

CE will utilize the analytical services of the NTSL and their approved subcontracted laboratory(s) which will be specified within the SAP Selected laboratories will be Minnesota Certified. Based upon RECs identified at other mine land brownfields, as well as preliminary information on the project areas, COPC may include volatiles, semi-volatiles, agrichemicals, and metals. In addition, analysis of some soil chemistry parameters may be required for fate and transport calculations. The analysis of the carcinogenic polynuclear aromatic hydrocarbons (cPAHs)[1] will be accomplished during initial characterization where the REC identifies a potential leak. This method will also be used during the RBSE phase of the investigation. Table 2 (Appendix C) contains analyte lists for various analysis methods, QA objectives for each method, and the laboratory that will perform the analysis. The SAPs will designate specific methods for each media sample based upon:

1. Method reporting limits less than or equal to Tier-1 SRV/SLV or HRL.

[1] Reference MPCA's Office Memorandum of October 29, 2002.

2. Inherent reliability of the method.
3. Cost.

The potential parameter groups, analysis method, and laboratory used include:

1. Volatile organic compounds (VOCs) tested by NTSL using methods MDH 465F and MDH 466 F or tested by subcontract laboratory by SW-846, 8260.
2. Semi-volatile organic compounds (SVOCs) tested by NTSL using methods SW-846 and SW-8270.
3. Pesticides and herbicides tested by subcontract laboratory using methods SW-846, 3545, 3550, 8081, and 8141A.
4. Organochlorine pesticides tested by subcontract laboratory using methods SW-846 and 8081.
5. Polynuclear aromatic hydrocarbons (PAHs) tested by subcontract laboratory using methods SW-846 and 8310 or by NTSL using the extended Selective Ion Detection Method for cPAH.
6. Polycyclic biphenols (PCBs) tested by subcontract laboratory using methods SW-846 and 8081.
7. Metals tested by NTSL using methods SW-846, 6010B, 7041, 7060A, 7091, 7131, 7196A, 7421, 7470A, 7471A, 7740, 7760A, and 7841.
8. Petroleum compounds tested by NTSL using WI DNR Modified Methods.
9. Other tested by NTSL using methods 9010, 9060, and 9045.

Sample preservation, holding times, and volume requirements as specified by SW-846, and outlined in Table 3, for samples collected as part of this project will be strictly adhered to by the laboratory. The soil, sediment, surface water, and groundwater samples will be analyzed for known and suspected contaminant parameters common to past activities and RECs associated with each subject site.

All environmental media samples will be collected and analyzed in accordance with this QAPP, SOPs, and the NTSL and subcontract laboratory QA/QC Plans, as discussed below.

Bottles/containers utilized for the collection of samples will be provided by Environmental Sampling Supply (ESS). ESS will supply a “Precleaned Certified Certificate of Compliance” with each box of sample containers. Each certificate has a clearly identified lot number. Lot numbers from the certificate will be written on labels on all of the sample containers. NTSL tests a random container of each size, from each lot of plastic sample containers, and a random container from each lot of 40-ml glass containers. The selected containers are rinsed with deionized water and the rinse water from the plastic containers is analyzed for metals, and the rinse water from the glass containers is analyzed for VOCs. A copy of an ESS "Precleaned Certified Certificate of Compliance" is appended as Appendix E.

NTSL will prepare the sample bottles for use in the field. Preparation of sample bottles includes:

1. Affixing labels to each sample container.
2. Writing the appropriate lot number on each label.
3. Weighing and recording bottle weights.
4. Adding the appropriate preservative (if necessary).
5. Preparation of a Trip Blank, if VOC analyses are performed

Sample collection activities will conform to NTS standard operating procedures (SOPs) which are included in Appendix E.

C. QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT

Three data types are available to investigators.

1. Field screening data.
2. Mobile laboratory data (VOC/petroleum compounds).
3. Court defensible laboratory data.

Decision making uses of the data are different. Field screening provides a lower quality of data. However, field screening methods provide the most rapid results and are often used for health and safety monitoring and initial characterization to provide rationale for subsequent sampling locations. Quality assurance for field screening is addressed primarily through the use of SOPs, QA objectives specified in Table 4, and preventive maintenance specified in Table 5.

Mobile laboratory data is higher quality than field screening and still provides very rapid data delivery to the investigator. Mobile laboratory data is used for health and safety monitoring, initial characterization to provide rationale for subsequent sampling locations and preliminary comparison to SRVs or SLVs. Confirmation samples are collected of a specified number of samples and are submitted to a fixed based laboratory. The mobile laboratory is only used to analyze VOC and petroleum compound samples. QA objectives for mobile laboratory data is specified in the NTS Mobile Laboratory Quality Control Manual contained in Appendix G.

Laboratory data is used for decision making steps discussed under "The CE's Decision Process". Quality assurance objectives for laboratory data is dependent upon how the sample is obtained (Field Quality Objectives) and how the sample is analyzed (Laboratory Quality Objectives). The Quality assurance objectives are shown on Table 3 in Appendix D. The overall QA objective for each project is to develop and implement procedures for field sampling, chain-of-custody, laboratory analysis, and reporting that will provide legally defensible results. Specific procedures for sampling, chain-of-custody and sample transport are described in NTS SOPs. Specific procedures for laboratory instrument operation and reporting of data are described in the NTS Laboratory Quality Assurance/Quality Control Plan.

Data quality objectives for measurements during this project will be addressed in terms of precision, accuracy, representativeness, completeness, and comparability (PARCC parameters). The numerical PARCC parameters will be determined from the project DQOs to insure that they are met. The DQOs and resulting PARCC parameters will require that the sampling be performed using standard methods, with properly operated and calibrated equipment, and conducted by trained personnel.

1. Precision

Precision is the determination of the reproducibility of measurement under a given set of conditions of a quantitative measure of the variability of a group of measurements compared to their average value. Precision is either reported, depending on the end use of the data, as relative difference (RPD) or standard deviation. The following describes field and laboratory precision objectives.

a. Field Precision Objectives

Field precision will be assessed through the collection and analysis of duplicate samples. Water matrix samples can be readily duplicated due to their homogeneous nature; however, the duplication of soil or sediment (solid) sample is much more difficult due to the non-homogeneous nature of soils/sediments. Accordingly, field duplicates will only be collected for aqueous matrices. A summary of the duplicate samples to be collected is presented in Table 1 along with the other quality control samples. One duplicate sample will be collected per 20 analytical samples for water matrices.

b. Laboratory Precision Objectives

The precision of laboratory analyses will be based upon laboratory matrix spike/matrix spike duplicate (MS/MSD) analyses as discussed in the NTSL and subcontract laboratory QA/QC Plans in Appendix H. Precision is reported as Relative Percent Difference (RPD). MS/MSD analyses will be at a rate of 1 per 20 samples received by the laboratory.

2. Accuracy

The definition of accuracy is the degree between a measurement or observed value and an accepted reference or true value. The field and laboratory accuracy objectives are identified below.

a. Field Accuracy Objectives

Sampling accuracy will be assessed by evaluating the results of field and trip blank samples for contamination. A trip blank will consist of a laboratory-prepared sample of reagent grade water. Trip blanks will accompany sample containers and be subjected to the same procedures as the investigative samples. Trip blanks are only required when volatile organic compounds are a COPC. Trip blanks will be submitted for analysis at the rate of one trip blank per shipping container containing investigative samples for VOC analyses.

Field blanks (equipment blanks) will be collected by pouring laboratory-prepared water or distilled water over or through the sampling equipment and collecting the rinseate in the proper analytical containers. Field blanks are required at the rate of one per 20 investigative samples for all matrices, except groundwater. Field blanks for groundwater are required at the rate of one per 20 investigative samples with a minimum of one per scheduled groundwater sampling event. A scheduled groundwater sampling event is a routine sampling of all monitoring wells within the monitoring system.

b. Laboratory Accuracy Objectives

The analysis of MS/MSD samples can be utilized to determine laboratory accuracy. This analysis is discussed in the NTSL and subcontract laboratory QA/QC Plans. Additionally, the analysis of reference standard samples, laboratory control samples, surrogate compounds, and percent recoveries are also utilized for laboratory accuracy determinations. Accuracy goals for parameters to be analyzed will be in accordance with the provisions of the U.S. EPA methods.

3. Completeness

The measure of the quantity of valid data obtained from a measurement system compared to the quantity that was expected, under normal conditions, is the definition of completeness. Although a completeness goal of 100% is desirable, an overall completeness goal of 90% may be realistically achieved under normal field sampling and laboratory analysis conditions. Field and laboratory completeness are described below.

a. Field Completeness Objectives

The field sampling crew will take measures to have data generated in the field be valid data (complete): however, some samples may be lost or broken in transit. Field completeness goals for this project will have 90% of samples collected be valid data.

b. Laboratory Completeness Objectives

Laboratory completeness will be a measure of the quantity of valid data measurements and analyses obtained from all the measurements and analyses completed for the project (See NTSL and subcontract laboratory QA/QC Plans – Appendix H). The laboratory completeness objective is for 90% of the samples analyzed to be valid data.

4. Representativeness

Representativeness is a qualitative measure of the degree to which measured results accurately reflect the medium being sampled. It is addressed through the ability of the SAP design to characterize the media representative volume. Sample quantity, location and method for assuring that the sample collected is characteristic of "the whole".

Adherence to the prescribed analytical methods and procedures, including holding times, blanks, and duplicates, decreases uncertainties in representativeness. Homogenization of soils, following volatiles bottle preparation, increases representativeness. Stabilization of pH, conductivity and temperature and low flow sampling techniques increases representativeness for ground water samples.

5. Comparability

The confidence with which one data set can be compared to another is a measure of comparability. The ability to compare data sets is particularly critical when a set of data for a specific parameter is compared to historical data for determining trends. Field and laboratory comparability are described below.

a. Measures to Ensure Comparability of Field Data

The comparability of field data will be satisfied by ensuring that the Work Plan/SAP and associated QAPP are adhered to and that all samples are properly handled and analyzed. Also, an effort will be made to have sampling done in a consistent manner by the same samplers (when possible).

b. Measures to Ensure Comparability of Laboratory Data

Analytical data are comparable when the data are collected and preserved in the same manner followed by analysis with the same standard method and reporting limits. Data comparability is limited to data from the same environmental media. Analytical method quality specifications have been established to help ensure the data will produce results that are comparable.

D. DOCUMENTATION AND RECORDS

Records are a critical aspect of a successful project. Records that shall be a part of the project documentation for the investigation include field forms, field logbooks, laboratory data sheets, chain of custody forms, and technical papers. Copies of blank field forms used by NTS are presented in Appendix I.

The draft and final Investigation Report submittal packages will include, at a minimum, the following:

1. Text describing field sampling methodologies, analytical results, conclusions, and recommendations
2. Figures showing site location, known underground and above ground utility lines, site boundaries, sampling locations, and summaries of the extent of contamination.
3. Tables comparing laboratory data to applicable SRVS, SLVs and HRLs, or other goals where appropriate.
4. Complete laboratory data reports, including QA/QC analytical results and copies of all chain of custody records.
5. Soil boring, groundwater monitoring, sediment sampling, and/or surface water sampling logs.
6. Other relevant material required to support the site development scenario.

Copies of the draft and Final Investigation Report will be submitted to the CE Project Manager and to the MPCA VIC Program project manager.

E. SAMPLE HANDLING AND CUSTODY REQUIREMENTS

The admissibility of environmental data as evidence in a court of law is dependant upon custody of the data, among other factors. Custody procedures will therefore be used to document the relevance and authenticity of data collected during the investigation during the EMARP. The data requiring custody procedures includes both field samples, and data files that can include field books, logs, and laboratory reports. An item is considered in custody if it is:

- In a person's possession;
- In view of the person after being in possession;
- Sealed in a manner that it can not be tampered with after having been in physical possession; or
- In a secured area restricted to authorized personnel.

Various aspects of sample handling and shipment, as well as the proposed sample identification system and documentation, are discussed in the following subsections and in the NTSL and subcontract laboratory QA/QC Manuals in Appendix H.

1. Sample Identification System

Sample containers will be labeled prior to being filled. Each sample label shall, at a minimum, indicate the container distribution lot number, sample type, date/time of sample collection, sampler's initials, required analyses, type of preservative, sample number and/or sample code number label, and the NTS sample location number. All labels will be filled out with waterproof ink. Samples collected for analysis by the laboratories will include NTS personnel-assigned sample numbers. NTS soil sample location numbers will be designated as follows.

AB-CD (E′)

- AB provides information about how the sample was obtained (GP = geoprobe, SB = soil boring, HA = hand auger, etc.)
- CD provides a designation to identify the sampling location. Soil samples begin with the number 01 and continue as sample locations are initiated.
- (E′) provides the depth of the soil sample to the nearest tenth of a foot.

For example, the soil sample designation SB-05 (10.5′) indicates a soil sample collected from a soil boring at location "05" at a depth of 10.5 feet.

Similarily, groundwater and surface water samples will be designated as follows:

FG-HI (H_2O)

- FG provides information on how the sample was obtained (MW = monitoring well, SB = soil boring, TW = temporary well, GP = geoprobe, SW = surface water, etc.)
- HI provides information on the location of the sample.
- H_2O provides verification that the sample is water.

Trip blanks are pre-labeled “Trip Blanks” in the laboratory. Field duplicates and blanks are labeled by the field sampler, and information regarding the sample location is recorded on a field form. The samples, without sample location information, are submitted to the laboratory for a true laboratory check. All field-collected soils and groundwater samples, field duplicates and blank samples designations are recorded on a field form for future reference.

2. Sample Packaging and Shipping

Samples will be packaged and transported in a manner that maintains the integrity of the sample and permits the analysis to be performed within the prescribed holding time. Each sample container will be prepared in the field by attaching a completed sample label (Refer to Sample Identification Section).

Following sample collection, each soil and/or groundwater sample will be placed in sealable bags prior to placement into ice-cooled coolers. The samples will be submitted to the NTS laboratory on the day of collection. If it is necessary to ship samples to a subcontracted laboratory, each bulk sample container (cooler) will be sealed by NTS prior to shipment using a Custody Seal. Shipping cooler custody seals must be placed on two opposite corners of the cooler, and positioned to bisect the interface of the cooler body and lid. NTS laboratory personnel are responsible for coordinating sample transfer to the subcontracted laboratory.

Samples shipped to the laboratory will be documented on the chain-of-custody form(s). The completed form will be enclosed in a Ziploc bag and taped to the inside lid of the cooler that contains the samples listed on the form. Additionally, preaddressed shipping Airbill tickets will be provided with each cooler shipment to the subcontract laboratory in order to provide for return of the sample coolers to NTS.

a. Documentation

Custody of samples shall be maintained and documented at all times. Chain of custody begins with the collection of the samples in the field. The documentation for each sample will include, at a minimum, the following information:

- Chain of Custody Form
- Laboratory Sample Tracking Log Number
- Sample Identification Number
- Sample Shipment Log
- Shipping Documents

NTS's SOP for chain of custody forms requires the basic information on specific forms be carefully filled out prior to going into the field. Items entered prior to performing the fieldwork include project number, project name, shipping carrier, etc. The sample numbers, location identifier, time and date of collection, and sampler's signature will be filled out in the field at the appropriate time.

b. Final Evidence Files Custody Procedure

NTS will be responsible for the custody of the evidence files and maintain the contents of the files for the duration of the project. The evidence files include all relevant records, reports, logs, field notebooks, pictures, subcontractor reports, and data reviews at the NTS office. Data files will be retained for a period of ten years.

F. INSTRUMENT CALIBRATION AND FREQUENCY

The calibration procedures to be employed for both the field and laboratory instruments used during site investigation work are referenced in this section. Measuring and test equipment used in the field and laboratory will be subjected to a formal calibration program. The program will require equipment of the proper type, range, accuracy, and precision to provide data compatible with the specified requirements and desired results. Calibration of measuring and test equipment may be performed internally using in-house reference standards, or externally by agencies or manufacturers.

The responsibility for the calibration of laboratory equipment rests with the laboratory. NTS site personnel are responsible for the calibration of NTS field equipment and field equipment provided by subcontractors.

Documented and approved procedures will be used for calibrating measuring and testing equipment. Widely accepted procedures, such as those published by EPA, ASTM, or procedures provided by manufactures in equipment manuals, will be adopted.

Calibrated equipment will be uniquely identified by either the manufacture's serial number, a NTS equipment identification number, or other means. This identification, along with a label indicating when the next calibration is due (only for equipment not requiring daily calibration), will be attached to the equipment. If this is not possible, records traceable to the equipment will be readily available for reference. It will be the responsibility of all personnel to check the calibration status from the due date labels or records prior to using the equipment.

Measuring and test equipment will be calibrated at prescribed intervals and/or as part of operational use. Frequency will be based on the type of equipment, inherent stability, manufacturer's recommendations, values given in national standards, intended use, and experience. Equipment will be calibrated, whenever possible, using reference standards having known relationships to nationally recognized standards (e.g., National Institute of Standards and Technology) or accepted values of physical constants. If national standards do not exist, the basis for calibration will be documented.

Physical and chemical reference standards will be used only for calibration. Equipment that fails calibration or becomes inoperable during use will be removed from service and segregated to prevent inadvertent use and will be tagged to indicate the fault. Such equipment will be recalibrated and repaired to the satisfaction of the laboratory personnel or NTS site personnel, as applicable. Equipment that cannot be repaired will be replaced.

Records will be prepared and maintained for each piece of calibrated measuring and test equipment to document that established calibration procedures have been followed. Records for subcontractor field equipment and NTS equipment used only for this specific project will be kept in the project files. Laboratory calibration records will be maintained by the laboratory.

1. Field Instrument Calibration

Instruments used to collect, generate, or measure field environmental data will be calibrated with sufficient frequency and in such a manner that accuracy and reproducibility of results are consistent with the manufacturer's specifications. Field measurement instruments for the field investigations will include PID/FID units that are used for detecting VOC vapors, instruments for measuring pH, conductivity, and the temperature of liquids. As applicable, each field measurement instrument will be calibrated daily prior to use. Calibration procedures will be documented in the field logbook. Documentation will include the checklist shown below.

Field Instrument Calibration Checklist:

- Date and time of calibration
- Identity of the person performing the calibration
- Reference standard used, as applicable
- Reading taken and adjustments to attain proper reading
- Any corrective action

2. Laboratory Equipment Calibration

The proper calibration of laboratory equipment is a key element in the quality of the analysis done by the laboratory. Each type of instrumentation and each EPA-approved method has specific requirements for the calibration procedures, depending on the analytes of interest and the medium of the sample.

The calibration procedures and frequencies of the equipment used to perform the analyses will be in accordance with the requirements established by the U.S. EPA. The laboratory QA Manager will be responsible for assuring that the laboratory instrumentation is maintained in accordance with specifications. Individual laboratory standard operating procedures (SOPs) for each method for each laboratory will be followed for corrective actions and preventive maintenance frequencies.

G. DATA MANAGEMENT

Raw data obtained during field activities, for example lithologic logs, pH measurements, etc., will be recorded on the appropriate field forms or in individual site logbooks. This data will become part of the project files to be maintained as described previously in this QAPP.

NTS will be responsible for data management for all laboratory activities. Analytical data reports generated by NTS or a subcontract laboratory will present all sample results, including all QA/QC samples.

The NTS Data Management Officer will manage the data processing. All laboratory internal QA/QC measures will be performed in accordance with the NTSL and subcontract laboratory QA/QC Plans.

IV. ASSESSMENT/OVERSIGHT

Performance and system audits will be completed to ensure that the field sampling activities and laboratory analyses are performed following the procedures established in this QAPP, including the attached SOPs, and the investigation Work Plans/SAPs. The audits may be both internally and externally led, as further described below.

A. Field Data

An NTS geologist/hydrogeologist will be present at the site during the sampling activities. The geologist/hydrogeologist will provide all on-site supervision required during the project. The NTS Project Professional Services Staffwill conduct the audits of field activities. The field audit will include the following tasks:

1. Review of field sampling records.
2. Review of field measurements procedures.
3. Examination of the application of sample identifications.
4. Review of field instrument calibration records and procedures.
5. Review of the sample handling and packaging procedures.
6. Review of chain-of-custody procedures.

The individual responsible for on-site supervision will be in daily contact with the NTS Project Manager or designee, who will then review compliance with the project objectives and sampling protocol outlined in this QAPP. Any anticipated modifications to the sampling or measuring procedures will be reported to CE and MPCA Project Managers. NTS site personnel will report modifications in writing to the NTS Project Manager, and the modifications will be documented by the geologist/hydrogeologist in the field logbook.

Sampling data precision will be determined by the collection and subsequent analysis of sample duplicates, decon blanks, VOA trip blanks, and bottle blanks to verify reproducibility.

B. Report Preparation

Prior to submittal to CE and the MPCA, all reports will undergo a peer review conducted by a project team within NTS. The standard NTS Peer Review Form is contained in Appendix I.

C. Laboratory Data

Laboratory results will be reviewed for compliance against the DQO criteria for the level of reporting required. Data verification and usability will also be accomplished.

V. DATA VERIFICATION AND USABILITY

A. DATA VERIFICATION AND USABILITY

Data verification and usability assessments provide a two step process toward assuring defensible, properly documented data of sufficient quantity to meet the project objectives. Verification and usability are done primarily through the use of standard checklists. Examples of these checklists are contained in Appendix I and contain more specific instructions for each checklist item. The process for Usability Assessment is discussed in detail below and is documented in the Phase II Report.

1. Data Verification

Data verification is a laboratory process of evaluating completeness, adherence to standard methods and compliance with internal QC requirements as stated in Section 5 and Section 6 of the NTS QA/QC Manual. Data verification may result in accepted, qualified or rejected data. The NTS Laboratory Manager prepares a QC Cover Letter for each data set. The cover letter discusses internal QC checks, anomalies in the data and specifically identifies data qualifications.

A representative subcontract laboratory QC Protocol is outlined in Section 11.0 of the MVTL QA/QC Manual. According to the manual, "The quality control measures taken at MVTL are used to test the reproducibility and accuracy of all data generated." The MVTL manual is included in Appendix H.

2. Data Usability

Data usability is a Project Professional Services Staff function that extends scrutiny of data beyond verification to discuss laboratory and field data as well as QA Objectives for Measurement specified in Table 5, Appendix D. The Lab completes a Routine Lab Report Checklist. (Appendix I). A review of the data for usability results in accepted, qualified or rejected data and is summarized within the data set's usability assessment.

Data Usability Assessment (Data Assessment) is the process of :

1. confirming laboratory data against the Laboratory Data Checklist
2. providing a reasonability check of the laboratory data against field data
3. reviewing the data for conformance to project data quality objectives
4. determining the limitations of the data in its use.

Data Assessment is done upon receipt of each data set to allow corrective action if required. The assessment is documented by the Project's Professional Services staff. A final assessment is done after the investigation field work is complete and documented in the Phase II Report.

The steps that will be included for the Usability Assessment are discussed below.

a. Precision

Field Precision is calculated from field duplicates collected during the investigative field work. The quantity of field duplicates is specified in Table 1 and will be reflected in the SAP. The precision calculation is as follows:

$$RPD = \frac{(C_1 - C_2) * 100}{(C_1 + C_2) / 2}$$

where RPD is the relative percent difference, C_1 is the larger of the two observed values and C_2 is the smaller of the observed values. If three or more replicates are used, then precision is determined from the relative standard deviation, RSD:

$$RSD = (s/x) * 100$$

where s is the standard deviation and x is the mean of the replicate analyses.

Laboratory Precision is calculated from laboratory matrix spike and matrix spike duplicates analyzed along with each sample set. The quantity of matrix spike and matrix spike duplicates are specified in Table 1 and the calculations are the same as for field precision.

Overall Precision is affected by sampling technique, sample transport, and/or heterogeneous matrices. In order to identify the cause of imprecision, the field sampling design rationale and sampling techniques will be evaluated by the Project QA Officer; and, both field and analytical duplicate/replicate sample results should be reviewed. If poor precision is indicated in both the field and analytical duplicates/replicates, then the laboratory may be the source of error. If poor precision is limited to the field duplicate/replicate results, then the sampling technique, field instrument variation, sample transport, and/or heterogeneous sample matrices may be the source of error.

If the Data Validation Checklist indicates that analytical imprecision exists for a particular data set, then the impact of that imprecision on data usability must be discussed in the Data Assessment section of the Phase II Report.

The Data Assessment section of the Phase II Report will discuss and compare overall field duplicate precision data from multiple data sets collected for the project for each matrix, analytical parameter and concentration level. The Data Assessment section will describe limitations on the use of project data when overall precision is poor or when poor precision is limited to a specific sampling or laboratory/analytical group, data set, matrix, analytical parameter or concentration level.

If the Project Professional Services Staff determines that the overall project-required precision is not achieved and project data are not usable to support project decision making, then the project staff member will notify, in writing, the NTS and CE Project Managers. The two Project Managers will assess the impact of the imprecise data to the overall goals of the project. The Project Managers will address how this problem will be resolved and discuss the potential need for re-sampling. The Project Professional Services Staff determinations and the Project Managers' resolution will be discussed in the Data Assessment section of the Phase II Report.

b. Accuracy / bias

Sample contamination: If field contamination is evident based upon results of field and trip blanks, the impact on data usability will be discussed in the Data Assessment Report Differentiation of field sample collection and transport contamination (equipment/rinsate blanks, trip blanks) from contamination introduced at the time of sample preparation and/or analysis, (i.e., method blank, storage blank, analytical instrument blanks) will be identified. Sample contamination may result in either negative or positive bias. For example, improperly cleaned sample containers for metals analysis may result in the retention of metals on interior container walls. This would result in lower metals concentration being reported than are actually present in the collected sample (i.e., negative bias). A positive bias would occur when sample container contamination results in additive effect, i.e., reported analyte concentrations are higher than the true sample concentrations for that analyte.

Laboratory Accuracy / Bias is calculated from matrix spike analyses or analysis of a standard reference material and is expressed by the following:

$$\%R = \{(S - U) / CA\} * 100$$

where %R is the percent recovery, S is the measured concentration in the spiked sample, U is the measured concentration in unspiked sample, and CA is the concentration of spike added. For a standard reference material the accuracy is determined by:

$$\%R = (M / C) * 100$$

where M is the measured concentration and C is the concentration of the standard reference material.

If contamination and/or analytical inaccuracies/bias exist for a particular data set, then the impact of that contamination and/or analytical inaccuracies/bias on data usability must be discussed in the Data Assessment section of the Phase II Report.

Overall Accuracy / Bias: The Data Assessment section of the Phase II Report will discuss and compare overall contamination and accuracy/bias data from multiple data sets collected for the project for each matrix, analytical parameter and concentration level. The Data Assessment section will describe the limitations on the use of the project data if extensive contamination and/or inaccuracy / bias exists or when it is limited to a specific sampling or laboratory analytical group, data set, matrix, analytical parameter or concentration level. The Data Assessment section will identify qualitative and/or quantitative bias trends for each matrix, analytical parameter and concentration level. The impact of any qualitative and/or quantitative trends in bias on the sample data will be discussed.

If the Project Professional Services Staffdetermines that the overall project-required accuracy/bias is not achieved and project data are not usable to support project decision making, then the officer will notify, in writing, the NTS and CE Project Managers. The two Project Managers will assess the impact of the inaccurate/biased data to the overall goals of the project. The Project Managers will address how this problem will be resolved and discuss the potential need for re-sampling. The QA Officer's determinations and the Project Managers' resolution will be discussed in the Data Assessment section of the Phase II Report.

c. Sample Representativeness

The Data Assessment section of the Phase II Report will Discuss sampling SOPs, Split Sampling and Analysis Audits, and QC check and sample data to assess sample representativeness. If field duplicate precision checks indicate potential spatial variability, then this may trigger additional scoping meetings and subsequent re-sampling in order to collect data that are more representative of a non-homogeneous matrix.

The Data Assessment section will discuss and compare overall representativeness for each matrix, parameter and concentration level. Data Assessment will describe the limitations on the use of project data when overall non-representative sampling has occurred or when non-representative sampling is limited to a specific sampling group, data set, matrix, analytical parameter or concentration level.

d. Sensitivity and Quantitation Limits

The NTS and subcontract laboratory QA/QC Manuals in Appendix H contain methods and procedures for determination of Method Detection Limits (MDL) and Reporting Limits (RL). If Data verification/usability reports indicate that sensitivity and/or RLs were not achieved, then the impact of that lack of sensitivity and/or higher RLs on data usability will be discussed in the Data Assessment section of the Phase II Report.

The Data Assessment section will discuss and compare overall sensitivity and RLs from multiple data sets collected for the project for each matrix, analytical parameter and concentration level. Data Assessment will also describe the limitations on the use of the project data if project-required sensitivity and RLs were not achieved for all project data or when it is limited to a specific sampling or laboratory / analytical group, data set, matrix, analytical parameter or concentration level.

If project-required RLs are not achieved and project data are not usable to adequately address the Decision Process (eg., RL greater than the Tier-1 SRV) the Data Assessment will address how this problem will be resolved and discuss the potential need for re-sampling. In this case, the Data Assessment will clearly differentiate between usable and unusable data for the data users.

e. Completeness

Completeness is a percentage of the number of valid measurements collected for each matrix, analytical parameter, and concentration level and is calculated by the following equation:

$$\%C = 100*(V/n)$$

where %C is the percent completeness, V is the number of valid measurements, and n is the total number of measurements.

The Data Assessment will discuss and compare overall completeness of multiple data sets collected for the project for each matrix, analytical parameter and concentration level. If particular data sets are more critical than others in decision making the Data Assessment will highlight them.

If project required completeness is not achieved and sufficient data are not available to adequately address the Decision Process then the Data Assessment will address how this problem will be resolved and discuss the potential need for additional re-sampling.

f. Comparability

Overall Comparability:

The Data Assessment will discuss and compare overall comparability between multiple data sets collected for the project for each matrix, analytical parameter and concentration level. The Data Assessment section of the Phase II Report will describe limitations on the use of data when required comparability is not achieved for the overall project or when it is limited to a specific sampling or laboratory/analytical group, data set, matrix, analytical parameter or concentration level.

If screen/confirmatory comparability criteria are not met, then this should be documented in the Data Assessment section and the effect on data usability should be discussed. If oversight split sampling comparability criteria are not met, then this should be documented in the Data Assessment section and the effect on data usability should be discussed. If data are not usable to adequately address environmental questions and/or support project decision making, then the Data Assessment section of the Phase II Report should address how this problem will be resolved and discuss the potential need for re-sampling.

Finally, if long-term monitoring data are not comparable, then the Data Assessment section of the Phase II Report should address whether the data indicate a changing environment or the anomalies are a result of sampling and/or analytical error. If data are not usable to adequately address environmental questions and/or support project decision making, the Data Assessment section should address how this problem will be resolved and discuss the potential need for re-sampling.

APPENDIX A

ACRONYMS

ACRONYMS

AOC	Area of Concern
AST	Aboveground Storage Tank
ASTM	American Society of Testing Materials
CE	Cliffs Erie LLC
CLP	Contract Laboratory Program
COC	Chain of Custody
COPC	Chemical of Potential Concern
DCQAP	Data Collection Quality Assurance Plan
DMP	Data Management Plan
DQO	Data Quality Objective
EPA	United States Environmental Protection Agency
ESA	Environmental Site Assessment
FPH	Free Phase Hydrocarbon
GC	Gas Chromatograph
HASP	Health & Safety Plan
mg	Milligram
mL	Milliliter
MPCA	Minnesota Pollution Control Agency
MVTL	Minnesota Valley Testing Laboratory, Inc.
NFA	No Further Action
NGVD	National Geodetic Vertical Datum
NIOSH	National Institute for Occupational Safety and Health
NTS	Northeast Technical Services, Inc.
NTSL	Northeast Technical Services, Inc. Laboratory
O&M	Operation and Maintenance
OSHA	Occupational Safety and Health Administration
PID	Photo-ionization detector
ppb	Parts per billion
ppm	Parts per million
QA/QC	Quality Assurance / Quality Control
QAPP	Quality Assurance Project Plan
QC	Quality Control
RAP	Response Action Plan
REC	Recognized environmental condition
RFI	RCRA Facility Investigation
SAP	Sampling Analysis Plan
SLV	Soil Leaching Value
SOP	Standard Operating Procedure
SRV	Soil Reference Value
SVOC	Semi-volatile Organic Compound
UST	Underground Storage Tank

ACRONYMS (continued)

VES	Vapor Extraction System
VIC	Agency Voluntary Investigation and Cleanup
VOA	Volatile Organic Analysis
VOC	Volatile Organic Compound
VRU	Vapor Recovery Unit
VSI	Visual Site Inspection

APPENDIX B

VIC AREAS OF CONCERN

APPENDIX C
RESUMES

Mr. Richard H. Crum, P.G.
Mr. Dennis L. Schubbe, P.G.

APPENDIX D

TABLES

APPENDIX E

SAMPLE CONTAINER QA DOCUMENTS

ESS Precleaned Certified Certificate of Compliance
En Core Sampler Certificate of Analysis

APPENDIX F

STANDARD OPERATING PROCEDURES

SOP for Chain-of-Custody
SOP for Decontamination of Sampling Equipment
SOP for Field Screening Soil Samples
SOP for Filtering of Groundwater and Surface Water Samples
SOP for PID Operation
SOP for Collection of Soil Samples for Laboratory Analyses
SOP for Investigative Waste Disposal
Surface and Groundwater Field Sampling Protocol

APPENDIX G

NTS MOBILE LABORATORY QA/QC MANUAL

APPENDIX H

LABORATORY QA/QC MANUALS

NTS Laboratory QA/QC Manual
MVTL QA/QC Manual
NTSL Laboratory SOPs
MVTL Laboratory SOPs

APPENDIX I

BLANK FORMS

NTS Geoprobe Log
Sample Bottle Labels
Chain-of-Custody Form
NTS Peer Review Tracking Form
NTS Field Report
NTS Routine Laboratory Report Checklist

APPENDIX J

STATE CLEANUP LEVELS

MPCA Summary of Tier 1Soil Reference Value Information

APPENDIX K

MPCA AQUIFER STATISTICS TABLES

MPCA Descriptive Statistics for the Biwabik Iron Formation

APPENDIX L

LABORATORY DATA CHECKLIST

Attachment C

ACM Specification Estimate

Attachment C1

NorthMet Project Closure Abatement Specification (Structures Only)

POLYMET
MINING

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NorthMet Project

Closure Abatement Specification (Structures Only)

June 23, 2016
Revision 2

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Attachments

Figures:

Figure 1 Building Locations (Overview)
Figure 1 A Process Plant Detail

Plant Site Drawing Index and Package

Plant Site Asbestos and Lead Survey Reports

1.0 Background

PolyMet Mining Corporation (PolyMet) is a publicly traded mine development company with operational headquarters near the Company's mine in Hoyt Lakes, Minnesota, and executive offices in St. Paul, Minnesota. PolyMet is developing a copper-nickel-precious metals project in the established mining district of the Mesabi Iron Range in northeastern Minnesota. PolyMet controls 100% of the NorthMet ore deposit and owns a large crushing and grinding facility with extensive associated infrastructure, where it plans to process copper, nickel, gold, and platinum group metal ores from the NorthMet mine. The NorthMet Project (Project) would become the first non-ferrous ore mining operation in Minnesota. Shares are traded on the New York Stock Exchange (NYSE-A: PLM) and Toronto Stock Exchange (TSX: POM).

PolyMet is progressing with a two phased design, construction, and production plan. Phase I involves construction of the mine and related facilities, reconditioning and upgrading of the existing plant, construction of a flotation plant, and construction of a rail load-out facility for production of a dual filter cake. Products produced after Phase I construction include a copper rich concentrate and a nickel rich concentrate also holding platinum group metals.

Phase II includes the design, construction, and commissioning of a new hydrometallurgical facility and oxygen plant. Once completed, PolyMet will produce a combination of copper filter cake, nickel filter cake, nickel/cobalt hydroxide and gold/ platinum group precipitate.

PolyMet designed its facility to maximize the reuse of the LTV Steel Mining Company's Erie Plant brownfield site and existing infrastructure.

2.0 Introduction

PolyMet is in the permitting process. As part of the Minnesota Department of Natural Resources' (MDNR) Permit to Mine, PolyMet will be required to provide adequate financial assurance to the State of Minnesota for proper closure of the Project. The planned closure of the Project is 20 years after startup, however, a condition of the Permit to Mine requires that the possibility of early closure is taken into account. The Permit to Mine will require the closure plans and the instrument of financial assurance to be updated annually. The updated closure plans and instrument of financial are submitted to the MDNR for review and acceptance that the financial assurance is sufficient to meet the existing obligations of closure and remediation.

At the time that the Permit to Mine is issued, PolyMet will have entered into a financial assurance agreement with the MDNR and provided the financial instrument that will guarantee payment for the closure of the project.

PolyMet is seeking to partner with a reputable abatement company (Contractor). The desired business arrangement is for the Contractor to provide closure estimates each year for the structural and equipment demolition work described within this specification. PolyMet would then enter into a yearly contract (the Closure Contract) with the Contractor for the performance of the work. In the event of closure of the Project, the Contractor will execute the Contract, payment of which is guaranteed by the financial instrument provided by PolyMet.

There will be salvage, demolition work, and asbestos removal required during the pre-construction and construction phase of the Project. This work is identified in the specification. Additionally there will be salvage and asbestos removal required during normal plant operations.

PolyMet intends to enter into a contract for the asbestos removal to be carried out in the Pre-Construction and Construction phases of the projects and to make a good faith effort toward establishing a long term relationship with the Contractor for on-going asbestos abatement requirements.

3.0 Request for Proposal

PolyMet is requesting a proposal for asbestos abatement from buildings associated with the Project as described herein. Abatement work in all of the other buildings, structures, and tunnels at the PolyMet NorthMet site are part of a separate abatement and demolition scope of work.

This document presents the specification for asbestos abatement from structures and equipment components of the Project as described in in Sections 8.1.1 through 8.1.14.

Notes:

- The planned closure of the Project is 20 years after startup. However, an unforeseen closure could occur anytime. PolyMet does realize that bidding many years into the future may not be a normal activity for Contractors. Please advise PolyMet in the form of a quotation for costs that would need to reimbursed (if any) in the creation of the proposal requested in this specification (i.e. estimator's time, etc.). The proposal will be considered and a separate purchase order may be issued if warranted.

- There will be demolition work and asbestos removal required during the Project, salvage and asbestos removal required during normal plant operations and possible pre-project salvage and asbestos removal associated with cleanup work required for plant health/safety. PolyMet intends to make a good faith effort toward establishing a long term relationship with the Contractor for on-going salvage, asbestos abatement, project demolition, and closure requirements.

4.0 Specification Support Documents

This specification includes:

- This specification document
- Figures 1 and 1A referenced in specification
- Plant Site drawing package per drawing index
- Plant Site asbestos and lead survey reports

5.0 Proposal Requirements

The demolition estimates shall include the following as a minimum:

- Asbestos remediation cost estimate by facility listed in Section 8.
- List of assumptions from which the proposal is based. Wherever possible describe any engineering concepts or assumptions from which the proposal is based (i.e. concrete will be placed in crusher basement, siding will be placed in landfill, etc.)
- List of exceptions to requests in the proposal including reason for exception.
- Biography of Contractor including any relevant experience in relation to the Contract.
- Experience working with Governmental Agencies (i.e. MDNR, MPCA, EPA) and Owner's agents to fulfill structure and equipment demolition obligations.
- An outline describing the major aspects of the Contractor's Safety Program shall be supplied.
- A performance bond may be required with yearly Contract. Provide information regarding any bonding capability, an indication of willingness to bond, and costs associated with bonding that would be passed on to PolyMet.
- Indicate anticipated yearly costs to provide an update to the estimate and Contract renewal for an additional one year. Note that these costs may be negotiated as we move forward and gain more understanding. However, an indication of costs is needed for internal use at PolyMet.

6.0 Contract Objective

The objective of the Contract is to place the facilities listed in Section 8 in a safe, secure, environmentally stable condition. In general, all environmental concerns will be evaluated, and all environmental hazards will be remediated to prepare the buildings for final demolition.

7.0 General Demolition Requirements

The following are general demolition requirements for the Contractor:

- Asbestos must be removed. The asbestos shall be disposed of at an off-site landfill approved by the U.S. Environmental Protection Agency which is operated in accordance with 40 CFR Section 61.154. If the landfill is operated in the state of Minnesota, ensure it is a MPCA approved solid waste facility permitted to accept the waste.
- The Contractor is responsible to obtain permits and submit all reports required by the state and federal agencies.
- Contractor shall plan to supply electricity from the Main Substation, water, offices, sanitary facilities, etc. as these items may not be available at the work site.
- MSHA requirements must be met while PolyMet is in operation. At closure PolyMet's plant site will be under the jurisdiction of OSHA.
- Contractor will control, clean up and dispose of all environmental releases as no releases of soils, waters, or liquids will leave the work site area.
- Services and utilities will be severed by others prior to commencement of demolition work.
- Demolition will require a General NPDES Construction Permit.
- Contractor shall provide PolyMet or MDNR with copies of all reports and permits that are required.

Notes:

- An asbestos and lead paint inventory has been performed for the Plant Site. The asbestos reports are provided as an attachment to this specification.

- PCB containing or contaminated items have been inventoried and removed from the PolyMet site. It is anticipated that no new PCB containing devices will be brought on site.

8.0 End of Year One Demolition Plan

Within three (3) years after closure begins, all buildings and structures will be removed and foundations razed to grade level. Provisions may be made for continued subsequent use of mine facilities that will have future benefits to the area including, pipelines, transmission lines, roads, and railroad lines. However, for the purposes of this document it shall be assumed that all of the PolyMet facilities must be removed and the facility footprints reclaimed.

All facilities listed in Sections 8.1.1 to 8.1.14 will be demolished over a maximum period of three years.

For building, area or equipment locations listed as headings in the following sections for the plants reference Figures 1 and 1A for details.

8.1 Existing Facilities

8.1.1 Area 1 Buildings

Area 1 shop buildings were and will be used for maintenance and repair of the mining equipment. Area 1 includes the following buildings; Shop and Truck Storage (220), Cold Storage (221), Boiler House (226), Fire Pump House (228), Reporting Building (231).

1. Remove and properly dispose all existing Category II Asbestos-Containing Materials identified in *Table II – Asbestos-Containing Materials Identification List* from Arrowhead Consulting & Testing Inc. Asbestos-Containing Materials Inspection Report, Zone H, Area 1 Truck Shop, dated October 2007 and identified during site visit and field inspection on May 12, 2016. **Note: ALL “Assumed” ACM will be treated as Category II Asbestos-Containing Material.**

Reference drawings for the Area 1 buildings include:

TE-8-142	Maintenance & Repair Shop Area 1 Phase 1 Fire Protection – Fire Pump & Tank
TE-8-310	Area 1 Shop Area Yard Piping System
TE-8-017	Sprinkler System for Traffic Control Center

TE-8-149 Maintenance & Repair Shop Area 1 Phase 2
Floor Plans-Existing Building

8.1.2 Area 2 Buildings

Area 2 buildings were and will be used for maintenance, mining employee reporting, and storage. Area 2 includes the following buildings; Service Shop (201), Truck Storage (202), Locomotive Service Shop (203), Cold Storage (204), Sample House (208), Hose House (209), Reporting Building (425), and Locomotive Fueling Building.

1. Remove and properly dispose all existing Category II Asbestos-Containing Materials identified in *Table II – Asbestos-Containing Materials Identification List* from Arrowhead Consulting & Testing Inc. Asbestos-Containing Materials Inspection Report, Zone I, dated June 2006. **Note: ALL "Assumed" ACM will be treated as Category II Asbestos-Containing Material.**

Reference drawings for the Area 2 buildings include:

MA-50-3	Service Area – East Pits Area Map
TE-8-008	General Revisions East Pit Service Shop
TE-8-014	Revised Shop Floor Plan East Pit Shops Bldg

8.1.3 General Shops

The General Shops, building number 601, were and will be used for maintenance and repair of the rail fleet as well as electrical equipment repairs, welding and fabrication, and other miscellaneous repairs. The General Shops buildings include the Welding Shop, Structural Shop, Locomotive Shop, Electric Shop, Machine Shop, Tool Room, and several offices and a locker room. The Acetylene Building, number 604 is considered to be part of the General Shops.

1. Remove and properly dispose all existing Category II Asbestos-Containing Materials identified in *Table II – Asbestos-Containing Materials Identification List* from Arrowhead Consulting & Testing Inc. Asbestos-Containing Materials Inspection Report, Zone A, dated May 2006. **Note: ALL "Assumed" ACM will be treated as Category II Asbestos-Containing Material.**

Reference drawings for the General Shops include:

TE-1	General Shops General Arrangement Plan
TE-50	General Shops Structural Steel Mezz. Framing Plans & Sections
TE-51	General Shops Architectural Elevations

8.1.4 Rebuild Shop

The Rebuild Shop, building number 602, was used for light fleet maintenance and is used for drill core storage and cutting.

1. Remove and properly dispose all existing Category II Asbestos-Containing Materials identified in *Table II – Asbestos-Containing Materials Identification List* from Arrowhead Consulting & Testing Inc. Asbestos-Containing Materials Inspection Report, Zone A, dated May 2006. **Note: ALL "Assumed" ACM will be treated as Category II Asbestos-Containing Material.**

Reference drawings for the Rebuild Shop include:

TE-267	Garage Building Structural Steel & Concrete Reinf. Warehouse Mezzanine and the Battery Storage Decks
TE-270	Garage Concrete Masonry Building Foundations
TE-271	Garage Concrete Masonry Building Foundations
TE-281	Garage Architectural Floor Plan and Section
TE-282	Garage Architectural Elevations
TE-284	Garage Architectural Door Schedule & Misc. Details

8.1.5 Lube House

The Lube House, building number 926, was and will be used as storage space for lubricants and paints.

1. Remove and properly dispose all existing Category II Asbestos-Containing Materials identified in *Table II – Asbestos-Containing Materials Identification List* from Arrowhead Consulting & Testing Inc. Asbestos-Containing Materials

Inspection Report, Lubricant Storage Building, dated July 28, 2008. **Note: ALL "Assumed" ACM will be treated as Category II Asbestos-Containing Material.**

Reference drawings for the Lube House include:

TE-316	Lubricating Oil & Paint Storage Structural Steel Plan & Details
TE-317	Lubricating Oil & Paint Storage Structural Steel Elevations & Details
TE-318	Lubricating Oil & Paint Storage Concrete Masonry Foundation Plan & Sects.
TE-319	Lubricating Oil & Paint Storage Concrete Masonry Section & Details
TE-320	Lubricating Oil & Paint Storage Concrete Reinforcing Foundation Plan Section & Details
TE-321	Lubricating Oil & Paint Storage Concrete Reinforcing Section & Details
TE-322	Lubricating Oil & Paint Storage Concrete Reinforcing Section & Details

8.1.6 Rubber Shop

The Rubber Shop, building number 605, was originally called the Untanking Tower and Emergency Diesel Generating Plant, both of those sections still exist in the building in addition to the rubber shop.

1. Remove and properly dispose all existing Category II Asbestos-Containing Materials identified in *Table II – Asbestos-Containing Materials Identification List* from Arrowhead Consulting & Testing Inc. Asbestos-Containing Materials Inspection Report, Rubber Storage Building, dated July 28, 2008. **Note: ALL "Assumed" ACM will be treated as Category II Asbestos-Containing Material.**

Reference drawings for the Rubber Shop include:

TD-680	Emergency Diesel Generating Plant General Arrangement Sections
TD-679	Emergency Diesel Generating Plant General Arrangement Plan
TD-698	Transformer Untanking Tower Diesel Generating Plant Structural Steel Plans & Details

TD-699	Transformer Untanking Tower Diesel Generating Plant Structural Steel Elevations & Details
TD-700	Transformer Untanking Tower Diesel Generating Plant Structural Steel Elevations & Details
TD-701	Transformer Untanking Tower Diesel Generating Plant Structural Steel Elevations & Details

8.1.7 Colby Lake Pump House

The Colby Lake Pump House is located approximately 5 miles from the plant site and supplied and will supply fresh water from Colby Lake to the plant site via a 36" diameter steel buried pipeline.

1. Remove and properly dispose all existing assumed Asbestos-Containing Materials identified during site visit and field inspection on May 12, 2016. **Note: ALL "Assumed" ACM will be treated as Category II Asbestos-Containing Material.**

Reference drawings for the Colby Lake Pumphouse include:

TG-18	Partridge Lake Pumping Station Plan and Pipe Line Profile Pipe Line from Pump Station to Reservoir
TG-19	Partridge Lake Pumping Station 36" Pipe Line to Plant Reservoir Details & B/M
TG-20	Partridge Lake Pumping Station 36" Pipe Line to Plant Reservoir Plan and Profile
TG-21	Partridge Lake Pumping Station 36" Pipe Line to Plant Reservoir Plan and Profile
TG-22	Partridge Lake Pumping Station 36" Pipe Line to Plant Reservoir Plan and Profile
TG-23	Partridge Lake Pumping Station 36" Pipe Line to Plant Reservoir Plan and Profile
TG-24	Partridge Lake Pumping Station 36" Pipe Line to Plant Reservoir Plan and Profile

8.1.8 Warehouse 45 Electrical

The electrical warehouse, building number 921, acts as cold storage space.

1. Remove and properly dispose all existing Category II Asbestos-Containing Materials identified in *Table II – Asbestos-Containing Materials Identification List* from Arrowhead Consulting & Testing Inc. Asbestos-Containing Materials Inspection Report, Zone A, dated May 2006. **Note: ALL "Assumed" ACM will be treated as Category II Asbestos-Containing Material.**

Reference drawings for the electrical warehouse include:

TE-116	Warehouse General Plan
TE-117	Warehouse Elevations
TE-118	Warehouse Wall Sections
TE-5-067	Warehouse Office Edition
TE-5-069	Training Room Partitions Warehouse #1 – Office Area

8.1.9 Warehouse 49

Warehouse 49, building number 920, acts as cold storage space.

1. Remove and properly dispose all existing Category II Asbestos-Containing Materials identified in *Table II – Asbestos-Containing Materials Identification List* from Arrowhead Consulting & Testing Inc. Asbestos-Containing Materials Inspection Report, Zone A, dated May 2006. **Note: ALL "Assumed" ACM will be treated as Category II Asbestos-Containing Material.**

Reference drawings for the Warehouse 49 include:

TE-5-011	Erection Drawing Cold Storage Warehouse
TE-5-012	Exterior Sheeting & Flashing Detail Cold Storage Warehouse

8.1.10 Administration Building

The Administration Building houses the site administrative offices.

1. Remove and properly dispose all existing Category I and II Asbestos-Containing Materials identified in *Table II – Asbestos-Containing Materials Identification List* from Arrowhead Consulting & Testing Inc. Asbestos-Containing Materials Inspection Report, Administration Building, dated December 2008. **Note: ALL "Assumed" ACM will be treated as Category II Asbestos-Containing Material.**

Reference drawings for the Administration Building include:

TE-6-282	Elevations
TE-6-283	Building Sections
TE-6-279	Site Plan
TE-6-052	Ground Floor Plan
TE-6-053	First Floor Plan Interior Wall Elevations
TE-6-054	Second Floor Plan Room Finish Schedule
TE-6-062	Foundation Plan & Details
TE-6-264	Administration Building Second Floor Plan Rev

8.1.11 Main Gate (Gatehouse)

The Main Gate consists of a Gatehouse. The Gatehouse is used to provide shelter for site security personnel.

1. Remove and properly dispose all existing assumed Asbestos-Containing Materials identified during site visit and field inspection on May 12, 2016. **Note: ALL "Assumed" ACM will be treated as Category II Asbestos-Containing Material.**

Reference Drawings for the Main Gate include:

TE-6-001	Entrance Road Guard House Plans, Elev. & Det.
TH-1-050	Main Gate Gasoline Refueling & Storage Facility General Arrangement
TH-1-051	Main Gate Gas Station Details

	Piping Details
TH-1-1017	Main Gate Gasoline Dispensing Station Electrical Layout and Schematic

8.1.12 Sewage Treatment Plant

The Sewage Treatment Plant was used to treat sewage at the plant site.

1. Remove and properly dispose all existing assumed Asbestos-Containing Materials identified during site visit and field inspection on May 12, 2016. **Note: ALL "Assumed" ACM will be treated as Category II Asbestos-Containing Material.**

Reference Drawings for Sewage Treatment Plant include:

TL-2-006	Sewage Treatment Plant Location & Plat Plan
TL-2-008	Sewage Treatment Plant Plan of Primary Clarifier & Right & Left Side Elevations
TL-2-009	Sewage Plant Sections
TL-2-010	Sewage Treatment Plant Details
TL-2-011	Sewage Treatment Plant Isometric Piping & Details
TL-2-012	Sewage Treatment Plant Details
TL-2-013	Sewage Treatment Plant Steel Section and Floor Plans
TL-2-014	Sewage Treatment Plant Steel Sections
TL-2-015	Sewage Treatment Plant Electrical Plan

8.1.13 Water Treatment Plant

The Water Treatment Plant was used to treat raw water for potable water at the plant site.

1. Remove and properly dispose all existing Category II Asbestos-Containing Materials identified in *Table II – Asbestos-Containing Materials Identification List* from Arrowhead Consulting & Testing Inc. Asbestos-Containing Materials Inspection Report, Water Treatment Plant & Associated Buildings, dated July 2008.

Note: ALL "Assumed" ACM will be treated as Category II Asbestos-Containing Material.

The reference drawings for the Water Treatment Plant include:

TG-6-020	Location Map & Title Page
TG-6-021	Site and Foundation Plan
TG-6-022	Floor Plans
TG-6-023	Roof Plan
TG-6-024	Sections
TG-6-025	Elevations
TG-6-026	Details
TG-6-031	Piping and Equipment Plans and Details

8.1.14 Tailings Basin Buildings

The Tailings Basin buildings are located near the southeast corner of Cell 2W and were and will be used for storage, offices, oil dispensing, and locker rooms. They include the following buildings; Foreman's Office (718), Reporting Building (719), Lube House (720), Reporting Building (724), and Lube Oil Building (725).

1. Remove and properly dispose all existing assumed Asbestos-Containing Materials identified during site visit and field inspection on May 17, 2016. **Note: ALL "Assumed" ACM will be treated as Category II Asbestos-Containing Material.**

There are no reference drawings for the Tailings Basin Buildings.

9.0 Special Material Disposal

Surveys for Asbestos-Containing Materials (ACMs) have been completed. ACMs (siding, hot water heating system insulation, lube system insulation, floor tile, etc.) from structure demolition will be removed, properly packaged and disposed in an off-site landfill approved by the U.S. Environmental Protection Agency which is operated in accordance with 40 CFR Section 61.154. If the landfill is operated in the state of Minnesota, ensure it is a MPCA approved solid waste facility permitted to accept the waste.

Attachment C2

Mavo ACM Estimate

SOW I.D.	Description	Est. Man-hours Labor	Operator	IW	Painters	Asbestos	Electrician	Est. Labor Cost	Est. Asbestos Volume (Cu. Yards)	Est. recovered Copper Lbs.
a.	**Coarse Crusher**									
1	Below the ground level elevation of 1710', remove **all** existing HTHW pipelines with damaged or deteriorated insulation and all insulation fragments.					1478		124,817		
2	Below the ground level elevation of 1710', remove all equipment lubrication lines with damaged or deteriorated insulation and all insulation fragments.					1469		124,057		
3	Below the ground level elevation of 1710', remove any loose or fallen paint chips.					80		6,756		
4	Above the ground elevation of 1710', remove all lubrication lines with damaged or deteriorated insulation and all insulation fragments. Remove the insulation on the lubrication holding tanks.					**730**		61,649		
5	In the electrical control room, remove all existing electric cable fireproofing wrap and all fragments of fireproofing wrap.					170		14,357		
6	In the electrical control room basement, remove all existing electric cable fireproofing wrap and all fragments of fireproofing wrap.					250		21,113		
7	Clean the Coarse Crusher building of all extraneous debris and taconite fines.	2564						204,248		
8	Kill and clean mold from all Coarse Crusher building surfaces.	80						6,373		
9	Install protective railings around floor openings on apron feeder floor. Reestablish the north conveyor gallery exit by replacing all structurally compromised stair treads.	200						15,932		
	Sub-totals	2844	0	0	0	4177	0	579,301	320	0
b.	**Conveyor 1A\1B tunnel & Drive house 1** (556 ft.)									
1	Remove approximately **1200'** of existing HTHW pipelines with damaged or deteriorated insulation and all fragments of insulation in 1A and 1 B tunnel.					418		35,300		
2	Abate any loose or fallen paint chips.					80		6,756		
3	Clean tunnel and Drive House walkways and stairs of extraneous debris and taconite fines.	1283						102,204		
4	Kill and clean mold from all tunnel and Drive House No. 1 building surfaces.	120						9,559		
5	In Drive House #1, remove approximately 120' of existing HTHW pipelines with damaged or deteriorated insulation and all fragments of insulation between 1A and 1B tunnel and S -3 tunnel. Patch remaining partially deteriorated HTHW pipeline insulation.					76		6,418		
	Subtotal	1403	0	0	0	574	0	160,237	0	0
	Totals	**4247**	**0**	**0**	**0**	**4751**	**0**	**$739,538**	**320**	**0**

Supervision & Field Administration	Man-hours est.	950	Est. Cost	$92,530.00
Craft support (Carpenters, teamster, Misc operator, Misc labor)	Man-hours est.		Est. Cost	
Estimated Equipment Costs (itemize)			Est. Cost	$132,900.00
Estimated Material Costs (Itemize)			Est. Cost	$5,000.00
Estimated Misc. Costs (Itemize)			Est. Cost	$100,650.00
			Total Estimated Cost	$1,070,618

SOW I.D.	Description	Est. Man-hours						Est. Labor Cost	Est. Asbestos Volume (Cu. Yards)	Est. recovered Copper Lbs.
		Labor	Operator	IW	Painters	Asbestos	Electrician			
c.	**Fine Crusher**									
1	Remove **all** existing HTHW pipelines with damaged or deteriorated insulation from the 4A/4B conveyor tunnel up to elevation 1794' on the north side of column 5. This insulation has tested positive for asbestos or probable ACM					496		41,887		
2	Remove all equipment lubrication lines damaged or deteriorated insulation and all insulation fragments from the 4A/4B conveyor tunnel up to the lube tanks at elevation 1817'-9" on the north side of column row 5. This insulation has tested positive for asbestos or probable ACM					901		76,089		
3	Remove any loose or fallen paint chips below the ground level elevation 1710'. The paint chips have tested positive for lead based material.					80		6,756		
4	Clean the Fine Crusher building of all extraneous debris and taconite fines.	987						78,624		
5	Kill and clean mold from Fine Crusher building surfaces.	80						6,373		
6										
	Sub-totals	1067	0	0	0	1477	0	209,730	0	0
f.	**Conveyors 4A\4B tunnel & Drive House No. 2** (120 ft. long)									
1	Remove approximately 275' of existing HTHW pipelines with damaged or deteriorated insulation and all fragments of insulation in 4A and 4B tunnel. The insulation has tested positive for asbestos or probable ACM.					139		11,739		
2	Abate any loose or fallen paint chips. The paint chips have tested positive for lead based material.					80		6,756		
3	Clean tunnel and Drive house walkways and stairs of extraneous debris and taconite fines.	607						48,354		
4	Kill and clean mold from all conveyor and Drive House No. 2 surfaces	80						6,373		
5	Remove approximately 120' of existing HTHW pipelines with damaged or deteriorated insulation and all fragments of insulation in Drive House No. 2. The insulation has tested positive for asbestos or probable ACM.					88		7,432		
	Sub-totals	687	0	0	0	307	0	80,653	0	0
	Totals	**1754**	**0**	**0**	**0**	**1784**	**0**	**$290,382**	**0**	**0**

Supervision & Field Administration	Man-hours est.	441	Est. Cost	42,953
Craft support (Carpenters, teamster, Misc operator, Misc labor)	Man-hours est.		Est. Cost	
Estimated Equipment Costs (itemize)			Est. Cost	$5,000.00
Estimated Material Costs (Itemize)			Est. Cost	$41,000.00
Estimated Misc. Costs (Itemize)			Est. Cost	$60,350.00
			Total Estimated Cost	$439,686

SOW I.D.	Description	Est. Man-hours						Est. Labor Cost	Est. Asbestos Volume (Cu. Yards)
		Labor	Operator	IW	Painters	Asbestos	Electrician		
d	**Service Tunnels**								
d-i.	**Service Tunnel S-1** (20X10X440)								
1	Remove approximately 915' of existing HTHW pipelines with damaged or deteriorated insulation and all fragments of insulation.					234		19,761	
2	Abate any loose or fallen paint chips.					44		3,716	
3	Clean tunnel walkways of extraneous debris and taconite fines.					488		41,212	
4	Kill and clean mold from all tunnel surfaces.					30		2,534	
	Sub-total	0	0	0	0	796	0	67,222	51
d-ii	**Service Tunnel S-2** (20X10X530)								
1	Remove approximately 1,100' of existing HTHW pipelines with damaged or deteriorated insulation and all fragments of insulation.					341		28,797	
2	Abate any loose or fallen paint chips. The paint chips have tested positive for lead based material.					53		4,476	
3	Clean tunnel walkways of extraneous debris and taconite fines.					525		44,336	
4	Kill and clean mold from all tunnel surfaces.					27		2,280	
	Sub-total	0	0	0	0	946	0	79,890	61
d-iii	**Service Tunnel S-3** (9X9X67)								
1	Remove approximately 165' of existing HTHW pipelines with damaged or deteriorated insulation and all fragments of insulation.					58		4,898	
2	Abate any loose or fallen paint chips.					6		507	
3	Clean tunnel walkways of extraneous debris and taconite fines.					14		1,182	
4	Kill and clean mold from all tunnel surfaces.					4		338	
	Sub-total	0	0	0	0	82	0	6,925	7
d-iv	**Service Tunnel S-4** (10X10X372)								
1	Remove approximately 800' of existing HTHW pipelines with damaged or deteriorated insulation and all fragments of insulation.					198		16,721	
2	Abate any loose or fallen paint chips.					37		3,125	
3	Clean tunnel walkways of extraneous debris and taconite fines.					89		7,516	
4	Kill and clean mold from all tunnel surfaces.					22		1,858	
	Sub-total	0	0	0	0	346	0	29,220	34
d-v.	**Service Tunnel S-5** (7X8X31)								
1	Remove approximately 65' of existing HTHW pipelines with damaged or deteriorated insulation and all fragments of insulation.					41		3,462	
2	Abate any loose or fallen paint chips.					8		676	
3	Clean tunnel walkways of extraneous debris and taconite fines.					6		507	
4	Kill and clean mold from all tunnel surfaces.					4		338	
	Sub-total	0	0	0	0	59	0	4,983	3
d-vi.	**Service Tunnel S-6** (8X9X31)								
1	Remove approximately 70' of existing HTHW pipelines with damaged or deteriorated insulation and all fragments of insulation.					49		4,138	
2	Abate any loose or fallen paint chips.					6		507	
3	Clean tunnel walkways of extraneous debris and taconite fines.					3		253	
4	Kill and clean mold from all tunnel surfaces.					2		169	
	Sub-total	0	0	0	0	60	0	5,067	3
d-vii.	**Service Tunnel S-7** (7X8X659)								
1	Remove approximately 1300' of existing HTHW pipelines with damaged or deteriorated insulation and all fragments of insulation.					438		36,989	
2	Abate any loose or fallen paint chips.					65		5,489	
3	Clean tunnel walkways of extraneous debris and taconite fines.					165		13,934	
4	Kill and clean mold from all tunnel surfaces.					36		3,040	
	Sub-total	0	0	0	0	704	0	59,453	53
d-viii.	**Service Tunnel S-8** (7X8X30)								
1	Remove approximately 100' of existing HTHW pipelines with damaged or deteriorated insulation and all fragments of insulation.					48		4,054	
2	Abate any loose or fallen paint chips.					6		507	
3	Clean tunnel walkways of extraneous debris and taconite fines.					6		507	
4	Kill and clean mold from all tunnel surfaces.					4		338	
	Sub-total	0	0	0	0	64	0	5,405	4
d-ix.	**Service Tunnel S-9** (6-6X7-6X350)								
1	Remove approximately 750' of existing HTHW pipelines with damaged or deteriorated insulation and all fragments of insulation.					226		19,086	
2	Abate any loose or fallen paint chips.					42		3,547	
3	Clean tunnel walkways of extraneous debris and taconite fines.					50		4,223	
4	Kill and clean mold from all tunnel surfaces.					18		1,520	
	Sub-total	0	0	0	0	336	0	28,375	30
d-x.	**Service Tunnel S-10** (6X5X65)								
1	Remove approximately 150' of existing HTHW pipelines with damaged or deteriorated insulation and all fragments of insulation.					52		4,391	
2	Abate any loose or fallen paint chips.					10		845	
3	Clean tunnel walkways of extraneous debris and taconite fines.					9		760	
4	Kill and clean mold from all tunnel surfaces.					4		338	
	Sub-total	0	0	0	0	75	0	6,334	6
d-xi.	**Service Tunnel S-11** (8X6X54)								
1	Remove approximately 135' of existing HTHW pipelines with damaged or deteriorated insulation and all fragments of insulation.					48		4,054	
2	Abate any loose or fallen paint chips.					16		1,351	
3	Clean tunnel walkways of extraneous debris and taconite fines.					6		507	
4	Kill and clean mold from all tunnel surfaces.					4		338	
	Sub-total	0	0	0	0	74	0	6,249	5
	Totals	**0**	**0**	**0**	**0**	**3542**	**0**	**299,122**	**257**

Supervision & Field Administration	Man-hours est.	553	Est. Cost	$53,862
Craft support (Carpenters, teamster, Misc operator, Misc labor)	Man-hours est.		Est. Cost	
Estimated Equipment Costs (itemize)			Est. Cost	$44,685.00
Estimated Material Costs (Itemize)			Est. Cost	$5,000.00
Estimated Misc. Costs (Itemize)			Est. Cost	$76,360.00
			Total Estimated Cost	$479,029

SOW I.D.	Description	Est. Man-hours						Est. Labor Cost	Est. Asbestos Volume (Cu. Yards)	Est. recovered Copper Lbs.
		Labor	Operator	IW	Painters	Asbestos	Electrician			
e.	**Electrical Tunnels**									
e-i.	**Electric Tunnel E-1N thru E-6N and E-1S thru E-4S** (7X8X268)									
1	Remove all existing electric cable fireproofing wrap and Transite conduit and all fragments of fireproofing wrap.					2109		178,105		
2	Remove all existing deteriorated electric cables.					782		66,040		
3	Remove extraneous debris and taconite dust in the tunnel.					302		25,504		
4	Kill and clean mold from all tunnel surfaces.					147		12,414		
5	Remove all taconite fines and reestablish the emergency egress hatches					224		18,917		
	Sub-total	0	0	0	0	3564	0	300,980	777	0
e-ii.	**Electric Tunnel E-7** (7X8X293)									
1	Remove all existing electric cable fireproofing wrap and Transite conduit and all fragments of fireproofing wrap.					424		35,807		
2	Remove all existing deteriorated electric cables.					147		12,414		
3	Remove extraneous debris and taconite dust in the tunnel.					24		2,027		
4	Kill and clean mold from all tunnel surfaces.					12		1,013		
	Sub-total	0	0	0	0	607	0	51,261	115	0
e-iii.	**Electric Tunnel E-8** (8 to 14 X 9-6 to 11 X 2756)									
1	Remove all existing electric cable fireproofing wrap and Transite conduit and all fragments of fireproofing wrap.					3125		263,906		
2	Remove all existing deteriorated electric cables.					1235		104,296		
3	Remove extraneous debris and taconite dust in the tunnel.					425		35,891		
4	Kill and clean mold from all tunnel surfaces.					211		17,819		
	Sub-total	0	0	0	0	4996	0	421,912	1008	0
e-iv.	**Electric Tunnel E-9** (5-6X6-9X248)									
1	Remove all existing electric cable fireproofing wrap and Transite conduit and all fragments of fireproofing wrap.					163		13,765		
2	Remove all existing deteriorated electric cables.					39		3,294		
3	Remove extraneous debris and taconite dust in the tunnel.					28		2,365		
4	Kill and clean mold from all tunnel surfaces.					15		1,267		
	Sub-total	0	0	0	0	245	0	20,690	86	0
e-v.	**Electric Tunnel E-10** (4-6X5-9X200)									
1	Remove all existing electric cable fireproofing wrap and Transite conduit and all fragments of fireproofing wrap.					151		12,752		
2	Remove all existing deteriorated electric cables.					38		3,209		
3	Remove extraneous debris and taconite dust in the tunnel.					28		2,365		
4	Kill and clean mold from all tunnel surfaces.					14		1,182		
	Sub-total	0	0	0	0	231	0	19,508	59	0
e-vi.	**Electric Tunnels E-11** (5-6X6-9X95), **E-12** (5X6-9X15 to 7-6X2-6X22), **E-13** (same as 12), **E-14** (7-6X2-6X22), **E-15** (same as 14), **West Service Tunnel, and East Service Tunnel** (both service tunnels (6X10X180)									
1	Remove all existing electric cable fireproofing wrap and Transite conduit and all fragments of fireproofing wrap.					374		31,584		
2	Remove all existing deteriorated electric cables.					102		8,614		
3	Remove extraneous debris and taconite dust in the tunnel.					74		6,249		
4	Kill and clean mold from all tunnel surfaces.					32		2,702		
	Sub-total	0	0	0	0	582	0	49,150	115	0
e-vii.	**Electric Tunnel E-16** (7X9-6X205)									
1	Remove extraneous debris and taconite dust in the tunnel.					80		6,756		
	Sub-total	0	0	0	0	80	0	6,756	0	0
	Concentrator									
6	In the North and South electrical control room basements, remove all existing ceiling tiles.					331		27,953		
7	In the North and South electrical control room basements, remove all existing electric cable fireproofing wrap and Transite conduit and all fragments of fireproofing wrap.					1433		121,017		
8	In the North and South electrical control room basements, remove all existing deteriorated electric cables					2143		180,976		
	Sub-total	0	0	0	0	3907	0	329,946	720	0
	Totals	**0**	**0**	**0**	**0**	**14212**	**0**	**1,200,203**	**2880**	**0**

Supervision & Field Administration	Man-hours est.	888	Est. Cost	86,491
Craft support (Carpenters, teamster, Misc operator, Misc labor)	Man-hours est.		Est. Cost	
Estimated Equipment Costs (itemize)			Est. Cost	210,100
Estimated Material Costs (Itemize)	**REPAIR BUDGET**		Est. Cost	15,000
Estimated Misc. Costs (Itemize)			Est. Cost	136,943
			Total Estimated Cost	1,648,738

SOW I.D.	Description	Est. Man-hours						Est. Labor Cost	Est. Asbestos Volume (Cu. Yards)	Est. recovered Copper Lbs.
		Labor	Operator	IW	Painters	Asbestos	Electrician			
g.	**Concentrator (1400 ft long building)**									
1	Remove approximately 3,000' of existing HTHW pipelines along "F" and "G" column lines with damaged or deteriorated insulation and all fragments of insulation in 4A and 4B tunnel.					822		69,418		
2	Remove all insulated equipment lubrication lines and all insulation fragments.					1266		106,914		
3	Remove any loose or fallen paint chips.					200		16,890		
4	Kill and clean mold from all Concentrator building surfaces.					150		12,668		
5	Install protective railings around floor openings on separator deck and north side rod mill deck.					200		16,890		
9	Remove all floor tiles from the offices, locker rooms, washrooms, and central control room					901		76,089		
10	Remove all ceiling tiles from the offices, locker rooms, washrooms, and central control room.					1147		96,864		
11	In the North and South Air and Cable Ducts, remove all existing electric cable fireproofing wrap and Transite conduit and all fragments of fireproofing wrap					841		71,022		
12	In the North and South Air and Cable Ducts, remove all existing deteriorated electric cables.					584		49,319		
	Sub-totals	0	0	0	0	6111	0	516,074	0	0
d-xii.	**Service Gallery G-1, G-2, and Service Tunnel S-12** (20X10X470)									
1	Remove approximately 1000' of existing HTHW pipelines with damaged or deteriorated insulation and all fragments of insulation. This insulation has tested positive for asbestos or probable ACM					858		72,458		
2	Abate any loose or fallen paint chips. The paint chips have tested positive for lead based material.					98		8,276		
3	Clean tunnel walkways of extraneous debris and taconite fines.					168		14,188		
4	Kill and clean mold from gallery and tunnel surfaces					30		2,534		
	Subtotal	0	0	0	0	1154	0	97,455	0	0
d-xiii.	**Service Gallery G-3 North Pipeway** (20X10X700)									
1	Remove approximately 1500' of existing HTHW pipelines with damaged or deteriorated insulation and all fragments of insulation. This insulation has tested positive for asbestos or probable ACM					1296		109,447		
2	Abate any loose or fallen paint chips. The paint chips have tested positive for lead based material.					80		6,756		
3	Clean tunnel walkways of extraneous debris and taconite fines.					260		21,957		
4	Kill and clean mold from gallery and tunnel surfaces					30		2,534		
	Subtotal	0	0	0	0	1666	0	140,694	0	0
d-xiv.	**Service Gallery G-4 South Pipe way, G-5 Gallery, and Service Tunnel S-13** (20X10X2200)									
1	Remove approximately 4500' of existing HTHW pipelines with damaged or deteriorated insulation and all fragments of insulation. This insulation has tested positive for asbestos or probable ACM					2900		244,905		
2	Abate any loose or fallen paint chips. The paint chips have tested positive for lead based material.					355		29,980		
3	Clean tunnel walkways of extraneous debris and taconite fines.					576		48,643		
4	Kill and clean mold from gallery and tunnel surfaces					100		8,445		
	Subtotal	0	0	0	0	3931	0	331,973	0	0
	Totals	0	0	0	0	12862	0	$1,086,196	0	0

Supervision & Field Administration	Man-hours est.	804	Est. Cost	78,310
Craft support (Carpenters, teamster, Misc operator, Misc labor)	Man-hours est.		Est. Cost	
Estimated Equipment Costs (itemize)			Est. Cost	$102,260.00
Estimated Material Costs (Itemize)			Est. Cost	$15,000.00
Estimated Misc. Costs (Itemize)			Est. Cost	$253,470.00
			Total Estimated Cost	$1,535,236

Coarse Crusher

Misc Cost Breakdown

Air Samples	$1,000
Haul & Dispose of ACM	$48,430
Dispose of Lead Based Paint Scrapings	$2,750
Insurance (1%)	$7,400
MDH Fees	$5,870
Admin Exp (phones, office, facilities,etc.)	$5,200
HAZ/Reg Waste Collection	$20,000
Stair/Railing Repair	$10,000
SUBCONTRACT TOTAL ========>	$100,650

Fine Crusher

Misc Cost Breakdown

Air Samples	$600
Haul & Dispose of ACM	$18,360
Dispose of Lead Based Paint Scrapings	$2,750
Insurance (1%)	$3,615
MDH Fees	$2,445
Admin Exp (phones, office, facilities,etc.)	$3,455
Scaffold	$21,000
Reg/Haz Waste Collection/Disposal	$8,125
SUBCONTRACT TOTAL ========>	$60,350

Service Tunnels

Misc Cost Breakdown

Air Samples	$1,600
Haul & Dispose of ACM, Fines, Salvage	$60,610
Dispose of Lead Based Paint Scrapings	$390
Insurance (1%)	$2,790
MDH Fees	$3,780
Admin Exp (phones, office, facilities,etc.)	$2,190
Access Construction (BUDGET)	$5,000
SUBCONTRACT TOTAL ========>	$76,360

Electrical Tunnels

Misc Cost Breakdown

Air Samples	$1,500
Haul & Dispose (acm, salvage)	$57,120
Dispose of Lead Based Paint Scrapings	$2,750
Insurance (1%)	$16,800
MDH Fees	$17,300
Haz/Reg Waste collection/disposal	$25,000
Admin Exp (phones, office, facilities,etc.)	$16,473
SUBCONTRACT TOTAL ========>	$136,943

CONCENTRATOR

Misc Cost Breakdown

Air Samples	$1,500
Haul & Dispose of ACM	$25,840
Dispose of Lead Based Paint Scrapings	$2,750
Insurance (1%)	$14,820
MDH Fees	$15,560
Admin Exp (phones, office, facilities,etc.)	$5,000
Reg/Haz Waste Collection/Disposal	$45,000
Scaffold	$143,000
SUBCONTRACT TOTAL ========>	$253,470

Attachment C3

Mavo ACM Estimate Bid Form

Asbestos Abatement Cost Proposal - Bid Form

Scope of Work Description	Reference Information	Asbestos Removal & Disposal Costs
Legacy Area 1 - used by project		
Area 1 Shop and Truck Storage (Bldg. 220)	ACT Report Zone H	$82,500
Area 1 Cold Storage (Bldg. 221)	No ACT report	$5,000
Area 1 Reporting Building (Bldg. 231)	No ACT report	$5,000
Area 1 Boiler House (Bldg. 226)	ACT Report Zone H	$2,500
Area 1 Fire Pump House & Water Tank (Bldg. 228)	ACT Report Zone H	$2,500
Legacy Area 2 - used by project		
Area 2 Service Shop (Bldg. 201)	ACT Report Zone I	$93,050
Area 2 Truck Storage (Bldg. 202)	ACT Report Zone I	$3,000
Area 2 Cold Storage (204)	ACT Report Zone I	$3,000
Area 2 Shop Locomotive Service Shop (Bldg. 203)	ACT Report Zone I	$52,150
Hose House (Bldg. 209)	No ACT report	$2,500
Sample House (Bldg. 208)	No ACT report	$5,000
Reporting Building (Bldg. 425)	No ACT report	$3,500
Area 2 Shop Locomotive Fueling	ACT Report Zone I	$2,500
Legacy Tailings Basin Buildings - used by project		
Foreman's Office (Bldg. 718)	No ACT report	$6,500
Reporting Building (Bldg. 719)	No ACT report	$6,500
Lube House (Bldg. 720)	No ACT report	$2,500
Reporting Building (Bldg. 724)	No ACT report	$2,500
Lube Oil Building (Bldg. 725)	No ACT report	$2,500
Legacy Plant Area - used by project		
Rebuild Shop (Bldg 602)	ACT Report Zone A	$85,000
General Shop (Bldg. 601)	ACT Report Zone A	$480,800
Carpenter Shop (Bldg. 603)	ACT Report Zone A	$2,500
Warehouse 49 (Bldg. 920)	ACT Report Zone A	$49,000
Warehouse 45 (Bldg. 921, Electrical)	ACT Report Zone A	$13,500
Lube House (Bldg. 926)	ACT Report Lubricant Storage Building	$52,000
Rubber Shop (Bldg. 605)	ACT Report Rubber Storage Building	$24,000
Water Treatment Plant & Storage Tanks	ACT Report Water Treatment Plant	$45,000
Colby Pump House	No ACT report	$2,500
Administration Building	ACT Report Administration Building	$850,000
Main Gate	No ACT report	$5,000
Sewage Treatment Plant	No ACT report	$5,000
Return Water Barge	No ACT report	$5,000

Total ACM Abatement Cost: **$1,902,000**

Attachment D

Arrowhead ACM Survey Estimates

Attachment D1

Arrowhead ACM Survey Estimate - May 2016

Arrowhead Consulting & Testing, Inc.
5606 Miller Trunk Highway • Duluth, Minnesota 55811 • Phone: 218/729-0987 • Fax: 218/729-8297

May 20, 2016

Mr. Michael Glissman
PolyMet Mining
P.O. Box 475
County Highway 666
Hoyt Lakes, Minnesota 55720

RE: **Asbestos Inspections - Miscellaneous Buildings**
Hoyt Lakes, Minnesota

In response to your request for proposal, Arrowhead Consulting & Testing, Inc., (Arrowhead) is pleased to provide PolyMet Mining (PolyMet) with the following proposal for an asbestos inspections of 10 miscellaneous buildings located at PolyMet in Hoyt Lakes, Minnesota. This document provides Arrowhead's scope of work, qualifications and fees for services provided per your request.

SCOPE OF WORK

Arrowhead will identify, quantify, sample and analyze suspect asbestos-containing materials (ACM) located throughout the Coarse and Fines Crushers. The Asbestos Hazard Emergency Response Act (AHERA) guidelines will be followed when conducting the inspection. A report will be prepared documenting, in an excel spreadsheet, the ACM identified by the inspection.

A Minnesota certified and licensed asbestos inspector will perform the inspection and sample collection. Three to nine samples will be collected for each suspect homogeneous ACM based upon surfacing area and material type. The sample materials will be grouped into homogeneous areas. An accredited laboratory (NVLAP certified) will perform analysis of suspect ACM. Analysis will be conducted only on the minimum number of samples required to confirm a material is ACM. However, as per the 40 CFR (EPA regulations) protocol for laboratory analysis of suspect ACM, analysis of all homogeneous samples will be conducted on any material determined to be non-asbestos-containing, to provide an adequate confirmation of the analytical results.

PROJECT COST

One Arrowhead asbestos inspector will inspect suspect asbestos containing materials including roofs and exterior siding. Arrowhead will collect samples of suspect ACM identified during the inspection and analyze the samples for asbestos content. The cost to provide these services is on a time and materials not to exceed cost. The following list summarizes the building cost to complete each building inspection.

Building	Cost
Building 951- Main Gate	$900.00
Building 231 – Reporting Building	$850.00
Sewage Treatment Plant	$900.00
The Barge (Return Water Barge)	$1300.00
Building 724	$900.00
Building 718	$1100.00
Building 719	$1100.00
Building 725	$850.00
Building 720 (Lube House)	$850.00
Building 709 (Colby Lake Pump House)	$1000.00

The costs are based upon completing each building individually as separate trips. The cost will be reduced if more than one building is inspected in one trip. PolyMet will only be charge for the number of samples analyzed for the project.

TIME TABLE

Arrowhead can begin the assessment within one week upon award of the contract. One Arrowhead professionals will collect the field data. It is estimated that five days will be needed to complete the inspection.

Arrowhead will compile the field data and submit a formal report within two weeks of completion of the inspection. The formal report will include an excel spreadsheet, documenting both non-asbestos and asbestos containing materials.

SAFETY

Arrowhead understands and respects the safety concerns of PolyMet Mining. Arrowhead personnel will provide the necessary safety equipment to safely perform the inspection, and will comply with PolyMet *Independent Contractor Safety Program*.

If you have any questions regarding the information provided, please call me at (218) 729-0987. We look forward to your favorable response.

Sincerely,
Arrowhead Consulting & Testing, Inc.

Linda K. Thiry

Linda K. Thiry
Owner/Industrial Hygienist

Attachment D2

Arrowhead ACM Survey Estimate - June 2016

Arrowhead Consulting & Testing, Inc.
5606 Miller Trunk Highway • Duluth, Minnesota 55811 • Phone: 218/729-0987 • Fax: 218/729-8297

June 23, 2016

Mr. Michael Glissman
PolyMet Mining
P.O. Box 475
County Highway 666
Hoyt Lakes, Minnesota 55720

RE: **Asbestos Inspections – Additional Miscellaneous Buildings**
Hoyt Lakes, Minnesota

In response to your request for proposal, Arrowhead Consulting & Testing, Inc., (Arrowhead) is pleased to provide PolyMet Mining (PolyMet) with the following proposal for an asbestos inspections of 10 miscellaneous buildings located at PolyMet in Hoyt Lakes, Minnesota. This document provides Arrowhead's scope of work, qualifications and fees for services provided per your request.

SCOPE OF WORK

Arrowhead will identify, quantify, sample and analyze suspect asbestos-containing materials (ACM) located throughout the Coarse and Fines Crushers. The Asbestos Hazard Emergency Response Act (AHERA) guidelines will be followed when conducting the inspection. A report will be prepared documenting, in an excel spreadsheet, the ACM identified by the inspection.

A Minnesota certified and licensed asbestos inspector will perform the inspection and sample collection. Three to nine samples will be collected for each suspect homogeneous ACM based upon surfacing area and material type. The sample materials will be grouped into homogeneous areas. An accredited laboratory (NVLAP certified) will perform analysis of suspect ACM. Analysis will be conducted only on the minimum number of samples required to confirm a material is ACM. However, as per the 40 CFR (EPA regulations) protocol for laboratory analysis of suspect ACM, analysis of all homogeneous samples will be conducted on any material determined to be non-asbestos-containing, to provide an adequate confirmation of the analytical results.

PROJECT COST

One Arrowhead asbestos inspector will inspect suspect asbestos containing materials including roofs and exterior siding. Arrowhead will collect samples of suspect ACM identified during the inspection and analyze the samples for asbestos content. The cost to provide these services is on a time and materials not to exceed cost. The following list summarizes the building cost to complete each building inspection.

Building	Cost
Building 208	$950.00
Building 209	$850.00
Building 425	$850.00

The costs are based upon completing each building individually as separate trips. The cost will be reduced if more than one building is inspected in one trip. PolyMet will only be charge for the number of samples analyzed for the project.

TIME TABLE

Arrowhead can begin the assessment within one week upon award of the contract. One Arrowhead professionals will collect the field data. It is estimated that five days will be needed to complete the inspection.

Arrowhead will compile the field data and submit a formal report within two weeks of completion of the inspection. The formal report will include an excel spreadsheet, documenting both non-asbestos and asbestos containing materials.

SAFETY

Arrowhead understands and respects the safety concerns of PolyMet Mining. Arrowhead personnel will provide the necessary safety equipment to safely perform the inspection, and will comply with PolyMet *Independent Contractor Safety Program*.

If you have any questions regarding the information provided, please call me at (218) 729-0987. We look forward to your favorable response.

Sincerely,
Arrowhead Consulting & Testing, Inc.

Linda K. Thiry

Linda K. Thiry
Owner/Industrial Hygienist

Attachment E

Additive Building and Heating Plant

Attachment E1

PolyMet Heating & Additives Plant - Demolition Specification

POLYMET
MINING

NorthMet Project

Heating & Additives Plant – Demolition Specification

August 16, 2016
Revision 1

Table of Contents

Attachments:

Enclosure 1 - Standard Form Contract
Enclosure 2 - MSHA Requirements
Enclosure 3 - General Conditions
Enclosure 4 - Safety Policy
Enclosure 5 - Environmental Policy

Exhibit A - Project Labor Agreement with Signature Page
Exhibit B - Confidentiality Agreement

Figures 1-2

Figure 1	Building Locations (Overview)
Figure 1 A	Process Plant Detail
Figure 2	Pipe Gallery/Tunnel Detail

Heating & Additives Plant Drawing Index and Reference Drawings Package

Heating & Additives Plant Asbestos and Lead Survey Reports (Zones D and E)

1.0 Background

PolyMet Mining Corporation (PolyMet) is a publicly traded mine development company with operational headquarters near the Company's mine in Hoyt Lakes, Minnesota, and executive offices in St. Paul, Minnesota. PolyMet is developing a copper-nickel-precious metals project in the established mining district of the Mesabi Iron Range in northeastern Minnesota. PolyMet controls 100% of the NorthMet ore deposit and owns a large crushing and grinding facility with extensive associated infrastructure, where it plans to process copper, nickel, gold, and platinum group metal ores from the NorthMet mine. The NorthMet Project (Project) would become the first non-ferrous ore mining operation in Minnesota. Shares are traded on the New York Stock Exchange (NYSE-A: PLM) and Toronto Stock Exchange (TSX: POM).

PolyMet is progressing with a two phased design, construction, and production plan. Phase I involves construction of the mine and related facilities, reconditioning and upgrading of the existing plant, construction of a flotation plant, and construction of a rail load-out facility for production of a dual filter cake. Products produced after Phase I construction include a copper rich concentrate and a nickel rich concentrate also holding platinum group metals.

Phase II includes the design, construction, and commissioning of a new hydrometallurgical facility and oxygen plant. Once completed, PolyMet will produce a combination of copper filter cake, nickel filter cake, nickel/cobalt hydroxide and gold/ platinum group precipitate.

PolyMet designed its facility to maximize the reuse of the LTV Steel Mining Company's Erie Plant brownfield site and existing infrastructure.

2.0 Introduction

PolyMet is in the advanced stages of the environmental review process and anticipates receiving the necessary permits to begin construction later this year. PolyMet intends to ensure the safety and health of everyone who enters the site. The existing Heating and Additives Plants have been identified as potential hazardous areas, therefore they will need to be razed to grade level.

Work on the Heating and Additives Plants includes equipment salvage, demolition work, and asbestos removal. This work is identified in Section 9.0 of this specification.

3.0 Request for Proposal

PolyMet is requesting proposals for demolition of structures and equipment associated with the Heating and Additives Plant as described in Section 9.0 of this specification. These demolition activities are driven by the current conditions of the facilities with regards to health and safety.

- PolyMet is seeking lump sum bids for the Heating and Additives Plant demolition activities as described in Section 9.0 of this specification. Contractor will retain all salvage materials unless noted otherwise.

4.0 Bidding Schedule

Site visitations can be conducted beginning May 13th, 2015 and bids are due on June 1st, 2015. Changes to the bidding schedule will be considered upon request.

5.0 Specification Support Documents

This specification includes:

- Pages 1-11 of this document
- Figures 1-2 referenced in specification
- Heating & Additives Plant drawing package per drawing index
- Heating & Additives Plant asbestos and lead survey reports

6.0 Proposal Requirements

The demolition estimates shall include the following as a minimum:

- Asbestos remediation cost estimate by facility listed in Section 9.
- Reclamation dirt work and seeding cost estimate by facility listed in Section 9.
- Concrete demolition cost estimate by facility listed in Section 9.
- Salvage value estimate broken down by salvage area (i.e. structural steel, electrical wire, equipment, etc.) by facility listed in Section 9.
- List of assumptions from which the proposal is based. Wherever possible describe any engineering concepts or assumptions from which the proposal is based (i.e. concrete will be crushed and used for fill, siding will be placed in landfill, etc.)

- List of exceptions to requests in the proposal including reason for exception.
- Biography of Contractor including any relevant experience in relation to the Contract.
- Experience working with Governmental Agencies (i.e. MDNR, MPCA, EPA) and Owner's agents to fulfill structure and equipment demolition obligations.
- An outline describing the major aspects of the Contractor's Safety Program shall be supplied.
- A performance bond may be required. Provide information regarding any bonding capability, an indication of willingness to bond, and costs associated with bonding that would be passed on to PolyMet.

7.0 Contract Objective

The objective of the Contract is to place the facilities listed in Section 9 in a safe, secure, environmentally stable condition. In general, all environmental concerns will be evaluated, environmental hazards will be remediated, all buildings and structures will be demolished, and all associated sites reclaimed and vegetated.

8.0 General Demolition Requirements

The following are general demolition requirements for the Contractor:

- Asbestos must be removed. The asbestos shall be disposed of at an off-site landfill approved by the U.S. Environmental Protection Agency which is operated in accordance with 40 CFR Section 61.154. If the landfill is operated in the state of Minnesota, ensure it is a MPCA approved solid waste facility permitted to accept the waste.
- The Contractor is responsible to obtain permits and submit all reports required by the state and federal agencies.
- Removal of asbestos containing Galbestos siding must be removed from the building in an environmentally safe manner so that no material is allowed to become airborne. Contractor must have an asbestos certified Site Supervisor oversee the removal of the Galbestos siding in accordance with all state and federal agencies. The Galbestos siding shall be disposed of at an off-site landfill approved by the U.S. Environmental Protection Agency which is operated in accordance with 40 CFR Section 61.154. If the landfill is operated in the state of Minnesota, ensure it is a MPCA approved solid waste facility permitted to accept

the waste.

- Removal of hazardous materials is the responsibility of the Contractor. Contractor must have a hazardous waste subcontractor inspect, inventory, remove and dispose of all hazardous waste. The Contractor is responsible to obtain permits and submit all reports required by the state and federal agencies.
- Removal of lead based paint is the responsibility of the Contractor. Contractor must have a licensed subcontractor inspect, inventory, remove and dispose of all lead based paints in accordance with all regulatory agency notification reports/permits.
- Contractor is responsible for the disposal of any item that has petroleum residue (in or on it), lead painted items, PCB containing or contaminated items, mercury containing or contaminated items (including lamps), CFC refrigeration devices, electrical transformers and related fluids, and batteries, etc.
- Concrete from the building demo may be used to fill in the existing foundations. Concrete that is crushed and used as fill material shall be no greater than 4” in diameter.
- Roofing must be characterized as asbestos containing or asbestos free. The asbestos containing roofing shall be disposed of at an off-site landfill approved by the U.S. Environmental Protection Agency which is operated in accordance with 40 CFR Section 61.154. If the landfill is operated in the state of Minnesota, ensure it is a MPCA approved solid waste facility permitted to accept the waste. The Contractor must secure the appropriately knowledgeable, certified, and/or licensed personnel to perform all asbestos abatement activities. The Contractor is responsible to obtain permits and submit all reports required by the state and federal agencies. Asbestos free roofing may be sold by the Contractor.
- Buildings must be demolished to ground level. Specific elevations are shown in Section 9. All existing floors below ground level may be left in place.
- Contractor shall provide filling of basements and the foundations will be covered with a minimum of two feet of surface overburden according to Minnesota Rules 6132.3200.
- Contractor shall plan to supply electricity from the Main Substation, water, offices, sanitary facilities, etc. as these items may not be available at the work site.
- MSHA requirements must be met while performing demolition work at PolyMet.
- Contractor will control, clean up and dispose of all environmental releases as no releases of soils, waters, or liquids will leave the work site area.

- Services and utilities will be severed by others prior to commencement of demolition work.
- Demolition will require a General NPDES Construction Permit.
- Contractor shall provide PolyMet or MDNR with copies of all reports and permits that are required.
- Contractor will have access to the PolyMet site for an extended period while preparing the package.

Notes:

- An asbestos and lead paint inventory has been performed for the Heating and Additives Plant. The asbestos reports are provided as an attachment to this specification.
- PCB containing or contaminated items have been inventoried and removed from the PolyMet site. It is anticipated that no new PCB containing devices will be brought on site.

9.0 2015 Health and Safety Demolition Sites

Within the summer/fall of 2015, all building and structures listed in Section 9.0 will be removed and foundations razed to grade level. Demolition of the structures listed is necessary to eliminate possible health and environmental hazards. This includes asbestos and possible mold contained within, degradation of support structures due to lack of upkeep and water damage, and deteriorated processing related buildings or power grid structures.

The timing of demolition for the individual buildings shall be suggested by the Contractor. All facilities listed in Sections 9.1.1 to 9.1.3 will be demolished over a maximum one year.

Reference Sections 9.1.1 to 9.1.3 for details for building, area or equipment locations listed as headings in the following sections. .

For major process equipment reference the Equipment List (attached).

9.1.1 Heating/Additive Plant (Soda Ash Silos)

The heating plant houses coal and natural gas boilers that were used to heat all of the site facilities with high temperature hot water. The additive plant houses tanks and material handling equipment that fed additives to the old taconite process. The Heating and Additive plant buildings will not be used as part of the Project and will be demolished during 2015 dependent upon scheduling with the Contractor.

The heating/additive plant contains the following large equipment in addition to many auxiliary systems:

- (2 ea) coal fired boilers (1950's vintage)
- (2 ea) natural gas fired boilers (1990's vintage)
- Compressors
- Tanks
- Pumps
- Conveyor

The site shall be left as follows:

- Remove all equipment (including boilers), piping, wiring, ductwork, equipment structures, etc. from interior of building of both the Heating and Additive buildings.
- Demolish the Heating and Additive buildings to elevation 1581'-0" including the conveyor gallery, G-6 gallery, and Soda Ash silos.
- To remain in PolyMet's possession after demolition are 4 high voltage transformers located in both heating and additive plant. These transformers will be flagged by PolyMet prior to demolition.
- Place clean fill in basement below elevation 1581'-0".
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

Reference drawings for the heating/additive plant include:

TC-297	Storage and Handling of Additives Coal Handling Drag Conveyors 1A to 1D General Arrangement
TC-298	Storage and Handling of Additives Additive Plant Coal Drying System with 14'-0" Cyclone Elevations Plan C B/M
TC-307	Storage and Handling of Additives Additive Plant General Arrangement Plan
TC-308	Storage and Handling of Additives Additive Plant General Arrangement Elevations A-A & B-B
TC-309	Storage and Handling of Additives Additive Plant

	General Arrangement Elevations C-C & D-D
TC-475	Storage and Handling of Additives Structural Steel Elevations & Sections
TC-641	Storage and Handling of Additives General Arrangement Plans & Elevations
TC-701	Storage and Handling of Additives Coal Drying and Grinding General Arrangement Elevations
TC-702	Storage and Handling of Additives Coal Drying and Grinding General Arrangement Elevation and Plans
TC-704	Pelletizing Plant Pipe Gallery G-7 Service Piping General Arrgt, Details & B/M
TC-710	Storage and Handling of Additives Starch Handling 6” Screw Conv. 3 9 Merchen Scale Feeder Arrangement, Details & B/M
TJ-114	Heating & Compressor Plant Operating Floor Plan Location of Foundations and Openings
TJ-115	Heating & Compressor Plant Cross Sections thru Boiler and Compressor Foundations
TJ-116	Heating & Compressor Plant General Arrangement Basement Plan
TJ-117	Heating & Compressor Plant General Arrangement Operating Floor Plan
TJ-119	Heating & Compressor Plant General Arrangement Cross Section X – X
TC-464	Storage & Handling of Additives Structural Steel Column Location Plan
TC-472	Storage & Handling of Additives Structural Steel Starch Bins Sections & Details
TC-1217	Storage & Handling of Additives Concrete Masonry & Reinfig Additive Building Floor Slab in Unloading Shed

Additional Resources (Heating Plant):

File Type	Number	Description
TJ-12	102	Demolition Plan & Sections
TJ-12	103	Underground Plumbing Plan Detail
TJ-12	104	Basement Plumbing Plan Detail
TJ-12	105	Floor Plan- HTTW, Glycol Piping
TJ-12	106	Floor Plan- Compressed Air, Safety Valve, Fuel Oil & Natural Gas Piping

TJ-12	107	Building Section
TJ-12	108	Building Section
TJ-12	109	Sections
TJ-12	110	Control and Instrumentation Diagram
TJ-12	111	Systems Flow Diagram
TJ-12	112	Diagrams
TJ-12	113	Details
TJ-12	114	Details
TJ-12	115	Schedules
TJ-12	1031	Electrical Floor Plan
TJ-12	1032	Existing Schematics
TJ-12	1033	Existing Wiring Diagrams MCC
TJ-12	1034	MCC
TJ-12	1035	Electrical Legend Schedule Details

Additional Resources (Additives Plant):

File Type	Number	Description
TC	482	misc. structure
TC	479	Roofing Siding Detail
TC	480	Roofing Siding Detail
TC	481	Platform Electrical Control Room
EDR-T	921	Soda Ash Silo (Portible Pump)
TJ	81	Sewage Piping
TC	490	Anthro Fine bin
TC	491	Anthro Fine bin
TG	251	Piping Yard Survey (gilsulate)
TC	87	Demo
TC	703	Pipe support gallery
TC	388	Demo
TC	472	Starch bin
TJ	107	Clad Cinder Demo (TJ 106)
TC	304	Drag chain
TC	305	Equipment & Drag Chain
EDR-T	946	Cyclone Ganite Lining & Fan Drive motor = appx. 200hp
TC	466	Coal Bunker (467-468 & 483)
TH	106	Shuttle Conveyor (parting line info) Anthrocite Bunker

TH	107	Shuttle Conveyor (parting line info)
TC	484	misc. Structure
TC	485	Platforms
TJ	217	Heating Plant annex
TC	288	Fire Wall annex
TC	289	Hot Air Stack
TC	463	Roofing Structure (464-465)
JC	928	Ash Piping
TC	922	Shoots Cyclone (light steel)
TC	464	Roofing Structure
TC	1217	Unloading Shed
TC	475	misc. structure
TJ	62	Insulated Building- Galbestos (E-DRT by H.H Robertson)
TJ	216	Heating (217-218)
TC	469	Bentonite/Ash Bins (470-471)
TJ	140	Flash Vessel Expansion Tank
TD	2	Electrical Print

11.0 Demolition Waste Disposal Plan

Concrete from demolition will be crushed to 4” or smaller and placed in building basements. All remaining non-hazardous demolition waste shall be disposed of in an off-site landfill.

12.0 Special Material Disposal

Surveys for Asbestos-Containing Materials (ACMs) have been completed. ACMs (siding, hot water heating system insulation, lube system insulation, floor tile, etc.) from structure demolition will be removed, properly packaged and disposed in an off-site landfill approved by the U.S. Environmental Protection Agency which is operated in accordance with 40 CFR Section 61.154. If the landfill is operated in the state of Minnesota, ensure it is a MPCA approved solid waste facility permitted to accept the waste.

Partially used paint, chemical and petroleum products will be collected and properly disposed.

Fluorescent and sodium halide bulbs will be removed from fixtures collected and properly disposed.

13.0 Cover and Vegetation of Building Area

After demolition of facilities listed in Section 9, 2 feet of overburden material suitable for vegetation will be placed upon the facility's former footprint.

Building areas will be reclaimed and vegetated according to Minnesota Rules 6132.2700.

Attachment E2

Lakehead Additive Building and Heating Plant Estimate

LAKEHEAD constructors inc.

Safety • Quality • Service • Innovation

PolyMet Mining, Inc. 3/3, 2016
PO Box 475
County Highway 666
Hoyt Lakes, MN 55750

Attn: Mr. Steve DeVaney

Re: Heating / Additive Plant Demolition

Mr. DeVaney:

Lakehead Constructors, Inc. (LCI) appreciates the opportunity to provide this proposal for the Northmet Project Heating & Additives Plant Demolition as described in the May 11 2015 specifications, associated drawings and documents as found on your drop box site, our site visit and conversations and on the clarifications below;

Work Included Pricing Estimate:
- Permit Fees and Notification
- Appropriate competent supervision for work provided by Rachel Contracting
- Mobilization and perdiem costs
- Engineering Surveys and erosion control BMP's
- Remove asbestos materials to materials identified in Arrowood Consulting reports dated June 2006 in compliance to current EPA, MPCA & Department of Health regulations
- Collection of Regulated and universal wastes

Heating Plant
- Complete removal of heating plant to 1' below surrounding grade
- Transport C&D waste to on-site landfill (SW-619)
- Backfill basement void with on-site tailing within 5 mile radius
- Top with on-site backfill and seed disturbed area upon completion

Additives Plant
- Demolition of building structure and remaining equipment in the additives plant to finish floor elevation matching surrounding grade
- Transport C&D waste to onsite landfill (SW-619)
- Fill in basement area of additives plant with tailings material supplied by Northmet
- Cap & grade remaining slab and foundations with 1.5' of cover (tailings)
- Place 6" topsoil layer and provide turf establishment

Project Assumptions

- Project will start in the summer or fall of 2016 (non-freezing months)
- Rachel Contracting retains all rights revenues from scrap and salvageable equipment remaining in the structures per site visit in June of 2015.
- Removal and disposal or residual product in tanks will be done on time and material basis

Work Excluded:

- Removal of any asbestos or other environmental hazards not identified in the surveys
- Concrete or foundation removal below 1st level top of finish slab existing slab elevation
- Allowances or costs for disconnection or abandonment of any utilities serving the buildings

Estimated Cost of Decommissioning Services:

Lump sum:	$1,385,800
ADD FOR OFF SITE DISPOSAL OF ASBESTOS AND C&D	$107,500
Add: Budgetary allowance for removal of remaining products in tanks	$100,000

All labor, equipment, materials, fuel and scrap values were priced at the values in February 2016. Pricing is good for 30 days & may fluctuate if project is delayed.

Thank you for the opportunity to present this proposal for your review. We trust it is complete and responsive to your needs. Our acceptance of your offer of a contract to perform this work will be contingent upon mutually agreeable contract terms and conditions between Polymet and Lakehead Constructors, Inc.

Sincerely,

Brad Jones

Brad Jones
Lakehead Constructors, Inc.

Attachment F

PolyMet Closure and Demolition Specification and Lakehead Estimates

Attachment F1

PolyMet Closure and Demolition Specification

POLYMET
MINING

NorthMet Project

Closure and Demolition Specification (Structures and Equipment Only)

June 30, 2016
Revision 6

Table of Contents

Attachments

1.0 Background

PolyMet Mining Corporation (PolyMet) is a publicly traded mine development company with operational headquarters near the Company's mine in Hoyt Lakes, Minnesota, and executive offices in St. Paul, Minnesota. PolyMet is developing a copper-nickel-precious metals project in the established mining district of the Mesabi Iron Range in northeastern Minnesota. PolyMet controls 100% of the NorthMet ore deposit and owns a large crushing and grinding facility with extensive associated infrastructure, where it plans to process copper, nickel, gold, and platinum group metal ores from the NorthMet mine. The NorthMet Project (Project) would become the first non-ferrous ore mining operation in Minnesota. Shares are traded on the New York Stock Exchange (NYSE-A: PLM) and Toronto Stock Exchange (TSX: POM).

PolyMet is progressing with a two phased design, construction, and production plan. Phase I involves construction of the mine and related facilities, reconditioning and upgrading of the existing plant, construction of a flotation plant, and construction of a rail load-out facility for production of a dual filter cake. Products produced after Phase I construction include a copper rich concentrate and a nickel rich concentrate also holding platinum group metals.

Phase II includes the design, construction, and commissioning of a new hydrometallurgical facility and oxygen plant. Once completed, PolyMet will produce a combination of copper filter cake, nickel filter cake, nickel/cobalt hydroxide and gold/ platinum group precipitate.

PolyMet designed its facility to maximize the reuse of the LTV Steel Mining Company's Erie Plant brownfield site and existing infrastructure.

2.0 Introduction

PolyMet is in the permitting process. As part of the Minnesota Department of Natural Resources' (MDNR) Permit to Mine, PolyMet will be required to provide adequate financial assurance to the State of Minnesota for proper closure of the Project. The planned closure of the Project is 20 years after startup, however, a condition of the Permit to Mine requires that the possibility of early closure is taken into account. The Permit to Mine will require the closure plans and the instrument of financial assurance to be updated annually. The updated closure plans and instrument of financial are submitted to the MDNR for review and acceptance that the financial assurance is sufficient to meet the existing obligations of closure and remediation.

At the time that the Permit to Mine is issued, PolyMet will have entered into a financial assurance agreement with the MDNR and provided the financial instrument that will guarantee payment for the closure of the project.

There will be salvage, demolition work and asbestos removal required during the pre-construction and construction phase of the Project. That work is not part of this scope of work specification.

3.0 Request for Demolition Estimate

PolyMet is requesting an estimate for demolition of structures and equipment associated with the Project as described herein.

This document presents the specification for demolition of structures and equipment components of the Project in two parts:

- PolyMet is seeking an estimate for Year 1 demolition activities as shown in Section 8.0 of this specification.
- PolyMet is also seeking estimates for future plant closure demolition activities (i.e. Year 20) as generally described previously. These activities are described in Section 9 of this specification.

There are two components to our site that need to be considered for each portion of the estimate:

- The Plant Site components are the portions of Cliffs Erie Plant Site acquired by PolyMet (see 8.1.1 to 8.1.29, and 8.2.1 to 8.2.6) and portions of the Plant Site to be constructed as part of the Project (see 9.1.1 to 9.1.3 and 9.3.1).
- The mine components are new facilities to be constructed at the Mine Site (see 9.2.1 to 9.2.3).

Notes:

- The planned closure of the Project is 20 years after startup. . However, an unforeseen closure could occur anytime.

4.0 Specification Support Documents

This specification includes:

- This specification document
- Figures 1- 9 referenced in specification
- Plant Site drawing package per drawing index
- Plant Site asbestos and lead survey reports
- Process equipment list (see attachments)
- PolyMet demolition quantity estimates (as reference where available)
- Mine Site drawing package

- Process Flow Diagrams – Process flow diagrams are provided for the existing plants and concentrate handling areas. An entire process flow diagram is available if required. In order to obtain a copy of the entire process flow diagram including the flotation area then the Contractor must enter into a confidentiality agreement with PolyMet.

5.0 Estimate Requirements

The demolition estimates shall include the following as a minimum:

- Reclamation dirt work and seeding cost estimate by facility listed in Section 8 and 9.
- Concrete demolition cost estimate by facility listed in Section 8 and 9.
- List of assumptions from which the proposal is based. Wherever possible describe any engineering concepts or assumptions from which the proposal is based (i.e. concrete will be placed in crusher basement, siding will be placed in landfill, etc.)
- List of exceptions to requests in the proposal including reason for exception.
- Biography of Contractor including any relevant experience in relation to the Contract.
- Experience working with Governmental Agencies (i.e. MDNR, MPCA, EPA) and Owner's agents to fulfill structure and equipment demolition obligations.
- An outline describing the major aspects of the Contractor's Safety Program shall be supplied.
- A performance bond may be required with yearly Contract. Provide information regarding any bonding capability, an indication of willingness to bond, and costs associated with bonding that would be passed on to PolyMet.
- Preliminary design drawings (i.e. layouts, arrangements) are provided for the Contractor for the demolition of new facilities. Note that the drawings shown are preliminary design layouts. PolyMet will provide more information to the selected Contractor as more detailed design drawings become available. The Contractor will have the opportunity to update the Contract as more detailed information is made available regarding the new facilities to be constructed by PolyMet.

6.0 Closure Estimate Objective

The objective of the Closure Estimate is to accurately estimate the costs to place the facilities listed in Section 8 and 9 in a safe, secure, environmentally stable condition. In general, all environmental concerns will be evaluated, environmental hazards will be remediated, all buildings and structures will be demolished, and all associated sites reclaimed and vegetated.

7.0 General Demolition Requirements

The following are general demolition requirements for the Contractor:

- Asbestos containing Galbestos siding must be removed from the building in an environmentally safe manner so that no material is allowed to become airborne. Contractor must have an asbestos certified Site Supervisor oversee the removal of the Galbestos siding in accordance with all state and federal agencies. The Galbestos shall be disposed of at an off-site landfill approved by the U.S. Environmental Protection Agency which is operated in accordance with 40 CFR Section 61.154. If the landfill is operated in the state of Minnesota, ensure it is a MPCA approved solid waste facility permitted to accept the waste.
- The Contractor is responsible to obtain permits and submit all reports required by the state and federal agencies.
- Removal of hazardous materials is the responsibility of the Contractor. Contractor must have a hazardous waste subcontractor inspect, inventory, remove and dispose of all hazardous waste. The Contractor is responsible to obtain permits and submit all reports required by the state and federal agencies.
- Concrete from the building demo may go to the sites located in Figure 8 “Concrete Demolition Disposal Locations”. Concrete that is crushed and used as fill material shall be no greater than 4” in diameter.
- Roofing must be characterized as asbestos containing or asbestos free. Asbestos free roofing may be sold by the Contractor.
- Buildings must be demolished to ground level. Specific elevations are shown in Section 8 and 9. All existing floors below ground level may be left in place.
- Contractor shall provide filling of basements and the foundations will be covered with a minimum of two feet of surface overburden according to Minnesota Rules 6132.3200.
- Contractor shall plan to supply electricity from the Main Substation, water,

offices, sanitary facilities, etc. as these items may not be available at the work site.

- MSHA requirements must be met while PolyMet is in operation. At closure PolyMet's plant site will be under the jurisdiction of OSHA.
- Contractor will control, clean up and dispose of all environmental releases as no releases of soils, waters, or liquids will leave the work site area.
- Services and utilities will be severed by others prior to commencement of demolition work.
- Demolition will require a General NPDES Construction Permit.
- Contractor shall provide PolyMet or MDNR with copies of all reports and permits that are required.
- Contractor shall assume that all equipment referenced in this specification is left in place for the Contractor at time of closure and that no other entities have salvaged the equipment for value.

Notes:

- An asbestos and lead paint inventory has been performed for the Plant Site. The asbestos reports are provided as an attachment to this specification. Abatement of these materials will take place during the pre-construction phase of the project and are not considered to be part of this scope of work.
- PCB containing or contaminated items have been inventoried and removed from the PolyMet site. It is anticipated that no new PCB containing devices will be brought on site.

8.0 Year 1 Demolition Plan

Within three (3) years after closure begins, all buildings and structures will be removed and foundations razed to grade level. Provisions may be made for continued subsequent use of mine facilities that will have future benefits to the area including, pipelines, transmission lines, roads, and railroad lines. However, for the purposes of this document it shall be assumed that all of the PolyMet facilities must be removed and the facility footprints reclaimed.

All facilities listed in Sections 8.1.1 to 8.1.29 and 8.2.1 to 8.2.6 will be demolished over a maximum period of three years. Facilities described in Section 9.4 may remain in service after closure (see Section 9.4).

For building, area or equipment locations listed as headings in the following sections for the plants reference Figures 1 and 1A for details.

For major process equipment reference the Equipment List (attached) and the Process Flow Diagrams (attached).

For the new facilities preliminary design drawings (i.e. layouts, arrangements) are provided for the Contractor. Note that the drawings shown are preliminary design layouts. The layout of equipment, etc. will change throughout the design process. These drawings show equipment and building sizes that are approximate. PolyMet will provide more information to the selected Contractor as more detailed design drawings become available.

8.1 Existing Facilities

8.1.1 Coarse Crushing Facilities

The Coarse Crusher houses two stages of crushing to reduce crude ore from run-of-mine size (up to 48") to 6" size. See the process flow diagram (drawing 010-P120-001-001 Rev D and 010-P120-001-002 Rev B) for major equipment reference.

The coarse crusher contains the following large equipment in addition to many auxiliary systems:

- (2 ea) 60" x 102" gyratory crusher
- (2 ea) 900 hp motor
- (8 ea) 36" x 70" gyratory crusher
- (8 ea) 400 hp motor
- (8 ea) Apron feeders
- (2 ea) 60" conveyors
- Overhead cranes
- Dust collection systems

The site shall be left as follows:

- Demolish structure to elevation 1711-0".
- Remove all equipment, piping, wiring, ductwork, equipment structures, etc. below elevation 1711'-0".
- Utility tunnels leaving the Coarse Crushing Facility will be sealed and closed in place.
- Basement levels below elevation 1711'-0" may be used for concrete disposal per the specification.
- Place clean fill in basement below elevation 1711-0" or fill with concrete demolition materials from other plant locations before final cover is placed
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

Reference drawings for the Coarse Crusher include:

TA-556	Coarse Crushing Plant Concrete Masonry Plan at El. 1711'-0"
TA-557	Coarse Crushing Plant Concrete Masonry Plan at El. 1711'-0"
TA-558	Coarse Crushing Plant Concrete Masonry Plan at El. 1711'-0"
TA-600	Coarse Crushing Plant Concrete Masonry Reinforcing Change House Foundations
TA-690	Coarse Crushing Plant Concrete Masonry Walls Between Elev. 1668'-6 & Elev.1694-0"
TA-691	Coarse Crushing Plant Concrete Masonry Walls Between Elev. 1668'-6 & Elev.1694-0"
TA-715	Coarse Crushing Plant Concrete Reinforcing Floor @ Elev. 1668'-6 & Elev.1694-0"
TA-716	Coarse Crushing Plant Concrete Reinforcing Floor @ Elev. 1668'-6 & Elev.1694-0"
TA-717	Coarse Crushing Plant Concrete Reinforcing Floor @ Elev. 1668'-6 & Elev.1694-0"
TA-718	Coarse Crushing Plant Concrete Masonry Walls Between El. 1694'-0 & Elev.1711'-0"
TA-719	Coarse Crushing Plant Concrete Masonry Walls Between El. 1694'-0 & Elev.1711'-0"
TA-720	Coarse Crushing Plant Concrete Reinforcing Walls Between El. 1668'-6 & Elev.1694-0"
TA-1-520	Coarse Crusher Change House Locker & Lunch Room Alteration
TA-1-556	Coarse Crushing Plant Silica Assay System Piping Arrangement
TA-1-557	Coarse Crushing Plant Silica Assay System Pump & Sump @ Dust Collector 27N
TA-1-558	Coarse Crushing Plant Silica Assay System Detail 27S Sump & Tailings Sump
010-P120-001-001 Rev D	Area 10 Coarse Crushing Process Flow Diagram
010-P120-001-002 Rev B	Area 10 Coarse Crushing Process Flow Diagram

8.1.2 Drive House 1

Drive House 1 contains the transfer points and drives for the 1A, 1B, 2A, and 2B conveyors.

The drive house contains the following large equipment in addition to auxiliary systems:

- (2 ea) 60” conveyors
- (4 ea) 600 hp primary drive motors and gearcases
- (4ea) 300 hp secondary drive motors and gearcases
- Overhead crane
- Dust collection systems

The site shall be left as follows:

- Demolish the conveyor gallery leading to the Fine Crusher and drive house 1 to elevation 1711-0”.
- Remove all equipment, piping, wiring, ductwork, equipment structures, etc. below elevation 1711’-0”.
- Seal conveyor tunnel to the Coarse Crushing Facility and close in place.
- Place clean fill in spaces below elevation 1711-0” before final cover is placed.
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

Reference drawings for the Drive House 1 include:

TA-18	Conveyors to Sec. Cr. Plant Junction & Drive House No. 1 Dust Control System Gen. Arrg’t & Bill of Material
TA-40	Conveyors to Secondary Crushing Plant 60” Belt Conveyors Nos. 2A & 2B (2nd Unit) General Arrangement and B/M
TA-41	Conveyors to Secondary Crushing Plant 60” Belt Conveyors Nos. 2A & 2B (2nd Unit) Curved Section-Horizontal to Incline Arrangement & Details
TA-42	Conveyors to Secondary Crushing Plant 60” Belt Conveyors Nos. 2A & 2B (2nd Unit) Drive & Take-Up Arrangement & Details Plan
TA-43	Conveyors to Secondary Crushing Plant 60” Belt Conveyors Nos. 2A & 2B (2nd Unit) Drive & Take-Up Long’l Elevation & Sections
TA-44	Conveyors to Secondary Crushing Plant 60” Belt Conveyors Nos. 2A & 2B (2nd Unit) Drive & Take-Up Sections & Details

TA-45	Conveyors to Secondary Crushing Plant 60" Belt Conveyors Nos. 2A & 2B (2nd Unit) Curved Section, Incline to Horizontal Arrangement and Details
TA-46	Conveyors to Secondary Crushing Plant 60" Belt Conveyors Nos. 2A & 2B (2nd Unit) Tail End Arrangement & Details
TA-47	Conveyors to Secondary Crushing Plant 60" Belt Conveyors Nos. 2A & 2B (2nd Unit) Head End Arrangement & Details
TA-48	Conveyors to Secondary Crushing Plant 60" Belt Conveyors #1A & #2A, & #1B & #2B (2nd Unit) Drive House #1 and Transfer Junction General Arrangement.
TA-49	Conveyors to Secondary Crushing Plant 60" Belt Conveyors #1A & #1B (2nd Unit) Head End, Dual Drive & Take-Up Arrangement & Sections
TA-50	Conveyors to Secondary Crushing Plant 60" Belt Conveyors #1A & #1B (2nd Unit) General Arrangement and B/M
TA-51	Conveyors to Secondary Crushing Plant 60" Belt Conveyors #1A & #1B (2nd Unit) Dual Drive Sections & Details
TA-52	Conveyors to Secondary Crushing Plant 60" Belt Conveyors #1A & #1B (2nd Unit) Gravity Take-Up Arrangement, Sections & Details
TA-53	Conveyors to Secondary Crushing Plant 60" Belt Conveyors #1A & #1B (2nd Unit) Curved Section Arrangement and Sections
TA-54	Conveyors to Secondary Crushing Plant 60" Belt Conveyors #1A & #1B (2nd Unit) Loading at 1st Unit Crushers Arrangement & Sections
TA-55	Conveyors to Secondary Crushing Plant 60" Belt Conveyors #1A & #2B (2nd Unit) Drive House #1 and Transfer Junction General Arrangement, Section BB & CC
TA-77	Conveyor Gallery – Conv. #2A & #2B Structural Steel Plans, Elevations & Sections
TA-78	Conveyor Gallery – Conv. #2A & #2B Structural Steel Details
TA-252	Conveyors to Secondary Crush. Plt. Structural Steel Drive House 1 Plans & Elevations
TA-253	Conveyors to Secondary Crush. Plt. Structural Steel Drive House 1 Sections & Details
TA-254	Conveyors to Secondary Crush. Plt.

	Structural Steel Drive House 1 Trusses T-1, T-2, T-3 & Details
TA-255	Conveyors to Secondary Crush. Plt. Structural Steel Drive House 1 Crane Girder & Col. Base Details
TA-259	Conveyors to Secondary Crush. Plant. Structural Steel Drive Hse Supports for Conv. 2A & 2B
TA-260	Conveyors to Secondary Crush. Plt. Concrete Masonry Drive House No.1
TA-261	Conveyors to Secondary Crush. Plt. Concrete Masonry Drive House No.1
TA-262	Conveyors to Secondary Crush. Plt. Concrete Masonry Drive House No.1
TA-263	Conveyors to Secondary Crush. Plt. Concrete Masonry Drive House No.1
TA-264	Conveyors to Secondary Crush. Plt. Concrete Masonry Drive House No.1
TA-265	Conveyors to Secondary Crush. Plt. Concrete Reinforcing Drive House No.1

8.1.3 Drive House 2

Drive House 2 contains the drives for the 4A and 4B conveyors. These conveyors feed ore from the Fine Crushers to the Concentrator.

The drive house contains the following large equipment:

- (2 ea) large 60" conveyors
- (2 ea) 500 hp primary drive motors and gear cases
- (2ea) 250 hp secondary drive motors and gear cases

The site shall be left as follows:

- Demolish the conveyor gallery to the concentrator and drive house 2 to elevation 1710-6".
- Remove all equipment, piping, wiring, ductwork, equipment structures, etc. below elevation 1710'-6".
- Seal conveyor tunnel to the Fine Crushing Facility and close in place.
- Place clean fill in spaces below elevation 1711-0" before final cover is placed.
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

Reference drawings for the Drive House 2 include:

TA-157	Conveyors to Concentrator 60" Belt Conveyors #4A & #4B General Arrangement & B/M
TA-161	Conveyors to Concentrator 60" Belt Conveyors #4A & #4B Drive House #2 Arrangement and Details

8.1.4 Fine Crushing Facility

The Fine Crusher houses two stages of crushing to reduce crude ore from 6" size to gravel size. See the process flow diagram (drawing 010-P120-001-001 Rev D and 010-P120-001-002 Rev B) for major equipment reference.

The fine crusher contains the following large equipment in addition to many auxiliary systems:

- (6 ea) 7' standard cone crusher
- (10 ea) 7' short head crusher
- (12 ea) 350 hp motor
- (12 ea) vibrating screen decks and feeders
- (18 ea) feeder with feed chute
- Several process support conveyors
- (3 ea) 100 ton Overhead cranes
- Dust collection systems
- (2ea) 60" conveyor and tripper

The site shall be left as follows:

- Demolish structure to elevation 1711-0".
- Remove all equipment, piping, wiring, ductwork, equipment structures, etc. below elevation 1711'-0".
- Utility tunnels leaving the Fine Crushing Facility will be sealed and closed in place.
- Place clean fill in basement below elevation 1711-0".
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

Reference drawings for the Fine Crusher include:

TA-58	Secondary Crushing Plant Structural Steel North Elevation
TA-59	Secondary Crushing Plant

	Structural Steel South Elevation
TA-60	Secondary Crushing Plant Structural Steel Transverse Sections
TA-61	Secondary Crushing Plant Structural Steel Bin Walls Plan & Sections
TA-64	Secondary Crushing Plant Structural Steel Crane Girder Details
TA-69	Secondary Crushing Plant Structural Steel Bin Main Longitudinal Girder
TA-70	Secondary Crushing Plant Structural Steel Longitudinal Sections
TA-71	Secondary Crushing Plant Structural Steel Longitudinal Sections
TA-79	Secondary Crushing Plant Structural Steel Bin Floor Members
TA-85	Secondary Crushing Plant Structural Steel Platforms at El 1755’-91/2”
TA-86	Secondary Crushing Plant Structural Steel Tripper Floor and Platform Plans
TA-88	Secondary Crushing Plant Structural Steel Frame F-1
TA-94	Secondary Crushing Plant Structural Steel Tunnel Roof Framing @ Repair Bay Plan, Sections & Details
TA-95	Secondary Crushing Plant Structural Steel Tunnel Roof Framing @ Repair Bay Girder Details
TA-96	Secondary Crushing Plant Structural Steel Change Room, Tool Room And Offices – Framing Plan & Elevs.
TA-98	Secondary Crushing Plant Structural Steel Tunnel Roof Framing @ Repair Bay Girder Details
TA-107	Secondary Crushing Plant Structural Steel Repair Bay Bracing @ El 1782’-5” Plan & Details
TA-109	Secondary Crushing Plant Conveyor Gallery Conv. #2A & #2B Masonry & Reinforced Concrete Gallery Footings
TA-110	Secondary Crushing Plant Concrete Masonry Foundation Plan
TA-111	Secondary Crushing Plant Concrete Masonry Repair Bay North Elevation

TA-112	Secondary Crushing Plant Concrete Reinforcing Repair Bay North Elevation
TA-113	Secondary Crushing Plant Concrete Reinforcing Repair Bay North Elevation
TA-114	Secondary Crushing Plant Concrete Masonry & Reinforcing Foundations Col. Line
TA-115	Secondary Crushing Plant Concrete Masonry Longitudinal Section of Crusher Wall on “B” Line
TA-116	Secondary Crushing Plant Concrete Masonry Longitudinal Section of Crusher Wall on “B” Line
TA-117	Secondary Crushing Plant Concrete Masonry Longitudinal Section of Crusher Wall on “D” Line
TA-118	Secondary Crushing Plant Concrete Masonry East & West Crusher Walls Between Col. Lines (9) & (15)
TA-119	Secondary Crushing Plant Concrete Masonry East & West Crusher Walls Between Col. Lines (5) & (9)
TA-120	Secondary Crushing Plant Concrete Masonry South Elevation
TA-121	Secondary Crushing Plant Concrete Reinforcing South Elevation
TA-122	Secondary Crushing Plant Concrete Masonry Repair Bay East Elevation
TA-123	Secondary Crushing Plant Concrete Masonry Repair Bay West Elevation
TA-124	Secondary Crushing Plant Concrete Masonry Floor at Repair Bay
TA-125	Secondary Crushing Plant Concrete Masonry Floor at Repair Bay
TA-126	Secondary Crushing Plant Concrete Masonry Floor at Repair Bay
TA-127	Secondary Crushing Plant Concrete Masonry Standard Crusher Foundations Plans, Sections & Details

TA-128	Secondary Crushing Plant Concrete Masonry Longitudinal Section Of Crusher Wall on D Line
TA-129	Secondary Crushing Plant Concrete Reinforcing Service Tun’l at Repair Bay Sections & Bar Schedule
TA-130	Secondary Crushing Plant Concrete Reinforcing Floor at Repair Bay
TA-131	Secondary Crushing Plant Concrete Reinforcing Floor at Repair Bay
TA-132	Secondary Crushing Plant Concrete Reinforcing Floor at Repair Bay
TA-133	Secondary Crushing Plant Concrete Reinforcing Floor at Repair Bay
TA-134	Secondary Crushing Plant Concrete Masonry Tunnel for Conveyors #4A-4B Roof Plan, Sections & Details
TA-135	Secondary Crushing Plant Concrete Masonry Tunnel for Conveyors #4A-#4B North Wall – Elev. & Dets.
TA-136	Secondary Crushing Plant Concrete Masonry Tunnel for Conveyors #4A-4B South Wall – Elevs. & Dets.
TA-137	Secondary Crushing Plant Concrete Masonry Tunnel for Conveyors #4A-#4B Bottom Plan, Sections & Dets
TA-138	Secondary Crushing Plant Concrete Reinforcing Tunnel for Conveyors #4A-#4B Plan & Sections
TA-139	Secondary Crushing Plant Concrete Reinforcing Tunnel for Conveyors #4A-4B Roof Plan
TA-140	Secondary Crushing Plant Concrete Reinforcing Tunnel for Conveyors #4A-#4B North Wall – Sect. & Dets.
TA-141	Secondary Crushing Plant Concrete Reinforcing Tunnel for Conveyors #4A-#4B North Wall – Sects. & Bar Schedule
TA-142	Secondary Crushing Plant Concrete Reinforcing Tunnel for Conveyors 4A & 4B South Wall Elevs. & Dets.
TA-143	Secondary Crushing Plant Concrete Reinforcing Tunnel for Conveyors #4A & 4B

	South Wall – Sections & Bar Schedule
TA-144	Secondary Crushing Plant Concrete Reinforcing Tunnel for Conveyors #4A & #4B Bottom Plan & Sections
TA-145	Secondary Crushing Plant Concrete Reinforcing Tunnel for Conveyors #4A & #4B Bottom Plan & Sections
TA-146	Secondary Crushing Plant Concrete Reinforcing Repair Bay – East Elevation Elevation & Sections
TA-147	Secondary Crushing Plant Concrete Reinforcing Repair Bay – East Elevation Sections & Bar Schedule
TA-148	Secondary Crushing Plant Concrete Reinforcing West Elevation
TA-149	Secondary Crushing Plant Concrete Reinforcing West Elevation Sections & Bar Schedule
TA-150	Secondary Crushing Plant Concrete Reinforcing Tunnel for Conveyor 4A & 4B Footing $ Dowel Plan
TA-510	Secondary Crushing Plant Architectural Plan of Change Room Tool Room, Offices, Etc.
TA-511	Secondary Crushing Plant Architectural Change Rm, Tool Rm & Offices Elevations & Sections
TA-512	Secondary Crushing Plant Architectural Change Rm, Tool Rm & Offices Miscellaneous Details.

015-P120-001-001 Rev D Area 10 Fine Crushing Process Flow Diagram

8.1.5 Concentrator (including pipe gallery to Booster Pumphouse #1 and the Load Out)

The Concentrator houses two stages of wet grinding mills to reduce crude ore from gravel size to powder in slurry form that feeds the new flotation plant. See the process flow diagram (drawing 020-P120-001-001 Rev E) for major equipment reference.

The Concentrator contains the following large equipment in addition to many auxiliary systems:

- (29 ea) Rod mill with 800 hp motor
- (30 ea) Ball mill with 1250 hp motor
- (3 ea) Regrind mill with 1850 hp motor
- (34 ea) Ball mill cyclone cluster
- (34 ea) Ball mill cyclone feed pump
- (2 ea) 60” Conveyor and Tripper
- Fine ore bin
- Overhead cranes
- Piping and tankage
- Dust collection systems

The site shall be left as follows:

- Remove all equipment, piping, wiring, ductwork, equipment structures, etc.
- Demolish structure to elevations 1710-8”, 1688’-6”, 1665’-0”, 1651’-0” and 1617’9”. These elevations coincide with the upper elevations of the sloping finished floor in the building sections (see drawing 322-1002 for reference).
- The Contractor may leave the mill pedestals above the finished floor but must provide clean fill to bury the pedestals prior to establishment of final cover.
- Utility tunnels leaving the Concentrator and completely contained inside of the Concentrator (i.e. electrical tunnels/vaults) will be sealed and closed in place.
- Place clean fill in any basement elevations (i.e. sumps).
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.
- The final cover must be a natural slope from elevation 1710’-8” to 1616’-0” and to ensure proper water drainage.

Reference drawings for the Concentrator include:

322-1002	Concentrator General Arrangement Elevation Looking South
322-1001	Concentrator General Arrangement Plan
332-1003	Regrind Annex Gen. Arrg’t Plans
332-1004	Regrind Annex Gen. Arrg’t Elevations
332-1005	Regrind Annex Gen. Arrg’t Elevations
331-3303	Regrind Annex Structural Steel Base Details & Misc. Steel
331-3307	Regrind Annex Structural Steel

	Floor Framing at El. 1652'-71/4" Plan, Sections & Details
331-3111	Regrind Annex Concrete Masonry & Reinf'g Slab at Elevation 1666'-0" Plan, Sections & Det.
TB-81	Concentrator Concrete Masonry & Reinforcing FNDNS in Repair Area Slab at Elev. 1710'-6"
TB-84	Concentrator Concrete Masonry & Reinforcing Foundations in Repair Area Mezzanine Floor
TB-85	Concentrator Concrete Masonry & Reinforcing Foundations in Repair Area Mezzanine Floor
TB-91	Concentrator Concrete Masonry Main Pipe Tunnel Col. Lines Y to F Panel 7
TB-99	Concentrator Concrete Masonry & Reinforcing Foundations in Repair Area Mezzanine Floor
TB-301	Electric Light & Power List of Drawings "TB"
TB-811	Concentrator Architectural Plan of Change Room & Offices at Elev. 1698'-6"
TB-812	Concentrator Architectural Plan of Toilet at Elev. 1686'-6"
TB-813	Concentrator Architectural Sections Thru Change Rm. Toilets, Offices, Etc.
020-P120-001-001 Rev E	Area 20 Grinding Process Flow Diagram

8.1.6 Area 1 Buildings

Area 1 shop buildings are used for maintenance and repair of the mining equipment and include the following buildings; Shop and Truck Storage (Bldg. 220), Cold Storage (Bldg. 221), Boiler House (Bldg. 226), Fire Pump House & Water Tank (Bldg. 228), Locomotive Fueling, Reporting Station (Bldg. 231) There is no large process equipment in this area.

The site shall be left as follows:

- Demolish the Area 1 shop buildings to elevation 1673'-0" (finished floor elevation).
- Demolish outlying cold storage, tanks and other buildings/equipment to existing grade level.
- Place clean fill in spaces below elevation 1673'-0" before final cover is placed.
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules

6132.3200.

Reference drawings for the Area 1 buildings include:

TE-8-142	Maintenance & Repair Shop Area 1 Phase 1 Fire Protection – Fire Pump & Tank
TE-8-310	Area 1 Shop Area Yard Piping System
TE-8-017	Sprinkler System for Traffic Control Center
TE-8-149	Maintenance & Repair Shop Area 1 Phase 2 Floor Plans-Existing Building

8.1.7 Area 2 Buildings

Area 2 buildings are used for reporting mining employee reporting and storage and include the following buildings; Cold Storage (Bldg. 204), Locomotive Service Shop (Bldg. 203), Maintenance Service Shop (Bldg. 201), Truck Storage Garage (Bldg. 202), Hose House (Bldg. 209), Sample House (Bldg. 208), Reporting Building (Bldg. 425), and Area 2 Locomotive Fueling.

There is no large process equipment in this area.

The site shall be left as follows:

- Demolish the Area 2 Service Shop and Truck Storage buildings to elevation 1672'-0" (finished floor elevation).
- Demolish the Area 2 Cold Storage building to elevation 1678.75' (finished floor elevation).
- Demolish Oil House to elevation 1674.58 and outlying tanks, locomotive sanding towers, and other buildings/equipment to existing grade level.
- Place clean fill in spaces below elevation 1672'-0" in Service shop before final cover is placed.
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

Reference drawings for the Area 2 buildings include:

MA-50-3	Service Area – East Pits Area Map
TE-8-008	General Revisions East Pit Service Shop
TE-8-014	Revised Shop Floor Plan

East Pit Shops Bldg

8.1.8 General Shops

The General Shops, building number 601, were and will be used for maintenance and repair of the rail fleet as well as electrical equipment repairs, welding and fabrication, and other miscellaneous repairs. The General Shops buildings include the Welding Shop, Structural Shop, Locomotive Shop, Electric Shop, Machine Shop, Tool Room, and several offices and a locker room. The Acetylene Building, number 604 is considered to be part of the General Shops. There is no large process equipment in this area except for overhead cranes.

The site shall be left as follows:

- Demolish the building, equipment, etc. to elevation 1710'-6" (finished floor elevation).
- Place clean fill in spaces below elevation 1710'-6" before final cover is placed.
  Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

Reference drawings for the General Shops include:

TE-1	General Shops General Arrangement Plan
TE-50	General Shops Structural Steel Mezz. Framing Plans & Sections
TE-51	General Shops Architectural Elevations

8.1.9 Rebuild Shop

The Rebuild Shop, building number 602, is used for drill core storage and cutting. There is no large process equipment in this area. There are overhead cranes.

The site shall be left as follows:

- Demolish the building to elevation 1711'-0" (finished floor elevation).
- Utility tunnels leaving the Rebuild Shop will be sealed and closed in place.
- Place clean fill in spaces below elevation 1711'-0" before final cover is placed.
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

Reference drawings for the Rebuild Shop include:

TE-267	Garage Building Structural Steel & Concrete Reinf. Warehouse Mezzanine and the Battery Storage Decks
TE-270	Garage Concrete Masonry Building Foundations
TE-271	Garage Concrete Masonry Building Foundations
TE-281	Garage Architectural Floor Plan and Section
TE-282	Garage Architectural Elevations
TE-284	Garage Architectural Door Schedule & Misc. Details

8.1.10 Lube House

The Lube House, building number 926, acts as storage space for lubricants and paints. The building does not contain any major pieces of equipment.

The site shall be left as follows:

- Demolish the building to elevation 1711’-0”.
- Utility tunnel under the Lube House will be sealed and closed in place.
- Place clean fill in spaces below elevation 1711’-0” before final cover is placed.
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

Reference drawings for the Lube House include:

TE-316	Lubricating Oil & Paint Storage Structural Steel Plan & Details
TE-317	Lubricating Oil & Paint Storage Structural Steel Elevations & Details
TE-318	Lubricating Oil & Paint Storage Concrete Masonry Foundation Plan & Sects.
TE-319	Lubricating Oil & Paint Storage Concrete Masonry Section & Details
TE-320	Lubricating Oil & Paint Storage Concrete Reinforcing Foundation Plan Section & Details
TE-321	Lubricating Oil & Paint Storage Concrete Reinforcing Section & Details

TE-322 Lubricating Oil & Paint Storage
Concrete Reinforcing Section & Details

8.1.11 Analytical Lab

The Analytical Lab is the on-site laboratory. The building does not contain any major pieces of equipment.

The site shall be left as follows:

- Demolish the building to elevation 1618'-0" (finished floor elevation).
- Place clean fill in spaces below elevation 1618'-0" before final cover is placed.
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

Reference drawings for the Analytical Lab include:

TE-4-007	Commercial Plant Analytical Laboratory Basement Floor – Plot Plan
TE-4-008	Commercial Plant Analytical Laboratory Main Floor Plan
TE-4-009	Commercial Plant Analytical Laboratory Exterior Elevation
TE-4-010	Analytical Laboratory Sections & Details
TE-4-013	Commercial Plant Analytical Laboratory Main Floor Framing
TE-4-014	Commercial Plant Analytical Laboratory Roof Framing Plan
TE-4-015	Commercial Plant Analytical Laboratory
TE-4-016	Commercial Plant Analytical Laboratory
TE-4-017	Analytical Laboratory, Supplementary Vent. Syst. Main Floor Plan

8.1.12 Water Tower (Plant Site) and Plant Reservoir

The Plant Site Water Tower site and Reservoir shall be left as follows:

- Plant Site Water Tower would be removed to elevation 1776'-0" (top of piers) at closure.
- Utility tunnel under Water Tower for the plant reservoir will be sealed and closed in place.
- Place clean fill in spaces below elevation 1776'-0" at the Water Tower Site and

Reservoir before final cover is placed.

- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

Reference Drawings for the Water Towers include (note that the tank details could not be found at this time):

TG-162	Fire Fighting System Concrete Masonry 100,000 Gal. Elevated Tank Foundation Details
TG-163	Fire Fighting System Concrete Reinforcing 100,000 Gal. Elevated Tank Foundation Details

8.1.13 Colby Lake Pump House

The Colby Lake Pump House is located approximately 5 miles from the plant site and supplies fresh water from Colby Lake to the plant site via a 36” diameter steel buried pipeline. The Colby Lake Pump House contains the following large pieces of equipment:

- (3 ea) Vertical turbine pump w/ 600 hp motor
- Service crane

The site shall be left as follows:

- Demolish the building to elevation 1448’-6” (finished floor elevation).
- Seal intake tunnel and fill pump area with clean fill.
- Place clean fill in areas lower the 1448’-6”.
- Remove or fill pipe access manways.
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

Reference drawings for the Colby Lake Pumphouse include:

TG-18	Partridge Lake Pumping Station Plan and Pipe Line Profile Pipe Line from Pump Station to Reservoir
TG-19	Partridge Lake Pumping Station 36” Pipe Line to Plant Reservoir Details & B/M
TG-20	Partridge Lake Pumping Station 36” Pipe Line to Plant Reservoir

	Plan and Profile
TG-21	Partridge Lake Pumping Station 36" Pipe Line to Plant Reservoir Plan and Profile
TG-22	Partridge Lake Pumping Station 36" Pipe Line to Plant Reservoir Plan and Profile
TG-23	Partridge Lake Pumping Station 36" Pipe Line to Plant Reservoir Plan and Profile
TG-24	Partridge Lake Pumping Station 36" Pipe Line to Plant Reservoir Plan and Profile

8.1.14 Bentonite Silos

The Bentonite Silos were used to contain Bentonite used in tailings dam construction.

The site shall be left as follows:

- Demolish bentonite silos, these are 120 ton and 90 ton bins.
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

Reference drawings for the heating/additive plant include:

TC-641	Storage and Handling of Additives General Arrangement, Plans & Elevations

8.1.15 Warehouse Electrical

The electrical warehouse, building number 921, acts as cold storage space. The building does not contain any major pieces of equipment.

The site shall be left as follows:

- Demolish the building to elevation 1711'-0" (finished floor elevation).
- Place clean fill in spaces below elevation 1711'-0" before final cover is placed.
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200. Slope overburden to elevation 1710'-0".

Reference drawings for the electrical warehouse include:

TE-116	Warehouse General Plan
TE-117	Warehouse Elevations
TE-118	Warehouse Wall Sections
TE-5-067	Warehouse Office Edition
TE-5-069	Training Room Partitions
	Warehouse #1 – Office Area

8.1.16 Warehouse 49

Warehouse 49, building number 920, acts as cold storage space. The building does not contain any major pieces of equipment.

The site shall be left as follows:
- Demolish the building to elevation 1711'-0" (finished floor elevation).
- Place clean fill in spaces below elevation 1711'-0" before final cover is placed.
- Utility tunnels under the Warehouse will be sealed and closed in place.
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200. Slope overburden to elevation 1710'-0".

Reference drawings for the Warehouse 49 include:

TE-5-011	Erection Drawing
	Cold Storage Warehouse
TE-5-012	Exterior Sheeting & Flashing Detail
	Cold Storage Warehouse

8.1.17 Administration Building

The Administration Building houses the site administrative offices. The building does not contain any major pieces of equipment.

The site shall be left as follows:
- Demolish the building to elevation 1500'-6" (finished floor elevation).
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200. Slope overburden at 3:1 from level 1513'-6" to level 1500'-6".

Reference drawings for the Administration Building include:

TE-6-282	Elevations
TE-6-283	Building Sections
TE-6-279	Site Plan
TE-6-052	Ground Floor Plan
TE-6-053	First Floor Plan Interior Wall Elevations
TE-6-054	Second Floor Plan Room Finish Schedule
TE-6-062	Foundation Plan & Details
TE-6-264	Administration Building Second Floor Plan Rev

8.1.18 Main Gate (Gatehouse and Gas Station)

The Main Gate consists of a Gatehouse and Gas Station. The Gatehouse is used to supply site security. The Gas Station includes tanks and pumps that supply gas to plant site vehicles during operations.

The site shall be left as follows:

- This Gatehouse building shall be demolished in total to the road way elevation.
- Gas Station tanks shall be demolished in a manner consistent with Section 9.4.4 of this specification.
- Site will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

Reference Drawings for the Main Gate include:

TE-6-001	Entrance Road Guard House Plans, Elev. & Det.
TH-1-050	Main Gate Gasoline Refueling & Storage Facility General Arrangement
TH-1-051	Main Gate Gas Station Details Piping Details
TH-1-1017	Main Gate Gasoline Dispensing Station Electrical Layout and Schematic

8.1.19 Tailings Booster Pump House #1

The Tailings Booster Pump House is used to boost pumping pressure to deliver tailings from the plant to the tailings basin. The Tailings Booster Pump House contains the following large pieces of equipment:

- (8 ea) GIW 14x39 pump w/ 500 hp motor
- Service crane

The site shall be left as follows:

- Demolish the building to elevation 1659'-0" (finished floor elevation).
- Seal floor drain pipe and fill areas below 1659'-0" with clean fill.
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

Reference Drawings for Booster Pump House include:

TB-7-101	Tailings Disposal Booster Pumping Station No. 1 Addition – General Arrangement
TB-7-102	Tailings Disposal Booster Pumping Station No. 1 Addition – General Arrangement
TB-1650	Tailings Disposal Booster Pumping Station Conc. Masonry & Reinf. Foundation Plan & Details
TB-1651	Tailings Disposal Booster Pumping Station Conc. Masonry & Reinf. Footing Details
TB-1652	Tailings Disposal Booster Pumping Station Conc. Masonry & Reinf. Footing Details
TB-1653	Tailings Disposal Booster Pumping Station Conc. Masonry & Reinf. Footing Details
TB-1654	Tailings Disposal Booster Pumping Station Conc. Masonry & Reinf. Footing Details
TB-1655	Tailings Disposal Booster Pumping Station Conc. Masonry & Reinf. Foundation Walls Elevs. & Sects.
TB-1657	Tailings Disposal Booster Pumping Station Conc. Masonry Equipment Foundations – Plans & Dets.
TB-662	Tailings Disposal Main and Auxiliary Transfer Pumps and Piping General Arrangement & B/M
TB-663	Tailings Disposal Auxiliary Transfer Pumps and Piping Plan, Elevs, Sects and Dets
TB-664-N	Tailings Disposal Main Transfer Pumps and Piping Plans. Elevs., Sects. and Dets
TB-664-S	Tailings Disposal Main Transfer Pumps and Piping Plans. Elevs., Sects. and Dets
TB-666	Tailings Disposal Booster Pumping Station No. 1 General Arrangement

8.1.20 Sewage Treatment Plant

The Sewage Treatment Plant is used to treat sewage at the plant site. This building does not contain major pieces of equipment but does have a digester and aerator.

The site shall be left as follows:

- Demolish the building to elevation 1546.35'.
- Fill areas below 1546.35' with clean fill.
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

Reference Drawings for Sewage Treatment Plant include:

TL-2-006	Sewage Treatment Plant Location & Plat Plan
TL-2-008	Sewage Treatment Plant Plan of Primary Clarifier & Right & Left Side Elevations
TL-2-009	Sewage Plant Sections
TL-2-010	Sewage Treatment Plant Details
TL-2-011	Sewage Treatment Plant Isometric Piping & Details
TL-2-012	Sewage Treatment Plant Details
TL-2-013	Sewage Treatment Plant Steel Section and Floor Plans
TL-2-014	Sewage Treatment Plant Steel Sections
TL-2-015	Sewage Treatment Plant Electrical Plan

8.1.21 Carpenter's Shop

The Carpenter's Shop acts as cold storage space. The building does not contain any major pieces of equipment.

The site shall be left as follows:
- Demolish the building to elevation 1710'-0" (finished floor elevation).
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

Reference drawings for the Carpenter's Shop do not exist. This building is a wood frame building with tin siding with dimensions of 55 ft x 101 ft.

8.1.22 Tailings Portable Pump Houses

Each Tailings Portable Pump House contains one tailing booster pumps. The pump is equipped with 500 hp motors and are used to boost line pressure to ensure proper tailings deposition. There are 29 portable pump houses located on site.

The site shall be left as follows:
- Demolish the Tailings Portable Pump Houses in entirety.

Reference Drawings for Tailings Basin Portable Pump House include:

TB-7-093	Skid & Roof Details for Booster Pumphouse with 16" SRT Pump & 300 H.P. Drive – Station #5
TB-7-094	Gen. Arrg't & Wall Elevations for Booster Pumphouse With 16" SRT Pump & 300 H.P. Drive – Station #5
TB-7-095	Typical Wall & Removable Roof Detail Booster Pumphouse Station #5

8.1.23 Return Water Barge

The Return Water Barge is used to return water from the tailings basin to the plant site reservoir. The Barge contains four water pumps each with 700 hp motors.

The site shall be left as follows:
- Demolish the Barge in its entirety.

Reference Drawings for Return Water Barge include:

TB-703	Pump Station Tailings Pond Pumping Barge General Arrangement
TB-1631	Pump Station Tailings Pond Pumping Barge Mill Water Air & Priming Piping Gen'l Arrg't & B/M

8.1.24 Hinsdale Bridge

The Hinsdale Bridge was used to deliver ore from the taconite pits located west of the plant site to the Coarse Crusher. The bridge will not be used at this time but will remain in place until closure.

The site shall be left as follows:

- Demolish the Hinsdale Bridge including concrete supports to the existing grade.
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

Reference Drawings for the Hinsdale Bridge include:

Sheet 1	D.M. & I.R.R.Y. Crossing Bridge General Plan and Elevation
Sheet 2	D.M. & I.R.R.Y. Crossing Bridge Foundation Location Plan and Log of Borings
Sheet 3	D.M. & I.R.R.Y. Crossing Bridge Abutments 1 & 6 and Pedestal for Bents 2 & 5
Sheet 4	D.M. & I.R.R.Y. Crossing Bridge Piers 3 & 4
Sheet 5	D.M. & I.R.R.Y. Crossing Bridge 96' Deck Girder Span
Sheet 6	D.M. & I.R.R.Y. Crossing Bridge 120' Deck Girder Span
Sheet 7	D.M. & I.R.R.Y. Crossing Bridge Shoes
Sheet 8	D.M. & I.R.R.Y. Crossing Bridge Bents 2 & 5
Sheet 9	D.M. & I.R.R.Y. Crossing Bridge Deck Details
Sheet 10	D.M. & I.R.R.Y. Crossing Bridge Deck Details and Inspection Walks
Sheet 13	D.M. & I.R.R.Y. Crossing Bridge Grading Details and Method of Removing Fill

8.1.25 Thickeners

The Thickeners were used in the processing of taconite and will no longer be used. Two thickeners will remain after construction.

The site shall be left as follows:

- Remove structures above grade 1616'-0" (top of concrete cone).
- Pipe tunnels under thickeners will be sealed and closed in place.
- Fill areas below 1616'-0" with clean fill.
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

Reference Drawings for Thickeners include:

TB-651	Concentrator Tailings Thickeners Excavation
TB-652	Tailings Disposal Concrete Masonry Pipe Tunnel Under R.R. Embankment Plan, Sections & Details
TB-653	Tailings Disposal Concrete Reinforcement Pipe Tunnel Under R.R. Embankment Plan, Sections & Details
TB-921	Tailings Disposal Concrete Masonry Tailings Thickeners Center Piers
TB-922	Tailings Disposal Concrete Masonry Tailings Thickeners Center Piers
TB-925	Tailings Disposal Structural Steel 255' Dia. Tailings Thickener Tanks
TB-926	Tailings Disposal Structural Steel 255' Dia. Tailings Thickener Tanks
TB-1040	Tailings Disposal Concrete Masonry & Reinforcing Overflow & Roof Drain Launders Plans & Sections
TB-1041	Tailings Disposal Concrete Masonry & Reinforcing 255' Dia. Tailings Thickener Tanks Tank Slab & Ring Wall
TB-1042	Tailings Disposal Concrete Masonry & Reinforcing 255' Dia. Tailings Thickener Tanks Ring Walls

8.1.26 Rubber Shop

The Rubber Shop, building number 605, was originally called the Untanking Tower and Emergency Diesel Generating Plant, both of those sections still exist in the building in addition to the rubber shop.

The site shall be left as follows:
- Remove structures above grade 1710'.
- Fill areas below 1710' with clean fill.
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

Reference Drawings for the Rubber Shop include:

TD-680	Emergency Diesel Generating Plant General Arrangement Sections
TD-679	Emergency Diesel Generating Plant General Arrangement Plan
TD-698	Transformer Untanking Tower Diesel Generating Plant Structural Steel Plans & Details
TD-699	Transformer Untanking Tower Diesel Generating Plant Structural Steel Elevations & Details
TD-700	Transformer Untanking Tower Diesel Generating Plant Structural Steel Elevations & Details
TD-701	Transformer Untanking Tower Diesel Generating Plant Structural Steel Elevations & Details

8.1.27 Water Treatment Plant & Storage Tanks

The Water Treatment Plant was used to treat raw water for potable water at the plant site.

The site shall be left as follows:
- Remove structures above grade 1777'.
- Fill areas below 1777' with clean fill.
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules

6132.3200.

Reference Drawings for the Water Treatment Plant & Storage Tanks include:

TG-6-020	Location Map & Title Page
TG-6-021	Site and Foundation Plan
TG-6-022	Floor Plans
TG-6-023	Roof Plan
TG-6-024	Sections
TG-6-025	Elevations
TG-6-026	Details
TG-6-031	Piping and Equipment Plans and Details

8.1.28 Tailings Basin Buildings

The Tailings Basin buildings are located near the southeast corner of Cell 2W and were and will be used for storage, offices, oil dispensing, and locker rooms. They include the following buildings; Foreman's Office (718), Reporting Building (719), Lube House (720), Reporting Building (724), and Lube Oil Building (725).

There are no reference drawings for the Tailings Basin Buildings. However, the following dimensions of each building are shown below:

Foreman's Office (719) – 20' x 40'
Reporting Building (718) – 20' x 40'
Lube House (720) – 12' x 22'
Reporting Building (724) – 12' x 22' w/ 6' x 12' lean-to
Lube Oil Building (725) – 12' x 21'

8.1.29 Area 2 Water Tower

The Water Tower at Area 2 is in a poor deteriorated condition and will not be used as part of the project. The Water Tower at Area 2 will be demolished prior to Phase 1 Construction, but may remain in place at the end of year 1.

The Area 2 Water Tower site shall be left as follows:

- Area 2 Water Tower would be removed to top of existing grade (top of concrete piers).
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

Reference Drawings for the Water Towers:

TG-162	Fire Fighting System Concrete Masonry 100,000 Gal. Elevated Tank Foundation Details
TG-163	Fire Fighting System Concrete Reinforcing 100,000 Gal. Elevated Tank Foundation Details

8.2 General Facilities – Existing Plant

8.2.1 Sanitary Systems and Well

The septic systems will be pumped out and the tanks filled with soil or crushed rock and backfilled. The well will be sealed by a licensed well driller in accordance with Minnesota Department of Health rules. Sanitary systems and well (See Figure 3 for locations).

- Area 1 Shops Septic System
- Area 2 Shops Septic System
- Administration Building Septic System
- Administration Building Well No. 665923
- Tailings Basin Reporting Septic System
- Booster Pumphouse #1 Septic System

Reference Drawings for the sanitary systems include:

Figure 3-1	Sanitary System Locations
MH-1-3	West Pit Service Area (Area 1) Detail of Sanitary Sewer Line
MH-22-2	Area #2 Service Area Septic Tank Details
MH-24	Area #2 Service Area Details of Sanitary Sewer & Floor Drains
TL-2-215	Wastewater Treatment System Improvements
TB-7-175	Tailings Basin Reporting Center Plot Plan
B-TB-7-202	Tailing Basin Reporting Center Alternate Sewage Disposal Method

8.2.2 Pipelines, Pipe Galleries, and Tunnels

Pipelines that will not remain as regional infrastructure will be removed, recycled or disposed, or abandoned in place. Major pipeline systems include (see Figure 4 for locations):

- Tailings Transport and Deposition- tailings transport lines from Booster Pumphouse #1 to the basin ponds reclaim water line from Barge #2 to Barge #1, water reclaim line from Barge #1 to the Concentrator
- Water Supply Pipeline from Colby Lake Pumphouse to the Plant Reservoir
- Inter-Pit Pipeline from the Plant Reservoir to the Area 1 Shop and Area 2 Shop
- Natural Gas Line from the Town Border Station to the demolished Pellet Plant

Above-ground pipelines will be disassembled or demolished and the material recycled or disposed. Underground pipelines will be abandoned in place. Manholes and above-ground pipeline supports and foundations will be demolished to ground level or below and covered with at least two feet of soil. Surface disturbances will be ripped and vegetated to achieve final reclamation.

Tunnels and Pipe Galleries (see Figure 2) shall be left in the following condition:

- Pipe Galleries shall be removed in total.
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.
- Tunnels shall have contents removed and shall be sealed in place.

Reference Drawings for the Pipe Lines, Pipe Galleries, and Tunnels include:

Figure 2	Pipe Gallery/Tunnel Detail
Figure 4	Pipeline Locations

8.2.3 Power Lines and Substations

Power lines (poles, pole hardware and conductors) and substations that will not remain as regional infrastructure will be removed and recycled. Foundations and anchors will be removed or demolished to at least ground surface and covered with at least two feet of soil and vegetated to achieve final reclamation. During Phase 1 construction, the unused power lines from Area 1 to North gate and Area 2 West Pit are to be reclaimed. In addition, due to degrading structural integrity and as preemptive fault prevention, the power line from the P1 substation to the 411 distribution line shall be reclaimed. However, for this specification, assume that these are part of Year 1 demolition.

Power lines to be removed include (See Figure 5 and 5-1 for locations):

- 13.8 Kv Line from the Main Substation to Colby Lake Pumphouse
- 13.8 Kv Lines from the Main Substation to Area 1 Shop and Area 2 Shop
- 13.8Kv and 4.16 Kv distribution lines from the Main Substation to the Tailings Basin and at the Tailings Basin (except those needed to support the Interception Wells and the Tailings Basin Waste Water Treatment Facility)
- 13.8 Kv distribution lines at the Mine Site (except those needed to support the Mine Site Waste Water Treatment Facility)
- 16,000ft of 3 conductor cable starting at Area 1 shop and heading along the north road (rd 666), ending at the North gate. (Figure 5-1)
- 21,800ft of 3 conductor cable starting at the main switch yard and heading south around Area 2 West mine pit. (Figure 5-1)
- 4,000ft of 3 conductor cable starting at the switch yard and heading east to Area 2 shop/ SD-026 pumping station. (Figure 5-1)

Reference Drawings for the Power Lines include:

Figure 5	Power Line Locations
Figure 5-1	Power Line Demo
TD-4-1308	Tailings Basin Power Distribution
TD-1	Power Distribution One Line Diagram Sheet 1 of 2
TD-2	Power Distribution One Line Diagram Sheet 2 of 2
TD-4-1259	Mine Power Distribution 13.8KV One-line Diagram

8.2.4 Tanks

The inventory of tanks that will require demolition is included in Table 2-3. See Figure 6 for locations of tanks.

Large above-ground storage tanks will be cleaned and painted surfaces tested for lead prior to demolition. Tanks with insulation and associated wall and/or roof covers will be evaluated for potential asbestos containing material. Insulation and coverings will be removed and disposed appropriately. Tank cleaning will remove remaining materials and sludge. The tanks will be cleaned and removed materials and cleaning residues will be sent to an appropriate recycling or waste disposal facility.

Tanks will be disassembled for disposal or recycling as appropriate. Where lead paint abatement is required, the disposal/recycling will be modified to accommodate the lead content. Below-grade foundations will be left in place and covered with a minimum of two feet of soil and vegetated. Smaller above-ground storage tanks will be cleaned and removed without disassembly.

Table 2-3 Inventory of Existing Tanks Requiring Demolition (See Figure 6 for Locations)

Tank Number	AST Contents (Above-Ground Storage Tanks) *All Tanks are out of service and outdoors unless stated otherwise*	Location	Storage Tank Size (gallons)
015	Fuel Oil	Concentrator	12,000
304	Mineral Oil	Concentrator	12,000
305	Mineral Oil	Concentrator	12,000
306	Mineral Oil	Concentrator	12,000
421	Waste Oil	Concentrator	
032	Fuel Oil (tanks have been cleaned)	Pellet Plant	3,384,000
033	Fuel Oil (tanks have been cleaned)	Pellet Plant	3,384,000
034	Fuel Oil (tanks have been cleaned)	Pellet Plant	3,384,000
080	Fuel Oil	Area 1 – Railroad South Grade Area	20,000
121	Gasoline (in-service)	Guard House – Entrance of County Road 666	6,000
122	Gasoline (in-service)	Guard House – Entrance off County Road 666	6,000
001	Fuel Oil (Underground)	Administration Building	

Reference Drawings for the Tanks include:

TH-67	Fuel Oil Storage & Distribution General Arrangement
TH-70	Fuel Oil Storage & Distribution Storage Tanks General Arrangement & Section
TH-81	Fuel Oil Storage & Distribution Steam Condensate & Hot Water Flow Diagram
TH-83	Fuel Oil Storage & Distribution Piping Inside of Storage Tanks
TH-134	Fuel Oil Storage & Distribution Concrete Masonry & Reinforcing Fuel Oil Storage Tank Ring Wall
TH-199	Fuel Oil Storage & Distribution Service Tanks & Misc. Tank Supports Conc. Masonry & Reinf. Plan, Sects. & Details
Figure 6	Outdoor Tank Locations

8.2.5 Railroad Tracks

Railroad track and ties controlled by PolyMet will be removed and recycled or disposed. Reclamation with overburden and subsequent vegetation will be used where roadbed is not needed for access. See Figure 7 for locations.

Railroad tracks to be grouped as follows:

- Existing track in the Plant Site area

Reference drawings include:

Figure 7	Railroad track locations
C1	Krech Ojard Drawing Ore Concentrates Handling

8.2.6 Roads and Parking Lots

Plant area roads which are deemed not necessary for access by the MDNR will be abandoned, scarified, and vegetated. Asphalt from paved surfaces will be removed and recycled. Reclamation of roads not controlled by PolyMet, such as the Dunka Road and the road from the North Gate, are not included in this plan or estimate; reclamation of these features is the responsibility of the owner of record for the roads. See Figure 9 for locations.

Building areas, roads and parking lots will be reclaimed and vegetated according to Minnesota Rules 6132.2700 by a qualified reclamation contractor. Any roads that may develop into unofficial off-road vehicle trails (Minnesota Rules 6132.3200) will require a variance to allow a 15-foot wide unpaved and un-vegetated track down the centerline of the road once reclamation is completed.

Roads and parking lots are to be grouped as follows:

- Existing roads and parking lots in the Plant Site area
- Existing roads in the Tailings Basin

Reference drawings include:

Figure 9	Road and Parking Lot Locations
Figure 9A	Road and Parking Lot Locations – Process Plant Detail
TJ-3-015	Plant site Parking Arrangement

TJ-3-026 Parking & Driveway Arrangement Administration Building

9.0 Twenty Year Demolition Plan

Within three (3) years after closure begins, all buildings and structures will be removed and foundations razed to grade level. Provisions may be made for continued subsequent use of mine facilities that will have future benefits to the area including, pipelines, transmission lines, roads, and railroad lines. However, for the purposes of this document it shall be assumed that all of the PolyMet facilities must be removed and the facility footprints reclaimed.

The timing of demolition for the individual buildings shall be suggested by the Contractor. All facilities listed in Sections 9.1 to 9.3 will be demolished over a maximum period of three years. Facilities described in Section 9.4 may remain in service after closure and will be bid separately (see Section 9.4).

For building, area or equipment locations listed as headings in the following sections for the plants reference Figures 1 and 1A for details.

For major process equipment reference the Equipment List (attached) and the Process Flow Diagrams (attached).

For the new facilities preliminary design drawings (i.e. layouts, arrangements) are provided for the Contractor. Note that the drawings shown are preliminary design layouts. The layout of equipment, etc. will change throughout the design process. These drawings show equipment and building sizes that are approximate. PolyMet will provide more information to the selected Contractor as more detailed design drawings become available.

9.1 Plant Site Facilities Constructed by PolyMet in Phase 1

9.1.1 Flotation Plant and Reagent Storage Building

A new Flotation Plant and Reagent Storage Building will be constructed as part of the Phase 1 Project operation. These buildings will be used to extract the sulfide minerals from the ore.
The flotation plant will house the following large pieces of equipment:

- Flotation Cells of varying sizes of tanks and drive systems
- Fine grinding mill
- Froth and slurry pumps
- Reagent storage tanks and mixing systems

The site shall be left as follows:

- Remove structures and equipment above grade 1616’-0”.
- Fill areas below 1616’-0” with clean fill.
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

The reference drawings for the Flotation Plant and Reagent Storage Building include:

SK-11-067	Option 20 Plant Layout Plan
025-15-11-013	Northmet Project General Arrangement Flotation Area - Section
025-15-11-014	Northmet Project General Arrangement Reagent Area – Sections
025-15-11-015	Northmet Project General Arrangement Section G
025-15-11-016	Northmet Project General Arrangement Section H
025-15-11-017	Northmet Project General Arrangement Section K
E0-18-11-400	Architectural Flotation Annex – Exterior Shell Cover Sheet
E0-18-11-401	Architectural Flotation Annex – Exterior Shell Floor Plan
E0-18-11-402	Architectural Flotation Annex – Exterior Shell Roof Plan
E0-18-11-411	Architectural Flotation Annex – Exterior Shell Building Elevations
E0-18-11-412	Architectural Flotation Annex – Exterior Shell Building Elevations
E0-18-11-421	Architectural Flotation Annex – Exterior Shell Building Sections
E0-18-11-422	Architectural Flotation Annex – Exterior Shell Building Sections/Door Schedule
E0-18-11-431	Architectural Flotation Annex – Exterior Shell Wall Sections
E0-18-11-432	Architectural Flotation Annex – Exterior Shell Wall Sections
E0-18-11-461	Architectural Flotation Annex – Exterior Shell Details
E0-18-11-462	Architectural Flotation Annex – Exterior Shell Details
E0-18-11-463	Architectural Flotation Annex – Exterior Shell Details

Note that the drawings shown are preliminary design layouts. The layout of equipment, etc. will change throughout the design process. These drawings show equipment and building sizes that are approximate. PolyMet will provide more information to the selected Contractor as more detailed design drawings become available.

9.1.2 Concentrate Storage and Loadout Facility

A new Concentrate Storage and Loadout Facility will be constructed as part of the Phase 1 Project operation. The location of these facilities will be close to existing location of the existing heating/additive plant that will no longer be required. The Concentrate Storage Building will be used to store copper and nickel concentrates for shipment via rail. The Concentrate Loadout Facility will be used to load concentrate into rail cars prior to shipment. These building will house the following large pieces of equipment:

- Concentrate tanks and thickeners
- Concentrate filter press (2 ea.)
- Conveyor systems

The site shall be left as follows:

- Remove structures and equipment above grade 1581’-0” (top of finished floor).
- Fill areas below 1581’-0” with clean fill.
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

The reference drawings for the Concentrate Storage and Loadout Facility include:

SK-11-033	Preliminary Filter ISO Layout
SK-11-038	Building Layout Option 2 Elevations Conveyor Feed System
SK-11-039	Building Layout Option 2 Plan Conveyor Feed System
027-P120-001-001	Copper Concentrate Loadout Process Flow Diagram
028-P120-001-001	Nickel Concentrate Loadout Process Flow Diagram

Note: No drawings have been created for the Concentrate Storage Facility. The amount of storage capacity and thus the size of the facility are being determined.

Note that the drawings shown are preliminary design layouts. The layout of equipment, etc. will change throughout the design process. These drawings show equipment and

building sizes that are approximate. PolyMet will provide more information to the selected Contractor as more detailed design drawings become available.

9.1.3 Plant Site Sewage Treatment

A new Plant Site Sewage Treatment plant will be constructed as part of the Phase 1 Project operation. The location of this facility will be at the location of the existing Sewage Treatment Plant. The building will house the following large pieces of equipment:

- Grinder pump
- Submersible pumps (2ea.)
- Valves and piping systems

The site shall be left as follows:

- Remove structures and equipment above grade 1548'-5" (top of finished floor).
- Fill areas below 1548'-5" with clean fill.
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

The reference drawings for the Plant Site Sewage Treatment Plant include:

SWGT-001	Overall Site Plan
SWGT-002	Mechanical Treatment Site Plan
SWGT-003	Stabilized Pond Option
SWGT-004	Lift Station and Grinder Pump Details
SWGT-005	Lift Station Details Stabilization Pond Option
SWGT-006	Miscellaneous Details

Note that the drawings shown are preliminary design layouts. The layout of equipment, etc. will change throughout the design process. These drawings show equipment and building sizes that are approximate. PolyMet will provide more information to the selected Contractor as more detailed design drawings become available.

9.2 Mine Site Facilities Constructed by PolyMet in Phase 1

9.2.1 Maintenance Service and Fueling Facility

As part of the Phase 1 operation a new Maintenance Service Facility and Fueling Facility will be built at the mine site. These facilities will be used for light maintenance and fueling of mining equipment.

The site shall be left as follows:

- Maintenance Service Facility shall be removed in total.
- Fueling Facility shall be removed in total.
- Foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

Reference Drawings for the Maintenance Service and Fueling Facility include (note that there are 2 each of the building represented in the following drawings):

D93-048205-00	Cover Drawing
D93-048205-01	Specific Anchor Bolt Drawing
D93-048205-01A	Specific Reaction Drawing
D93-048205-01B	Anchor Bolt Detail Sheet
D93-048205-02	Cross Section Erection Drawing
D93-048205-02A	Cross Section Erection Drawing Detail Sheet
D93-048205-03	Wind Bracing Drawing
D93-048205-04	Roof Secondary Structural Framing Plan
D93-048205-04A	Roof Secondary Structural Detail Sheet
D93-048205-05	Wall Secondary Structural Elevation
D93-048205-05B	Wall Secondary Structural Elevation
D93-048205-05C	Wall Secondary Structural Elevation
D93-048205-05D	Wall Secondary Structural Elevation Detail Sheet
D93-048205-06	Wall Panel Drawing
D93-048205-06A	Wall Panel Drawing
D93-048205-07	Roof Panel Drawing
TH-1-066	Mobile Equipment Fueling Building Concrete Slab – Area 6, 2E, & 2WX

9.2.2 Rail Transfer Hopper

The rail transfer hopper is located at the mine site. The Rail Transfer Hopper is used to hold ore dumped via truck and subsequently fill rail cars for transport of ore to the Plant. The Rail Transfer Hopper includes a Control Building, and Platform.

The site shall be left as follows:

- Rail Transfer Hopper shall be removed in total.
- Foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

Reference Drawings for the Rail Transfer Hopper include:

Barr Engineering	SOW – 15 Rail Transfer Hopper
93909-S1	Area II East Superpocket

	Electrical & Hydraulic Room Plans & Elevations
93909-A3	Area II East Superpocket Control Room Steel Elevations
93909-A1	Area II East Superpocket Control Room Plans, Elevations & Details
93909-M3	Area II East Superpocket Discharge Chute Gate
93909-M2	Area II East Superpocket Discharge Chute
93909-M1	Area II East Superpocket Feeder Hopper Assembly
93909-3	Area II East Superpocket Section - A
93909-1	Area II East Superpocket Plot Plan

9.2.3 Central Pumping Station

The Central Pumping Station is located at the mine site. The Central Pumping Station is used to pump treated mine water back to the tailings basin for use in the plants.

The site shall be left as follows:

- Central Pumping Station shall be removed in total.
- Treated Water Pipeline from the Mine Site Central Pumping Station to the tailings basin shall be removed in total.
- Foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

Reference Drawings for the Central Pumping Station include:

Central pumping station
WWTF & CPS Plan

9.3. General Facilities – Phase 1

9.3.1 Pipelines

Pipelines that will not remain as regional infrastructure will be removed, recycled or disposed, or abandoned in place.

- Plant Site pipelines constructed by PolyMet (Phase 1)

- Mine Site pipelines constructed by PolyMet (Phase 1)

Above-ground pipelines will be disassembled or demolished and the material recycled or disposed. Underground pipelines will be abandoned in place. Manholes and above-ground pipeline supports and foundations will be demolished to ground level or below and covered with at least two feet of soil. Surface disturbances will be ripped and vegetated to achieve final reclamation.

Reference Drawings for the Pipe Lines:

Barr Engineering	SOW – 05 Process Water Systems
Barr Engineering	SOW – 06 WWTF
Barr Engineering	SOW – 08 TWP
Barr Engineering	SOW – 12 Tailings Basin Seepage Recovery
Barr Engineering	SOW – 14 Flotation Tailings Basin Dam Construction

9.3.2 Power Lines and Substations

Power lines (poles, pole hardware and conductors) and substations that will not remain as regional infrastructure will be removed and recycled. Foundations and anchors will be removed or demolished to at least ground surface and covered with at least two feet of soil and vegetated to achieve final reclamation.

Reference Drawings for the Power Lines include:

Barr Engineering	SOW – 13 Mine Site Electrical Distribution
SK-11-255	Building Layout Option 3 General Arrangement Plan

9.3.3 Railroad Tracks

Railroad track and ties controlled by PolyMet will be removed and recycled or disposed. Reclamation with overburden and subsequent vegetation will be used where roadbed is not needed for access. See Figure 7 for locations.

Railroad tracks to be grouped as follows:

- Plant Site track constructed by PolyMet for concentrate handling (Phase 1)
- Connection (CE main line to crusher feed) constructed by PolyMet (Phase 1)
- Mine Site spur for Rail Transfer Hopper (Phase 1)
- VSEP Concentrate Track (Phase 1)

Reference drawings include:

Figure 7	Railroad track locations
C1	Krech Ojard Drawing Ore Concentrates Handling
Barr Engineering	SOW – 16 Rail and Earthwork for Rail Transfer Hopper
Barr Engineering	SOW – 17 Rail Connection Track
Barr Engineering	SOW – 18 VSEP Concentrate Track
Barr Engineering	SOW – 19 Plant Site Rail

9.3.4 Roads and Parking Lots

Plant area roads which are deemed not necessary for access by the MDNR will be abandoned, scarified, and vegetated. Asphalt from paved surfaces will be removed and recycled. Reclamation of roads not controlled by PolyMet, such as the Dunka Road and the road from the North Gate, are not included in this plan or estimate; reclamation of these features is the responsibility of the owner of record for the roads. See Figure 9 for locations.

Building areas, roads and parking lots will be reclaimed and vegetated according to Minnesota Rules 6132.2700 by a qualified reclamation contractor. Any roads that may develop into unofficial off-road vehicle trails (Minnesota Rules 6132.3200) will require a variance to allow a 15-foot wide unpaved and un-vegetated track down the centerline of the road once reclamation is completed.

Roads and parking lots are to be grouped as follows:

- Plant Site roads and parking lots constructed by PolyMet (Phase 1)
- Mine Site roads and parking lots constructed by PolyMet (Phase 1)

Reference drawings include:

Barr Engineering	SOW – 01 Haul Roads
Figure 9	Road and Parking Lot Locations
Figure 9A	Road and Parking Lot Locations – Process Plant Detail
TJ-3-015	Plantsite Parking Arrangement
SK-11-255	Building Layout Option 3 General Arrangement Plan

9.4 Plant Site Facilities Constructed by PolyMet in Phase 2

9.4.1 Oxygen Plant, Limestone Preparation, Hydrometallurgical Plant, Hydrometallurgical Reagents

A Hydrometallurgical Processing Plant will be constructed as part of the Phase 2 Project operation. These buildings will be used to produce oxygen gas, process limestone, and house the Autoclave where high pressure and temperature is used to treat nickel concentrates to extract and isolate platinum group, precious metals, and base metals. At this time, no detailed engineering has been completed in regard to these buildings, therefore, only a general arrangement drawing is available.

The hydrometallurgical plant buildings will house the following large pieces of equipment:

- Autoclave
- Reagent storage tanks and mixing systems
- Cryogenic oxygen processing equipment
- Limestone processing and slurrification equipment
- Residue Transport and Deposition - residue transport lines from Booster Pumphouse #1 to the Hydrometallurgical Residue Facility
- Water reclaim line from the Hydrometallurgical Residue Facility to Booster Pumphouse #1
- Railroads
- Pipelines
- Power Lines
- Roads and Parking Lots

The site shall be left as follows:

- Remove structures and equipment above grade elevations.
- Fill areas below grade elevations with clean fill.
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.
- Railroad track and ties controlled by PolyMet will be removed and recycled or disposed. Reclamation with overburden and subsequent vegetation will be used where roadbed is not needed for access. See Figure 7 for locations.
- Above-ground pipelines will be disassembled or demolished and the material recycled or disposed. Underground pipelines will be abandoned in place. Manholes and above-ground pipeline supports and foundations will be demolished to ground level or below and covered with at least two feet of soil. Surface disturbances will be ripped and vegetated to achieve final reclamation.
- Power lines (poles, pole hardware and conductors) and substations that will not remain as regional infrastructure will be removed and recycled. Foundations and anchors will be removed or demolished to at least ground surface and covered with at least two feet of soil and vegetated to achieve final reclamation.
- Roads and parking lots will be reclaimed and vegetated according to Minnesota

Rules 6132.2700 by a qualified reclamation contractor. Any roads that may develop into unofficial off-road vehicle trails (Minnesota Rules 6132.3200) will require a variance to allow a 15-foot wide unpaved and un-vegetated track down the centerline of the road once reclamation is completed.

9.5 Facilities Needed for Closure – demolition date (To Be Determined)

9.5.1 Mine Site Waste Water Treatment Facility (Including power supply from main substation and pipelines from WWTF to East and West Pits)

There will be a Mine Site Waste Water Treatment Facility that may remain at closure for a number of years while the pits are filling with water. At the time of this writing, the length of time that the facility must remain in service has not been well defined. At this time, no detailed engineering has been completed in regard to this building, therefore, only general arrangement drawings are available. Note: For purposes of this demolition specification, assume that the equalizer basins and CPS pond and liners will be demolished and reclaimed by another party.

The Mine Site Waste Water Treatment Facility (WWTF) will house the following large pieces of equipment:

- Chemical storage tanks and mixing systems
- Reverse Osmosis water processing equipment
- Chemical precipitation thickener tanks
- Pumping systems
- Greensand filtering systems
- Filter presses

The site shall be left as follows:

- Remove structures and equipment above grade elevations.
- Fill areas below grade elevations with clean fill.
- Remaining floor and/or foundations will be covered with a minimum of two feet of surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.
- Above-ground pipelines will be disassembled or demolished and the material recycled or disposed. Underground pipelines will be abandoned in place. Manholes and above-ground pipeline supports and foundations will be demolished to ground level or below and covered with at least two feet of soil. Surface disturbances will be ripped and vegetated to achieve final reclamation.

- Railroad track and ties controlled by PolyMet will be removed and recycled or disposed. Reclamation with overburden and subsequent vegetation will be used where roadbed is not needed for access.
- Power lines (poles, pole hardware and conductors) and substations that will not remain as regional infrastructure will be removed and recycled. Foundations and anchors will be removed or demolished to at least ground surface and covered with at least two feet of soil and vegetated to achieve final reclamation.
- Roads and parking lots will be reclaimed and vegetated according to Minnesota Rules 6132.2700 by a qualified reclamation contractor. Any roads that may develop into unofficial off-road vehicle trails (Minnesota Rules 6132.3200) will require a variance to allow a 15-foot wide unpaved and un-vegetated track down the centerline of the road once reclamation is completed.

Reference drawings include:

Barr Engineering SOW – 06 WWTF

9.5.2 Tailings Basin Waste Water Treatment Plant (Including power supply from main substation, containment system, collection pumps and piping at toe of tailings basin, pipelines from collection system to WWTP, and pipelines from WWTP to discharge points)

There will be a Tailings Basin Waste Water Treatment Plant that may remain at closure for a number of years to control water at the tailings basin. At the time of this writing, the length of time that the facility must remain in service has not been well defined. At this time, no detailed engineering has been completed in regard to this building, therefore, only general arrangement drawings are available. Note: For purposes of this demolition specification, assume that the pretreatment basin and liner will be demolished and reclaimed by another party.

The Tailings Basin Waste Water Treatment Plant (WWTP) will house the following large pieces of equipment:

- Limestone storage tanks and mixing systems
- Reverse Osmosis water processing equipment
- Pumping systems
- Greensand filtering systems

The site shall be left as follows:

- Remove structures and equipment above grade elevations.
- Fill areas below grade elevations with clean fill.
- Remaining floor and/or foundations will be covered with a minimum of two feet of

surface overburden (topsoil) and vegetated according to Minnesota Rules 6132.3200.

- Above-ground pipelines will be disassembled or demolished and the material recycled or disposed. Underground pipelines will be abandoned in place. Manholes and above-ground pipeline supports and foundations will be demolished to ground level or below and covered with at least two feet of soil. Surface disturbances will be ripped and vegetated to achieve final reclamation.
- Power lines (poles, pole hardware and conductors) and substations that will not remain as regional infrastructure will be removed and recycled. Foundations and anchors will be removed or demolished to at least ground surface and covered with at least two feet of soil and vegetated to achieve final reclamation.
- Roads and parking lots will be reclaimed and vegetated according to Minnesota Rules 6132.2700 by a qualified reclamation contractor. Any roads that may develop into unofficial off-road vehicle trails (Minnesota Rules 6132.3200) will require a variance to allow a 15-foot wide unpaved and un-vegetated track down the centerline of the road once reclamation is completed.

Reference drawings include:

Barr Engineering SOW – 20 WWTP

10.0 Demolition Waste Disposal Plan

Demolition waste from structure removal will be disposed of in an off-site landfill. Concrete from demolition will be placed in building basements where possible including coarse crusher basement, fine crusher basement and concentrator basement and the Plant Reservoir. (See Figure 2-06 for locations.)

11.0 Special Material Disposal

Surveys for Asbestos-Containing Materials (ACMs) have been completed. ACMs (i.e., pipe and electrical insulation) in utility tunnels will be sealed prior to the tunnels being sealed.

During initial closure of the Cliffs Erie facility, all PCB transformers (including sixteen large ones) and capacitors were removed and properly disposed.

During closure of the Cliffs Erie facility, all nuclear sources were inventoried and disposed.

Partially used paint, chemical and petroleum products will be collected and properly disposed.

Fluorescent and sodium halide bulbs will be removed from fixtures collected and properly disposed.

12.0 Cover and Vegetation of Building Area, Road, Parking Lots

After demolition of facilities listed in Sections 8 and 9, 2 feet of overburden material suitable for vegetation will be placed upon the facility's former footprint. Plant area roads which are not deemed necessary for access by the MDNR will also be abandoned and, if necessary, covered with 2 feet of overburden material that is suitable for vegetation. Asphalt from paved surfaces will be removed and recycled. Reclamation of roads not controlled by PolyMet, such as the Dunka Road, and the road from the North Gate are not contained within this estimate.

Building areas, roads and parking lots will be reclaimed and vegetated according to Minnesota Rules 6132.2700. Any roads that may develop into unofficial off-road vehicle trails (Minnesota Rules 6132.3200) will require a variance to allow a 15-foot wide unpaved and un-vegetated track down the centerline of the road.

Attachment F2

Lakehead Estimates

September 1, 2016

Mike Glissman
Polymet Mining

Re: 2013 Northmet Closure and Demolition Price Proposal Update

Mr. Glissman

The terms and conditions of our proposal response to the Polymet Inquiry No. PR-0027 dated 6 August 2013 remain unchanged for bid form item 1except as amended by the following;

- Subsequent pricing requests, latest of which is per the provided Closure and Demolition Specification (Structures and Equipment Only) Rev. 4 document, associated spreadsheet titled “demo data needed final adjustments 7-28-2016” and scope clarification emails and attachments provided.
- Attached version of the aforementioned spreadsheet is current as of August 15, 2016.
- The labor and equipment rates provided are no longer current and would be subject to change dependent upon final contract date.

Conditions and pricing for additional bid items found in our proposal are no longer valid or have been subsequently updated or amended by alternate pricing requests.

Sincerely,

Brad Jones

Brad Jones
Sr. Estimator
Lakehead Constructors

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Demo and Asbestos Abatement Cost Summary

Scope of Work Description	Demo Specification Section Number	Reference Information / Drawings	Lakehead 2014 Updates: Miscellaneous	Universal Waste Collection	Galbestos Removal	Demolition	Total Demo	Site Restoration	Assets Recovery	ACT 10/11/13: Asbestos Lead Paint Mold
Pre-Demolition Services			$54,400							
Legacy - demoed as part of construction										
Additive Building & Heating Plant		Galbestos removal included in ACT abatement		$7,500.00		$932,800.00	$940,300	$53,000.00		$600,000.00
Bentonite silos	8.1.14						$1,326,500			
Area 2 Water Tower (price separate from Heating & Additives buildings)	8.1.29									
Legacy Tailings Basin Buildings - Demoed as part of construction										
Foreman's Office (Bldg. 718)	8.1.28	No ACT report			~~$13,500.00~~	$9,350.00		$400.00		
Reporting Building (Bldg. 719)	8.1.28	No ACT report			~~$15,400.00~~	$9,900.00		$400.00		
Lube House (Bldg. 720)	8.1.28	No ACT report			~~$2,500.00~~	$2,500.00		$400.00		
Reporting Building (Bldg. 724)	8.1.28	No ACT report			~~$3,300.00~~	$3,300.00		$400.00		
Lube Oil Building (Bldg. 725)	8.1.28	No ACT report			~~$2,500.00~~	$2,500.00		$400.00		
							inc in above			
Legacy Area 1 - used by project										
Area 1 Shop and Truck Storage (Bldg. 220)	8.1.6	ACT Report Zone H		$2,900.00	$106,900	$103,332	$213,132	$74,669	$37,000	
Area 1 Cold Storage (Bldg. 221)	8.1.6	ACT Report Zone H		$400.00	$48,970	$10,860	$60,230	$13,400	$2,800	
Area 1 Reporting Building (Bldg. 231)	8.1.6	No ACT report				$9,900				
Area 1 Boiler House (Bldg. 226)	8.1.6	ACT Report Zone H		$200.00	$13,500	$9,875	$23,575	$3,000	$200	
Area 1 Fire Pump House & Water Tank (Bldg. 228)	8.1.6	TE-8-142 and TE-8-144, ACT Report Zone H		$410.00		$11,250	$11,660			
Area 1 Locomotive Fueling	8.1.6	ACT Report Zone H		$500.00	$22,500	$10,100	$33,100	$6,250	$1,000	
Legacy Area 2 - used by project										
Area 2 Service Shop (Bldg. 201)	8.1.7	ACT Report Zone I		$2,200.00	$160,900	$38,990	$202,090	$37,334	$10,940	
Area 2 Truck Storage (Bldg. 202)	8.1.7	ACT Report Zone I		$2,000.00	$63,190	$9,175	$74,365	$13,988	$3,075	
Area 2 Cold Storage (204)	8.1.7	ACT Report Zone I		$697.00	$42,560	$13,080	$56,337	$14,100	$1,700	
Area 2 Shop Locomotive Service Shop (Bldg. 203)	8.1.7	ACT Report Zone I		$3,400.00	$20,500	$12,300	$36,200	$11,113	$1,625	
Area 2 Locomotive Fueling	8.1.7	ACT Report Zone I		$2,000.00	$20,900	$11,800	$34,700	$6,250	$975	
Hose House (Bldg. 209) Not to be used in project	8.1.7	No ACT report			$3,000	$9,150				
Sample House (Bldg. 208) Not to be used in project	8.1.7	No ACT report			$25,400	$20,300				
Reporting Building (Bldg. 425) Not to be used in project	8.1.7	No ACT report			$3,300	$9,200				
Legacy Plant Area - used by project										
Rebuild Shop (Bldg 602)	8.1.9	ACT Report Zone A		$3,000.00	$70,200	$125,600	$198,800	$27,560	$13,940	
General Shop (Bldg. 601) Includes Acetylene Building (Bldg.604)	8.1.8	ACT Report Zone A		$15,000.00	$199,190	$353,600	$567,790	$182,300	$113,796	
Carpenter Shop (Bldg. 603)	8.1.21	ACT Report Zone A		$2,000.00	$10,200	$13,250	$25,450	$3,300	$100	
Coarse Crusher	8.1.1			$10,000.00	$313,345	$1,551,800	$1,875,145	$593,890	$199,325	
Drive House 1 conv and housings	8.1.2	Drive Houses 1 & 2 and conveyors are all considered	$133,200	$7,500.00	$165,569	$141,540	$314,609	$46,900	$41,050	
Drive House 2 inc conv and housings	8.1.3	to be one structure	inc in above		inc in above	inc in above	inc in above	inc in above	inc in above	
Fine Crusher	8.1.4			$45,000.00	$302,430	$1,373,460	$1,720,890	$203,400	$205,250	
Warehouse 49 (Bldg. 920)	8.1.16	ACT Report Zone A		$6,500.00	$27,586	$82,800	$116,886	$15,947	$5,350	
Warehouse 45 (Bldg. 921, Electrical)	8.1.15	ACT Report Zone A		$2,500.00	$35,159	$72,700	$110,359	$15,947	$3,590	
Lube House (Bldg. 926)	8.1.10	ACT Report Lubricant Storage Building		$578.00	$17,000	$20,550	$38,128	$7,385	$1,600	
Rubber Shop (Bldg. 605)	8.1.26	ACT Report Rubber Storage Building		$1,000.00	$30,464	$36,550	$68,014	$11,269	$5,150	
Concentrator Building and Thickeners	8.1.5 AND 8.1.25			$100,000.00	$1,248,260	$5,895,850	$7,244,110	$1,145,998	$2,141,430	
A-Lab	8.1.11			$500.00	$9,400	$14,560	$24,460	$2,940	$2,450	
Hinsdale Bridge	8.1.24			$0.00	$16,700	$616,300	$633,000	$15,200	$148,500	
Water Reservoir	8.1.12			$5,000.00		$98,100	$103,100	$914,400	$7,750	
Plant Site Water Tower	8.1.12	TG-7-005, Similar to Area 2 water tower				$30,000	$30,000	$2,500	$1,125	
Water Treatment Plant & Storage Tanks	8.1.27	TG-6-021		$1,000.00	$20,000	$72,600	$93,600	$2,250		
Colby Pump House	8.1.13				$41,000	$8,260	$49,260	$1,500		
Administration Building	8.1.17			$3,900.00		$157,935	$161,835	$18,200		
Main Gate	8.1.18			$100.00		$11,400	$11,500	$875		
Booster Pump House #1	8.1.19			$300.00		$23,500	$23,800	$9,200		
Sewage Treatment Plant	8.1.20	No ACT report		$0.00		$62,700	$62,700	$19,520		

Demo and Asbestos Abatement Cost Summary

			Lakehead 2014 Updates							ACT 10/11/13
Scope of Work Description	**Demo Specification Section Number**	**Reference Information / Drawings**	**Miscellaneous**	**Universal Waste Collection**	**Galbestos Removal**	**Demolition**	**Total Demo**	**Site Restoration**	**Assets Recovery**	**Asbestos Lead Paint Mold**
Portable Pump Houses	8.1.22	No ACM materials - See Dwg. TB-7-095		$0.00		$9,890	$9,890	$3,400		
Return Water Barge	8.1.23	No ACT report		$0.00		$44,900	$44,900			
General Infrastructure (railroads, tunnels, roadways, etc)						$4,988,921	$4,988,921	$1,504,000	$237,500	
Railroads	8.2.5	Figure 7 and Krech & Ojard Dwg. C1		$0.00		$380,000	$380,000			
Tunnels	8.2.2	TJ-63		$0.00		$1,856,000	$1,856,000			
Galleries	8.2.2	Was estimated as a portion of the concentrator								
Sanitary Systems and Wells	8.2.1					$17,500				
Pipelines				$0.00		$2,190,000	$2,190,000	$591,000		
Colby Lake water supply	8.2.2					$900,000		$98,000		
Inter pit pipeline	8.2.2					$562,000				
Natural Gas line	8.2.2					$150,000				
Tailings management above ground	8.2.2					$378,000				
Tailings management underground						$200,000				
Power Lines	8.2.3	Figures 5 & 5.1		$0.00		$97,810.00	$97,810			
Roads and Parking Lots	8.2.6	Figure 9		$0.00		$465,000	$465,000	$195,000		
New - Phase 1 - Plant Site										
Flotation Plant and Reagent Building	9.1.1			$75,000		$621,800	$696,800	$147,600	$242,500	
Concentrate Storage and Loadout Facility	9.1.2			$12,000		$273,760	$285,760	$48,100	$37,500	
Plant Site Sewage Treatment Plant	9.1.3	See Barr SOW 23 & Dwg. TL-2		$1,000.00		$118,000	$118,000	$30,000		
Railroads	9.3.3	See Barr SOW 19		$0.00		$185,000		$111,000		
Pipelines	9.3.1	SOW 12 and 14		$0.00		$1,555,000		$375,000		
Power Lines	9.3.2	SK-11-255		$0.00						
Roads and Parking Lots	9.3.4			$0.00						
Plant Site Wastewater Treatment Plant (WWTP)	9.5.2	See Barr SOW 20		$0.00		$245,000				
New - Phase 1 - Mine Site										
Maintenance Service and Fueling Facility	9.2.1			$1,100		$19,210	$20,310	$7,300	$1,200	
Rail Transfer Hopper	9.2.2	See Barr SOW 15		$1,100.00		$40,000	$41,100	$45,000	$1,200	
Rail Transfer Hopper Control Bldg	9.2.2	See Barr SOW 15		$100.00		$18,600	$18,700			
Rail Transfer Hopper Platform	9.2.2	See Barr SOW 15				$60,000	$60,000			
Central Pumping Station	9.2.3	See Barr SOW 7		$500.00		$14,000	$14,500	$1,200		
Railroads	9.2.4	See Barr SOW's 16, 17, 18		$0.00		$45,000	$45,000	$33,750		
Pipelines	9.3.1	See Barr SOW'S 05, 06, and 08		$0.00		$580,133	$580,133	$217,000		
Power Lines	9.3.2	See Barr SOW 13		$0.00		$83,900	$83,900		$7,175	
Roads and Parking Lots	9.3.4	See Barr SOW 1		$0.00		$392,000	$392,000	$132,000		
Mine Site Wastewater Treatment Facility (WWTF)	9.5.1	See Barr SOW 06		$0		$498,000	$498,000	$14,000		
New - Phase 2							$0			
Reagent Building	9.4.1	Bldg. Dims: 270' x 85' x 75' tall		$15,000.00		$820,000	$835,000	$4,100	$22,500	
Oxygen Plant	9.4.1	310' x 310' x 75' tall		$65,000.00		$4,238,600	$4,303,600	$16,600	$72,500	
Limestone Preparation	9.4.1	125' x 70' x 60' tall		$7,500.00		$345,000	$352,500	$1,750	$12,500	
Hydrometallurgical Plant	9.4.1	525' x 144' x 90' tall		$49,000.00		$4,365,000	$4,414,000	$13,500	$62,500	
Hydrometallurgical Reagents	9.4.1	144' x 90' x 90' tall		$15,000.00		$815,000	$830,000	$2,200	$17,500	
Railroads	9.4.1	Already bid, part of existing / Phase 1 infrastructure		$0.00						
Pipelines	9.4.1	Based on size of buildings and quantities in other buildings on site.		$0.00		$1,450,000				
Power Lines	9.4.1	Already bid, part of existing / Phase 1 infrastructure		$0.00						
Roads and Parking Lots	9.4.1	Based on size of buildings and quantities in other buildings on site.		$0.00		$156,000		$59,225		

NorthMet Contingency Reclamation Estimate

9/4/2014

Above Ground Storage Tanks

Name	Tank #	Fluid	Gallons	Location	Fluid Removal/ Disposal	Demolition/ Removal	Asbestos Lead Paint	Site Restoration	Assets Recovery	Notes
Legacy - Area 1 Shop					$0	$24,100	$0	$3,000		**to Demo tab**
Portable tank on skids (silver)	048	Fuel Oil	1,800	E of Area 1 Shop		$600				Out of Service - Disconnected, Labeled lube oil, Silver tank
Storage Tank	080		20,000	Area 1 - South of Rail Road Grade		$1,000				BASIS: Costs based on conceptual plan, site experience and historical knowledge.
Storage Tank	358	Used Anti-freeze		N. Side Area 1 Shop		$0				Included as part of Area 1 Shop demo
Storage Tank	420	Used Anti-freeze		N. Side Area 1 Shop		$0				Included as part of Area 1 Shop demo
Black Tank	n/a		20,000	N of Area 1 Shop		$7,500		$1,000.00	$1,500.00	
Black Tank	n/a		20,000	N of Area 1 Shop		$7,500		$1,000.00	$1,500.00	
3 Blue			20,000	N of Area 1 Shop		$7,500		$1,000.00	$1,500.00	Out of Service. Disconnected, Labeled "save for conc."
~~Locomotive Fueling~~		~~# 1,2 Fuel Oil~~		~~West end of Panel Yard~~		-				This tank is no longer on site.
Legacy - Area 2 Shop					$0	$0	$0	$0		**to Demo tab**
Locomotive Fueling		# 1,2 Fuel Oil								
Legacy - Plant Area					$0	$199,525	$0	$25,700		**to Demo tab**
Storage Tank	015	# 1,2 Fuel Oil	12,000	E. Side Concentrator		$600				
Storage Tank	032	# 2, 6 Fuel Oil	3,384,000	Tank Farm		$62,000		$8,100.00	$40,000.00	
Storage Tank	033	# 6 Fuel Oil	3,384,000	Tank Farm		$62,000		$8,100.00	$40,000.00	
Storage Tank	034	# 6 Fuel Oil	3,384,000	Tank Farm		$62,000		$8,100.00	$40,000.00	
Storage Tank	304	Mineral Oil	12,000	E. Side Concentrator		$600				
Storage Tank	305	Mineral Oil	12,000	E. Side Concentrator		$600				
Storage Tank	306	Mineral Oil	12,000	E. Side Concentrator		$600				
Storage Tank	408	Lube oil	20,000	SW of Tailings Basin Reporting Area		$0				Out of Service, but piping still in place and no signs are posted
Storage Tank	421	Alcohol	10,000	E side Concentrator		$500				
Storage Tank	506	Fuel Oil	500	Heating Plant		$25				
WTP Backwash (green)			16,000	NE of Drivehouse 1		$5,000		$700.00	$1,000.00	
Tank (white)			14,000	SE of Tailings Basin Reporting Area		$5,000		$700.00	$1,000.00	Out of Service. Disconnected, no visible labels
Dispensing Tanks at Main Gate	121	Gasoline	6,000	See gas station dwg's for reference		$600				
Dispensing Tanks at Main Gate	122	Gasoline	6,000	See gas station dwg's for reference		$600				
New - Phase 1 - Plant Site					$0	$0	$0	$0		**to Demo tab**
Storage Tank	TBD	CuSO4				$0				tanks provided by supplier
Storage Tank	TBD	Magnafloc 10	10,600			$0				tanks provided by supplier
Storage Tank	TBD	PAX	3,000			$0				tanks provided by supplier
Storage Tank	TBD	Lime	22,500			$0				tanks provided by supplier
New - Phase 1 - Mine Site					$0	$0	$0	$0		**to Demo tab**
Mine Site Truck Fueling	TBD	# 1,2 Fuel Oil		Fueling and Maintenance Facility		$0				
New - Phase 2 - Plant Site					$0	$0	$0	$0		**to Demo tab**
Storage Tank	TBD	H2SO4	40,000			$0				tanks provided by supplier
Storage Tank	TBD	HCl	60,000			$0				tanks provided by supplier
Storage Tank	TBD	Liquid SO2	21,000			$0				tanks provided by supplier
Storage Tank	TBD	Magnafloc 342/351				$0				tanks provided by supplier
Storage Tank	TBD	Mg(OH)	80,000			$0				tanks provided by supplier
Storage Tank	TBD	NaHS	13,200			$0				tanks provided by supplier
Storage Tank	TBD	NaOH	40,000			$0				tanks provided by supplier
Removed										
Day Tanks	083	# 6 Fuel Oil	20,000	Tank Farm						
Day Tanks	084	# 6 Fuel Oil	20,000	Tank Farm						
Day Tanks	085	# 6 Fuel Oil	20,000	Tank Farm						

NorthMet Contingency Reclamation Estimate

9/4/2014

Above Ground Storage Tanks

Name	Tank #	Fluid	Gallons	Location	Fluid Removal/ Disposal	Demolition/ Removal	Asbestos Lead Paint	Site Restoration	Assets Recovery	Notes
Blue		Waste oil		W side of Coarse Crusher						
Blue		Lube oil		NE cor. Fine Crusher						
White		Anti-Freeze		NW cor. Fine Crusher						

Attachment G

NTS AOC Estimates

Environmental Science
& Engineering

Via Email

March 23, 2016

Mr. Kevin Pylka
PolyMet Mining, Inc.
P.O. Box 475
Hoyt Lakes, MN 55750

RE: Cost Estimate Evaluation, PolyMet Mining, Inc. Areas of Concern, Hoyt Lakes, Minnesota

Dear Mr. Pylka:

Northeast Technical Services, Inc. (NTS) has completed an evaluation of cost estimates provided by PolyMet Mining, Inc. (PolyMet) for 23 areas of concern (AOCs) identified on PolyMet's property, Hoyt Lakes, Minnesota. The following are the results of the evaluation:

1. Average consultant rates assumed in the cost estimates were compared to NTS's current average consultant rates. The assumed rates were found to be consistent with NTS's current average consultant rates. Therefore, no changes to the AOC cost estimates are recommended based on this comparison.

2. PolyMet provided equipment (including operator) rates (i.e., union scale rates) to help NTS determine if the AOC estimated remediation costs for contractor hauling and excavating are comparable with respect to union scale rates. A direct comparison could not be completed at this time. No changes to the AOC cost estimates are recommended.

3. The only change to the AOC cost estimates that is recommended is to reduce the cost estimate for AOC 37 from $28,500 to $7,500 (updated cost estimate attached). The scope of the updated cost estimate includes completion of the Phase I Environmental Site Assessment (ESA) and submittal of the Phase I ESA to Minnesota Pollution Control Agency (MPCA) for Technical Review. It is assumed that the Phase I ESA will document completion of the land treatment site soil monitoring requirements (see attached MPCA letter dated February 24, 2006), including completion of petroleum remediation requirements, and will also document that no other recognized environmental conditions (RECs) are present at AOC 37.

Please feel free to contact me at the cell phone number below if you have questions.

Sincerely,

Dennis Schubbe
Senior Project Manager
Cell: 218-750-7316

Site Name: [redacted]
Area of Concern Number: [redacted] **Date Updated:** [redacted]
Total acres: 5 to 6 acres
Chemicals of Concern: DRO
Site Summary: This area was used as a permitted petroleum land application site. Approximately 25,000 cubic yards of soil from the Area 1 Shops Tank Farm cleanup and the Knox Fueling Station cleanup were thin spread at this site. Completion of land treatment soil monitoring documented in MPCA letter dated 02/24/2006.

Task Description	**Estimated Costs**	
Phase I ESA/SAP	[redacted]	
Implementation of SAP		
Consultant Costs	$	-
Laboratory Costs	$	-
Contractor Costs	$	-
Complete Phase II Investigation		
Consultant Costs	$	-
Laboratory Costs	$	-
Contractor Costs	$	-
Remediation Costs		
Consultant Costs	$	-
Laboratory Costs	$	-
Contractor Costs	$	-
TOTALS	$	7,500

Comments:

Worksheet

Implementation of SAP				
Field Work per day				
Geologist	0	100	$	-
Equip (soil)	0	300	$	-
Equip (geoprobe gw))	0		$	-
Equip (wells)	0		$	-
Daily Field Total			$	-
Number of Days	0	$ -	$	-
Limited Phase 2 Repc	0	10000	$	-
PM Time (20% of cost)			$	-
Consulting total			**$**	**-**
Complete Phase II Investigation				
Field Work per day				
Geologist	0	100	$	-
Equip (soil)	0	300	$	-
Equip (geoprobe gw)	0		$	-
Equip (wells)	0		$	-
Field Total			$	-
Phase II Report	0	25000	$	-
PM Time			$	-
Consulting total			**$**	**-**

Remediation Costs
(none anticipated)

Assumptions:
No non-petroleum Recognized Environmental Conditions will be identified when completing the Phase I ESA for AOC 37.
MPCA will provide Technical Review of the Phase I ESA and agree that no additional work is necessary for AOC 37.

Depth to groundwater	greater than 20 feet
Nearest surface water	Basin 1E, approximately 800 feet NW
Identified Vapor receptors	none

Implementation of SAP
No SAP necessary.

Complete Phase II Investigation
No Phase II Investiation necessary.

Remediation Costs
Will remediation be required? No
Risk Criteria

Direct Exposure	Land treatment soil monitoring requirements met per MPCA letter dated February 24, 2006.
Groundwater	Potential pathway to surface water (see below).
Surface Water	The nearest surface water appears to be Basin 1E, approximately 800 feet to the northwest. It is unlikely that the surface water would have been impacted.
Vapor Intrusion	There do not appear to be any structures within 100 feet of the site.

Minnesota Pollution Control Agency

February 24, 2006

Mr. Bruce Gerlach
Cliffs Erie LLC
P. O. Box 900
County Road 666
Hoyt Lakes, MN 55750

RE: Completion of Land Treatment Site Soil Monitoring Requirements
Site: LTV Steel Area 5 Landfarm (from Knox Refueling Site)
Site ID#: LEAK6499

Dear Mr. Gerlach:

The MPCA staff has received and reviewed the monitoring results for soil samples collected at the above referenced land treatment site on October 14, 2005. The results indicate that the soil has been adequately treated. Therefore, no further follow-up soil monitoring and tillage is required at this land treatment site.

If you have any questions, please contact me at 651-296-7717.

Sincerely,

Amy Miller
Project Manager
Petroleum Remediation Unit 1
Petroleum Division

AM:ais

cc: Richard Bradford, Administrative City Clerk, Hoyt Lakes
Ted Troolin, St. Louis County Solid Waste Officer
Dennis Schubbe, Northeast Technical Services
Department of Commerce-Petrofund Staff

AOC 001 Detailed Estimate

Site Name:	Area 1 Shops		
Area of Concern Number:	AOC01	**Date Updated:**	06/10/14
Total acres:	3 to 5 acres		
Chemicals of Concern:	VOCs, SVOCs, GRO/DRO, RCRA metals, PCBs		
Site Summary:	Primary maintenance and storage buildings for western mining area and included locomotive and mining equipment fueling		

Yellow Highlight indicates to CRE Estimate AOC tab

Task Description	**Estimated Costs**	
Phase I ESA/SAP	$ 7,500	
Implementation of SAP		
Consultant Costs	$ 56,000	
Laboratory Costs	$ 104,615	
Contractor Costs	$ 48,000	$ 208,615
Complete Phase II Investigation		
Consultant Costs	$ 83,000	
Laboratory Costs	$ 104,615	
Contractor Costs	$ 48,000	$ 235,615
Remediation Costs		
Consultant Costs	$ 80,000	
Laboratory Costs	$ 30,000	
Contractor Costs	$ 270,000	$ 380,000
TOTALS	$ 831,730	

Comments:

AOC 001 Detailed Estimate

Assumptions:

Depth to groundwater	greater than 20-feet	
Nearest surface water	none	
Identified Vapor receptors	none	

Implementation of SAP

Consultant costs will include	Field Work	20 days
	Reporting	Limited Phase 2 Report
	Project Coordination	
Laboratory Costs		
	Soil	170 soil samples all COC
	Groundwater	75 water samples all COC
Contractor costs	Drilling	20 days

Complete Phase II Investigation

Consultant costs will include	Field Work	30 days
	Reporting	Complete Phase 2 Report
	Project Coordination	
Laboratory Costs		
	Soil	170 soil samples all COC
	Groundwater	75 water samples all COC
Contractor costs	Drilling	20 days

Remediation Costs

Will remediation be required?	yes
Risk Criteria	
Direct Exposure	Likely
Groundwater	10 to 20 feet. Groundwater contamination likely. GW discharge to wetlands/ponds nearby.
Surface Water	Ponds and wetland adjacent to site
Vapor Intrusion	Several on-site buildings

AOC 001 Detailed Estimate

Remediation Assumptions

1. Transformer areas will be excavated to 4-feet, and disposed as hazardous waste. COC is PCBs.
   Total volume is esitmated at 90 cubic yards.
2. Excavation of soils along outfall lines, and disposed as Solid waste. COC are VOCs/DRO/GO.
   Total volume is estimated at 1,500 cubic yards
3. Surface excavations, related to general industrial use exceedences
   Total volume is estimated at 1,500 cubic yards
4. Groundwater remediation may be necessary, however the need of this and the cost are unable
   to be determined at this time.

Remediation Costs

	Unit Rate	Units	Totals
Excavator	3,090	8	24720
Trucking and Disposal			
-Hazardous Waste	90	300	27000
-Solid Waste	3000	57	171000
Backfill	3090	15	46350
			269070

Site Name: Oily Waste Disposal Area
Area of Concern Number: AOC06 **Date Updated:** 06/10/14
Total acres: 3 to 5 acres
Chemicals of Concern: DRO, GRO, VOC, RCRA Metals, PAH, PCB
Site Summary:

Yellow Highlight indicates to CRE Estimate AOC tab

Oily waste from floor drains form the General Shops area was dumped at the land surface.

Task Description	Estimated Costs	
Phase I ESA/SAP	$ 7,500	
Implementation of SAP		
Consultant Costs	$ 23,550	
Laboratory Costs	$ 18,440	
Contractor Costs	$11,200	**$ 53,190**
Complete Phase II Investigation		
Consultant Costs	$ 32,450	
Laboratory Costs	$ 45,600	
Contractor Costs	$22,400	**$ 100,450**
Remediation Costs		
Consultant Costs	$ 27,530	
Laboratory Costs	$ 18,240	
Contractor Costs	$27,500	$ 73,270
TOTALS	**$ 234,410**	

Comments: Assumes that direct exposure is the only risk pathway. Remediation includes hot spot excavation and disposal.

Site Name:	Bull Gear Disposal		
Area of Concern Number:	AOC07	**Date Updated:**	06/10/14
Total acres:	~1 to 2 acres		
Chemicals of Concern:	PAH and RCRA metals		
Site Summary:	This area reportedly received a one-time disposal of bull gear grease (a heavy lubricant) in the 1970s. No visible signs of the disposal were observed during site reconnaissance in 2002 or on air photos reviewed during the initial investigation.		

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Task Description	**Estimated Costs**	
Phase I ESA/SAP	$ 7,500	
Implementation of SAP		
Consultant Costs	$ 18,000	
Laboratory Costs	$ 8,000	
Contractor Costs	$ 9,600	$ 35,600
Complete Phase II Investigation		
Consultant Costs	$ -	
Laboratory Costs	$ -	
Contractor Costs	$ -	
Remediation Costs		
Consultant Costs	$ -	
Laboratory Costs	$ -	
Contractor Costs	$ -	
TOTALS	$ 43,100	

Comments:

Assumptions:

Depth to groundwater	greater than 20 feet
Nearest surface water	approximately 1300 feet SW
Identified Vapor receptors	none

Implementation of SAP

Consultant costs will include	Field Work	4 days
	Reporting	Limited Phase 2 Report
	Project Coordination	
Laboratory Costs		
	Soil	24 composite PAH samples, 24 composite cPAH SVOC samples, 24 composite RCRA metals samples
	Groundwater	none
Contractor costs	Drilling	4 days

Complete Phase II Investigation

Consultant costs will include	Field Work	-
	Reporting	-
	Project Coordination	
Laboratory Costs		
	Soil	-
	Groundwater	-
Contractor costs	Drilling	-

Remediation Costs

Will remediation be required?	no
Risk Criteria	
Direct Exposure	Possible.
Groundwater	The anticipated depth to groundwater is more than 20 feet below ground. Groundwater impacts are not anticipated.
Surface Water	The nearest surface water appears to be approximately 1300 feet to the southwest. It is unlikely that the surface water would have been impacted.
Vapor Intrusion	There do not appear to be any nearby structures that would be at risk for vapor intrusion.

AOC-009 Remediation

Consultant costs

	quantity		avg rate	
Field Work	150	hrs	$100	$15,000
Reporting	80	hrs	$108	$8,640
Project Managment, MPCA coordination	80	hrs	$125	$10,000
Direct Costs				$8,000
				$41,640

Laboratory Costs

	Mercury	TCLP Mercury	DRO	Lead	TCLP Lead	RCRA Metals	Total Arsenic	TCLP Arsenic
#1 Mercury Contaminated Soil	7	2						
#2 Leaded Grease Spill			10	10	2			
#3 Waste Fill Area - Ash						45		
#4 Waste Fill Area - Railroad Ties								
#5 Non-Surficial Arsenic Release							55	10
Quantity	7	2	10	10	2	45	55	10
Unit cost	$35	$60	$25	$11	$60	$70	$11	$60
Unit total	$245	$120	$250	$110	$120	$3,150	$605	$600
	Lab total				**$5,200**			

Contractor Costs

Description	Item	Rate	Unit	Quantity	Total	Note
Contractor Costs Mercury Contaminated Soil						
Assumes remediation driven by field screening with Lumex,disposal as hazardous waste, and mercury levels <260 ppm. Excavation size is assumed to be 20 feet x 20 feet x 3 feet deep. Also assumes soil will be disposed in roll off containers of 20 cubic yards each.	Disposal	$280	ton	65	$18,200	
	Hauling	$4,330	roll off box	3	$12,990	Note: Transport price includes hauling, roll off rental, liner charge, and demurrage.
	Roll Off Rental	$15	box, per day	21	$315	
	Liner Charge	$60	liner	3	$180	
	Demurrage	$100	hour	6	$600	
	Add'l Fuel Surcharge	26	% of transport price		$3,662	
					$35,947	
Contractor Costs Leaded Grease Spill						
Assumes remediation is driven visually and by soils greater than 10 ppm using PID and disposal as hazardous waste. Excavation size is assumed to be 30 feet x 30 feet x 4 feet deep. Also assumes soil will be disposed in roll off containers of 20 cubic yards each.	Disposal	$280	ton	200	$56,000	
	Hauling	$4,330	roll off box	7	$30,310	Note: Transport price includes hauling, roll off rental, liner charge, and demurrage.
	Roll Off Rental	$15	box, per day	49	$735	
	Liner Charge	$60	liner	7	$420	
	Demurrage	$100	hour	14	$1,400	
	Add'l Fuel Surcharge	26	% of transport price		$8,545	
					$97,410	
Contractor Costs Waste Fill Area - Ash						
Estimate assumes excavation 450 feet x 60 feet x 4 feet deep. No hazardous waste. Disposal in CE landfill. No bottom verification samples; assumed arsenic impacted soil below.	Mobilization	$1,500	lump	1	$1,500	
	Excavation	$8	cubic yard	4000	$32,000	
	Hauling	$18	cubic yard	4000	$72,000	
	Disposal	$1,100	day	4	$4,400	
					$109,900	
Contractor Costs Waste Fill Area - Railroad Ties						
Assumes collection and disposal is necessary for ~200 railroad ties. No hazardous waste.	Mobilization	$1,500	lump	1	$1,500	
	Loading	$8	cubic yard	50	$400	
	Hauling	$18	cubic yard	50	$900	
	Disposal	$40	cubic yard	50	$2,000	
					$4,800	
Contractor Costs Non-Surficial Arsenic Release						
Assumes remediation driven by delineation using soil borings. Estimate assumes excavation 500 feet x 70 feet x 12 feet deep (beneath ash). No hazardous waste.	Mobilization	$1,500	lump	1	$1,500	
	Excavation	$8	cubic yard	16000	$128,000	
	Hauling	$18	cubic yard	16000	$288,000	
	Disposal	$40	cubic yard	16000	$640,000	
					$1,057,500	
						$1,305,557

Site Name: Airport
Area of Concern Number: AOC10 **Date Updated:** 06/10/14
Total acres: 5 to 10 acres
Chemicals of Concern: DRO, GRO, VOC, RCRA Metals, PAH, PCB
Site Summary:

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Approximately 5 acres acres used for equipment teardown and salvage

Task Description	Estimated Costs	
Phase I ESA/SAP	$ 7,500	
Implementation of SAP		
Consultant Costs	$ 13,740	
Laboratory Costs	$ 15,440	
Contractor Costs	$0	**$ 29,180**
Complete Phase II Investigation		
Consultant Costs	$ 18,980	
Laboratory Costs	$ 38,600	
Contractor Costs	$0	**$ 57,580**
Remediation Costs		
Consultant Costs	$ 17,300	
Laboratory Costs	$ 15,440	
Contractor Costs	$27,500	**$ 60,240**
TOTALS	**$ 154,500**	

Comments: Assumes that direct exposure is the only risk pathway. Remediation includes hot spot excavation and disposal.

Site Name: Stoker Coal Ash Disposal
Area of Concern Number: AOC11 **Date Updated:** 06/10/14
Total acres: 5 to 10 acres
Chemicals of Concern: B, Mn, SO4, As, Li, Mo, Th
Site Summary:

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Unlined landfill for coal ash generated at the heating plant between 1957 and 1989. Volume is unknown but assumed to be approximately 3000 cubic yards.

Task Description	Estimated Costs	
Phase I ESA/SAP	$ 7,500	
Implementation of SAP		
Consultant Costs	$ 13,740	
Laboratory Costs	$ 3,840	
Contractor Costs	$12,600	**$ 30,180**
Complete Phase II Investigation		
Consultant Costs	$ 18,980	
Laboratory Costs	$ 2,688	
Contractor Costs	$17,200	**$ 38,868**
Remediation Costs		
Consultant Costs	$ 44,300	
Laboratory Costs	$ 4,320	
Contractor Costs	$196,500	**$ 245,120**
TOTALS	**$ 321,668**	

Comments: Assumes that groundwater is the predominant risk pathway. Remediation includes excavation disposal and groundwater monitoring

Site Name: 2001 Storage Area
Area of Concern Number: AOC13 **Date Updated:** 06/10/14
Total acres: 5 acres
Chemicals of Concern: DRO, GRO, VOC, RCRA Metals, PAH, PCB
Site Summary:

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Approximately 5 acres acres used for equipment storage. Assume no remediation required. Phase II Risk Assessment leads to no action.

Task Description	Estimated Costs		
Phase I ESA/SAP	$	7,500	
Implementation of SAP			
Consultant Costs	$	13,740	
Laboratory Costs	$	15,440	
Contractor Costs		$0	**$ 29,180**
Complete Phase II Investigation			
Consultant Costs	$	18,980	
Laboratory Costs	$	38,600	
Contractor Costs		$0	**$ 57,580**
Remediation Costs			
Consultant Costs	$	-	
Laboratory Costs	$	-	
Contractor Costs		$0	
TOTALS	**$**	**94,260**	

Comments: Assumes that direct exposure is the only risk pathway. Risk assessment results in No action.

Site Name:	Sandblasting and large Equipment Painitng Area		
Area of Concern Number:	AOC14	**Date Updated:**	06/10/14
Total acres:	11 acres		
Chemicals of Concern:	RCRA metals, VOC, DRO, GRO, PCB, PAH,		

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Areas was used sandbalsting locomotives and other large equipment and to repaint them

Task Description	**Estimated Costs**	
Phase I ESA/SAP	$ 7,500	
Implementation of SAP		
Consultant Costs	$34,300	
Laboratory Costs	$13,896	
Contractor Costs	$9,600	**$57,796**
Complete Phase II Investigation		
Consultant Costs	$ 29,100	
Laboratory Costs	$ 360	
Contractor Costs	$0	**$ 29,460**
Remediation Costs		
Consultant Costs	$ 25,300	
Laboratory Costs	$ 270	
Contractor Costs	$18,000	**$ 43,570**
TOTALS	**$ 138,326**	

Comments: It is anticipated that osand blast waste will be required to be removed due to dermal exposure risk. No groundwater issues anticipated. The Phase II work would consist of preparing a DRAP for excavating and disposing of sand blasting media.

Recognized Environmental Conditions* that Recquire Further Investigaton	**COC**	**Viable risk pathways**	**Remediation?**
Sand blasting media	VOCs, GRO/DRO, RCRA, PCB, PAHs	Direct exposure	Yes
Sidetrack for railroad	VOCs, GRO/DRO, RCRA, PCB, PAHs	Direct exposure	No

Site Name: Dunka Water Treatment Plant Sludge
Area of Concern Number: AOC35 **Date Updated:** 06/10/14
Total acres: 3 to 5 acres
Chemicals of Concern: RCRA metals
Site Summary:

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This area was used to stage sludge generated from the Dunka Water Treatement Plant, which was used to remove metals from stockpile seep water. The sludge was shipped off-site for final disposal.

Task Description	Estimated Costs		
Phase I ESA/SAP	$	7,500	
Implementation of SAP			
Consultant Costs	$	15,000	
Laboratory Costs	$	1,000	
Contractor Costs	$	4,800	**$ 20,800**
Complete Phase II Investigation			
Consultant Costs	$	32,000	
Laboratory Costs	$	1,000	
Contractor Costs	$	4,800	**$ 37,800**
Remediation Costs			
Consultant Costs	$	-	
Laboratory Costs	$	-	
Contractor Costs	$	-	
TOTALS	$	66,100	

Comments:

Assumptions:

Depth to groundwater	greater than 20-feet
Nearest surface water	none
Identified Vapor receptors	none

Implementation of SAP

Consultant costs will include	Field Work	2 days
	Reporting	Limited Phase 2 Report
	Project Coordination	
Laboratory Costs		
	Soil	10 RCRA metal composite samples
	Groundwater	none
Contractor costs	Drilling	2 days

Complete Phase II Investigation

Consultant costs will include	Field Work	2 days
	Reporting	Complete Phase 2 Report
	Project Coordination	
Laboratory Costs		
	Soil	10 RCRA metal grab samples
	Groundwater	none
Contractor costs	Drilling	2 days

Remediation Costs

Will remediation be required?	No
Risk Criteria	
Direct Exposure	Possible, however metals liley are immobilzed due to high pH. PH is below 13
Groundwater	The anticipated depth to groundwater is over 20-feet in depth, and because the metals likely are immobile, groundwater impacts are not anticipated.
Surface Water	There no surface water's identified near the site.
Vapor Intrusion	The COC are non-volatile and there are no structures within 100-feet of the site.

Site Name:	Line 9 Area 5 Petroleum Contaminated Soil	
Area of Concern Number:	AOC37	**Date Updated:** 03/23/16
Total acres:	5 to 6 acres	
Chemicals of Concern:	DRO	
Site Summary:	This area was used as a permitted petroleum land application site. Approximately 25,000 cubic yards of soil from the Area 1 Shops Tank Farm cleanup and the Knox Fueling Station cleanup were thin spread at this site. Completion of land treatment soil monitoring documented in MPCA letter dated 02/24/2006.	Worksheet

Task Description	**Estimated Costs**
Phase I ESA/SAP	$ 7,500
Implementation of SAP	
Consultant Costs	$ -
Laboratory Costs	$ -
Contractor Costs	$ -
Complete Phase II Investigation	
Consultant Costs	$ -
Laboratory Costs	$ -
Contractor Costs	$ -
Remediation Costs	
Consultant Costs	$ -
Laboratory Costs	$ -
Contractor Costs	$ -
TOTALS	$ 7,500

Implementation of SAP

Field Work per day			
Geologist	0	100	$ -
Equip (soil)	0	300	$ -
Equip (geoprobe gw))	0		$ -
Equip (wells)	0		$ -
Daily Field Total			$ -
Number of Days	0	$ -	$ -
Limited Phase 2 Repo	0	10000	$ -
PM Time (20% of cost)			$ -
Consulting total			**$ -**

Complete Phase II Investigation

Field Work per day			
Geologist	0	100	$ -
Equip (soil)	0	300	$ -
Equip (geoprobe gw)	0		$ -
Equip (wells)	0		$ -
Field Total			$ -
Phase II Report	0	25000	$ -
PM Time			$ -
Consulting total			**$ -**

Comments:

Remediation Costs

(none anticipated)

Assumptions:

No non-petroleum Recognized Environmental Conditions will be identified when completing the Phase I ESA for AOC 37.
MPCA will provide Technical Review of the Phase I ESA and agree that no additional work is necessary for AOC 37.

Depth to groundwater	greater than 20 feet
Nearest surface water	Basin 1E, approximately 800 feet NW
Identified Vapor receptors	none

Implementation of SAP

No SAP necessary.

Complete Phase II Investigation

No Phase II Investiation necessary.

Remediation Costs

Will remediation be required? No

Risk Criteria

Direct Exposure	Land treatment soil monitoring requirements met per MPCA letter dated February 24, 2006.
Groundwater	Potential pathway to surface water (see below).
Surface Water	The nearest surface water appears to be Basin 1E, approximately 800 feet to the northwest. It is unlikely that the surface water would have been impacted.
Vapor Intrusion	There do not appear to be any structures within 100 feet of the site.

Site Name:	Area 2 Shops
Area of Concern Number:	AOC38
Total acres:	25 acres
Chemicals of Concern:	RCRA metals, VOC, DRO, GRO, PCB, PAH,

Date Updated: 06/10/14

Includes a train fueling maintenance area, light vehicle fueling, a fabrication shop, laydown areas, and storage

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Task Description	**Estimated Costs**		
Phase I ESA/SAP	already completed		
Implementation of SAP	already completed		
Consultant Costs			
Laboratory Costs			
Contractor Costs			**$ -**
Complete Phase II Investigation			
Consultant Costs	$	100,920	
Laboratory Costs	$	42,190	
Contractor Costs		$99,000	**$ 242,110**
Remediation Costs			
Consultant Costs	$	43,460	
Laboratory Costs	$	12,396	
Contractor Costs		$123,940	**$ 179,796**
TOTALS	**$**	**421,906**	

Comments: The Limited Phase II has confirmed groundwater contamination and surface contaminaton of metals and PAHs. The groundwater likely discharges to adjacent surface water/wetland features via underground utility line. The petroleum aspect of the contamination has been remediated under the PRP.

Recognized Environmental Conditions* that Recquire Further Investigaton	**COC**	**Viable risk pathways**	**Remediation?**
15A/B Building 201	VOCs, GRO/DRO, RCRA, PCB	Discharge to surface water	Yes
16A/B Building 202	VOCs, GRO/DRO	Discharge to surface water	Yes
17A/B Building 203	VOCs, GRO/DRO, RCRA, PCBs, cPAHs	Discharge to surface water	Yes
18A Building 204	PCBs	TSCA regulated area	Yes
25 New Mound System	VOCs, GRO/DRO, RCRA, PCBs, cPAHs	Discharge to surface water	Yes
27 and 28 SW laydown Area	VOCs, DRO	Discharge to surface water	No
32 South Outfall	VOCs, GRO/DRO, PCBs	Discharge to surface water	Yes
33 Burn Piles	VOCs, DRO	Direct Exposure	Yes

*Represents number assinged to REC in Ph 2 Investigation SAP, dated May 2006

Site Name:	Heavy Duty Garage		
Area of Concern Number:	AOC40	**Date Updated:**	06/10/14
Total acres:	1 to 2 acres		
Chemicals of Concern:	DRO/VOC/PCB/PAHs/RCRA metals		

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Area was used for maintenance o f heavy equipment for approx. 10-years, and has been used as cold storage since the 1960's. One UST was removed from the facility in the 1980's.

Task Description	**Estimated Costs**	
Phase I ESA/SAP	$ 7,500	
Implementation of SAP		
Consultant Costs	$ 15,000	
Laboratory Costs	$ 1,200	
Contractor Costs	$ 4,800	**$ 21,000**
Complete Phase II Investigation		
Consultant Costs	$ 34,000	
Laboratory Costs	$ 1,200	
Contractor Costs	$ 4,800	**$ 40,000**
Remediation Costs		
Consultant Costs	$ -	
Laboratory Costs	$ -	
Contractor Costs	$ -	
TOTALS	$ 68,500	

Comments:

Assumptions:

Depth to groundwater	greater than 20-feet	
Nearest surface water	none	
Identified Vapor receptors	none	

Implementation of SAP

Consultant costs will include	Field Work	2 days
	Reporting	Limited Phase 2 Report
	Project Coordination	
Laboratory Costs		
	Soil	5 RCRA metal and 5 DRO/VOC samples
	Groundwater	-
Contractor costs	Drilling	2 days

Complete Phase II Investigation

Consultant costs will include	Field Work	3000
	Reporting	25000
	Project Coordination	5000
Laboratory Costs		
	Soil	10 RCRA metals/ and 5 DRO/VOC
	Groundwater	-
Contractor costs	Drilling	2 days

Remediation Costs

Will remediation be required?	No	
Risk Criteria		
Direct Exposure		Possible, however only minor releases are expected
Groundwater		Due to shallow bedrock, groundwater is not anticipated
Surface Water		There is no nearby surface water.
Vapor Intrusion		There are no structures within the AOC; no vapor risk is present.

Bunker C Tank Farm Removal Estimate
October 17, 2014

Task Description	Cost
Remove tanks and lines	$400,000
Closure Sampling/Demo Coord	$15,000
Asbestos abatement	$500,000
Total	

Remove Tanks and Lines: includes remove and dispose of AST insulation (assume to be non-ACM), demolish/dispose of ASTs (assume the ASTs are clean), remove/dispose of piping (assume pipes are clean), remove/dispose of concrete vaults (assume vaults are clean), obtain necessary permits, and submit MPCA notifications

Closure Sampling/Demo Coordination: includes collecting samples every 20-feet along the piping runs and collecting 10 samples from below each tank, laboratory analyses (90 DRO samples), preparation of a closure report, oversight of demolition contractor, overall project coordination.

Asbestos Abatement: assumes two steam lines in each pipe run for a total of 3,000 lineal feet of insulated piping, and 150,000 square feet of transite siding on the tanks. Please note there has not been an asbestos inspection on this tank system, so the presence or absence of asbestos has not been confirmed.

Non-Routine Maintenance Costs: this cost included maintenance and modifications to equipment that is typically not routine. Assume 4 year lifespan.

Disposal of Recoverable Product Costs: Assume 100 gallons per month at $3 per gallon for disposal.

Since the MPCA has closed this leaksite it is assumed that no additional clean-up of the surface impacts will be required. However, if contaminated soils are encountered during development in this area then the contaminated soils would need to be properly managed.

Site Name:	Administration Building	
Area of Concern Number:	AOC43	**Date Updated:** 06/10/14
Total acres:	1 to 2 acres	
Chemicals of Concern:	DRO and VOC	
Site Summary:	An underground storage tank (UST) was abandoned in place in the Administration Building. The tank (UST 025) was used for heating oil. Domestic waste was pumped into the plant site wastewater treatment plant; a new well and septic system were installed in 2001. The Administration Building is still in use.	

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Task Description	Estimated Costs	
Phase I ESA/SAP	$ 7,500	
Implementation of SAP		
Consultant Costs	$ 15,000	
Laboratory Costs	$ 800	
Contractor Costs	$ 4,800	**$ 20,600**
Complete Phase II Investigation		
Consultant Costs	$ -	
Laboratory Costs	$ -	
Contractor Costs	$ -	
Remediation Costs		
Consultant Costs	$ -	
Laboratory Costs	$ -	
Contractor Costs	$ -	
TOTALS	$ 28,100	

Comments:

Assumptions:

Depth to groundwater	greater than 20 feet	
Nearest surface water	approximately 1600 ft E	
Identified Vapor receptors	Administration Building	

Implementation of SAP

Consultant costs will include	Field Work	2 days
	Reporting	Limited Phase 2 Report
	Project Coordination	
Laboratory Costs		
	Soil	8 DRO composite samples, 8 VOC composite samples
	Groundwater	1 DRO, 1 VOC (site well)
Contractor costs	Drilling	2 days

Complete Phase II Investigation

Consultant costs will include	Field Work	-
	Reporting	-
	Project Coordination	
Laboratory Costs		
	Soil	-
	Groundwater	-
Contractor costs	Drilling	-

Remediation Costs

Will remediation be required?	no
Risk Criteria	
Direct Exposure	Surface contamination, and therefore direct exposure, are unlikely.
Groundwater	The anticipated depth to groundwater is more than 20 feet below ground. Groundwater impacts are not anticipated. Note: A domestic well is located adjacent to the Administration Building (Well ID #665923). Static water level information was not found on the well record.
Surface Water	The nearest surface water appears to be approximately 1600 feet to the east. It is unlikely that the surface water would have been impacted.
Vapor Intrusion	The Administration Building is only likely to be at risk for vapor intrusion if contamination is identified.

Site Name:	Main Gate Vehicle Fueling Area		
Area of Concern Number:	AOC44	**Date Updated:**	06/10/14
Total acres:	~0.25		
Chemicals of Concern:	GRO, DRO, VOC		
Site Summary:	This area is several hundred feet from the Administration Building. The fueling area consists of two ASTs (AST 121 and AST 122) that are used for fueling light trucks.		
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Task Description	**Estimated Costs**	
Phase I ESA/SAP	$ 7,500	
Implementation of SAP		
Consultant Costs	$ 14,000	
Laboratory Costs	$ 600	
Contractor Costs	$ 2,400	**$ 17,000**
Complete Phase II Investigation		
Consultant Costs	$ 32,000	
Laboratory Costs	$ 500	
Contractor Costs	$ 2,400	**$ 34,900**
Remediation Costs		
Consultant Costs	$ 8,000	
Laboratory Costs	$ 1,200	
Contractor Costs	$ 15,000	**$ 24,200**
TOTALS	$ 83,600	

Comments:

Assumptions:

Depth to groundwater	greater than 20 feet
Nearest surface water	approximately 200 ft NE
Identified Vapor receptors	none

Implementation of SAP

Consultant costs will include	Field Work	1 day
	Reporting	Limited Phase 2 Report
	Project Coordination	
Laboratory Costs		
	Soil	5 DRO composite samples, 5 GRO composite samples, and 5 VOC composite samples
	Groundwater	none
Contractor costs	Drilling	1 day

Complete Phase II Investigation

Consultant costs will include	Field Work	1 day
	Reporting	Complete Phase 2 Report/Limited Site Investigation Report
	Project Coordination	
Laboratory Costs		
	Soil	4 DRO grab samples, 4 GRO grab samples, and 4 VOC grab samples
	Groundwater	-
Contractor costs	Drilling	1 day

Remediation Costs

Will remediation be required?	Possible, due to the likely presence of surface contamination in the dispenser area.
Risk Criteria	
Direct Exposure	Possible, if surface contamination is present. The site is not currently listed as a leak site.
Groundwater	The anticipated depth to groundwater is more than 20 feet below ground. Groundwater impacts are not anticipated.
Surface Water	The nearest surface water appears to be approximately 200 feet to the northeast. It is unlikely that the surface water would have been impacted.
Vapor Intrusion	There appears to be a building approximately 10 feet from the western AST; however, the building is not inhabitable.

Site Name:	Plant Site and General Shops
Area of Concern Number:	AOC46 **Date Updated:** 06/10/14
Total acres:	60 -80 acres
Chemicals of Concern:	RCRA metals, VOC, DRO, GRO, PCB, PAH,
Summary:	
Yellow Highlight indicates to CRE Estimate AOC tab	Includes the crushers, concentrator, general shops, rebuild garage, warehouses, associated rail, laydown areas, substations.

Task Description	**Estimated Costs**	
Phase I ESA/SAP	$ 7,500	
Implementation of SAP		
Consultant Costs	$27,800	
Laboratory Costs	$19,544	
Contractor Costs	$12,000	**$ 59,344**
Complete Phase II Investigation		
Consultant Costs	$ 71,460	
Laboratory Costs	$ 74,700	
Contractor Costs	$43,600	**$ 189,760**
Remediation Costs		
Consultant Costs	$ 111,920	
Laboratory Costs	$ 60,960	
Contractor Costs	$471,810	**$ 644,690**
TOTALS	**$ 901,294**	

Comments: The overiding assumption within this estimate is the near surface bedrock and lack of a groundwater or surface water risk pathway. This assumption limits remediation to direct exposure and vapor wich is typicaly mitigated through engineering controls or liimited excavation rather than large scale remediation.

Recognized Environmental Conditions	**COC**	**Viable risk pathways**	**Remediation?**
#1 Concentrator Tank Farm	VOC, DRO, GRO	Vapor intrusion to conveyor tunnel and upper two feet direct exposure.	Yes
#2 Rebuild Garage UST	VOC, DRO, GRO	Upper two feet direct exposure.	Yes
#3 Substation -1	DRO, PCB	TSCA regulated vessel 1 ppm for high occupancy	Yes
#4 Substation-2	DRO, PCB	TSCA regulated vessel 1 ppm for high occupancy	Yes
#5 General Shop Perimeter and Floor Drains	VOC, DRO, GRO, PAH, RCRA Metals	Direct Exposure, Vapor intrusion	Yes
#6 Rebuild Garage Perimeter and Floor Drains	VOC, DRO, GRO, PAH, RCRA Metals	Direct Exposure, Vapor intrusion	Yes
#7 Yard Area	VOC, DRO, GRO, PAH, PCB RCRA Metals	Direct Exposure, Vapor intrusion	Yes
#8 Concentrator	VOC, DRO, GRO, PAH, PCB RCRA Metals	Direct Exposure, Vapor intrusion	No

Site Name:	Tailings Basin Reporting		
Area of Concern Number:	AOC47	**Date Updated:**	06/10/14
Total acres:	approximately 3 acres		
Chemicals of Concern:	DRO, GRO, VOC		
Site Summary: **Yellow Highlight indicates to CRE Estimate AOC tab**	This site contains a lube station fueling area, a septic tank and a drain field system. Two underground storage tanks (USTs) were removed in 1988. It is a closed leaksite.		

Task Description	Estimated Costs
Phase I ESA/SAP	$ 7,500
Implementation of SAP	
Consultant Costs	$ -
Laboratory Costs	$ -
Contractor Costs	$ -
Complete Phase II Investigation	
Consultant Costs	$ -
Laboratory Costs	$ -
Contractor Costs	$ -
Remediation Costs	
Consultant Costs	$ -
Laboratory Costs	$ -
Contractor Costs	$ -
TOTALS	$ 7,500

Comments: It is assumed that the leaksite will not need to be reopened due to new MPCA requirements or new site information. Reports associated with the leak site will be reviewed during the Phase I investigation.

Assumptions:

Depth to groundwater	greater than 20 feet	
Nearest surface water	approximately 600 feet east	
Identified Vapor receptors	none	

Implementation of SAP

Consultant costs will include	Field Work	-
	Reporting	-
	Project Coordination	
Laboratory Costs		
	Soil	-
	Groundwater	-
Contractor costs	Drilling	-

Complete Phase II Investigation

Consultant costs will include	Field Work	-
	Reporting	-
	Project Coordination	
Laboratory Costs		
	Soil	-
	Groundwater	-
Contractor costs	Drilling	-

Remediation Costs

Will remediation be required?	no, unless leak site is reopened based on new information/MPCA requirements
Risk Criteria	
Direct Exposure	Unlikely.
Groundwater	The anticipated depth to groundwater is more than 20 feet below ground. Groundwater impacts are not anticipated.
Surface Water	The nearest surface water appears to be Basin 1E, approximately 600 feet to the east. Surface water impacts are not anticipated.
Vapor Intrusion	There do not appear to be any inhabitable structures within 400 feet of the site.

Site Name:	Booster Pump House with Transformer		
Area of Concern Number:	AOC48	**Date Updated:**	06/10/14
Total acres:	approximately 1 acre		
Chemicals of Concern:	PCB and DRO		
Site Summary:			
Yellow Highlight indicates to CRE Estimate AOC tab	The site consists of several pumping stations and transformers in the area of the Tailings Basin, as well as a substation on the southeast side of the basin. CE records indicated that, at the time of the original investigation in 2002, the transformers contained non-PCB mineral oil.		

Task Description	**Estimated Costs**	
Phase I ESA/SAP	$ 7,500	
Implementation of SAP		
Consultant Costs	$ 15,000	
Laboratory Costs	$ 1,100	
Contractor Costs	$ 4,800	**$ 20,900**
Complete Phase II Investigation		
Consultant Costs	$ 33,000	
Laboratory Costs	$ 900	
Contractor Costs	$ 4,800	**$ 38,700**
Remediation Costs		
Consultant Costs	$ -	
Laboratory Costs	$ -	
Contractor Costs	$ -	
TOTALS	$ 67,100	

Comments:

Assumptions:

Depth to groundwater	greater than 20 feet	
Nearest surface water	Basin 1E, approximately 250 feet SE	
Identified Vapor receptors	none	

Implementation of SAP

Consultant costs will include	Field Work	2 days
	Reporting	Limited Phase 2 Report
	Project Coordination	
Laboratory Costs		
	Soil	12 PCB composite samples and 12 DRO composite samples
	Groundwater	none
Contractor costs	Drilling	2 days

Complete Phase II Investigation

Consultant costs will include	Field Work	2 days
	Reporting	Complete Phase 2 Report
	Project Coordination	
Laboratory Costs		
	Soil	10 PCB grab samples and 10 DRO grab samples
	Groundwater	none
Contractor costs	Drilling	2 days

Remediation Costs

Will remediation be required?	no
Risk Criteria	
Direct Exposure	Direct exposure is possible if PCB-containing oil was previously used in the transformers and if PCB-containing oil contacted the soil.
Groundwater	The anticipated depth to groundwater is more than 20 feet below ground. Groundwater impacts are not anticipated.
Surface Water	The nearest surface water appears to be Basin 1E, approximately 250 feet to the southeast. Surface water impacts are not anticipated.
Vapor Intrusion	A booster pump house is located on the south side of the basin, and several smaller booster pump houses are located between Basin 2W and Basin 1E. None of these buildings appear to be inhabitable.

Site Name:	Coarse Crusher Petroleum Contaminated Soil		
Area of Concern Number:	AOC49	**Date Updated:**	06/10/14
Total acres:	approximately 1 acre		
Chemicals of Concern:	DRO		
Site Summary:	An object along the railroad track to the north of the plant/general shops punctured a locomotive's saddle tank. Approximately 300 gallons of diesel were spilled. The contaminated soil was excavated and thin spread.		

Yellow Highlight indicates to CRE Estimate AOC tab

Task Description	**Estimated Costs**	
Phase I ESA/SAP	$ 7,500	
Implementation of SAP		
Consultant Costs	$ 14,000	
Laboratory Costs	$ 300	
Contractor Costs	$ 2,400	**$ 16,700**
Complete Phase II Investigation		
Consultant Costs	$ 32,000	
Laboratory Costs	$ 700	
Contractor Costs	$ 2,400	**$ 35,100**
Remediation Costs		
Consultant Costs	$ -	
Laboratory Costs	$ -	
Contractor Costs	$ -	
TOTALS	$ 59,300	

Comments:

Assumptions:

Depth to groundwater	greater than 20 feet
Nearest surface water	approximately 1500 feet E
Identified Vapor receptors	building approximately 100 feet SE

Implementation of SAP

Consultant costs will include	Field Work	1 day
	Reporting	Limited Phase 2 Report
	Project Coordination	
Laboratory Costs		
	Soil	12 DRO composite samples
	Groundwater	none
Contractor costs	Drilling	1 day

Complete Phase II Investigation

Consultant costs will include	Field Work	1 day
	Reporting	Complete Phase 2 Report/Limited Site Investigation Report
	Project Coordination	
Laboratory Costs		
	Soil	5 DRO grab samples, 5 VOC grab samples
	Soil Vapor	1 TO-15 grab sample
	Groundwater	none
Contractor costs	Drilling	1 day

Remediation Costs

Will remediation be required?	no
Risk Criteria	
Direct Exposure	Possible.
Groundwater	The anticipated depth to groundwater is more than 20 feet below ground. Groundwater impacts are not anticipated.
Surface Water	The nearest surface water is approximately 1500 feet to the east. Surface water impacts are not anticipated.
Vapor Intrusion	There are buildings located approximately 100 feet to the southeast, 400 feet to the west-northwest, and 500 feet to the southwest. Of these, the only anticipated potential vapor impact is to the nearest building.

Site Name:	Tailings Basin Salvage and Scrap Areas		
Area of Concern Number:	AOC51	**Date Updated:**	06/10/14
Total acres:	11 acres		
Chemicals of Concern:	RCRA metals, VOC, DRO, GRO, PCB, PAH,		

Yellow Highlight indicates to CRE Estimate AOC tab

Surficial laydown area, and an area where general industrial waste has been incorporated into fill material on the edge of the Emergency Basin

Task Description	**Estimated Costs**	
Phase I ESA/SAP	$ 7,500	
Implementation of SAP		
Consultant Costs	$36,200	
Laboratory Costs	$30,108	
Contractor Costs	$17,000	**$ 83,308**
Complete Phase II Investigation		
Consultant Costs	$ 22,450	
Laboratory Costs	$ -	
Contractor Costs	$0	**$ 22,450**
Remediation Costs		
Consultant Costs	$ 43,300	
Laboratory Costs	$ 1,544	
Contractor Costs	$363,400	**$ 408,244**
TOTALS	**$ 521,502**	

Comments: It is anticipated that only small surface releases will be present at this site. Negligible groundwater contamination is anticipated. The only concern is the presence of buried waste, which would constitute an unpermitted dump. Phase II would consist of preparation of a DRAP to excavate and dispose of waste from unpermitted dump.

Recognized Environmental Conditions* that Recquire Further Investigaton	**COC**	**Viable risk pathways**	**Remediation?**
Laydown areas, including various types of equip	VOCs, GRO/DRO, RCRA, PCB	Discharge to surface water Direct Exposure	No
Buried waste (approx. 2-acres in size)	VOCs, GRO/DRO, RCRA, PCB	Discharge to surface water Constitutes an unpermitted dump	Yes

Site Name:	Cell 2W Salvage Area		
Area of Concern Number:	AOC52	**Date Updated:**	06/10/14
Total acres:	1 acre		
Chemicals of Concern:	DRO/VOC/PCB/PAHs/RCRA metals		
Site Summary:			
Yellow Highlight indicates to CRE Estimate AOC tab	Area was used as a small salvage and laydown area. A mobile Chorerex AST was located here as well. No releases are anticipated.		

Task Description	**Estimated Costs**	
Phase I ESA/SAP	$ 7,500	
Implementation of SAP		
Consultant Costs	$ 15,000	
Laboratory Costs	$ 1,200	
Contractor Costs	$ 4,800	**$ 21,000**
Complete Phase II Investigation		
Consultant Costs	$ -	
Laboratory Costs	$ -	
Contractor Costs	$ -	
Remediation Costs		
Consultant Costs	$ -	
Laboratory Costs	$ -	
Contractor Costs	$ -	
TOTALS	$ 28,500	

Comments:

Assumptions:

Depth to groundwater	greater than 20-feet	
Nearest surface water	none	
Identified Vapor receptors	none	

Implementation of SAP

Consultant costs will include	Field Work	2 days
	Reporting	Limited Phase 2 Report
	Project Coordination	
Laboratory Costs		
	Soil	5 RCRA metal and 5 DRO/VOC samples
	Groundwater	5 DRO/VOC
Contractor costs	Drilling	2 days

Complete Phase II Investigation

Consultant costs will include	Field Work
	Reporting
	Project Coordination
Laboratory Costs	
	Soil
	Groundwater
Contractor costs	Drilling

Remediation Costs

Will remediation be required?	No
Risk Criteria	
Direct Exposure	Possible, however no releases are anticipated.
Groundwater	Possible, however no releases are anticipated.
Surface Water	Possible, however no releases are anticipated.
Vapor Intrusion	There are no structures within the AOC; no vapor risk is present.

Site Name:	Hornfels Burial		
Area of Concern Number:	AOC53	**Date Updated:**	06/10/14
Total acres:	~1-2 acres		
Chemicals of Concern:	sulfide minerals		
Site Summary:	This area is within Cell 2W and contains buried hornfels, a waste rock type that contains sulfide minerals. The site is surrounded by three monitoring wells, which are monitored as part of a National Pollutant Discharge Elimination System (NPDES) permit.		

Yellow Highlight indicates to CRE Estimate AOC tab

Task Description	Estimated Costs	
Phase I ESA/SAP	$	7,500
Implementation of SAP		
Consultant Costs	$	-
Laboratory Costs	$	-
Contractor Costs	$	-
Complete Phase II Investigation		
Consultant Costs	$	-
Laboratory Costs	$	-
Contractor Costs	$	-
Remediation Costs		
Consultant Costs	$	-
Laboratory Costs	$	-
Contractor Costs	$	-
TOTALS	$	7,500

Comments:

Assumptions:

Depth to groundwater	less than 5 feet
Nearest surface water	none
Identified Vapor receptors	none

Implementation of SAP

Consultant costs will include	Field Work	-
	Reporting	-
	Project Coordination	
Laboratory Costs		
	Soil	-
	Groundwater	-
Contractor costs	Drilling	-

Complete Phase II Investigation

Consultant costs will include	Field Work	-
	Reporting	-
	Project Coordination	
Laboratory Costs		
	Soil	-
	Groundwater	-
Contractor costs	Drilling	-

Remediation Costs

Will remediation be required?	no
Risk Criteria	
Direct Exposure	Unlikely.
Groundwater	The depth to groundwater is anticipated to be less than 5 feet. However, three monitoring wells surround the site. The wells are sampled as part of a NPDES permit.
Surface Water	The nearest surface water appears to be more than 1,000 feet from the site. Surface water impacts are not anticipated.
Vapor Intrusion	There do not appear to be any vapor receptors in the vicinity of the site.

Site Name:	Colby Lake Pumping Station		
Area of Concern Number:	AOC59	**Date Updated:**	06/10/14
Total acres:	2 to 3 acres		
Chemicals of Concern:	DRO/VOC/PCB/RCRA metals		
Site Summary:	Remote pumping statation on Colby Lake that provided drinking water to the plant. Includes former fuel oil AST, transformer, and various mercury contaiing pressure gauges.		
Yellow Highlight indicates to CRE Estimate AOC tab			

Task Description	**Estimated Costs**	
Phase I ESA/SAP	$ 7,500	
Implementation of SAP		
Consultant Costs	$ 15,000	
Laboratory Costs	$ 1,200	
Contractor Costs	$ 4,800	**$ 21,000**
Complete Phase II Investigation		
Consultant Costs	$ -	
Laboratory Costs	$ -	
Contractor Costs	$ -	
Remediation Costs		
Consultant Costs	$ -	
Laboratory Costs	$ -	
Contractor Costs	$ -	
TOTALS	$ 28,500	

Comments:

Assumptions:

Depth to groundwater	greater than 20-feet
Nearest surface water	none
Identified Vapor receptors	none

Implementation of SAP

Consultant costs will include	Field Work	2 days
	Reporting	Limited Phase 2 Report
	Project Coordination	
Laboratory Costs		
	Soil	5 RCRA metal and 5 DRO/VOC samples
	Groundwater	5 DRO/VOC
Contractor costs	Drilling	2 days

Complete Phase II Investigation

Consultant costs will include	Field Work
	Reporting
	Project Coordination
Laboratory Costs	
	Soil
	Groundwater
Contractor costs	Drilling

Remediation Costs

Will remediation be required?	No	
Risk Criteria		
	Direct Exposure	Possible, however no releases are anticipated. AST site already closed
	Groundwater	Possible, however no releases are anticipated. AST site already closed
	Surface Water	Possible, however no releases are anticipated. AST site already closed
	Vapor Intrusion	Possible, however no releases are anticipated. AST site already closed

Site Name:	Pellet Plant
Area of Concern Number:	AOC61 — **Date Updated:** 06/10/14
Total acres:	approximately 14.5 acres
Chemicals of Concern:	GRO, DRO, PCB, VOC, SVOC, RCRA metals
Summary:	The plant on this site was used to make iron ore pellets. The site included an electrical building, transformers, a substation system, pipelines for transformer oil and steam, and above-ground storage tanks for petroleum products. Two closed leak sites are located on adjacent properties.

Yellow Highlight indicates to CRE Estimate AOC tab

Task Description	**Estimated Costs**	
Phase I ESA/SAP Update (in progress)	$ 7,500	
Implementation of SAP		
Consultant Costs	$ 40,300	
Laboratory Costs	$ 34,626	
Contractor Costs	$ 24,000	**$ 98,926**
Complete Phase II Investigation		
Consultant Costs	$ 36,300	
Laboratory Costs	$ 10,125	
Contractor Costs	$ 12,000	**$ 58,425**
Remediation Costs		
Consultant Costs	$ 38,300	
Laboratory Costs	$ 5,810	
Contractor Costs	$ 214,436	**$ 258,546**
TOTALS	**$ 423,397**	

Comments: This estimate assumes that the only risk is from direct exposure; it is assumed that the depth to groundwater is greater than 20 feet and that the groundwater is not impacted. There are no inhabitable buildings nearby; therefore, it is assumed that there is no risk of vapor intrusion. PCB remediation is driven by TSCA regulations rather than risk-based guidance.

Recognized Environmental Conditions	**COC**	**Viable risk pathways**	**Remediation?**
#1 Substation System	PCB, DRO	Direct Exposure	Yes
#2 Laydown Areas	VOC, SVOC, DRO, PCB, RCRA Metals	Direct Exposure	No
#3 Former Outdoor Storage Tanks	DRO, GRO, VOC, SVOC	Direct Exposure	Yes
#4 Adjacent Property to Northeast	DRO, VOC	Direct Exposure	No

Attachment H

Ames Correspondence

Attachment H1

Ames Letter to Support Ames Portion of unit $ Reclamation Tab

Ames Construction, Inc.®

2000 Ames Drive
Burnsville, MN 55306
952-435-7106 • Fax 952-435-7142

To whom it may concern:

- Over the course of several weeks during the first half of 2016, Ames Construction provided to PolyMet Mining, Inc. construction cost estimates for the purpose of establishing the initial financial assurance estimate for PolyMet's Northmet Project.
- The Ames construction cost estimates are based upon information provided and quantities established by Barr Engineering on PolyMet's behalf.
- The unit costs are based on established Northern Minnesota labor and benefit rates and current fuel oil and construction material pricing. Ames' productivity rates are based on our experience working in Minnesota and across the country.
- Ames Construction is familiar with PolyMet's Northmet project, first becoming involved in 2008. At that time Ames provided project construction cost estimates for the development of the proposed mine site and tailings basin. Since 2008, Ames has worked with PolyMet and Barr personnel as the scope of the project has been refined and has provided several project construction cost estimate updates.

Sincerely,

Martin Husnik, P.E.
Midwest Chief Estimator
Ames Construction Inc.

Emil "Butch" Trebesch, P.E
Sr. VP Midwest Region
Ames Construction Inc.

Attachment H2

Ames Email with New Item Unit $ Reclamation Tab

From: Michael Glissman <mglissman@polymetmining.com>
Sent: Thursday, April 27, 2017 2:49 PM
To: Jim Scott (jr.scott@frontiernet.net)
Cc: Jim Tieberg; Kevin Pylka
Subject: FW: Question on Demo Landfills
Attachments: image002.jpg; image004.jpg; image003.jpg; image004.jpg; image005.jpg; image006.jpg; image007.jpg

Jim-

See attached string from NTS on landfill demo tipping rates. I'm not exactly clear on how the fuel tax rate applies at Canyon, but overall, Canyon appears to be the worst choice (most expensive).

Just found out that freight rates to the SKB site in Cloquet would be $600 / truck load.

I am also working on obtaining what the capacity of the haul trucks are in cubic yards because we will most likely be hauling lots of air with the piping unless we come up with a way to crush it flat or grind it up so that it doesn't take up as much volume.

In summary:

<u>Dem-Con Companies General Waste in Keewatin:</u>
Clean Construction Demo - $9.40 plus $0.60 cents per cubic yard tax = $ 10.00 / cubic yard

<u>SKB Environmental Services – Shamrock Trucking in Cloquet:</u>
Clean Demo - $20 per ton (dependent on quantity)
Industrial (Contaminated) Waste - $28 per ton (dependent on quantity)

<u>Waste Management in Canyon:</u>
Please note that this is just a general special waste quote.
Disposal: $30 per ton (3 ton minimum)
Fuel: 4.8% *This percentage changes weekly
Environmental: $22 per load
Tax: All applicable taxes, $0.36 per ton
Profile: $200 (onetime fee)

Will continue to send you information as it becomes available.
Thanks
Mike

From: Kevin Pylka
Sent: Thursday, April 27, 2017 12:28 PM
To: Michael Glissman
Subject: FW: Question on Demo Landfills

Mike,

See the email and thread below detailing pricing. I can walk you through this if needed, but am headed to a 1:00-3:00 meeting. I can talk after that.
KEvin

From: Jenny Holmes [mailto:JHolmes@netechnical.com]
Sent: Tuesday, April 25, 2017 4:10 PM
To: Kevin Pylka <kpylka@polymetmining.com>
Subject: Question on Demo Landfills

Hi Kevin,

Allison was able to get some answers for you. Please see her message below and let me know if we can help with anything else. Thanks!!

Sent from my iPhone

Begin forwarded message:

> **From:** Allison Smrekar <asmrekar@netechnical.com>
> **Date:** April 25, 2017 at 3:26:44 PM CDT
> **To:** Jenny Holmes <JHolmes@netechnical.com>
> **Subject: RE: Question on Demo Landfills**
>
> Hi Jenny,
>
> To answer the first question, it is $9.40 per cubic yard plus $0.60 per cubic yard as tax.
>
> For the second question, the tax amount depends on the type of material and is usually less than $1 ($0.36 was the original estimate) so if it is $30 per ton for disposal, with tax it would be $30.36 per ton for disposal. We can disregard the $13 per ton tax as that applies for Wisconsin only (she forgot to take it out when sending the quote). The fuel and environmental charges apply, even for disposal only, so fuel tax is approximately 4.8% per load, and environmental is $22 per load.
>
> The costs listed above are for disposal only with no transportation fees included. I hope this helps – please let me know if you need me to clarify anything, or if it just doesn't make sense. Thanks!
>
> **Allison Smrekar**
> **Geological Engineer, EIT**
> **OFFICE:** (218) 741-4290 | asmrekar@netechnical.com
> **DIRECT:**(218) 742-1054 | www.netechnical.com
>
>

From: Jenny Holmes
Sent: Tuesday, April 25, 2017 12:40 PM
To: Allison Smrekar <asmrekar@netechnical.com>
Subject: Fwd: Question on Demo Landfills

Would you check on Kevin's question?

Sent from my iPhone

Begin forwarded message:

> **From:** Kevin Pylka <kpylka@polymetmining.com>
> **Date:** April 25, 2017 at 11:29:26 AM CDT
> **To:** Jenny Holmes <JHolmes@netechnical.com>
> **Subject: RE: Question on Demo Landfills**
>
> Jenny,
>
> Thanks for the info! Is the $9.40 on the Dem Con information $9.40 per load plus $0.60 cents per cubic yard, or $9.40/ton, plus 0.60 per cubic yard?
>
> Thanks
> Kevin
>
> ---
>
> **From:** Jenny Holmes [mailto:JHolmes@netechnical.com]
> **Sent:** Tuesday, April 25, 2017 10:51 AM
> **To:** Kevin Pylka <kpylka@polymetmining.com>
> **Cc:** Bruce Trebnick <BTrebnick@netechnical.com>
> **Subject:** RE: Question on Demo Landfills
>
> Good morning,
>
> Below is a cost summary for estimated waste disposal of geomembrane materials and plastic piping from the three closest demo landfills.
>
> <u>Dem-Con Companies General Waste in Keewatin:</u>
> Clean Construction Demo - $9.40 plus $0.60 cents per cubic yard
>
> <u>SKB Environmental Services – Shamrock Trucking in Cloquet:</u>
> Clean Demo - $20 per ton (dependent on quantity)
> Industrial (Contaminated) Waste - $28 per ton (dependent on quantity)
>
> <u>Waste Management in Canyon:</u>
> Please note that this is just a general special waste quote.
> Disposal: $30 per ton (3 ton minimum)
> Fuel: 4.8% *This percentage changes weekly
> Environmental: $22 per load
> Tax: All applicable taxes, $0.36 per ton, $13/ton
> Profile: $200 (onetime fee)

I hope this is what you were looking for. Please let me know if you need additional information or if you have a volume estimate so we can get better pricing for you. Thank you!

Jenny Holmes
Senior Project Manager
OFFICE: (218) 741-4290 | jholmes@netechnical.com
DIRECT:(218) 742-1033 | www.netechnical.com

From: Jenny Holmes
Sent: Friday, April 21, 2017 12:35 PM
To: 'Kevin Pylka' <kpylka@polymetmining.com>; Bruce Trebnick <BTrebnick@netechnical.com>
Subject: RE: Question on Demo Landfills

Absolutely! I will get back to you by early next week with some options. Thank you!

From: Kevin Pylka [mailto:kpylka@polymetmining.com]
Sent: Friday, April 21, 2017 11:21 AM
To: Jenny Holmes <JHolmes@netechnical.com>; Bruce Trebnick <BTrebnick@netechnical.com>
Subject: RE: Question on Demo Landfills

Jenny,

Would you or someone at NTS be able to secure pricing for demolition waste for landfills in the area, maybe the three closest? This is an exercise for cost estimating future reclamation estimates so I don't have a waste or material that is generated. We would have to assume it fits into the appropriate "demolition waste" guidelines but as mentioned previously it would be geomembrane materials and plastic piping removed from a site. Not hazardous material nor containing hazardous waste.

I realize it would have to be contingent upon acceptance of a waste profile. I just need something that can be used as a reference in a cost analysis.

Thanks,
Kevin

From: Jenny Holmes [mailto:JHolmes@netechnical.com]
Sent: Friday, April 21, 2017 10:27 AM
To: Kevin Pylka <kpylka@polymetmining.com>; Bruce Trebnick <BTrebnick@netechnical.com>
Subject: RE: Question on Demo Landfills

Hi Kevin,

Dem-Con companies General Waste located in Keewatin is likely your best bet. Disposal rates are around $21.00 or $22.00 per ton and will depend on current acceptance of the material.

If you need additional assistance, please let me know. We would be happy to coordinate any efforts for the disposal of these materials or obtain a quote based on the amount of material intended for disposal.

Thank you!

Jenny Holmes
Senior Project Manager
OFFICE: (218) 741-4290 | jholmes@netechnical.com
DIRECT:(218) 742-1033 | www.netechnical.com

From: Kevin Pylka [mailto:kpylka@polymetmining.com]
Sent: Friday, April 21, 2017 8:50 AM
To: Bruce Trebnick <BTrebnick@netechnical.com>; Jenny Holmes <JHolmes@netechnical.com>
Subject: Question on Demo Landfills

Bruce / Jenny,

Would you or someone at NTS know the current closest demolition landfills available to dispose of waste like geomembrane liners and plastic piping. I assume it would be either the Canyon Landfill, the Carlton Landfill, or General Waste near Keewatin. If so have you obtained recent pricing for tipping fees?

Kevin

Kevin Pylka
Manager of Environmental Permitting and Compliance
Mobile: 218-750-2054 | Office: 218-471-2150 | Direct: 218-471-2162 | Fax: 218-471-2159
kpylka@polymetmining.com | www.polymetmining.com

Attachment I

NTS Correspondence

Attachment I1

NTS Tipping Fee Email

From: Tom Radue <tradue@barr.com>
Sent: Monday, November 13, 2017 7:34 AM
To: 'jrscotthl@gmail.com'; Jennifer Saran; Jim Tieberg
Subject: FW: PolyMet Unit Prices for Reclamation Estimate
Attachments: Copy of unit prices.pdf; Copy of unit prices.xlsx

Jim, Jennifer and Jim - See attached from Ames. Tom

Tom Radue, PE

Vice President
Senior Geotechnical Engineer
Minneapolis, MN office: 952.832.2871
cell: 952.240.4051
tradue@barr.com
www.barr.com

resourceful. naturally. BARR

From: Martin Husnik [mailto:MartinHusnik@amesco.com]
Sent: Monday, November 13, 2017 7:29 AM
To: Tom Radue
Subject: RE: PolyMet Unit Prices for Reclamation Estimate

Tom,

See attached.

Ames Construction	**Martin Husnik, P. E.**
2000 Ames Drive	Chief Estimator
Burnsville, MN 55306	MartinHusnik@amesco.com
Midwest: 952-435-7106	Mobile: 612-919-3405

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Description	Unit	Basis for Quantities (drawing # or describe)	Unit Price	Comments
Grading uneven area for gentle contour and drainge	CY or Ac	Grading for depths 6" to 16"	$3200/AC	No hauling of material, Mid size dozer work.
Abandon Monitoring or Drinling Water Well	each			No pricing requested from Ames
grader for road snow plowing or gravel road maintenance	hr		$200/hr	One grader with Operator, Assumes Ames is onsite working on other activities.
load bentonite at rail cars and spread on FTB beach	cy or t		$8/cy	26,000 ft haul using side dumps, spread and disc in 1 foot on the beach, likely a controlled spreading type machine to get the correct lb/sf.

Attachment I2

NTS Transport Email

From: Michael Glissman <mglissman@polymetmining.com>
Sent: Thursday, April 27, 2017 11:13 AM
To: Jim Scott (jr.scott@frontiernet.net)
Cc: Jim Tieberg; Kevin Pylka
Subject: FW: Pricing

Jim-

See response from Wayne Transport below.

To summarize;

Freight rates from the mine site to either Waste Management's Canyon Landfill or General Waste's Landfill by Keewatin would be $ 415.00 / load.
Non-permitted load capacity is 50,000 lbs.
Non-permitted load lengths are 40 ft.

We are still waiting for tipping fee costs from Kevin Pylka (cc'd here as friendly reminder) and estimated tonnages from Ames for the geomembrane and piping.

Thank you
Mike

From: Steve DeVaney
Sent: Thursday, April 27, 2017 10:24 AM
To: Michael Glissman ; Jim Tieberg
Subject: Fwd: Pricing

Bid on trucking

Sent from my iPhone

Begin forwarded message:

> **From:** Jeff Hill <JeffH@waynetransports.com>
> **Date:** April 27, 2017 at 9:38:20 AM CDT
> **To:** Steve DeVaney <sdevaney@polymetmining.com>
> **Subject: Re: Pricing**
>
> Hi Steve,
> Sorry I didn't get back to you sooner, I've been traveling all week and it's been pretty hectic. Anyway the rate would be the same to both places. $415.00 per load, we could haul roughly 50,000 lbs and handle lengths up to 40ft without permitting. If the lengths were longer the rate would go up considerably. I hope this helps you out. If you need more please contact me.
> Thanks and have a good day.
> Jeff

Sent from my iPhone

On Apr 24, 2017, at 10:10 PM, Steve DeVaney <sdevaney@polymetmining.com> wrote:

Hi Jeff,

PolyMet is working on a Reclamation Estimate (for permitting purposes) to dispose of geomembrane material and drain pipe from the mine stockpiles (about 6 miles east of the plant site) to either Waste Management's Canyon Landfill or General Waste's Landfill by Keewatin. Quantities are unknown at this time. Please forward a cost per truck, weight limitations and length of loads.

If you have any questions, the technical contact is Mike Glissman: (o) 218-471-2175, (c) 218-750-2991 or mglissman@polymetmining.com

Thank you,

Steve DeVaney

Procurement Manger

PolyMet Mining, Inc.

Attachment I3

NTS Rate Letter

April 22, 2016

Environmental Science & Engineering

PolyMet Mining, Inc.
Attn. Steve DeVaney
Via Email
sdevaney@polymetmining.com

RE: Cost Estimates on Several Items

Attached are the cost estimates that will be used in the Contingency Reclamation Estimate (CRE) as part of the application for the permit to mine with the State of Minnesota. Included are the following items:

1. Hourly labor rates by staff type
2. Hourly rate for surveying
3. Wetland data collection, data entry and quality assurance, per annum cost estimate
4. DMR data collection, data entry, quality assurance and report preparation, per annum cost estimate
5. Water quality report preparation, per annum cost estimate
6. SW-619 industrial landfill monitoring and maintenance, per annum cost estimate (closed state)
7. Tailings basin instrumentation inspection and data collection, per annum cost estimate (current activity)
8. Tailings basin instrumentation report preparation, per annum cost estimate (current activity)
9. Tailings basin instrumentation inspection and data collection, per annum cost estimate (operating activity)
10. Tailings basin instrumentation report preparation, per annum cost estimate (operating activity)
11. Reverse osmosis treatment plants operation, per annum cost estimate

The cost estimates for items 3-8 are based on our experience performing these duties in years past. We have a high degree of certainty in terms of level of effort and unit rates for these items. For items 9 and 10 we lack detail as to how operating conditions would affect the level of effort, therefore we roughly estimated double the level of effort of current, non-operating conditions. For Item 11 we based our cost estimate on our experience elsewhere, however with the absence of design criteria and operating requirements, we estimated what typical plants of this size may cost to operate.

Please note that all pricing is valid for the remainder of calendar year 2016. Pricing is subject to an increase not to exceed 2.5% each year thereafter, effective on Jan 1st, for a period of 10 years. If you should have any questions, please feel free to contact Mr. Bruce Trebnick at 218-742-1051 (office) or 218-780-2006 (cell).

Sincerely,

Richard H. Crum, PG
NTS, President

PRICING REQUEST FOR SEVERAL ITEMS FOR THE CONTINGENCY RECLAMATION ESTIMATE (CRE)
AS PART OF THE APPLICATION FOR THE PERMIT TO MINE WITH THE STATE OF MINNESOTA

<u>Prepared For</u>

Steve DeVaney

PolyMet Mining, Inc.

<u>Prepared By</u>

Northeast Technical Services, Inc. (NTS)

526 Chestnut Street

Virginia, Minnesota 55792

218.741.4290

April 21, 2016

Environmental Science & Engineering

Table of Contents

1. **Hourly labor rates by staff type**

Staff Type	Hourly Rate
Entry Level Professional (I)	88
Middle Level Professional (II)	108
Senior Level Professional (III)	128
Principal Level Professional (IV)	148
WWTP Operator, Class B, C & D	58
WWTP Operator, Class A	128
Field Scientist	78
Project Support (Clerical)	58
Laborer/Intern	48

2. **Hourly rate for surveying**

$98/hour; includes Professional Engineer or EIT along with survey equipment. NTS is not permitted to survey property boundaries at this time.

3. **Wetland data collection, data entry and quality assurance, per annum cost estimate**

Item	Rate	Unit	Quantity	Subtotal
Field Equipment	2220.00	/lump	1	2220
Misc. Consumable Items	504.00	/lump	1	504
Pickup Truck 4x4	0.70	/mile	2000	1,400
Staff, Data Collection (Avg Rate)	83.00	/hour	520	43,160
			Total:	$47,284

Per annum cost estimate *per monitoring point* (21 points): $2,252

4. **DMR data collection, data entry, quality assurance and report preparation, per annum cost estimate**

Facility #1) Hoyt Lakes Tailings Basin

Item	Rate	Unit	Quantity	Subtotal
Field Equipment	7,276.00	/lump	1	7,276
Misc. Consumable Items	3,000.00	/lump	1	3,000
Pickup Truck 4x4	0.70	/mile	3400	2,380
Staff, Data Collection (Avg Rate)	83.00	/hour	560	46,480
Staff, Reporting (Avg Rate)	92.00	/hour	240	22,080
			Total:	$81,216

Facility #2) Hoyt Lakes Mining Area

Item	Rate	Unit	Quantity	Subtotal
Field Equipment	4,957.00	/lump	1	4,957
Misc. Consumable Items	648.00	/lump	1	648
Pickup Truck 4x4	0.70	/mile	1600	1,120
Staff, Data Collection (Avg Rate)	83.00	/hour	260	21,580
Staff, Reporting (Avg Rate)	92.00	/hour	264	24,288
			Total:	$52,593

Per Annum Cost Estimate, Total for *Both Facilities*: $133,809

5. **Water quality report preparation, per annum cost estimate**

Item	Rate	Unit	Quantity	Subtotal
Staff, Reporting (Avg Rate)	97.00	/hour	36	3,492
			Total:	$3,492

6. **SW-619 industrial landfill monitoring and maintenance, per annum cost estimate (closed state)**

Item	Rate	Unit	Quantity	Subtotal
Landfill Inspection	400.00	/ea	3	1,200
Cover Mowing	5327.00	/lump	1	5,327
Groundwater Monitoring	850.00	/well	7	5,950
Gas Vent Monitoring	600.00	/vent	7	4,200
Staff, Reporting (Avg Rate)	88.00	/day	60	5,280
			Total:	$21,957

Actual cost for maintenance will vary year-to-year. Costs shown are 3 year average.

NTS recommends that if the landfill leachate plume is proven to be stable, the number of groundwater sampling events/locations be reduced after five years.

7. **Tailings basin instrumentation inspection and data collection, per annum cost estimate (current activity)**

Item	Rate	Unit	Quantity	Subtotal
Field Equipment	2360.00	/lump	1	2360
Misc. Consumable Items	76.00	/lump	1	76
Pickup Truck 4x4	0.70	/mile	400	280
Staff, Data Collection (Average Rate)	113.00	/hour	112	12,656
			Total:	$15,372

Per Annum Cost Estimate, *per event* (2 events): $7,686

8. **Tailings basin instrumentation report preparation, per annum cost estimate (current activity)**

Item	Rate	Unit	Quantity	Subtotal
Staff, Reporting (Average Rate)	114.00	/hour	50	5,700
			Total:	$5,700

Per Annum Cost Estimate, *per event* (2 events): $2,850

9. **Tailings basin instrumentation inspection and data collection, per annum cost estimate (operating activity)**

Assumed Double Effort of Current Activity (Item #7)

Per Annum Cost Estimate, *per event* (2 events): $15,372

10. **Tailings basin instrumentation report preparation, per annum cost estimate (operating activity)**

Assumed Double Effort of Current Activity (Item #8)

Per Annum Cost Estimate, *per event* (2 events): $5,700

11. **Reverse osmosis treatment plants operation, per annum cost estimate**

Operation of RO treatment systems is dependent upon numerous variables. Proposed cost estimates are subject to the following variables and qualifying statements:

- Typical hours of plant operation required, assuming not continuous.
- Typical level of capacity required, assuming not maximum.
- Typical influent water quality and expected variability.
- Treatment objectives.
- Operational Strategies and SCADA Capabilities: Automation, remote monitoring, remote control capabilities, etc
- Are we to include membrane filter replacement in the estimate?
- How will reject water be stored or otherwise handled?

The following per annum cost estimate is based on this set of assumptions:

- Plants are operational 24/7 at 50% of capacity.
- Two RO plants (500gpm and 2000gpm) are both in operation; the cost estimate below is for combined operation and maintenance.
- Operator required 1 site visit per day.
- Operator scheduled 8 hours per day, 7 days a week.
- Operators are paid flat rate $40 per 8 hours "on-call".
- Not charging travel time for routine operation.
- Class A operator oversight 8 hours per week on average.
- Initial water quality is moderately impaired and moderately variable.
- Membrane filter replacement is not included.
- Potential reject water handling costs are not included.
- See Appendix A for detailed assumed design parameters.

Wastewater Treatment:

Item	Rate	Unit	Quantity	Subtotal
Energy Costs*	112,000.00	/lump	1	112,000
Chemical Costs*	599,000.00	/lump	1	599,000
Maintenance Costs*	124,000.00	/lump	1	124,000
Pickup Truck 4x4	0.70	/mi	32,000	22,400
Operator "on-call" charge	40.00	/8 hours	730	29,200
Operator, Class B, C or D	58.00	/hour	3,800	220,400
Operator, Class A	128.00	/hour	416	53,248
			Total:	$1,160,248

*See Appendix B for detailed breakdown of costs.

Wastewater Pretreatment:

Item	Rate	Unit	Quantity	Subtotal
Coagulation/Flocculation/Settling	245,000.00	/lump	1	245,000
Ultrafiltration	105,000.00	/lump	1	105,000
			Total:	$350,000

Pretreatment may be optional depending on influent water quality and effluent objectives.

Treatment costs may increase/decrease dependent on pretreatment options.

Appendix A: Assumed design parameters for WWTP's

Design Parameters:		
Percent Recovery	75%	
Design Feed Flow (Max)	3.6	mgd
Design Permeate Flow (Max)	2.70	mgd
Design Concentrate Flow (Max)	0.90	mgd
Average Feed Flow	1.80	mgd
Average Permeate Flow	1.35	mgd
Average Concentrate Flow	0.45	mgd
No. of Skids	3	skids
Size of RO Skids	0.90	mgd
RO Flux Rate	10	gfd
RO Area per Element	400	ft/elements
Number of Pressure Vessels per Skid	7	PV/skid
Number of RO Elements per Skid	231.00	elements/skid
Number of Cartridge Filters	157.00	

Appendix B: Detailed operation & maintenance costs for WWTP's

Annual Energy Cost	$112,000.00	$/year
Annual Energy Rate	$0.08	/kwh
Annual Feed Energy Cost	$97,700.24	$/year
Feed Pressure	200	psi
Interstage Boost Pressure	0	psi
Pump Motor Efficiency	78%	
Energy Consumption	3,345.90	kwh/day
Annual Concentrate Pump Energy Cost	14,000.00	$/year
Head	150.00	
Pump Horsepower	25.00	hp
Hours in Operation	24.00	hours/day
Energy Consumption	447.60	kwh/day

Annual Chemical Costs	$599,000.00	$/year
Antiscalant	$102,738.38	$/year
Dose	5.00	mg/L
Unit Cost	$3.75	$/lb
CIP Chemicals	$395,416.67	$/year
Acid CIP Frequency	30.00	days
Acid CIP Cost (2011 Cost)	$6,500.00	$/CIP
Caustic CIP Frequency	45.00	days
Caustic CIP Cost (2011 Cost)	$6,500.00	$/CIP
Miscellaneous Chemical	$99,631.01	$/year
Percentage of Non-CIP Chemicals	20%	
Final pH adjustment	$616.43	$/year
NaOH	0.25	mg/L
Strength	50%	% Concentration
Cost	$0.30	$/lb

Annual Maintenance Cost	$124,000.00	$/year
Annual Cartridge Filter Replacement Cost	$4,775.42	$/year
Filters to be Replaced	78.50	filters
Filter Replacement Frequency	90.00	days
Filter Cost	$15.00	$/filter
Annual RO Element Replacement Cost	$103,950.00	$/year
RO Elements to be Replaced	346.50	elements
RO Element Replacement Frequency	2.00	years
RO Element Cost	$600.00	$/element
Annual Maintenance Cost	$15,000.00	$/year
RO Capital Cost	$3,000,000	$
Maintenance Cost Percentage	0.50%	of capital cost/year

Attachment J

D&T Letter

D & T Landscaping, Inc.
PO Box 65
Solway, MN 56678
Office Phone & Fax 218-467-9242
Email: dntwinge@paulbunyan.net

Dave's Cell   218-556-4560
Deb's Cell   218-760-0894
Tom's Cell   218-760-3795

4/5/16

PolyMet Mining, Inc.
PO Box 475, 6500 Co Rd 666
Hoyt Lakes, MN 55750

Att: Steve DeVaney,

Below, please find some rough estimates for the Contingency Reclamation Estimate:

1.) **Commercial Fertilizer and Seed for Tailings Basin Flats – Supply/Apply/ Incorporate Unit Pricing per acre @ 500 lb/acre $390.00/Acre**
2.) **Commercial Fertilizer and Seed for Tailings Basin Slopes – Supply/Apply/Incorporate Unit Pricing per acre @ 200 lb/Acre $540.00/Acre**
3.) **Commercial Fertilizer and Seed for Overburden – Supply/Apply/Incorporate Unit Pricing per Acre @ 200 lb/Acre $295.00/Acre**
4.) **Mulch – Supply and Incorporate. Unit Pricing per Acre @ 2 ton/acre of Hay or Straw Mulch $340.00/Acre**

Thank You,

Deb Winge

Attachment K

Barr Documents

Attachment K1

Barr 2016 Fee Schedule

BARR

Fee Schedule—2016

Rev. 01/01/16

Description	**Rate* (U.S. dollars)**
Principal	$145-295
Consultant/Advisor	$155-250
Engineer/Scientist/Specialist III	$125-150
Engineer/Scientist/Specialist II	$95-120
Engineer/Scientist/Specialist I	$65-90
Technician III	$125-150
Technician II	$95-120
Technician I	$50-90
Support Personnel II	$95-150
Support Personnel I	$50-90

Rates for litigation support services will include a 30% surcharge.

A ten percent (10%) markup will be added to subcontracts for professional support and construction services to cover overhead and insurance surcharge expenses.

Invoices are payable within 30 days of the date of the invoice. Any amount not paid within 30 days shall bear interest from the date 10 days after the date of the invoice at a rate equal to the lesser of 18 percent per annum or the highest rate allowed by applicable law.

Reimbursable expenses including, but not limited to, the actual and reasonable costs of transportation, meals, lodging, parking costs, postage, and shipping charges will be billed at actual cost. Materials and supplies charges, printing charges, and equipment rental charges will be billed in accordance with Barr's standard rate schedules. Mileage will be billed at the IRS-allowable rate.

Principal category includes consultants, advisors, engineers, scientists, and specialists who are officers of the company.

Consultant/Advisor category includes experienced personnel in a variety of fields. These professionals typically have advanced background in their areas of practice and include engineers, engineering specialists, scientists, related technical professionals, and professionals in complementary service areas such as communications and public affairs.

Engineer/Scientist/Specialist categories include registered professionals and professionals in training (e.g. engineers, geologists, and landscape architects), and graduates of engineering and science degree programs.

Technician category includes CADD operators, construction observers, cost estimators, data management technicians, designers, drafters, engineering technicians, interns, safety technicians, surveyors, and water, air, and waste samplers.

Support Personnel category includes information management, project accounting, report production, word processing, and other project support personnel.

*Rates do not include sales tax on services that may be required in some jurisdictions.

Attachment K2

Barr Geotechnical Letter

April 1, 2016

Mr. Steve DeVaney
Procurement Manager
PolyMet Mining Corporation
6500 County Road 666
PO Box 475
Hoyt Lake, MN 55750

Re: Proposal for NorthMet Dam Safety Inspection

Dear Mr. DeVaney:

As requested, this letter provides the scope and cost estimate for performing onsite inspection of tailings basin dams at the NorthMet project site and providing a summary of observations and recommendations in an inspection report. Inspection is anticipated to occur under one of two primary tailings basin operating conditions:

- Tailings Basin Idle – Assumes that the basin is idle (no active tailings discharge into the basin, but discharge of water into the basin from groundwater collection system operations)
- Tailings Basin Active – Assumes that the basin is active (active tailings discharge into the basin, with discharge of water into the basin from groundwater collection system operations)

Barr Engineering Co. has performed dam safety inspections of NorthMet's dams for multiple years, beginning when the site was owned and operated by LTV Steel Mining Company. Using this long-term experience at the site, future dam safety inspections will be performed by a two-person geotechnical engineering team including a mid-level geotechnical engineer, and a senior or principal geotechnical engineer who has previously been involved with dam safety and design of these basins. One or both engineers will be registered professional engineers in the State of Minnesota. Barr's geotechnical engineers will review the integrity of the basins and evaluate field conditions. If possible, the inspection team will also meet with you while onsite to describe preliminary findings.

For 'Tailings Basin Idle' conditions we anticipate spending approximately one full day onsite to review the toe, mid-slope, and crest of the dams to review conditions. Any areas of interest noted from previous inspections, or identified during the proposed inspection, will be evaluated in greater detail. The inspection will be documented with GPS feature location confirmation, photography, and field notes. Additional time on site can be anticipated for inspections performed during 'Tailings Basin Active' conditions, to review acceptability of dam construction procedures and adequacy of dam alignment and geometry control activities.

The observations from onsite inspections will be summarized in a dam safety report, including notes on any dam modifications made since the previous inspection, and recommendations for action items necessary to improve performance of the dams or management of the basin. In addition, the instrumentation monitoring data collected during the prior year will be reviewed and discussed in the report and compared with past instrumentation data. This includes data for pneumatic and standpipe piezometers, inclinometers, and weirs. The dam safety report will also contain considerations for instrumentation repair, abandonment, or replacement based on anticipated site conditions for the following year. Supplemental surveying may be proposed if needed to confirm alignment and geometry of any existing and newly constructed dams. Table 1 provides a summary of the anticipated dam safety inspection and reporting costs.

Table 1 Tailings Basin Inspection and Reporting Cost Estimate (1)

Activity	Estimated Labor Hours	Estimated Labor Cost (2)	Estimated Expense Cost (3)	Estimated Total Cost
Tailings Basin Idle				
Inspection	40	$6,000	$1,000	$7,000
Data Analysis and Reporting	70	$10,000	$500	$10,500
			Estimated Total Cost (Tailings Basin Idle)	**$17,500**
Tailings Basin Active				
Inspection	60	$9,000	$1,000	$10,000
Data Analysis and Reporting	100	$13,000	$500	$13,500
			Estimated Total Cost (Tailings Basin Active)	**$23,500**
			Supplemental Surveying – Differential GPS, Leica, or UAV (Hourly as Needed) (4)	$200 - $300/Hour
			Supplemental Surveying – Z-Boat Bathymetry (Hourly as Needed) (4)	$350 - $450/Hour

Notes:

1) Estimated costs are valid through December 31, 2016. At the time that inspections are requested, the inspection scope will be confirmed and the estimated costs updated accordingly.
2) For estimating future labor costs, assume an annual total labor rate inflation factor on the order of 3 – 5 percent.
3) For estimating future expense costs, assume an annual total expense rate inflation factor on the order of 3 – 5 percent.
4) Hourly cost for surveying will be determined on a project-specific basis and will depend on the type and scope of survey required, the crew size required, and the equipment types and survey materials necessary. For cost estimating purposes assume single-person Differential GPS based surveys for confirmatory evaluation of alignment and geometry, and single-person Leica HDS Scan or UAV Scan for detailed topographic survey. Assume two-person crew with Z-Boat for pond bathymetry surveys.

For cases where a single-day geotechnical inspection may be required, Barr recommends the inspection be performed by a senior or principal engineer. Estimated total cost (labor and expenses) for a single-day inspection and follow-up memorandum can be predicted to be in the range of $3,000 to $4,000.

For each complete dam safety review a draft report will be submitted to PolyMet Mining Corporation for their review approximately 6 weeks after performing the inspection. Upon receipt of comments, a final report will be issued within 1 to 2 weeks.

The costs summarized herein are estimates of total cost. Work will be performed on a time and materials basis in accordance with the Barr fee schedule that is in affect at the time that the work is performed.

We appreciate the opportunity to continue working with you to review and maintain the integrity of these dams.

Sincerely,

Thomas J. Radue

Thomas J. Radue, PE
Vice President

Attachment L

Minnesota DOLI Prevailing Wage List

MINNESOTA DEPARTMENT OF LABOR AND INDUSTRY PREVAILING WAGES FOR STATE FUNDED CONSTRUCTION PROJECTS

THIS NOTICE MUST BE POSTED ON THE JOBSITE IN A CONSPICUOUS PLACE

Construction Type: Commercial

County Number: 69

County Name: ST. LOUIS

Effective: 2016-12-27 Revised: 2017-05-08

This project is covered by Minnesota prevailing wage statutes. Wage rates listed below are the minimum hourly rates to be paid on this project.

All hours worked in excess of eight (8) hours per day or forty (40) hours per week shall be paid at a rate of one and one half (1 1/2) times the basic hourly rate.

Violations should be reported to:

Department of Labor and Industry
Prevailing Wage Section
443 Lafayette Road N
St Paul, MN 55155
(651) 284-5091
DLI.PrevWage@state.mn.us

* Indicates that adjacent county rates were used for the labor class listed.

County: ST. LOUIS (69)

LABOR CODE AND CLASS		EFFECT DATE	BASIC RATE	FRINGE RATE	TOTAL RATE
LABORERS (101 - 112) (SPECIAL CRAFTS 701 - 730)					
101	LABORER, COMMON (GENERAL LABOR WORK)	2016-12-27	24.14	16.92	41.06
102	LABORER, SKILLED (ASSISTING SKILLED CRAFT JOURNEYMAN)	2016-12-27	24.14	16.92	41.06

103	LABORER, LANDSCAPING (GARDENER, SOD LAYER AND NURSERY OPERATOR)	2016-12-27	20.62	16.25	36.87
104*	FLAG PERSON	2016-12-27	24.14	16.92	41.06
105*	WATCH PERSON	FOR RATE CALL 651-284-5091 OR EMAIL DLI.PREVWAGE@STATE.MN.US			
106	BLASTER	2016-12-27	24.84	16.92	41.76
107	PIPELAYER (WATER, SEWER AND GAS)	2016-12-27	31.73	17.02	48.75
108	TUNNEL MINER	FOR RATE CALL 651-284-5091 OR EMAIL DLI.PREVWAGE@STATE.MN.US			
109	UNDERGROUND AND OPEN DITCH LABORER (EIGHT FEET BELOW STARTING GRADE LEVEL)	2016-12-27	29.93	17.02	46.95
110	SURVEY FIELD TECHNICIAN (OPERATE TOTAL STATION, GPS RECEIVER, LEVEL, ROD OR RANGE POLES, STEEL TAPE MEASUREMENT; MARK AND DRIVE STAKES; HAND OR POWER DIGGING FOR AND IDENTIFICATION OF MARKERS OR MONUMENTS; PERFORM AND CHECK CALCULATIONS; REVIEW AND UNDERSTAND CONSTRUCTION PLANS AND LAND SURVEY MATERIALS). THIS CLASSIFICATION DOES NOT APPLY TO THE WORK PERFORMED ON A PREVAILING WAGE PROJECT BY A LAND SURVEYOR WHO IS LICENSED PURSUANT TO MINNESOTA STATUTES, SECTIONS 326.02 TO 326.15.	2016-12-27	24.14	16.92	41.06
111	TRAFFIC CONTROL PERSON (TEMPORARY SIGNAGE)	FOR RATE CALL 651-284-5091 OR EMAIL DLI.PREVWAGE@STATE.MN.US			

SPECIAL EQUIPMENT (201 - 204)

201	ARTICULATED HAULER	2016-12-27	36.13	18.40	54.53
		2017-05-01	37.83	18.65	56.48

202	BOOM TRUCK	2016-12-27	36.13	18.40	54.53
		2017-05-01	37.83	18.65	56.48
203	LANDSCAPING EQUIPMENT, INCLUDES HYDRO SEEDER OR MULCHER, SOD ROLLER, FARM TRACTOR WITH ATTACHMENT SPECIFICALLY SEEDING, SODDING, OR PLANT, AND TWO-FRAMED FORKLIFT (EXCLUDING FRONT, POSIT-TRACK, AND SKID STEER LOADERS), NO EARTHWORK OR GRADING FOR ELEVATIONS	2016-12-27	35.65	17.15	52.80
204*	OFF-ROAD TRUCK	2016-12-27	36.13	18.40	54.53
		2017-05-01	37.83	18.65	56.48
205	PAVEMENT MARKING OR MARKING REMOVAL EQUIPMENT (ONE OR TWO PERSON OPERATORS); SELF-PROPELLED TRUCK OR TRAILER MOUNTED UNITS.	2016-12-27	26.91	19.87	46.78

HIGHWAY/HEAVY POWER EQUIPMENT OPERATOR

GROUP 2		2016-12-27	32.92	17.20	50.12
306	GRADER OR MOTOR PATROL				
308	TUGBOAT 100 H.P. AND OVER WHEN LICENSE REQUIRED (HIGHWAY AND HEAVY ONLY)				
GROUP 3		2016-12-27	33.84	18.90	52.74
		2017-05-01	34.04	19.70	53.74
309	ASPHALT BITUMINOUS STABILIZER PLANT				
310	CABLEWAY				
312	DERRICK (GUY OR STIFFLEG)(POWER)(SKIDS OR STATIONARY) (HIGHWAY AND HEAVY ONLY)				
314	DREDGE OR ENGINEERS, DREDGE (POWER) AND ENGINEER				
316	LOCOMOTIVE CRANE OPERATOR				
320	TANDEM SCRAPER				
322	TUGBOAT 100 H.P AND OVER (HIGHWAY AND HEAVY ONLY)				
GROUP 4		2016-12-27	33.54	18.90	52.44

	2017-05-01	33.74	19.70	53.44

323 AIR TRACK ROCK DRILL

324 AUTOMATIC ROAD MACHINE (CMI OR SIMILAR) (HIGHWAY AND HEAVY ONLY)

325 BACKFILLER OPERATOR

327 BITUMINOUS ROLLERS, RUBBER TIRED OR STEEL DRUMMED (EIGHT TONS AND OVER)

328 BITUMINOUS SPREADER AND FINISHING MACHINES (POWER), INCLUDING PAVERS, MACRO SURFACING AND MICRO SURFACING, OR SIMILAR TYPES (OPERATOR AND SCREED PERSON)

329 BROKK OR R.T.C. REMOTE CONTROL OR SIMILAR TYPE WITH ALL ATTACHMENTS

330 CAT CHALLENGER TRACTORS OR SIMILAR TYPES PULLING ROCK WAGONS, BULLDOZERS AND SCRAPERS

331 CHIP HARVESTER AND TREE CUTTER

332 CONCRETE DISTRIBUTOR AND SPREADER FINISHING MACHINE, LONGITUDINAL FLOAT, JOINT MACHINE, AND SPRAY MACHINE

334 CONCRETE MOBIL (HIGHWAY AND HEAVY ONLY)

335 CRUSHING PLANT (GRAVEL AND STONE) OR GRAVEL WASHING, CRUSHING AND SCREENING PLANT

336 CURB MACHINE

337 DIRECTIONAL BORING MACHINE

338 DOPE MACHINE (PIPELINE)

340 DUAL TRACTOR

341 ELEVATING GRADER

345 GPS REMOTE OPERATING OF EQUIPMENT

347 HYDRAULIC TREE PLANTER

348 LAUNCHER PERSON (TANKER PERSON OR PILOT LICENSE)

349 LOCOMOTIVE (HIGHWAY AND HEAVY ONLY)

350 MILLING, GRINDING, PLANNING, FINE GRADE, OR TRIMMER MACHINE

352 PAVEMENT BREAKER OR TAMPING MACHINE (POWER DRIVEN) MIGHTY MITE OR SIMILAR TYPE

354 PIPELINE WRAPPING, CLEANING OR BENDING MACHINE

356 POWER ACTUATED HORIZONTAL BORING MACHINE, OVER SIX INCHES

357 PUGMILL

359 RUBBER-TIRED FARM TRACTOR WITH BACKHOE INCLUDING ATTACHMENTS (HIGHWAY AND HEAVY ONLY)

360 SCRAPER

361 SELF-PROPELLED SOIL STABILIZER

362 SLIP FORM (POWER DRIVEN) (PAVING)

363 TIE TAMPER AND BALLAST MACHINE

365

TRACTOR, WHEEL TYPE, OVER 50 H.P. WITH PTO UNRELATED TO LANDSCAPING (HIGHWAY AND HEAVY ONLY)

367 TUB GRINDER, MORBARK, OR SIMILAR TYPE

GROUP 5 *	2016-12-27	18.77	8.18	26.95

370 BITUMINOUS ROLLER (UNDER EIGHT TONS)

371 CONCRETE SAW (MULTIPLE BLADE) (POWER OPERATED)

372 FORM TRENCH DIGGER (POWER)

375 HYDRAULIC LOG SPLITTER

376 LOADER (BARBER GREENE OR SIMILAR TYPE)

377 POST HOLE DRIVING MACHINE/POST HOLE AUGER

379 POWER ACTUATED JACK

381 SELF-PROPELLED CHIP SPREADER (FLAHERTY OR SIMILAR)

382 SHEEP FOOT COMPACTOR WITH BLADE . 200 H.P. AND OVER

383 SHOULDERING MACHINE (POWER) APSCO OR SIMILAR TYPE INCLUDING SELF-PROPELLED SAND AND CHIP SPREADER

384 STUMP CHIPPER AND TREE CHIPPER

385 TREE FARMER (MACHINE)

GROUP 6	2016-12-27	29.55	16.08	45.63

387 CAT, CHALLENGER, OR SIMILAR TYPE OF TRACTORS, WHEN PULLING DISK OR ROLLER

389 DREDGE DECK HAND

391 GRAVEL SCREENING PLANT (PORTABLE NOT CRUSHING OR WASHING)

393 LEVER PERSON

395 POWER SWEEPER

396 SHEEP FOOT ROLLER AND ROLLERS ON GRAVEL COMPACTION, INCLUDING VIBRATING ROLLERS

397 TRACTOR, WHEEL TYPE, OVER 50 H.P., UNRELATED TO LANDSCAPING

COMMERCIAL POWER EQUIPMENT OPERATOR

GROUP 1	2016-12-27	39.14	18.40	57.54
	2017-05-01	40.04	19.45	59.49

501 HELICOPTER PILOT (COMMERCIAL CONSTRUCTION ONLY)

502 TOWER CRANE 250 FEET AND OVER (COMMERCIAL CONSTRUCTION ONLY)

503 TRUCK CRAWLER CRANE WITH 200 FEET OF BOOM AND OVER, INCLUDING JIB (COMMERCIAL CONSTRUCTION ONLY)

GROUP 2	2016-12-27	38.80	18.40	57.20
	2017-05-01	39.70	19.45	59.15

504 CONCRETE PUMP WITH 50 METERS/164 FEET OF BOOM AND OVER (COMMERCIAL CONSTRUCTION ONLY)

505 PILE DRIVING WHEN THREE DRUMS IN USE (COMMERCIAL CONSTRUCTION ONLY)

506 TOWER CRANE 200 FEET AND OVER (COMMERCIAL CONSTRUCTION ONLY)

507 TRUCK OR CRAWLER CRANE WITH 150 FEET OF BOOM UP TO AND NOT INCLUDING 200 FEET, INCLUDING JIB (COMMERCIAL CONSTRUCTION ONLY)

GROUP 3	2016-12-27	37.39	18.40	55.79
	2017-05-01	38.29	19.45	57.74

508 ALL-TERRAIN VEHICLE CRANES (COMMERCIAL CONSTRUCTION ONLY)

509 CONCRETE PUMP 32-49 METERS/102-164 FEET (COMMERCIAL CONSTRUCTION ONLY)

510 DERRICK (GUY & STIFFLEG) (COMMERCIAL CONSTRUCTION ONLY)

511 STATIONARY TOWER CRANE UP TO 200 FEET

512 SELF-ERECTING TOWER CRANE 100 FEET AND OVER MEASURED FROM BOOM FOOT PIN (COMMERCIAL CONSTRUCTION ONLY)

513 TRAVELING TOWER CRANE (COMMERCIAL CONSTRUCTION ONLY)

514 TRUCK OR CRAWLER CRANE UP TO AND NOT INCLUDING 150 FEET OF BOOM, INCLUDING JIB (COMMERCIAL CONSTRUCTION ONLY)

GROUP 4	2016-12-27	37.05	18.40	55.45
	2017-05-01	37.95	19.45	57.40

515 CRAWLER BACKHOE INCLUDING ATTACHMENTS (COMMERCIAL CONSTRUCTION ONLY)

516 FIREPERSON, CHIEF BOILER LICENSE (COMMERCIAL CONSTRUCTION ONLY)

517 HOIST ENGINEER (THREE DRUMS OR MORE) (COMMERCIAL CONSTRUCTION ONLY)

518 LOCOMOTIVE (COMMERCIAL CONSTRUCTION ONLY)

519 OVERHEAD CRANE (INSIDE BUILDING PERIMETER) (COMMERCIAL CONSTRUCTION ONLY)

520 TRACTOR . BOOM TYPE (COMMERCIAL CONSTRUCTION ONLY)

GROUP 5	2016-12-27	36.13	18.40	54.53
	2017-05-01	37.03	19.45	56.48

521 AIR COMPRESSOR 450 CFM OR OVER (TWO OR MORE MACHINES) (COMMERCIAL CONSTRUCTION ONLY)

522 CONCRETE MIXER (COMMERCIAL CONSTRUCTION ONLY)

523 CONCRETE PUMP UP TO 31 METERS/101 FEET OF BOOM

524 DRILL RIGS, HEAVY ROTARY OR CHURN OR CABLE DRILL WHEN USED FOR CAISSON FOR ELEVATOR OR BUILDING CONSTRUCTION (COMMERCIAL CONSTRUCTION ONLY)

525 FORKLIFT (COMMERCIAL CONSTRUCTION ONLY)

526 FRONT END, SKID STEER 1 C YD AND OVER

527 HOIST ENGINEER (ONE OR TWO DRUMS) (COMMERCIAL CONSTRUCTION ONLY)

528 MECHANIC-WELDER (ON POWER EQUIPMENT) (COMMERCIAL CONSTRUCTION ONLY)

529 POWER PLANT (100 KW AND OVER OR MULTIPLES EQUAL TO 100KW AND OVER) (COMMERCIAL CONSTRUCTION ONLY)

530 PUMP OPERATOR AND/OR CONVEYOR (TWO OR MORE MACHINES) (COMMERCIAL CONSTRUCTION ONLY)

531 SELF-ERECTING TOWER CRANE UNDER 100 FEET MEASURED FROM BOOM FOOT PIN (COMMERCIAL CONSTRUCTION ONLY)

532 STRADDLE CARRIER (COMMERCIAL CONSTRUCTION ONLY)

533 TRACTOR OVER D2 (COMMERCIAL CONSTRUCTION ONLY)

534 WELL POINT PUMP (COMMERCIAL CONSTRUCTION ONLY)

GROUP 6	2016-12-27	34.62	18.40	53.02
	2017-05-01	35.52	19.45	54.97

535 CONCRETE BATCH PLANT (COMMERCIAL CONSTRUCTION ONLY)

536 FIREPERSON, FIRST CLASS BOILER LICENSE (COMMERCIAL CONSTRUCTION ONLY)

537 FRONT END, SKID STEER UP TO 1 C YD

538 GUNITE MACHINE (COMMERCIAL CONSTRUCTION ONLY)

539 TRACTOR OPERATOR D2 OR SIMILAR SIZE (COMMERCIAL CONSTRUCTION ONLY)

540 TRENCHING MACHINE (SEWER, WATER, GAS) EXCLUDES WALK BEHIND TRENCHER

GROUP 7	2016-12-27	33.50	18.40	51.90
	2017-05-01	34.40	19.45	53.85

541 AIR COMPRESSOR 600 CFM OR OVER (COMMERCIAL CONSTRUCTION ONLY)

542 BRAKEPERSON (COMMERCIAL CONSTRUCTION ONLY)

543 CONCRETE PUMP/PUMPCRETE OR COMPLACO TYPE (COMMERCIAL CONSTRUCTION ONLY)

544 FIREPERSON, TEMPORARY HEAT SECOND CLASS BOILER LICENSE (COMMERCIAL CONSTRUCTION ONLY)

545 OILER (POWER SHOVEL, CRANE, TRUCK CRANE, DRAGLINE, CRUSHERS AND MILLING MACHINES, OR OTHER SIMILAR POWER EQUIPMENT) (COMMERCIAL CONSTRUCTION ONLY)

546 PICK UP SWEEPER (ONE CUBIC YARD HOPPER CAPACITY) (COMMERCIAL CONSTRUCTION ONLY)

547 PUMP AND/OR CONVEYOR (COMMERCIAL CONSTRUCTION ONLY)

GROUP 8 *

FOR RATE CALL 651-284-5091 OR EMAIL DLI.PREVWAGE@STATE.MN.US

548 ELEVATOR OPERATOR (COMMERCIAL CONSTRUCTION ONLY)

549 GREASER (COMMERCIAL CONSTRUCTION ONLY)

550 MECHANICAL SPACE HEATER (TEMPORARY HEAT NO BOILER LICENSE REQUIRED) (COMMERCIAL CONSTRUCTION ONLY)

TRUCK DRIVERS

GROUP 1	2016-12-27	29.70	15.65	45.35
	2017-05-01	30.25	16.60	46.85

601 MECHANIC . WELDER

602 TRACTOR TRAILER DRIVER

603 TRUCK DRIVER (HAULING MACHINERY INCLUDING OPERATION OF HAND AND POWER OPERATED WINCHES)

GROUP 2	2016-12-27	29.15	15.65	44.80
	2017-05-01	29.70	16.60	46.30

604 FOUR OR MORE AXLE UNIT, STRAIGHT BODY TRUCK

GROUP 3	2016-12-27	29.05	15.65	44.70
	2017-05-01	29.60	16.60	46.20

605 BITUMINOUS DISTRIBUTOR DRIVER

606 BITUMINOUS DISTRIBUTOR (ONE PERSON OPERATION)

607 THREE AXLE UNITS

GROUP 4 *	2016-12-27	25.10	10.85	35.95

608 BITUMINOUS DISTRIBUTOR SPRAY OPERATOR (REAR AND OILER)

609 DUMP PERSON

610 GREASER

611 PILOT CAR DRIVER

612 RUBBER-TIRED, SELF-PROPELLED PACKER UNDER 8 TONS

613 TWO AXLE UNIT

614 SLURRY OPERATOR

615 TANK TRUCK HELPER (GAS, OIL, ROAD OIL, AND WATER)

616 TRACTOR OPERATOR, UNDER 50 H.P.

SPECIAL CRAFTS

701*	HEATING AND FROST INSULATORS	2016-12-27	40.31	16.75	57.06
702	BOILERMAKERS	2016-12-27	35.15	27.02	62.17
703	BRICKLAYERS	2016-12-27	32.91	22.82	55.73
704	CARPENTERS	2016-12-27	29.97	16.96	46.93
705	CARPET LAYERS (LINOLEUM)	2016-12-27	33.00	14.39	47.39
		2017-06-01	34.40	14.39	48.79
706	CEMENT MASONS	2016-12-27	30.86	17.13	47.99
707	ELECTRICIANS	2016-12-27	34.92	25.06	59.98
		2017-06-03	35.83	25.71	61.54
708	ELEVATOR CONSTRUCTORS	2016-12-27	45.87	29.99	75.86
		2017-01-01	46.90	36.78	83.68
709	GLAZIERS	2016-12-27	27.62	20.12	47.74
710*	LATHERS	2016-12-27	29.97	16.96	46.93
712	IRONWORKERS	2016-12-27	31.54	24.90	56.44
714	MILLWRIGHT	2016-12-27	33.44	15.61	49.05
		2017-05-07	35.29	15.61	50.90
715	PAINTERS (INCLUDING HAND BRUSHED, HAND SPRAYED, AND THE TAPING OF PAVEMENT MARKINGS)	2016-12-27	26.91	19.87	46.78
716	PILEDRIVER (INCLUDING VIBRATORY DRIVER OR EXTRACTOR FOR PILING AND SHEETING OPERATIONS)	2016-12-27	34.57	18.16	52.73

717	PIPEFITTERS . STEAMFITTERS	2016-12-27	39.07	18.73	57.80
718	PLASTERERS	2016-12-27	31.49	17.88	49.37
719	PLUMBERS	2016-12-27	39.07	18.73	57.80
720	ROOFER	2016-12-27	28.50	11.79	40.29
721	SHEET METAL WORKERS	2016-12-27	31.87	25.54	57.41
722	SPRINKLER FITTERS	2016-12-27	35.08	17.77	52.85
		2017-01-01	36.33	18.49	54.82
723	TERRAZZO WORKERS	2016-12-27	37.58	16.83	54.41
724	TILE SETTERS	2016-12-27	24.41	23.02	47.43
725*	TILE FINISHERS	2016-12-27	17.91	18.02	35.93
726	DRYWALL TAPER	2016-12-27	26.91	19.87	46.78
727	WIRING SYSTEM TECHNICIAN	2016-12-27	36.90	14.97	51.87
		2017-07-01	37.82	14.97	52.79
728	WIRING SYSTEMS INSTALLER	2016-12-27	25.84	12.40	38.24
		2017-07-01	26.49	12.40	38.89
729	ASBESTOS ABATEMENT WORKER	2016-12-27	29.20	17.43	46.63
		2017-01-01	29.95	18.03	47.98
730	SIGN ERECTOR	2016-12-27	27.10	13.42	40.52

Attachment M

PolyMet Snow Plowing Historical Cost

Attachment M

SNOW PLOWING 2013-2016

	2015-2016 WINTER			
DINCAU CONSTRUCTION				
	DATE	AREA	HOURS*	COST
	13-Nov-15	ADMIN BLDG PARK LOT, SCALE, FUEL STA	2.0	$170.00
	2-Dec-15	ADMIN BLDG PARK LOT, SCALE, FUEL STA	2.0	$170.00
	16-Dec-15	SCALE AREA & SALT	3.5	$297.50
	17-Dec-15	ADMIN BLDG PARK LOT, SCALE, FUEL STA, ROADS, 2WX PUMP, PLANT SITE & HAUL ROADS	12.5	$1,277.50
	27-Dec-15	ADMIN BLDG PARK LOT, SCALE, FUEL STA, ROADS, 2WX PUMP, PLANT SITE & HAUL ROADS	15.0	$1,450.00
	8-Jan-16	ADMIN BLDG PARK LOT, SCALE, FUEL STA	3.5	$297.50
	12-Jan-16	ROAD TO MINE SITE BORE HOLE, ROADS TO TEST HOLES	7.5	$717.50
	15-Jan-16	ADMIN BLDG PARK LOT, SCALE, FUEL STA, ROADS, 2WX PUMP, PLANT SITE & HAUL ROADS	17.0	$1,700.00
	25-Jan-16	DUNKA ROAD, TEST HOLE ROADS	8.0	$780.00
	26-Jan-16	ADMIN BLDG PARK LOT, SCALE, FUEL STA, ROADS, 2WX PUMP, PLANT SITE & HAUL ROADS	14.0	$1,365.00
	27-Jan-16	TEST HOLE ROADS	4.5	$400.00
	28-Jan-16	ADMIN BLDG PARK LOT, SCALE, FUEL STA, ROADS, 2WX PUMP, PLANT SITE, DUNKA ROAD & TEST HOLES	21.5	$2,065.00
	29-Jan-16	TEST HOLE ROADS	5.0	$445.00
	30-Jan-16	TEST HOLE ROADS	4.5	$400.00
	1-Feb-16	TEST HOLE ROADS	3.5	$310.00
	4-Feb-16	TAILINGS BASIN	3.0	$305.00
	8-Feb-16	ADMIN BLDG PARK LOT, SCALE, FUEL STA, ROADS, DUNKA ROAD & TEST HOLES	27.0	$2,530.00
	9-Feb-16	ROADS, CLEAN UP ROADS & SCALE AREA	6.0	$545.00
	15-Feb-16	ADMIN BLDG PARK LOT, SCALE, FUEL STA, ROADS, 2WX PUMP, PLANT SITE, DUNKA ROAD & TEST HOLES	18.0	$1,645.00
	16-Feb-16	ROADS	5.0	$465.00
	20-Feb-16	ROADS & DUNKA ROAD	6.5	$772.50
	24-Feb-16	ADMIN BLDG PARK LOT, SCALE, FUEL STA, ROADS, 2WX PUMP, PLANT SITE, DUNKA ROAD & TEST HOLES	23.5	$2,322.50
TOTAL	22 CALLOUTS		213.0	**$20,430.00**
	2014-2015 WINTER			
C&C Winger				
	8-Dec-14	NO DESCRIPTIONS OF AREAS PLOWED - SEE MAP	3.5	$483.00
	11-Dec-14		3.0	$309.00
	12-Dec-14		3.0	$504.00
	16-Dec-14		8.0	$1,239.00
	22-Dec-14		0.5	$69.00
	3-Jan-15		12.75	$1,543.25
	5-Jan-15		3.5	$483.00
	8-Jan-15		3.5	$483.00
	15-Jan-15		4.0	$572.00
	16-Jan-15		3.0	$414.00
	18-Jan-15		2.5	$345.00
	19-Jan-15		7.5	$1,035.00
	26-Jan-15		12.75	$1,322.25
	27-Jan-15		6.0	$589.50
	2-Feb-15		2.75	$393.25
	11-Feb-15		14.25	$1,822.00
	16-Feb-15		4.0	$340.00
	20-Feb-15		10.1	$1,225.50
	21-Feb-15		3.0	$255.00
	24-Feb-15		1.0	$138.00
	25-Feb-15		4.0	$552.00
	3-Mar-15		11.1	$1,501.80
	8-Apr-15		1.0	$163.00
TOTAL	23 CALLOUTS		124.7	**$15,781.55**
	2013-2014 WINTER			
EARTH TECH INC.				
	3-Dec-13	NO DESCRIPTIONS OF AREAS PLOWED - SEE MAP	5.0	$375.00
	4-Dec-13		5.5	$412.00
	5-Dec-13		11.5	$862.50
	6-Dec-13		4.5	$337.50
	8-Dec-13		6.0	$700.00
	9-Dec-13		3.5	$262.50
	16-Dec-13		6.0	$450.00
	18-Dec-13		6.5	$487.50
	23-Dec-13		4.0	$300.00
	26-Dec-13		7.5	$562.50
	28-Dec-13		1.0	$75.00
	4-Jan-14		7.0	$525.00
	5-Jan-14		2.5	$187.50
	6-Jan-14		6.0	$450.00
	8-Jan-14		4.0	$300.00
	14-Jan-14		2.5	$212.50
	16-Jan-14		1.0	$75.00
	19-Jan-14		6.0	$480.00
	20-Jan-14		11.0	$935.00
	21-Jan-14		9.0	$765.00
	22-Jan-14		15.5	$1,417.50
	26-Jan-14		14.5	$1,207.50
	29-Jan-14		9.0	$765.00
	30-Jan-14		11.0	$935.00
	2-Feb-14		10.0	$800.00
	13-Feb-14		1.5	$112.50
	15-Feb-14		3.5	$262.50
	17-Feb-14		18.5	$1,472.50
	18-Feb-14		14.0	$1,212.50
	19-Feb-14		19.0	$1,605.00
	21-Feb-14		25.5	$2,082.50
	22-Feb-14		28.5	$2,317.50
RADOTICH ENTERPRISES				
	27-Feb-14 \			
	28-Feb-14 ------------->		42.5	$4,675.00
	2-Mar-14 /			
	21-Mar-14 \			
	22-Mar-14 ------------->		16.25	$1,787.50
	27-Mar-14 /			
	1-Apr-14 \			
	2-Apr-14 /		9.0	$990.00
TOTAL	40 CALLOUTS		348.3	**$30,397.00**

NOTE: HOURS* - MULTIPLE PIECES OF EQUIPMENT AT DIFFERENT RATES

Total	**$66,608.55**
<u>Average</u>	**<u>$22,202.85</u>**
Average of 2 highest	$25,413.50

Attachment N

Pace Price List

Pace Analytical Services, Inc.
2016 Price List

Water		
Analyte	**Method Number**	**Unit Price**
Organics		
Gas Chromatography / Mass Spectrometry (GC/MS)		
VOCs (medium level)	8260B	$81.25
VOCs - Low Level	8260B	$87.50
1,4 Dioxane	8260B SIM	$118.75
VOCs 524.2 (drinking water)	524.2	$137.50
VOCs 624 (waste water)	624	$162.50
SVOC	8270C, D	$206.25
Acid Extractibles - Phenols	8270C,D	$156.25
Base Neutral (BN) Extractibles	8270C, D	$156.25
SVOC 625 (waste water)	625	$243.75
PAHs	8270C,D	$125.00
PAHs (low level)	8270C,D SIM	$87.50
cPAH	8270C,D SIM	$206.25
MN Dept of Ag List 1	8270D	$206.25
MN Dept of Ag List 2	8270D	$225.00
Pentachlorophenol (PCP)	8270C,D SIM	$218.75
Gas Chromatography (GC)		
DBCP, EDB	8011	$62.50
PCBs	8082/8082A	$75.00
Pesticides, Organochlorine	8081A, B	$137.50
Pesticides, Organochlorine and PCBs	8081A,B + 8082A	$225.00
Petroleum Hydrocarbons		
Total Purgeable Petroleum Hydrocarbons		
BTEX	8260B	$31.25
BTEX/MTBE	8260B	$33.75
BTEX/WI GRO	8260/WI GRO	$43.75
BTEX/TPH as Gas	8260/8015	$43.75
BTEX/MTBE/WI GRO	8260/WI GRO	$43.75
BTEX/MTBE/Naphthalene	8260B	$45.00
BTEX/MTBE/Naphthalene/1,2 DCA	8260B	$50.00
BTEX/MTBE/Trimethylbenzenes (PVOC)	8260B	$50.00
Gasoline Range Organics (GRO)	AK 101	$56.25
Gasoline Range Organics (GRO)	WI GRO	$28.75
NWTPH-Gx	NWTPH-Gx	$56.25
TPH as Gas	OA-1	$68.75
TPH as Gasoline (C6-C10)	8015B,C	$31.25
VPH	MA VPH	$93.75
Petroleum Hydrocarbons		
Total Extractible Petroleum Hydrocarbons		
Diesel Range Organics (DRO)	AK 102	$68.75
Residual Range Organics (RRO)	AK 103	$68.75
Diesel Range Organics (DRO)/Residual Range Organics (RRO)	AK 102/AK 103	$93.75
Diesel Range Organics (DRO)	WI DRO	$37.50
WI DRO w/silica gel clean-up on final run	WI DRO	$56.25
Extended Range Organics C10-C32 **or** C10-C36	WI DRO	$81.25
Extended Range Organics C10-C36	WI DRO	$81.25
EPH screen	MA EPH	$68.75
EPH fractions after screen	MA EPH	$125.00
TPH as Diesel (C10-C28)	8015B,C	$37.50
TPH as Diesel (C10-C28) with silica gel clean-up	8015B,C	$56.25
Motor Oil Range (C24-C36)	8015B,C	$50.00
Motor Oil Range (C24-C36) with silica gel clean-up	8015B,C	$68.75
Oil and Grease	1664A	$62.50
HEM - SGT (TPH)	1664A	$81.25
NWTPH-Dx	NWTPH-Dx	$75.00
NWTPH-Dx with silica gel clean-up	NWTPH-Dx	$93.75
TPH as Diesel	OA-2	$75.00

Water		
Analyte	**Method Number**	**One-time client**
Wet Chemistry / Inorganic Analysis		
Acidity	SM2310B	$18.75
Alkalinity, Total (includes carbonate, bicarbonate, hydroxide) reported as CaCO3	SM2320B	$18.75
BOD, 5 day	Hach 10360/SM5210B	$37.50
Bromide	300.0	$25.00

BTUs	ASTM D240, D5865	$22.50
Carbon, Total Organic (double run)	SM5310C	$56.25
Carbon, Total Organic (quad run)	9060A	$131.25
Cation/Anion Balance (Na, Ca, Mg, K, Alkalinity, Sulfate, Chloride, N+N, Fluoride) Calculation only	Calculation only, see indiv. methods	$12.50
CBOD	Hach 10360/SM5210B	$37.50
Chloride	300.0	$25.00
Chloride	SM4500-Cl-E	$12.50
Chlorine, Residual	SM4500Cl-G	$12.50
Chlorophyll a	SM10200H	$37.50
Chromium, hexavalent	SM3500-Cr B	$43.75
Chromium, trivalent	Calculation only	$12.50
COD	SM5220D	$25.00
Color	SM2120	$12.50
Cyanide, Total	SM4500CN-E	$37.50
Dissolved Oxygen	Hach 10360	$62.50
Wet Chemistry / Inorganic Analysis		
E. coli bacteria	Quantitray	$62.50
Eh	ASTM D1498	$37.50
Fecal coliform bacteria	SM9222D	$25.00
Fluoride	300.0	$25.00
Fluoride	SM4500F-C	$16.25
Formaldehyde	NIOSH 3500	$56.25
Hardness (calc only) (requires Ca and Mg at additional charge)	SM2340B/200.7	$12.50
Heterotrophic Plate Count (HPC)	SM 9215 B	$22.50
Nitrogen, Ammonia	SM4500NH3/350.1	$18.75
Nitrogen, Ammonia (if distillation is required)	SM4500NH3/350.1	$37.50
Nitrogen, Nitrate	SM4500 NO3-H/353.2/300.0	$17.50
Nitrogen, Nitrite	SM4500-NO2-B/353.2/300.0	$17.50
Nitrogen, Nitrate+Nitrite	SM4500 NO3-H/353.2/300.0	$17.50
Nitrogen, Total Kjeldahl	351.2	$31.25
Total Inorganic Nitrogen	Calculation only	$12.50
Total Organic Nitrogen (calc. only, requires 351.2, 350.1)	Calculation only	$12.50
Total Persulfate Nitrogen	SM 4500 N-C	$62.50
pH (Corrosivity)	SM4500H+B	$6.25
Phosphorus, Ortho	SM4500P-E	$31.25
Phosphorus, Ortho	365.3/300.0	$31.25
Phosphorus, Ortho, Low Level	SM4500P-E	$37.50
Phosphorus, Total or Dissolved	SM4500P-E	$25.00
Phosphorus, Total or Dissolved	365.1	$25.00
Phosphorus, Total, Low Level	SM4500P-E	$37.50
Phosphorus, Total or Dissolved, Low Level	365.1	$37.50
Specific Conductance	SM2510B/120.1	$12.50
Sulfate	ASTM D516/300.0	$25.00
Sulfide	SM4500S2D	$37.50
Surfactants (MBAS)	SM5540C	$93.75
Total Coliform (membrane filtration)	SM 9222 B (quantitative)	$28.75
Total Coliform & E. Coli	SM 9223 B (presence/absence)	$22.50
Total Dissolved Solids	SM2540C	$12.50
Total Phenolics (recoverable)	420.4	$31.25
Total Settleable Solids	SM 2540F	$12.50
Total Suspended Solids	SM2540D/USGS I-3765	$12.50
Total Suspended Solids - low level	SM2540D/USGS I-3765	$18.75
Total Volatile Solids	160.4	$25.00
Turbidity	SM2130B/180.1	$12.50
Water		
Metals		
Hexavalent Chromium (Cr VI)	SM3500-Cr-B	$43.75
Mercury (Hg)	7470A/245.1	$43.75
Mercury - Low Level	1631 E	$112.50
Methyl Mercury	1630	$218.75
Selenium Hydride	SM 3114C	$93.75
Sodium Absorption Ratio (includes Ca, Mg, Na)	6010B,C/6020/6020A	$56.25
Individual Metals by ICP (Inductively Coupled Plasma) EPA 6010B, C		
Metal Analysis	6010B,C/200.7	$13.75
RCRA metals (As, Ba, Cd, Cr, Pb, Hg, Se, Ag)	6010B,C/200.7/7470A	$87.50
Individual Metals by ICP/MS (Inductively Coupled Plasma/Mass Spectrometry) EPA 6020/6020A		
Metal Analysis	6020/6020A/200.8	$20.00
Dioxin and PCB Congeners		
2,3,7,8 TCDD (drinking water)	1613B/8290/8290A	$250.00
17 Dioxin Compounds	1613B/8290/8290A	$743.75
PCB Congeners - Food List (7 Congeners)	1668	$531.25
PCB Congeners - WHO List (12 Congeners)	1668	$600.00
PCB Congeners - 209 Congeners	1668	$981.25
Dissolved Gases		

Methane only	RSK 175	$72.50
Ethane, Ethene, Methane, Propane	RSK 175	$100.00

Other Charges

Charges can include any/all of the items noted to the right - to be charged when applicable. Prices may vary	Cost of sample supplies Disposal of unused sample supplies Time for packing/shipping of sample supplies Shipping/courier charges Unused sample supplies
Additional compounds (added to method after analysis)	$75/hour + analysis
Composite of samples	$10/container
Copy of chromatogram (if not requested at time of sample submittal)	$15/analysis/sample
Data validation/technical review of data	$100/hour
Deionization (DI) water - laboratory grade	$25/Gallon
Deionization (DI) water - ultra pure	Cost + Shipping + 15%
Delivery of sample containers (<1 workday notice)	$100 + Shipping
Delivery of sample containers (<3 workday notice)	$50 + Shipping
Disposal of unanalyzed material	materials + handling
Electronic Data Deliverable (EDD)	request quote
Extract and hold or hold of sample	50% of cost of analysis
Hard copy of Final Report	$10
Minimum laboratory order (one-time client)	$250
Reporting in multiple formats	$35
Return shipping - if requesting other than standard carrier	Cost
Sample filtration	$10/container
Sample preparation fee	$75/hour
Summa canisters not returned in 2 weeks	$50/can per week
Unannounced short hold or samples received <50% of hold time	Applicable rush surcharge

Hourly Time & Material Rates

Technician	$60/hour
Project Manager	$70/hour
Analyst	$75/hour
Supervisor	$105/hour
Lab Manager / Assistant General Manager	$125/hour
Senior General Manager	$150/hour
Officer	$200/hour

Turnaround Times and Rush Surcharges

Standard (10 Working Business Days)	Not Applicable	No Surcharge
6-9 Business Days	Not Applicable	1.25x
5 Business Days	Not Applicable	1.5x
3-4 Business Days	Not Applicable	2x
2 Business Days	Not Applicable	2.5x
1 Business Day	Not Applicable	3x
Less than 1 Business Day	Not Applicable	Quote

Standard TAT is 10 Business days. All requested turnaround times less than 5 business days MUST be pre-arranged to insure on-time delivery. Day of sample receipt is day zero. Report due close of business on agreed upon day.

Deliverables / Data Packages

Level 1 Sample Data Reporting Only	No Surcharge
Level 2 Complete Quality Control (QC) Data Blanks, Spikes, duplicates (including matrix spike duplicates), laboratory control samples, relative percent difference (RPD), percent recovery	No Surcharge
Level 3 Items listed in Level 2 plus QC limits, QA batch cross reference table. Allow an additional two weeks for data package.	15% Surcharge ($50 minimum per Work Order)
Level 4 Items listed in Levels 2 and 3 including sample raw data and chromatograms. Allow an additional two weeks for data package.	20% Surcharge ($50 minimum per Work Order)

Pricing Notes

All prices include:

a) Containers, preservatives, coolers, labels, chain-of-custody forms, *except* terracore kits and encore sample containers

b) Standard Electronic Deliverables via email

c) Access to Data via PacePort

Items included represent services provided by Pace Analytical. Numerous additional services and certifications are available throughout our nationwide network of labs. The prices shown are for routine projects with standard turnaround times. Specific projects may be bid individually. These prices should be used as guidelines, as exact pricing will depend on project size and expected turnaround time. Please consult Pace Analytical for assistance.

· Pace Analytical will dispose of all non-hazardous samples. Pace Analytical reserves the right to return to the client any highly hazardous, acutely toxic, or radioactive samples and sample containers.

· The Client is responsible for informing Pace of any necessary certifications, reporting limits and/or methods at the time of initial project set-up.

· Pace Analytical reserves the right to subcontract any method listed with prior consent of the Client.

· Methods listed are EPA Methods unless otherwise noted.

Appendix 15.4

NorthMet Project Feature Changes Over Time Memo

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Memorandum

To: Jennifer Saran
From: Pete Kero and Nancy Dent
Subject: NorthMet Project Feature Changes Over Time
Date: November 15, 2017
c: Jim Scott

1.0 Introduction

Some NorthMet Project (Project) features change over the Project's 20-year Life of Mine (LOM). Under Minnesota Rules, PolyMet will update its Contingency Reclamation Estimate (CRE) annually based on these changes to Project features, as well as other regulatory and technological changes that may occur. The purpose of this document is to describe the planned changes in mine features over time, quantify those changes, and provide a basis for the quantities.

Generally, the size and number of Project features grow to a peak in Mine Year 11, then decrease as mining and progressive reclamation take place concurrently through Mine Year 20. After Mine Year 20 (during the reclamation phase), Project features and quantities will change only as a result of closure activities. This memorandum accordingly provides data for only Mine Years 1 through 20, and does not address post-mining reclamation. The changes to facilities over the life of the mine that are described in this memorandum are based on permit-level designs, and may be updated after final design to reflect any refinements.

This document is organized in the following manner: Table 1 summarizes the features at several key points in the Project's life (operations phase): Mine Years 1, 11 and 20. Mine Year 1 is the year operations begin. Mine Year 11 is the year that stockpiles reach their maximum extent. Mine Year 20 is the end of mine life. Table 1 also summarizes data during the construction phase. Large Table 1 provides the changes in Project features on a year-by-year basis and is the source for Table 1. Large Figure 1 illustrates the construction phase features at the Mine Site that will change over time. Note that the water treatment features within the Equalization Basin Area shown on Large Figure 1 are described in a separate memorandum (Reference (1)), and are not listed in Table 1 or Large Table 1. Large Figure 2 illustrates the construction phase features at the Plant Site. Section 2.0 of this memo discusses the changes in Project features over time and provides the basis for how Large Table 1 was developed.

Table 1 Project Feature Changes Over Time

	Construction Phase	Operations Phase			
		Mine Year 1	Mine Year 3	Mine Year 11	Mine Year 20
Category 2/3 Waste Rock Stockpile					
Liner Acres to be Removed and Footprint Reclaimed	Mine Year 1*	63	119	181	0
Total Liner Collection Piping Feet to be Removed (sub-totals by size below)	Mine Year 1*	45,300	76,500	118,500	0
• Category 2/3 Stockpile Overliner and Underdrain Piping - 4-inch (LF)	Mine Year 1*	32,200	55,100	84,900	0
• Category 2/3 Stockpile Overliner and Underdrain Piping - 6-inch (LF)	Mine Year 1*	9,600	16,200	25,100	0
• Category 2/3 Stockpile Overliner and Underdrain Piping - 8-inch (LF)	Mine Year 1*	1,400	2,100	4,200	0
• Category 2/3 Stockpile Overliner and Underdrain Piping - 10-inch (LF)	Mine Year 1*	2,000	2,900	4,100	0
• Category 2/3 Stockpile Overliner and Underdrain Piping - 12-inch (LF)	Mine Year 1*	100	100	200	0
Sump/Pond Acres to be Reclaimed	Mine Year 1*	6.7	9.2	12.2	0
Pumps to Equalization Basin Area to be Removed	Mine Year 1*	2	4	6	0
Piping Feet to Equalization Basin Area to be Removed	Mine Year 1*	8,000	10,000	12,000	0
Tons to Relocate	none	5,238,766	13,968,736	44,021,108	0
Category 4 Waste Rock Stockpile					
Liner Acres to be Removed and Footprint Reclaimed	Mine Year 1*	29	57	57	0
Total Liner Collection Piping Feet to be Removed (sub-totals by size below)	Mine Year 1*	21,590	41,690	41,690	0
• Category 4 Stockpile Overliner and Underdrain Piping - 4-inch (LF)	Mine Year 1*	14,000	31,000	31,000	0
• Category 4 Stockpile Overliner and Underdrain Piping - 6-inch (LF)	Mine Year 1*	6,300	9,400	9,400	0
• Category 4 Stockpile Overliner and Underdrain Piping - 8-inch (LF)	Mine Year 1*	1,200	1,200	1,200	0
• Category 4 Stockpile Overliner and Underdrain Piping - 10-inch (LF)	Mine Year 1*	30	30	30	0
• Category 4 Stockpile Overliner and Underdrain Piping - 12-inch (LF)	Mine Year 1*	60	60	60	0
Sump/Pond Acres to be Reclaimed	Mine Year 1*	4.5	4.5	4.5	0
Pumps to Equalization Basin Area to be Removed	Mine Year 1*	2	2	2	0
Piping Feet to Equalization Basin Area to be Removed	Mine Year 1*	2,500	2,500	2,500	0
Tons to Relocate	none	1,489,201	3,379,412	6,206,813	0

	Construction Phase	Operations Phase			
		Mine Year 1	Mine Year 3	Mine Year 11	Mine Year 20
Ore Surge Pile					
Liner Acres to be Removed and Footprint Reclaimed	Mine Year 1*	32	32	32	32
Total Liner Collection Piping Feet to be Removed (sub-totals by size below)	Mine Year 1*	30,000	30,000	30,000	30,000
• OSP Overliner and Underdrain Piping - 4-inch (LF)	Mine Year 1*	19,700	19,700	19,700	19,700
• OSP Overliner and Underdrain Piping - 6-inch (LF)	Mine Year 1*	7,400	7,400	7,400	7,400
• OSP Overliner and Underdrain Piping - 8-inch (LF)	Mine Year 1*	1,600	1,600	1,600	1,600
• OSP Overliner and Underdrain Piping - 10-inch (LF)	Mine Year 1*	900	900	900	900
• OSP Overliner and Underdrain Piping - 12-inch (LF)	Mine Year 1*	400	400	400	400
Sump/Pond Acres to be Reclaimed	Mine Year 1*	2.3	2.3	2.3	2.3
Pumps to Equalization Basins to be Removed	Mine Year 1*	2	2	2	2
Piping Feet to Equalization Basins to be Removed	Mine Year 1*	1,600	1,600	1,600	1,600
Tons to Relocate	none	2,275,000	2,275,000	2,275,000	2,275,000
Overburden Storage and Laydown Area (OSLA)					
OSLA Reclamation (acres)	Mine Year 1*	41.8	41.8	41.8	41.8
Category 1 Waste Rock Stockpile					
Footprint Acres to Reclaim	13	0	0	0	0
Cover - Estimated Flat Area (acres)	none	164	147	196	65
Cover - Estimated Slope Area (acres)	none	49	229	341	0
Containment System Feet to Extend	none	2,800	2,800	0	0
Containment System Acres to Breach & Reclaim	41	0	0	0	0
		Mine Year 1	Mine Year 3	Mine Year 11	Mine Year 20

	Construction Phase	Operations Phase			
		Mine Year 1	Mine Year 3	Mine Year 11	Mine Year 20
Mine Pits					
East Exposed/Unblasted Rock Acres to Reclaim	95	0	0	0	0
East Pit Rim Overburden Backslopes Acres to Reclaim	none	10.1	10.1	9.2	9.2
West Pit Exposed/Unblasted Rock Acres to Reclaim	none	0	0	65	0
West Pit Rim Overburden Backslopes Acres to Reclaim	none	0	8.7	13.5	13.5
Central Pit Rim Overburden Backslopes Acres to Reclaim	none	0	0	8.9	8.9
Pit Perimeter Fence - Barb Wire	none	1,100	1,400	2,300	1,400
Pit Perimeter Fence - Non-Climbable	none	11,000	19,900	32,800	33,700
Pit Access Gates	none	1	2	2	3
Mine Site Mine Water Ponds and Equalization Basins					
Pond Acres to be Reclaimed	Mine Year 1*	19.4	21.6	23.1	23.1
Liner Acres to be Removed (not all ponds lined)	Mine Year 1*	12.4	14.6	16.1	16.1
Pumps to Equalization Basin Area to be Removed	Mine Year 1*	4	6	6	6
Piping Feet to Equalization Basin Area to be Removed	Mine Year 1*	9,000	11,000	11,000	11,000
Mine Drainage Pond Underdrains - 6-inch (LF)	Mine Year 1*	4,500	6,000	6,900	6,900
Equalization Basin Reclamation (acres)	Mine Year 1*	29.8	29.8	29.8	29.8
Mine Site Stormwater Systems					
Pond Acres to Reclaim	Mine Year 1*	17.4	21.7	21.7	21.7
Ditch Feet to Reclaim	5,200	10,700	10,700	10,700	8,300
Mine Site Haul Roads					
Feet to be Reclaimed	Mine Year 1*	22,000	28,700	31,500	21,500
Flotation Tailings Basin (FTB)					
Beach Acres to Reclaim	40	0	0	0	0
Beach Acres to Amend	none	95	93	212	428
Pond Acres to Amend	none	421	427	1,124	905
Borrow Area Acres to Reclaim	31.6	44.7	16.5	18.0	19.5
Top Lift Flat Areas (acres)	48.7	41.9	39.6	90.6	81.4

	Construction Phase	Operations Phase			
		Mine Year 1	Mine Year 3	Mine Year 11	Mine Year 20
Hydrometallurgical Residue Facility (HRF)					
Pre-Load Disturbed Acres to Reclaim	5	25	0	0	0
Acres to Cover	none	0	49	49	98
Years to Drain	none	0	1	5	9

*NOTE: Conservatively assumed to be equal to Mine Year 1

2.0 Changes in Project Features over time

Large Table 1 details the Project features that will change on a year-to-year basis as the mine develops. It also shows how the quantities are currently expected to change over time (e.g., the acres of West Pit Wall that will need to be reclaimed every year, starting in Mine Year 1 and ending in Mine Year 20). The basis for the changes over time is described below. Drawings referenced below are compiled and attached to this memo.

2.1 Mine Pits

The pits increase in size as mining progresses, initially mining from the East Pit only. The length of pit perimeter fence and number of pit lake access gates increase as the pits expand. The acres of pit rim overburden backslopes to be reclaimed increase as mining progresses and decrease as progressive reclamation occurs.

The NorthMet Permit to Mine Application (Reference (2)) describes the development and progressive reclamation of mine features over time. Pit rim overburden backslopes area needing reclamation (in acres) was determined from measurements using a 3-Dimensional Civil 3D model created by importing year-by-year pit dimensional AutoCAD drawings provided by PEG Engineering. The number of pit access gates relates to the number of active mine pits over time (e.g., one while only the East Pit is active, two when both the East and West Pits are active, etc.). Fencing requirements (4-strand barbed wire and non-climbable fence) were based on the pit perimeter measurements from the AutoCAD drawings for Mine Years 1 through 11, and GIS figures for Mine Years 11 through 20.

2.2 Mine Site Haul Roads

The haul roads and associated mine water ditches increase in length as mining progresses and decrease as temporary stockpiles are no longer used and the associated roads become inactive. The length of haul roads needing reclamation (in linear feet) and progressive reclamation was estimated by AutoCAD measurements using attached Mine Site and Dunka Road Earthwork Drawings EW-010 and EW-011, Mine Site and Dunka Road Earthwork Haul Road Reclamation Plans A (Mine Years 1-11) and B (Mine Years 11-20).

2.3 Category 1, 2/3 and 4 Stockpiles, Ore Surge Pile, Overburden Storage and Laydown Area, and associated Liners, Underdrains, Sumps and Ponds

The Category 1 Waste Rock Stockpile footprint increases in size until Mine Year 6 at which point the Category 1 Stockpile has sufficient capacity for disposal of all mined Category 1 Waste Rock. The acres to be covered increase as mining progresses and decrease as progressive reclamation occurs. In the early years of operation while the footprint of the stockpile is being established, the west end of the Category 1 Stockpile Groundwater Containment System is open. This means that if there is a contingency closure during those years, closure of the west end of the Category 1 Stockpile Groundwater Containment System must be provided as part of the Reclamation Plan. The length of this extension increases as mining progresses and is completed when the footprint is fully established in Mine Year 6.

The progressive construction of the Category 1 Stockpile Groundwater Containment System over the first five years of mining is described in the Rock and Overburden Management Plan (ROMP, Reference (3)). For Mine Years 1 through 4 (prior to full completion of the Category 1 Stockpile Groundwater

Containment System in Mine Year 5), the additional length of Category 1 Stockpile Groundwater Containment System that would need to be constructed to close the loop was estimated by AutoCAD measurements using Category 1 Stockpile Groundwater Containment System Drawings GCS-003, GCS-004, GCS-005, and GCS-006 for the Category 1 Stockpile Groundwater Containment System Mine Years 0, 2, 3 and 5 Layouts, respectively. Breaching of the Category 1 Groundwater Containment System during pre-operation construction was also based on these drawings. The construction and progressive reclamation of the Category 1 stockpile are described in the ROMP (Reference (3)) and it was assumed that progressive reclamation begins in Mine Year 14 at a rate of 66 acres per year.

The temporary waste rock stockpiles increase in size until Mine Year 11 at which point the East Pit becomes available for direct disposal of mined Category 2/3 and Category 4 Waste Rock and relocation of the waste rock in the Category 2/3 and Category 4 Waste Rock Stockpiles. The liner acres, collection piping length, the number sumps, and number of pumps/piping length to the Equalization Basin Area increase during operations as the stockpile footprints increase. The amount of rock to be relocated increases as mining progresses.

The construction and progressive reclamation of the Category 2/3 and 4 stockpile and Ore Surge Pile liner systems and associated mine water sumps and overflow ponds are described in the ROMP (Reference (3)). The acres of Category 2/3 and 4 or Ore Surge Pile stockpile liner systems were estimated by AutoCad measurements using Category 1, 2/3, and 4 Stockpile Drawings SKP-003, SKP-004, SKP-005, and SKP-006, Mine Year 1, 2, 11 and 21 Limits, respectively. It was assumed that deconstruction of the Category 4 stockpile liner will be completed by the end of Mine Year 11 and deconstruction of the Category 2/3 stockpile liner begins in Mine Year 14 at a rate of 30 acres per year. The acres of associated stockpile liner sumps/ponds were estimated by AutoCAD measurements for progressive construction and reclamation using Mine Site Mechanical Infrastructure Drawing MW-016 Mine Water Infrastructure Reclamation Plan. The length of Category 2/3 and 4 Stockpile collection and Ore Surge Pile overliner and underdrain piping over time was estimated by AutoCAD measurements using Category 1, 2/3, and 4 Stockpile Drawings SKP-016, SKP-017, SKP-022, SKP-023, SKP-028 and SKP-029 related to the Category 2/3 and 4 stockpile and Ore Surge Pile underdrain and overliner piping plans.

The Category 2/3 and 4 Stockpile and Ore Surge Pile piping and pumping system to the Equalization Basin Area are detailed in the Water Management Plan - Mine (Reference (4)). The length of piping for the Category 2/3 and 4 Stockpiles and Ore Surge Pile was estimated by AutoCAD measurements using Drawing MW-002 Mine Water Infrastructure Mine Year 11 General Layout from the Mine Site Mechanical Infrastructure drawing set. The number of stockpile pumps is shown on Mine Site Mechanical Infrastructure Drawing ME-003 Mechanical Infrastructure General Drawings, Mine Site, Mine Water Flow Diagram.

The tons of stockpile and Ore Surge Pile to relocate was calculated using year-by-year mining estimates for waste rock and ore as documented in the Permit to Mine Application (Reference (2)).

The acreage of Overburden Storage and Laydown Area (OSLA) needing reclamation was measured by GIS from Figure 3-3 of the Permit to Mine Application.

2.4 Mine Site Stormwater, Mine Water Ponds and Equalization Basins

The Mine Site stormwater collection system increases over time as infrastructure expands. Stormwater ditches, perimeter dikes, ponds, and outlet structures are added as the existing system expands with new facilities. Stormwater pond construction is detailed in the Water Management Plan - Mine (Reference (4)). After Mine Year 20, Pond B and the associated portion of the North Perimeter Stormwater Ditch, Pond C-West, Pond C-East and the associated portion of the South Perimeter Stormwater Ditch and Pond D and Ditch D will be removed. Pond A will remain in post closure maintenance (regraded to drain to the East Pit) as well as the other stormwater ditches. Stormwater pond acres to be reclaimed and stormwater ditches to be reclaimed were estimated by AutoCAD measurements for progressive construction and reclamation using Mine Site Stormwater Drawing SW-031 Dikes, Ditches, and Ponds, Reclamation Plan.

The mine water management system increases in size as mining progresses. The pond acres, liner acres, number sumps and number of pumps/piping length to the Equalization Basin Area increase as mining progresses. The construction of mine water ponds, liners, pumps and piping are detailed in the Water Management Plan - Mine (Reference (4)). The acres of mine water ponds, liners and linear feet of mine water pond piping to be reclaimed was estimated by AutoCAD measurements using Drawing MW-002 Mine Water Infrastructure Mine Year 11 General Layout in the Mine Site Mechanical Infrastructure drawing set. The number of mine water pumps is shown on Drawing ME-003 Mechanical Infrastructure General Drawings, Mine Site, Mine Water Flow Diagram.

Equalization basins at the Mine Site will require reclamation, except for the high-strength basin and Central Pumping Station which will be retained through closure. The acreage of the equalization basins which would be reclaimed in Contingency Reclamation was measured using AutoCAD from Drawing WWTS-004.

2.5 Flotation Tailings Basin

The Flotation Tailings Basin (FTB) changes as the exterior dams are raised and the tops move inward. The acres of beach and pond change over the Project life to reflect dam raises. The acres of existing tailings that are disturbed change over the Project life, reflecting their use as a borrow source.

Acres of beach and pond bottom at the FTB to amend with bentonite was documented in Appendix B of the NorthMet Project Water Quality Modeling Data Package, Volume 1 – Mine Site (Reference (5)). The acreage of the borrow areas within the Tailings Basin that need to be reclaimed was computed using the borrow areas from FTB Support Drawing FTB-003; Existing Conditions. The Top Lift Flat Area Acres to reclaim were calculated by spreadsheet based on perimeter dam length, top of dam crest width, and dam interior slope length dimension changes per year.

2.6 Hydrometallurgical Residue Facility

The Hydrometallurgical Residue Facility (HRF) changes as the exterior dams are raised and the tops move inward. The acres to be covered change over the Project life to reflect dam raises. The time to drain the material in the facility for placement of the final cover increases with the amount of material in the facility. Because the HRF will not be constructed in the first phase of the Project, it is not included in the CRE until Mine Year 3, except the footprint reclamation needed from pre-loading activities.

The acres of HRF to cover and years to drain were calculated based on HRF development sequencing (footprint impacted) and timing, the year-by-year accumulation of hydrometallurgical residue, and assumed drainage rate of 115 gallons per cubic yard of material (Reference (7)). The acres were estimated using HRF Drawings HRF-005, HRF-008 and HRF-010; Emergency Basin Excavations and Removals, Lift 1 Layout, and Lift 3 Layout, respectively.

2.7 Water Treatment

Water treatment changes over the life of the Project in response to changes in Project features discussed above. Quantities for water treatment (i.e., time periods and flow rates) and unblasted rock acres to reclaim are described in detail, with basis for estimated closure in Mine Year 1, in Reference (1).

References

1. **Barr Engineering Co.** NorthMet Project – O&M for water treatment during reclamation and long-term closure after Mine Year 1 – 10 mg/L WWTS Sulfate Target Technical Memo to Jennifer Saran. 2017.

2. —. Permit to Mine Application (v3). Prepared for Poly Met Mining, Inc. NorthMet Project. December 2017.

3. **Poly Met Mining, Inc.** NorthMet Project Rock and Overburden Management Plan (v10). December 2017.

4. —. NorthMet Project Water Management Plan - Mine Site (v7). December 2017.

5. —. NorthMet Project Water Modeling Data Package Volume 1 - Mine Site (v14). February 2015.

6. —. NorthMet Project Water Modeling Data Package Volume 2 - Plant Site (v11). March 2015.

Large Tables

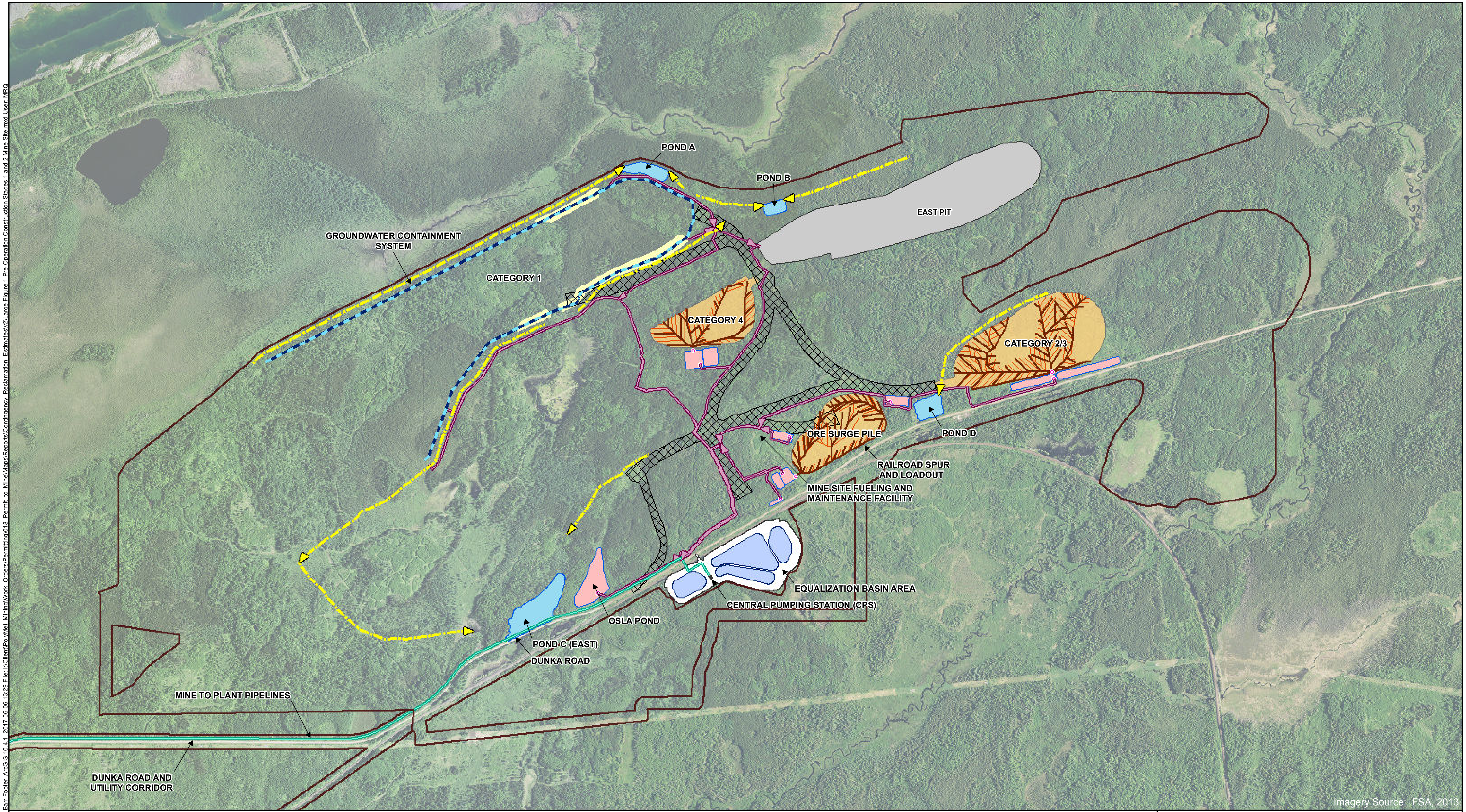
Large Table 1 Reclamation Features that Vary by Closure Year

Year of Closure	Construction	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Category 2/3 Stockpile Liner (acres)	63	63	63	119	119	119	181	181	181	181	181	181	181	181	181	150	120	90	60	30	0
Category 2/3 Stockpile Piping (LF)	8,000	8,000	8,000	10,000	10,000	10,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	0	0
Category 2/3 Stockpile Sump/Pond (acres)	6.7	6.7	6.7	9.2	9.2	9.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	9.2	9.2	6.7	6.7	6.7	0.0
Category 2/3 Stockpile Pumps	2	2	2	4	4	4	6	6	6	6	6	6	6	6	6	6	6	6	6	0	0
Category 2/3 Stockpile Overliner and Underdrain Piping - 4-inch (LF)	32,200	32,200	32,200	55,100	55,100	55,100	84,900	84,900	84,900	84,900	84,900	84,900	84,900	84,900	84,900	84,900	67,920	50,940	33,960	16,980	0
Category 2/3 Stockpile Overliner and Underdrain Piping - 6-inch (LF)	9,600	9,600	9,600	16,200	16,200	16,200	25,100	25,100	25,100	25,100	25,100	25,100	25,100	25,100	25,100	25,100	20,080	15,060	10,040	5,020	0
Category 2/3 Stockpile Overliner and Underdrain Piping - 8-inch (LF)	1,400	1,400	1,400	2,100	2,100	2,100	4,200	4,200	4,200	4,200	4,200	4,200	4,200	4,200	4,200	4,200	3,360	2,520	1,680	840	0
Category 2/3 Stockpile Overliner and Underdrain Piping - 10-inch (LF)	2,000	2,000	2,000	2,900	2,900	2,900	4,100	4,100	4,100	4,100	4,100	4,100	4,100	4,100	4,100	4,100	3,280	2,460	1,640	820	0
Category 2/3 Stockpile Overliner and Underdrain Piping - 12-inch (LF)	100	100	100	100	100	100	200	200	200	200	200	200	200	200	200	200	160	120	80	40	0
Category 2/3 Stockpile Relocation (tons)	0	5,238,766	9,671,631	13,968,736	17,624,295	20,039,335	24,388,312	26,954,315	31,286,526	35,946,676	40,017,183	44,021,108	44,021,108	38,281,584	32,542,061	26,802,537	21,063,014	15,323,491	9,583,967	3,844,444	0
Category 4 Stockpile Liner (acres)	29	29	29	57	57	57	57	57	57	57	57	57	0	0	0	0	0	0	0	0	0
Category 4 Stockpile Piping (LF)	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	0	0	0	0	0	0	0	0	0
Category 4 Stockpile Sump/Pond (acres)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	0	0	0	0	0	0	0	0	0
Category 4 Stockpile Pumps	2	2	2	2	2	2	2	2	2	2	2	2	0	0	0	0	0	0	0	0	0
Category 4 Stockpile Overliner and Underdrain Piping - 4-inch (LF)	14,000	14,000	14,000	31,000	31,000	31,000	31,000	31,000	31,000	31,000	31,000	31,000	0	0	0	0	0	0	0	0	0
Category 4 Stockpile Overliner and Underdrain Piping - 6-inch (LF)	6,300	6,300	6,300	9,400	9,400	9,400	9,400	9,400	9,400	9,400	9,400	9,400	0	0	0	0	0	0	0	0	0
Category 4 Stockpile Overliner and Underdrain Piping - 8-inch (LF)	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	0	0	0	0	0	0	0	0	0
Category 4 Stockpile Overliner and Underdrain Piping - 10-inch (LF)	30	30	30	30	30	30	30	30	30	30	30	30	0	0	0	0	0	0	0	0	0
Category 4 Stockpile Overliner and Underdrain Piping - 12-inch (LF)	60	60	60	60	60	60	60	60	60	60	60	60	0	0	0	0	0	0	0	0	0
Category 4 Stockpile Relocation (tons)	0	1,489,201	2,251,698	3,379,412	4,206,959	4,648,816	5,314,412	5,863,428	5,974,068	6,107,575	6,184,408	6,206,813	0	0	0	0	0	0	0	0	0
OSP Liner (acres)	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32
OSP Piping (LF)	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600
OSP Sump/Pond (acres)	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
OSP Pumps	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
OSP Overliner and Underdrain Piping - 4-inch (LF)	19,700	19,700	19,700	19,700	19,700	19,700	19,700	19,700	19,700	19,700	19,700	19,700	19,700	19,700	19,700	19,700	19,700	19,700	19,700	19,700	19,700
OSP Overliner and Underdrain Piping - 6-inch (LF)	7,400	7,400	7,400	7,400	7,400	7,400	7,400	7,400	7,400	7,400	7,400	7,400	7,400	7,400	7,400	7,400	7,400	7,400	7,400	7,400	7,400
OSP Overliner and Underdrain Piping - 8-inch (LF)	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600
OSP Overliner and Underdrain Piping - 10-inch (LF)	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900
OSP Overliner and Underdrain Piping - 12-inch (LF)	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400
OSP Relocation (tons)	0	2,275,000	2,275,000	2,275,000	2,275,000	2,275,000	2,275,000	2,275,000	2,275,000	2,275,000	2,275,000	2,275,000	2,275,000	2,275,000	2,275,000	2,275,000	2,275,000	2,275,000	2,275,000	2,275,000	2,275,000
OSLA Reclamation (acres)	41.8	41.8	41.8	41.8	41.8	41.8	41.8	41.8	41.8	41.8	41.8	41.8	41.8	41.8	41.8	41.8	41.8	41.8	41.8	41.8	41.8
Category 1 Footprint to Reclaim (acres)	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Category 1 Stockpile Cover - Estimated Flat Area (acres)	0	164	120	147	161	176	196	196	196	196	196	196	196	196	176	155	134	113	93	72	65
Category 1 Stockpile Cover - Estimated Slope Area (acres)	0	49	96	229	261	292	341	341	341	341	341	341	341	341	294	247	200	153	106	60	0
Category 1 Stockpile Containment System Completion (LF)	0	2,800	2,800	2,800	2,800	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Category 1 Stockpile Containment System Breach & Reclaim (acres)	41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
East Pit Exposed/Unblasted Rock to Reclaim (Acres)	95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
East Pit Wall Unreclaimed (Acres)	0	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2

Large Table 1 Reclamation Features that Vary by Closure Year

Year of Closure	Construction	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
West Pit Exposed/Unblasted Rock to Reclaim (Acres)	0	0	0	0	4	40	0	0	0	0	52	65	0	0	0	0	0	0	0	0	0
West Pit Wall Unreclaimed (Acres)	0	0	8.7	8.7	8.7	8.9	8.9	8.9	11.0	11.0	16.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
Central Pit Wall Unreclaimed (Acres)	0	0	0	0	0	0	0	0	0	0	0	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9
Fence - 4 strand barb wire (LF)	0	1,100	1,400	1,400	1,400	1,400	1,400	1,400	1,700	1,700	1,600	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	1,400
Fence - non climbable (LF)	0	11,000	19,900	19,900	21,200	20,700	20,700	20,700	22,100	22,100	30,100	32,800	32,800	32,800	32,800	32,800	32,800	32,800	32,800	32,800	33,700
Pit Access Gates	0	1	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3
Mine Drainage Pond (acres)	19.4	19.4	19.4	21.6	21.6	21.6	23.1	23.1	23.1	23.1	23.1	23.1	23.1	23.1	23.1	23.1	23.1	23.1	23.1	23.1	23.1
Mine Drainage Pond Liner (acres)	12.4	12.4	12.4	14.6	14.6	14.6	16.1	16.1	16.1	16.1	16.1	16.1	16.1	16.1	16.1	16.1	16.1	16.1	16.1	16.1	16.1
Mine Drainage Pond Pumps	4	4	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
Mine Drainage Pond Pipe (LF)	9,000	9,000	11,000	11,000	11,000	11,000	11,000	11,000	11,000	11,000	11,000	11,000	11,000	11,000	11,000	11,000	11,000	11,000	11,000	11,000	11,000
Mine Drainage Pond Underdrains - 6-inch (LF)	4,500	4,500	5,200	6,000	6,000	6,000	6,900	6,900	6,900	6,900	6,900	6,900	6,900	6,900	6,900	6,900	6,900	6,900	6,900	6,900	6,900
Equalization Basin Reclamation (acres)	29.8	29.8	29.8	29.8	29.8	29.8	29.8	29.8	29.8	29.8	29.8	29.8	29.8	29.8	29.8	29.8	29.8	29.8	29.8	29.8	29.8
Stormwater Pond (acres)	17.4	17.4	21.7	21.7	21.7	21.7	21.7	21.7	21.7	21.7	21.7	21.7	21.7	21.7	21.7	21.7	21.7	21.7	21.7	21.7	21.7
Stormwater Ditch (LF)	5,200	10,700	10,700	10,700	10,700	10,700	10,700	10,700	10,700	10,700	10,700	10,700	10,700	10,700	10,700	10,700	10,700	10,700	10,700	8,300	8,300
Unreclaimed Haul Road (LF)	22,000	22,000	28,700	28,700	28,700	28,700	28,700	28,700	28,700	28,700	28,700	31,500	31,500	31,500	29,500	27,500	27,500	27,500	27,500	21,500	21,500
FTB Beach to Reclaim (acres)	40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FTB Beach to Amend with Bentonite (acres)	0	95	95	93	92	91	89	87	203	207	211	212	212	212	212	216	219	222	225	420	428
FTB Pond Bottom to Amend with Bentonite (acres)	0	421	424	427	430	432	434	443	1068	1093	1118	1124	1130	1136	1142	1136	1129	1122	1116	905	905
FTB Borrow Area to Reclaim (acres)	31.6	44.7	16.9	16.5	16.5	15.9	15.9	12.0	12.0	12.0	12.0	18.0	22.4	22.4	22.4	26.8	26.8	26.8	26.8	21.5	19.5
FTB Top Lift Flat Areas (acres)	48.7	41.9	52.0	39.6	46.5	34.6	41.7	48.7	39.3	67.4	98.5	90.6	81.9	73.3	109.8	101.0	92.2	82.5	97.1	89.5	81.4
HRF Disturbed Acres to Reclaim (acres)	5	25	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HRF cover (acres)	0	0	0	49	49	49	49	49	49	49	49	49	54	60	65	71	76	82	87	93	98
HRF drainage (years)	0	0	0	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8	9	9

Large Figures



Barr Footer: ArcGIS 10.4.1, 2017-06-06 13:29 File: I:\Client\PolyMet Mining\Work Orders\Permitting\018_Permit to Mine\Maps\Reports\Contingency_Reclamation_Estimates\v2\Large Figure 1 Pre-Operation Construction Stages 1 and 2 Mine Site.mxd User: MSO

Mining Area
East Pit Exposed/Unblasted Rock to Reclaim
Stockpile Footprint to Reclaim
Stockpile Liner Acres to be Removed and Footprint Reclaimed
Overliner Collection Piping
Underliner Collection Piping

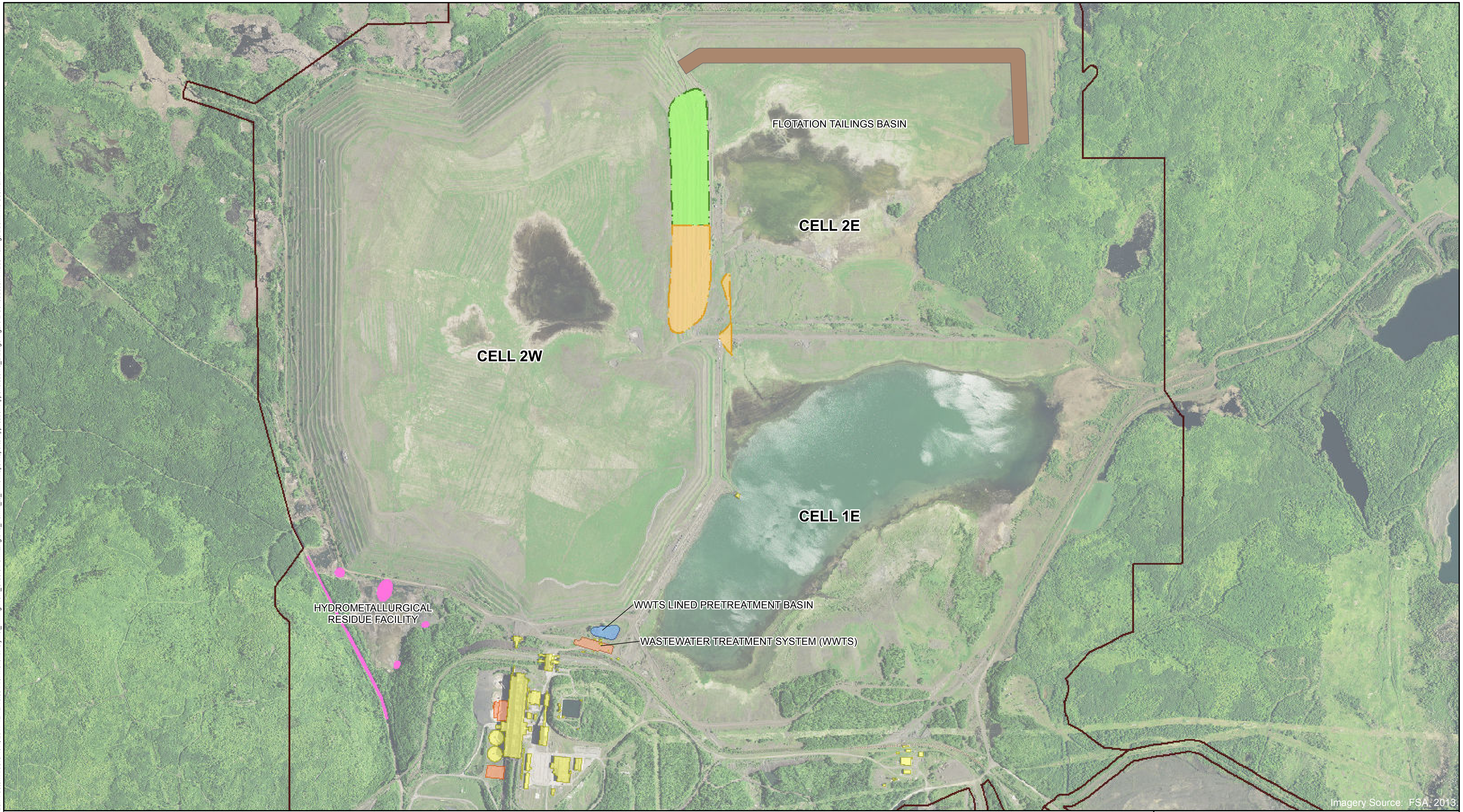
Haul Roads to be Reclaimed
Stormwater Systems
Ditch to Reclaim
Pond Acres to Reclaim
Groundwater Containment System

Mine Water Systems
Pond/Liner to be Reclaimed (OSLA pond not lined)
Mine to Plant Pipelines
Piping to be Removed
Pumps to be Removed

0 750 1,500 3,000
Feet

CONSTRUCTION PHASE - MINE SITE
NorthMet Project
Poly Met Mining, Inc.

Large Figure 1



- Mining Area
- Beach Area to Reclaim
- Pre-Load Distrubed Acres to Reclaim
- Borrow Area to Reclaim - Stage 1
- Borrow Area to Reclaim - Stage 2
- Existing Buildings
- Proposed Buildings

0 750 1,500 3,000
Feet

CONSTRUCTION PHASE -
TAILINGS BASIN
NorthMet Project
Poly Met Mining, Inc.

Large Figure 2

Drawings

Mine Site and Dunka Road Earthwork Errata Sheet
EW-010 Haul Road Reclamation Plan A Mine Years 1-11
EW-011 Haul Road Reclamation Plan B Mine Years 11-20
FTB-003 Existing Conditions
Category 1 Stockpile Groundwater Containment System Errata Sheet
GCS-003 Construction Year 2
GCS-004 Mine Year 2 Layout
GCS-005 Mine Year 3 Layout
GCS-006 Mine Year 5 Layout
HRF-005 Emergency Basin Excavations and Removals
HRF-008 Lift 1 Layout
HRF-010 Lift 3 Layout
Mechanical Infrastructure Errata Sheet
ME-003 Mine Site Mine Water Flow Diagram
MW-002 Mine Year 11 General Layout
MW-016 Reclamation Plan
Categories 1, 2/3, and 4 Stockpiles and Ore Surge Pile Design Errata Sheet
SKP-003 Mine Year 1 Limits
SKP-004 Mine Year 2 Limits
SKP-005 Stockpile Layouts – at Planned Utilization Limits
SKP-006 Mine Year 21 Limits Closure Configuration
SKP-016 Underdrain Piping Plan Mine Year 1 and Maximum
SKP-017 Overliner Drainage Piping Plan Mine Year 1 and Maximum
SKP-022 Underdrain Piping Plan Mine Year 1 and Maximum
SKP-023 Overliner Drainage Piping Plan Mine Year 1 and Maximum
SKP-028 Underdrain Piping Plan
SKP-029 Overliner Drainage Piping Plan
Mine Site Stormwater Errata Sheet
SW-031 Dikes, Ditches, and Ponds Reclamation Plan

Select individual drawing sheets are included in this appendix. Complete drawing sets are included in Appendix 3 through Appendix 10 of the Permit to Mine Application.

Errata Sheet

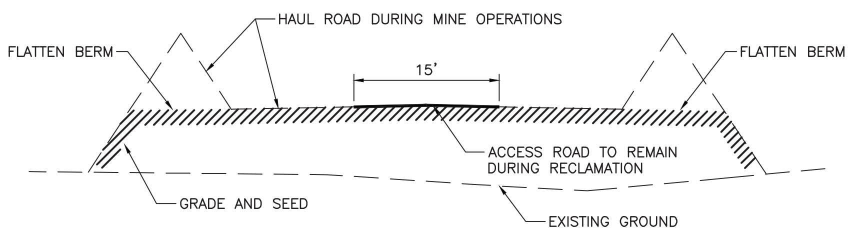
Poly Met Mining, Inc. NorthMet Project

Permit Application Support Drawings: Mine Site and Dunka Road Earthwork

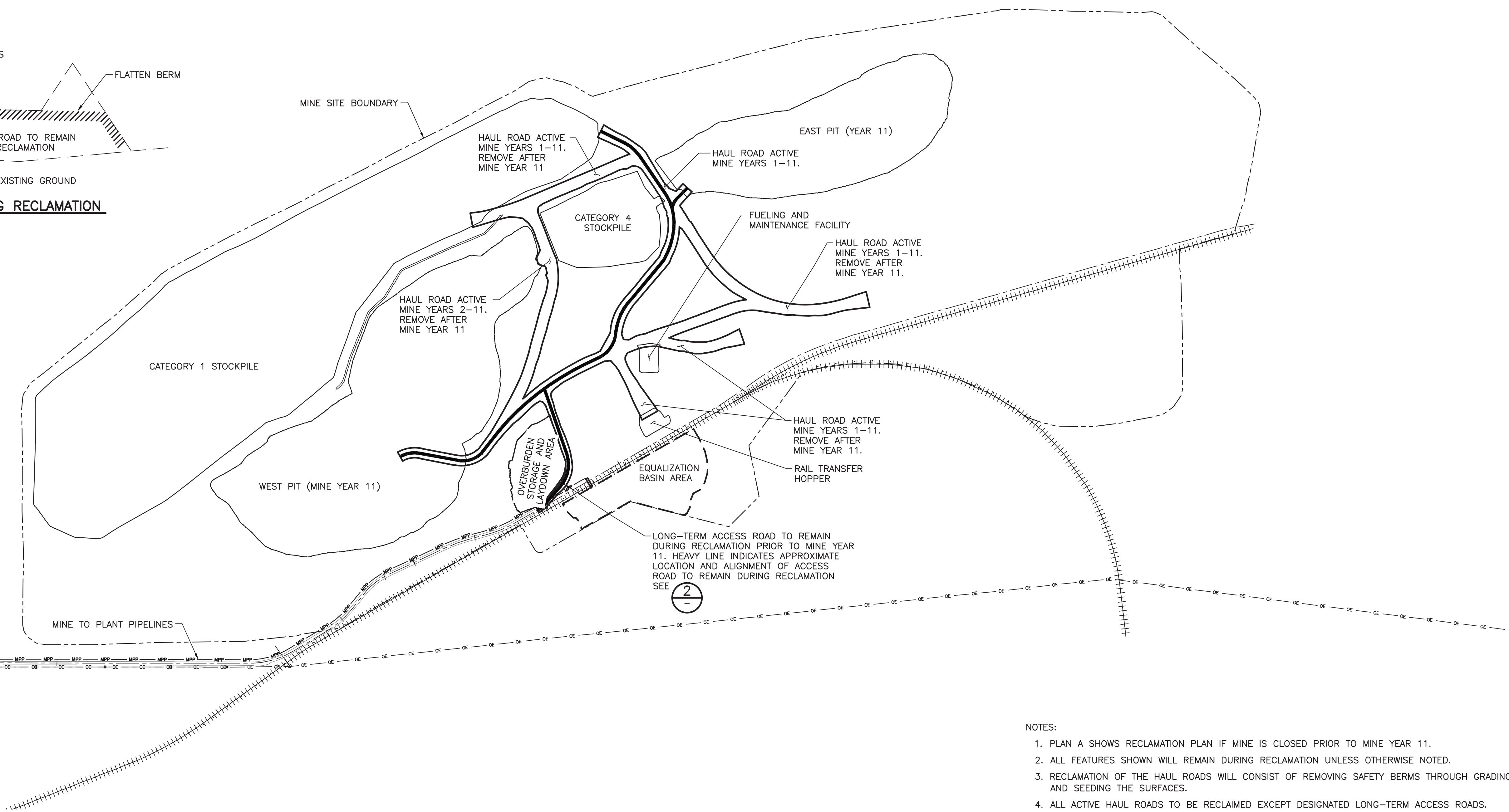
November 2017 (version 4)

Engineering design is currently in progress. The table below lists changes that have been identified to-date and have not yet been incorporated in the attached permit application support drawings within this set. Final design will incorporate these changes along with additional site-specific information (e.g., supplementary geotechnical data); therefore, additional adjustments may be made during final design that will be incorporated into the final design drawing set.

Drawing Sheet(s)	Change
Global change to all sheets, as needed	The terminology "mine drainage" as noted in these drawings will be changed to "mine water".
EW-003	Temporary sedimentation basins or stormwater infiltration basins may be added to meet construction stormwater requirements along Dunka Road. These construction stormwater features require additional site-specific data and will be evaluated in final design.
EW-008	All references to "pre-stripping" will be changed to "stripping"
EW-002, EW-003, EW-005, EW-009, EW-010, EW-011	The "Mine Site Boundary" will be replaced by the "Mining Area Boundary" as shown on figures included in the Permit to Mine Application.
EW-010, EW-011	Note 3 will be modified to read: "Reclamation of the Haul Roads will consist of removing safety berms through grading, seeding the regraded surface, and establishing a 15-foot-wide access road near the centerline of all haul roads." Note 3 will be modified to read: "All active haul roads to be reclaimed."



2 SECTION: ACCESS ROAD DURING RECLAMATION



NOTES:

1. PLAN A SHOWS RECLAMATION PLAN IF MINE IS CLOSED PRIOR TO MINE YEAR 11.
2. ALL FEATURES SHOWN WILL REMAIN DURING RECLAMATION UNLESS OTHERWISE NOTED.
3. RECLAMATION OF THE HAUL ROADS WILL CONSIST OF REMOVING SAFETY BERMS THROUGH GRADING AND SEEDING THE SURFACES.
4. ALL ACTIVE HAUL ROADS TO BE RECLAIMED EXCEPT DESIGNATED LONG–TERM ACCESS ROADS.

1 PLAN: HAUL ROAD RECLAMATION PLAN A

N

0 1000 2000
SCALE IN FEET

PLANT DRAWING NUMBER:

MINE SITE AND DUNKA ROAD EARTHWORK
HAUL ROAD RECLAMATION PLAN A
MINE YEARS 1–11

POLYMET MINING

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR

BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1–800–632–2277

VER NO	DATE	DESCRIPTION
1	5/21/15	ISSUED FOR INCLUSION IN PERMIT APPLICATION
3	6/7/2017	PERMIT APPLICATION UPDATES

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	3	6/7/2017
FOR CONSTRUCTION		

NOT APPROVED FOR CONSTRUCTION.

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME PAUL T. SWENSON
SIGNATURE
DATE 5/26/17 LICENSE# 20533

DRAWN: KKB
CHECKED: ATS
BARR PROJECT NO.: 23/69–0C29
SCALE: AS SHOWN

DWG. NO. EW–010
REV B

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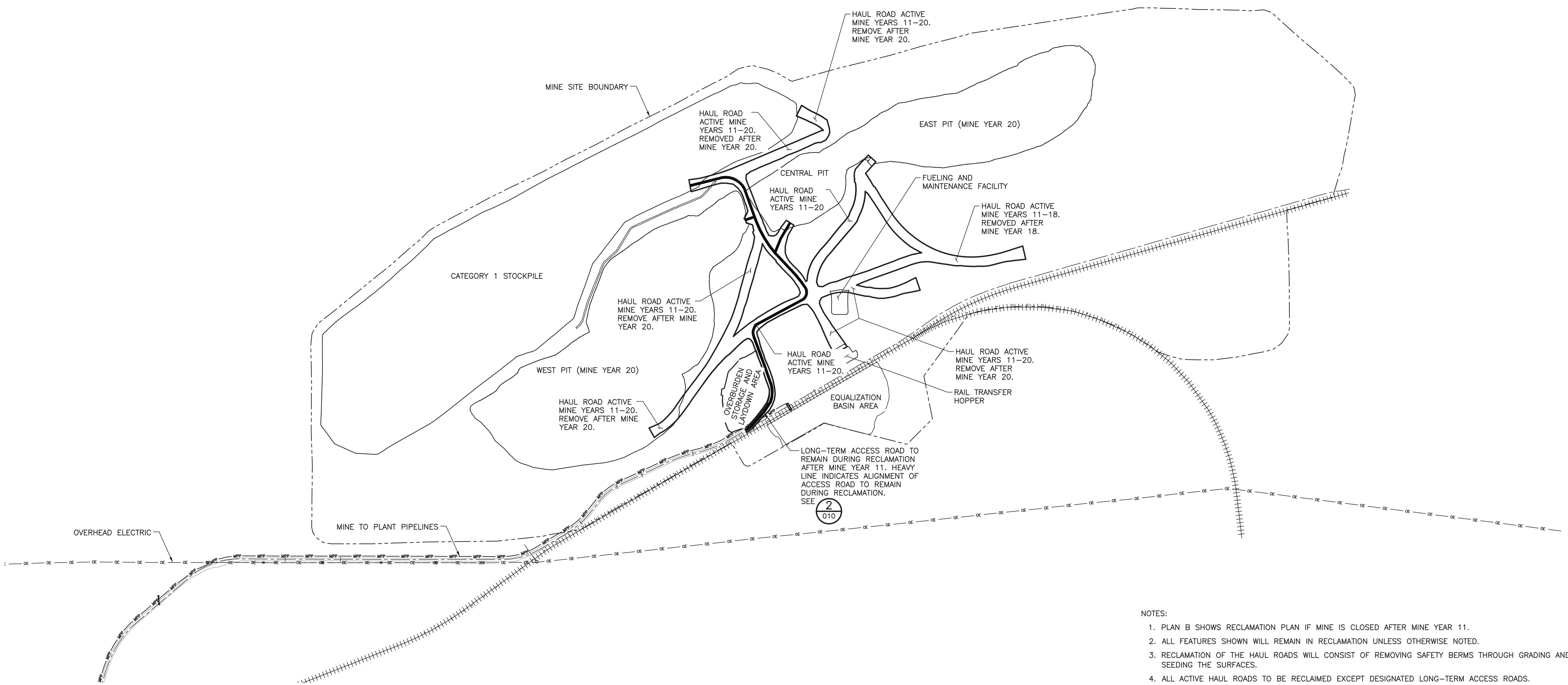

NOTES:

1. PLAN B SHOWS RECLAMATION PLAN IF MINE IS CLOSED AFTER MINE YEAR 11.
2. ALL FEATURES SHOWN WILL REMAIN IN RECLAMATION UNLESS OTHERWISE NOTED.
3. RECLAMATION OF THE HAUL ROADS WILL CONSIST OF REMOVING SAFETY BERMS THROUGH GRADING AND SEEDING THE SURFACES.
4. ALL ACTIVE HAUL ROADS TO BE RECLAIMED EXCEPT DESIGNATED LONG–TERM ACCESS ROADS.

1 PLAN: HAUL ROAD RECLAMATION PLAN B

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SCALE IN FEET

PLANT DRAWING NUMBER:

MINE SITE AND DUNKA ROAD EARTHWORK
HAUL ROAD RECLAMATION PLAN B
MINE YEARS 11–20

VER NO	DATE	DESCRIPTION
1	5/05/17	ISSUED FOR INCLUSION IN PERMIT APPLICATION
3	6/7/2017	PERMIT APPLICATION UPDATES

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	3	6/7/2017
FOR CONSTRUCTION		

NOT APPROVED FOR CONSTRUCTION.

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME PAUL T. SWENSON
SIGNATURE
DATE 5/26/17 LICENSE# 20533

DRAWN: KKB
CHECKED: ATS
BARR PROJECT NO.: 23/69–0C29
SCALE: AS SHOWN

POLYMET MINING

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR

BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1–800–632–2277

DWG. NO. EW–011

REV B

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Errata Sheet

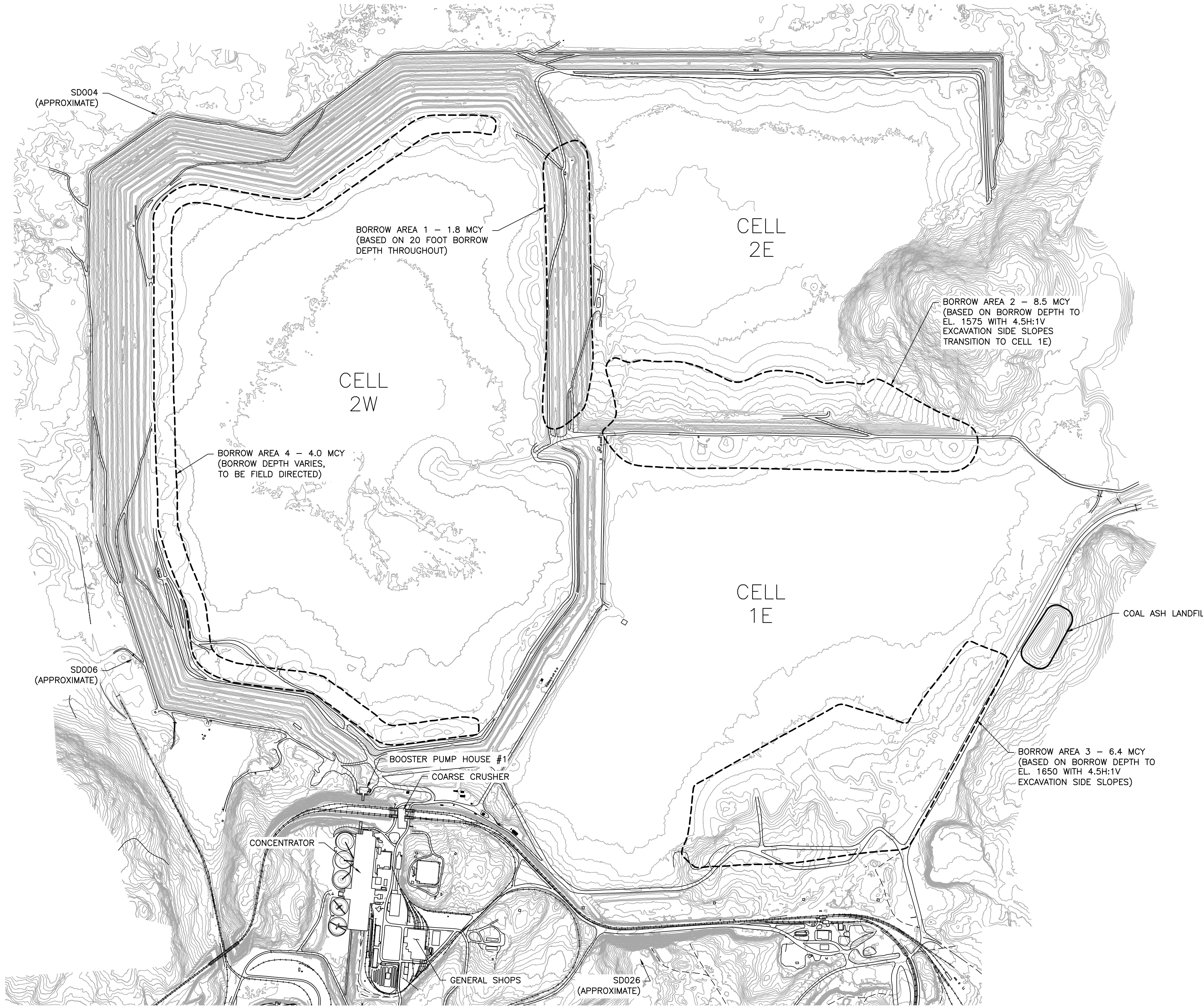
Poly Met Mining, Inc. NorthMet Project

Permit Application Support Drawings: FTB Seepage Containment and Stream Augmentation Systems

July 2016 (version 2)

Engineering design is currently in progress. The table below lists changes that have been identified to-date and have not yet been incorporated in the attached permit application support drawings within this set. Final design will incorporate these changes along with additional site-specific information (e.g., supplementary geotechnical data); therefore, additional adjustments may be made during final design that will be incorporated into the final design drawing set.

Drawing Sheet(s)	Change
FTBCA-002	A note 5 will be added to say: The term “stream augmentation” in this drawing set is synonymous with “surface water discharge”; these terms are used in the Water Appropriations Consolidated Permit Application and the NPDES/SDS Permit Application, respectively.
FTBCA-013, FTBCA-015	The cross slope on the perimeter access road surface will be revised so that it slopes entirely towards the FTB, instead of being crowned in the center.
FTBCA-013, FTBCA-015	To eliminate additional fill in wetlands, the monitoring wells located outside of the perimeter access road will be moved to within the road embankment.
FTBCA-004 through FTBCA-010	The final location and number of discharge locations to Unnamed Creek and Trimble Creek will be determined in permitting and final design.



NOTES:

1. CONTOURS DO NOT REFLECT BORROW REMOVAL.
2. THE GENERAL BORROW SEQUENCING WILL BE:
   - AREAS THAT WILL BE INUNDATED BY OPERATIONS
   - AREAS NEAREST THE POINT OF USE
   - REMAINING BORROW AREAS
3. COAL ASH LANDFILL TO BE RELOCATED TO HYDROMET RESIDUE FACILITY OR ALTERNATE PERMITTED FACILITY PRIOR TO TAILINGS DEPOSITION IN CELL 1E.

1 PLAN: EXISTING CONDITIONS

0 800 1600
SCALE IN FEET

VER NO	DATE	DESCRIPTION
1	10/14/11	FLOTATION TAILINGS MANAGEMENT PLAN – VERSION 1 – ATTACHMENT A
2	12/07/12	FLOTATION TAILINGS MANAGEMENT PLAN – VERSION 2 – ATTACHMENT A
3	04/12/13	FLOTATION TAILINGS MANAGEMENT PLAN – VERSION 3 – ATTACHMENT A
4	11/25/14	FLOTATION TAILINGS MANAGEMENT PLAN – VERSION 4 – ATTACHMENT A
5	03/03/15	FLOTATION TAILINGS MANAGEMENT PLAN – VERSION 5 – ATTACHMENT A
6	05/20/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
7	05/12/17	PERMIT APPLICATION UPDATES

ISSUE STATUS		
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FOR PERMITTING	7	5/12/17
FOR CONSTRUCTION	–	–
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PRINTED NAME THOMAS J. RADUE
SIGNATURE Thomas J. Radue
DATE 5/12/17 LICENSE# 20951

DRAWN: CAD
CHECKED: TJR
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

FLOTATION TAILINGS BASIN
EXISTING CONDITIONS

POLYMET MINING

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

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BARR ENGINEERING CO.
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SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. FTB-003
REV A

CADD USER: Cristion A. Diaz FILE: K:\DESIGN\23690C29.10\PERMIT_NMT-02-CS-003.DWG PLOT SCALE: 1:2 PLOT DATE: 5/12/2017 10:04 AM

INCHES 1 2

Errata Sheet

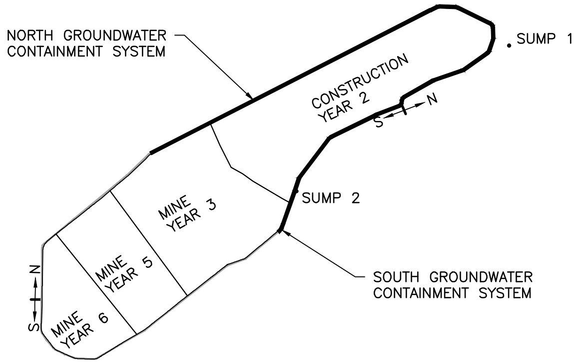
Poly Met Mining, Inc. NorthMet Project

Permit Application Support Drawings: Category 1 Stockpile Groundwater Containment System

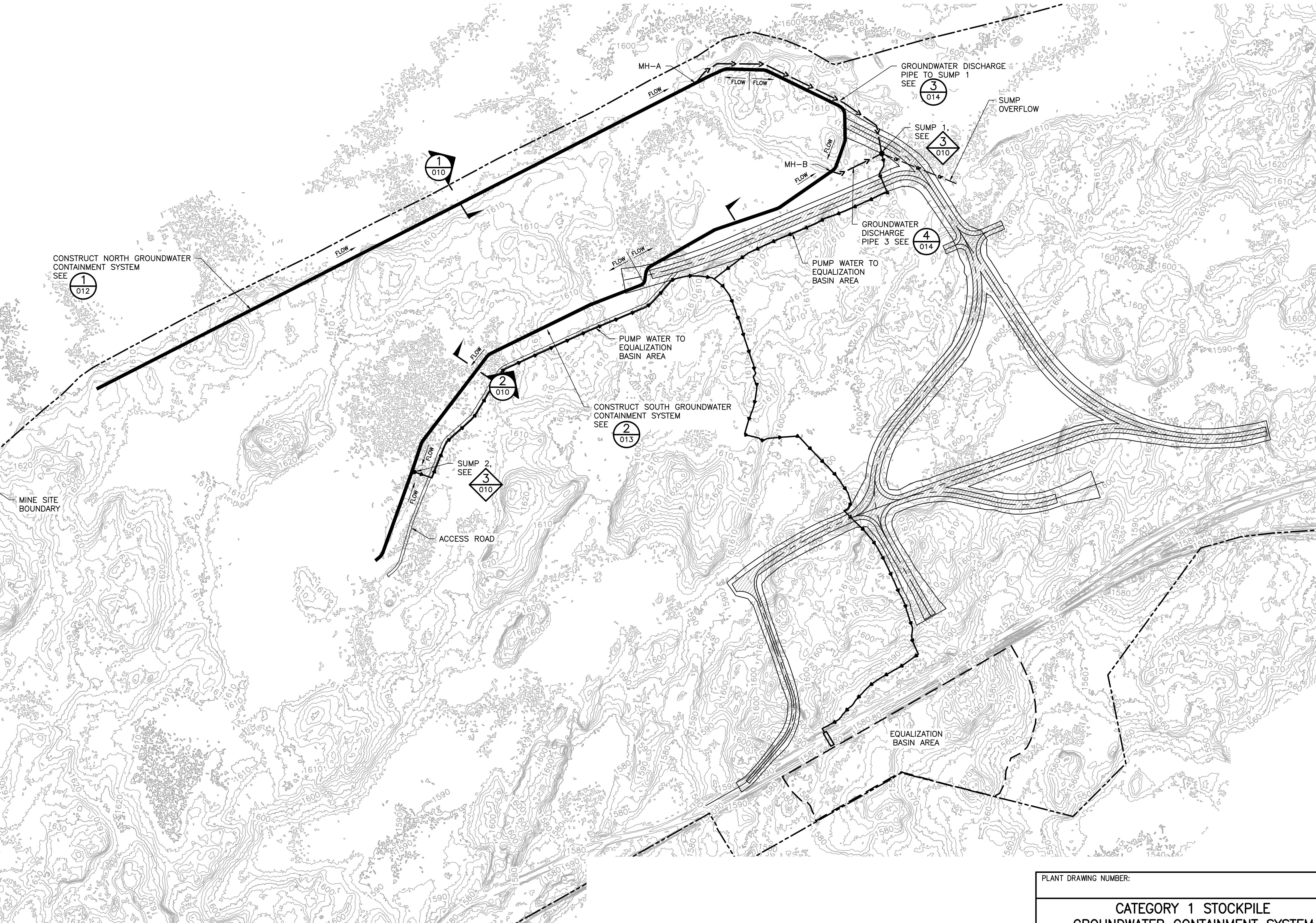
August 2017 (version 3)

Engineering design is currently in progress. The table below lists changes that have been identified to-date and have not yet been incorporated in the attached permit application support drawings within this set. Final design will incorporate these changes along with additional site-specific information (e.g., supplementary geotechnical data); therefore, additional adjustments may be made during final design that will be incorporated into the final design drawing set.

Drawing Sheet(s)	Change
Global change to all sheets, as needed	The terminology "mine drainage" as noted in these drawings will be changed to "mine water".
GCS-003	To meet construction stormwater requirements, a temporary berm will be added on the west side of the Mine Year 0 Category 1 Stockpile footprint to control mine water runoff as the stockpile is built out.
GCS-003, GCS-004, GCS-005, GCS-006, GCS-007, GCS-008, GCS-009	The "Mine Site Boundary" will be replaced by the "Mining Area Boundary" as shown on figures included in the Permit to Mine Application.



1 PLAN: OVERALL CONFIGURATION
-- NTS



2 PLAN: GCS – MINE YEAR 0 LAYOUT
-- 0 500 1000
SCALE IN FEET

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VER NO	DATE	DESCRIPTION
1	10/18/11	ROCK AND OVERBURDEN MANAGEMENT PLAN – VERSIONS 5, 6, 7 – ATTACHMENT C
2	05/28/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
3	07/25/17	PERMIT APPLICATION UPDATES

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SIGNATURE Thomas J. Radue
DATE 7/25/17 LICENSE# 20951

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BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

CATEGORY 1 STOCKPILE
GROUNDWATER CONTAINMENT SYSTEM
CONSTRUCTION YEAR 2

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DWG. NO. GCS-003

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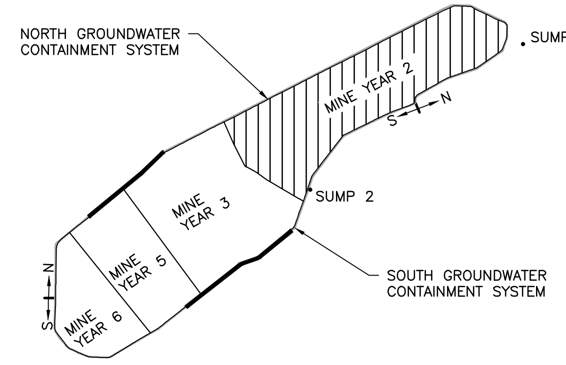
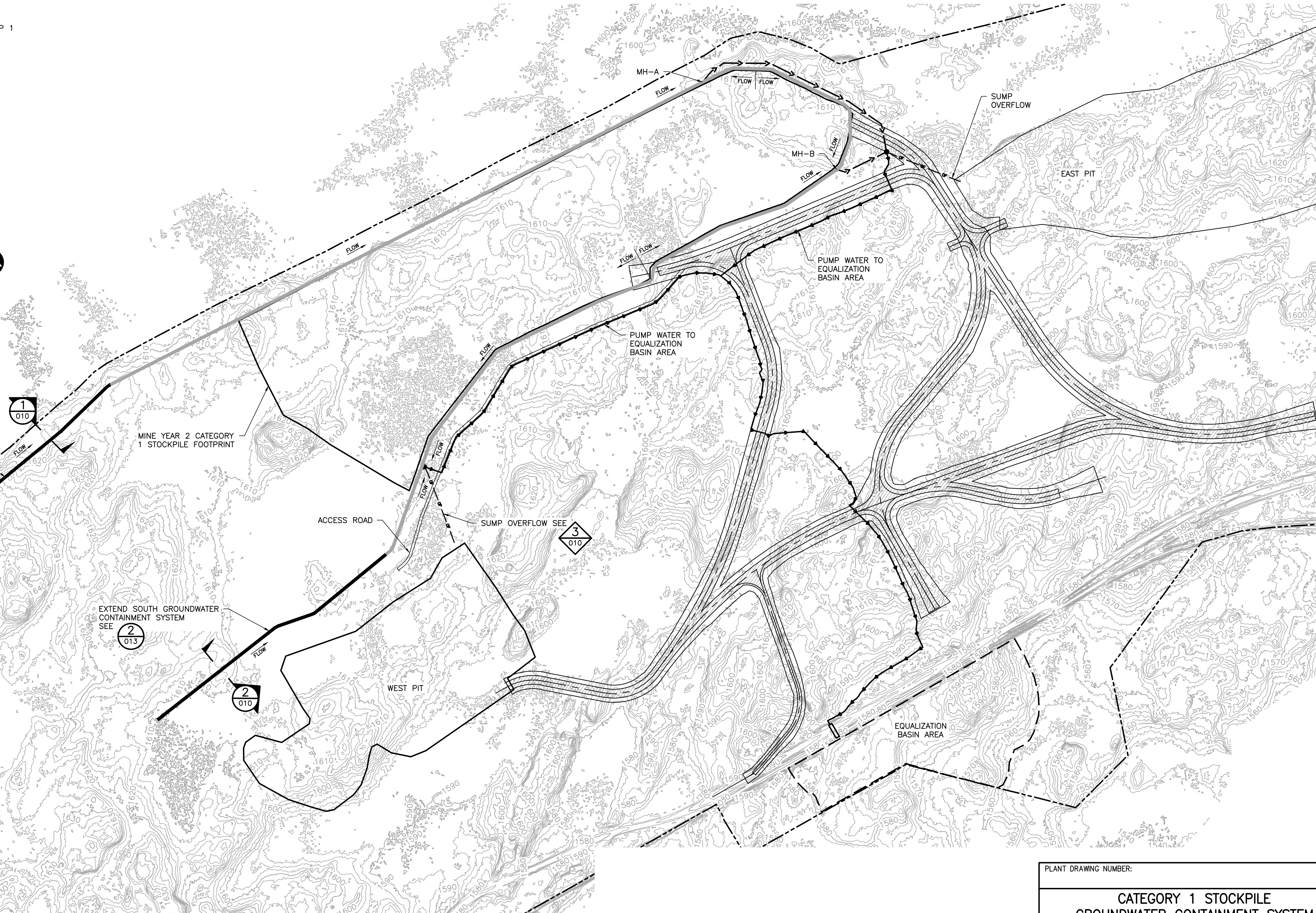


1 PLAN: OVERALL CONFIGURATION
-- NTS



2 PLAN: GCS – MINE YEAR 2 LAYOUT
-- 0 500 1000
SCALE IN FEET

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PLANT DRAWING NUMBER:

CATEGORY 1 STOCKPILE
GROUNDWATER CONTAINMENT SYSTEM
MINE YEAR 2 LAYOUT

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DWG. NO. GCS-004
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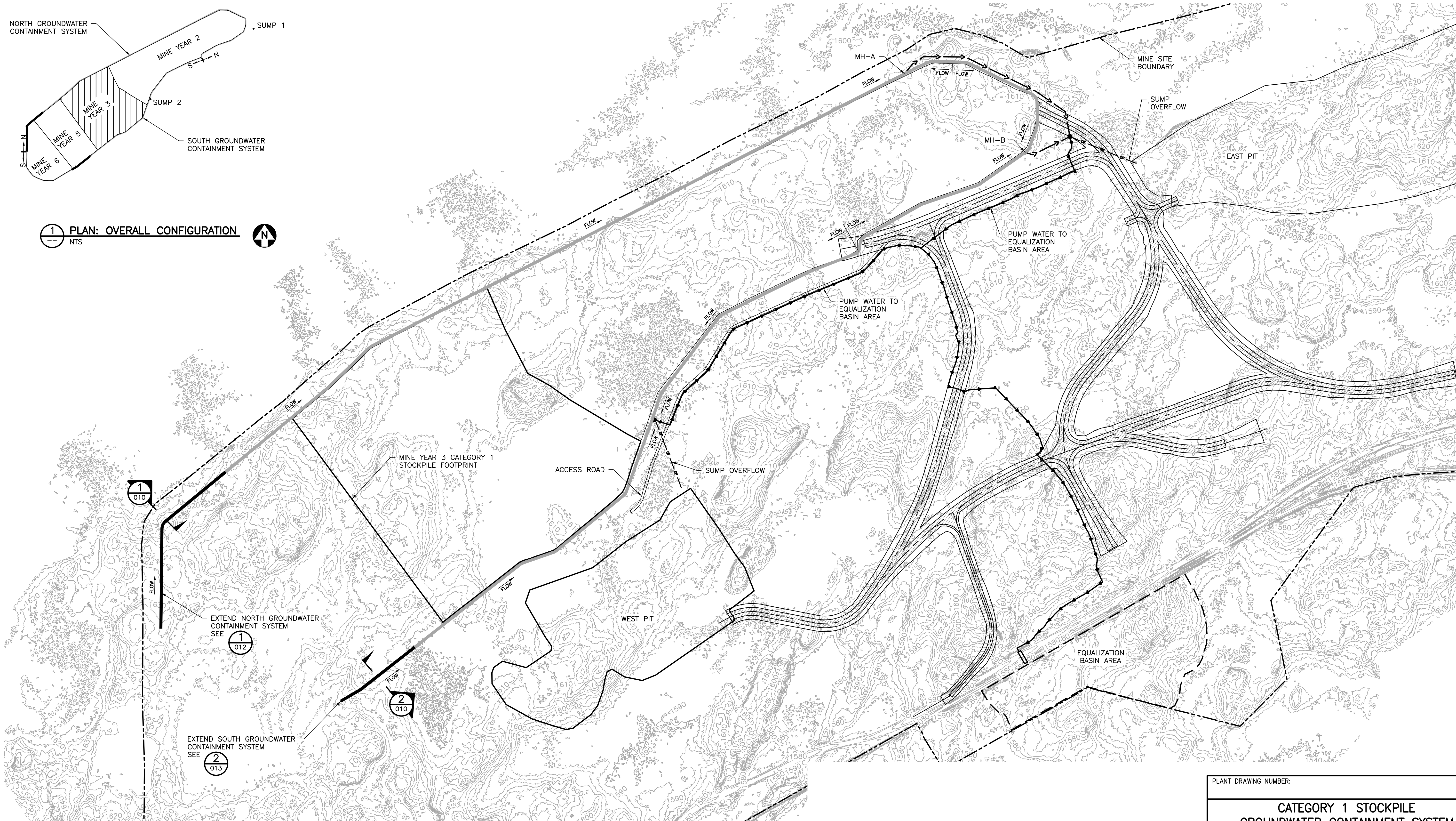
CADD USER: Cristian A. Diaz FILE: K:\DESIGN\23690C29.10\PERMIT_NMM-21-CS-004.DWG PLOT SCALE: 1:2 PLOT DATE: 7/25/2017 11:06 AM

INCHES 1 2



1 PLAN: OVERALL CONFIGURATION
NTS

2 PLAN: GCS – MINE YEAR 3 LAYOUT
0 500 1000
SCALE IN FEET

CADD USER: Cristian A. Diaz FILE: K:\DESIGN\23690C29.10\PERMIT_NMM-21-CS-005.DWG PLOT SCALE: 1:2 PLOT DATE: 7/25/2017 11:09 AM

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SCALE: AS SHOWN

PLANT DRAWING NUMBER:

CATEGORY 1 STOCKPILE
GROUNDWATER CONTAINMENT SYSTEM
MINE YEAR 3 LAYOUT

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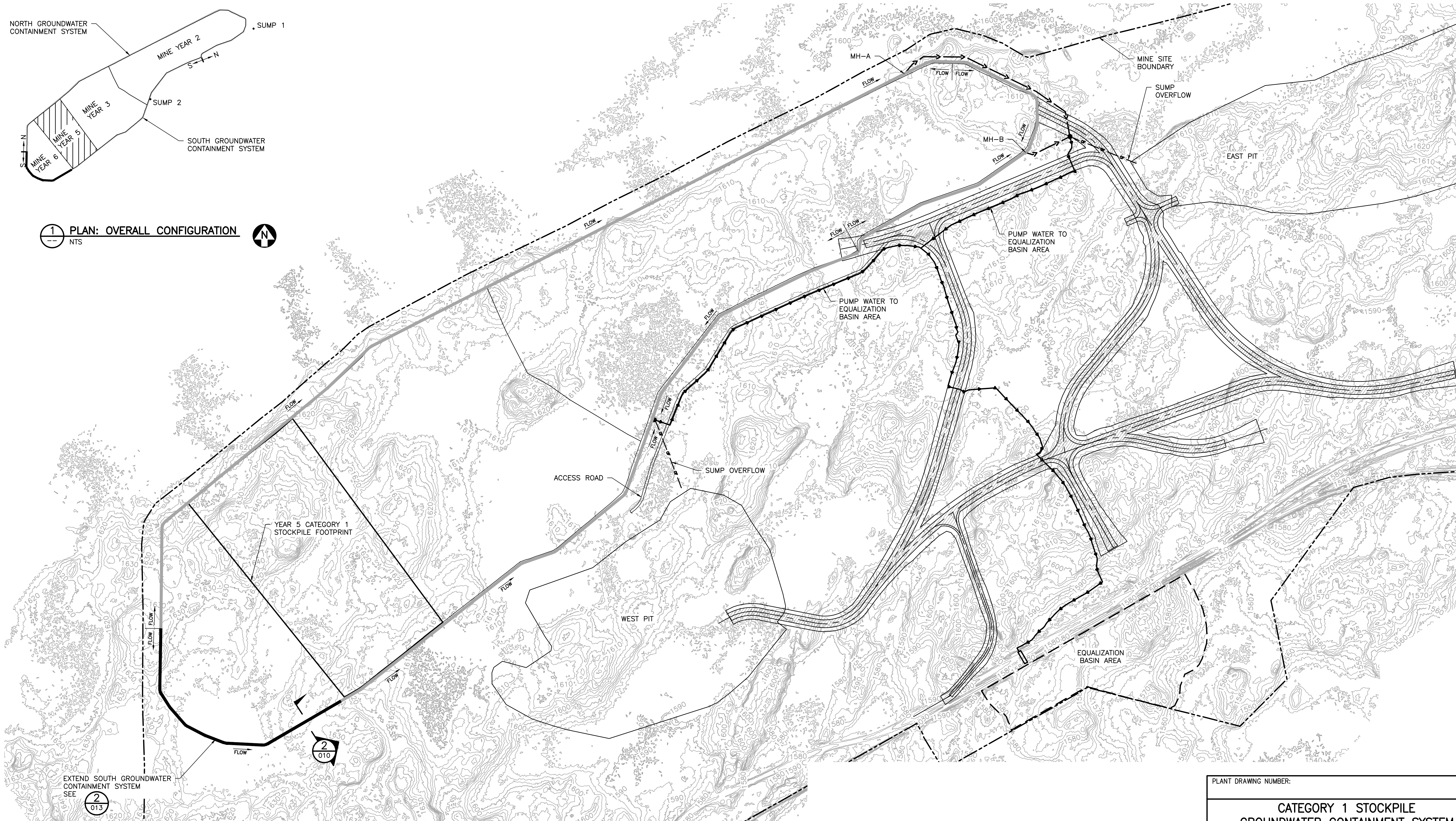
DWG. NO. GCS-005
REV



1 PLAN: OVERALL CONFIGURATION
NTS

2 PLAN: GCS – MINE YEAR 5 LAYOUT
0 500 1000
SCALE IN FEET

VER NO	DATE	DESCRIPTION
1	10/18/11	ROCK AND OVERBURDEN MANAGEMENT PLAN – VERSIONS 5, 6, 7 – ATTACHMENT C
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DATE 7/25/17 LICENSE# 20951

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PLANT DRAWING NUMBER:

CATEGORY 1 STOCKPILE
GROUNDWATER CONTAINMENT SYSTEM
MINE YEAR 5 LAYOUT

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DWG. NO. GCS–006
REV

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CADD USER: Cristion A. Diaz FILE: K:\DESIGN\23690C29.10\PERMIT_NMT-01-CS-005.DWG PLOT SCALE: 1:2 PLOT DATE: 5/15/2017 6:32 PM

NOTES:

1. APPROXIMATE SOIL AND ROCK REMOVAL VOLUME = 329,000 CY

1 PLAN: EMERGENCY BASIN REMOVALS

0 200 400
SCALE IN FEET

VER NO	DATE	DESCRIPTION
1	10/14/11	RESIDUE MANAGEMENT PLAN – VERSION 1 – ATTACHMENT A
2	06/29/12	RESIDUE MANAGEMENT PLAN – VERSION 1 – RESPONSE TO COMMENTS
3	12/14/12	RESIDUE MANAGEMENT PLAN – VERSION 2 – ATTACHMENT A
4	05/19/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
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CHECKED: TJR
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

HYDROMETALLURGICAL RESIDUE FACILTY
EMERGENCY BASIN EXCAVATIONS
AND REMOVALS

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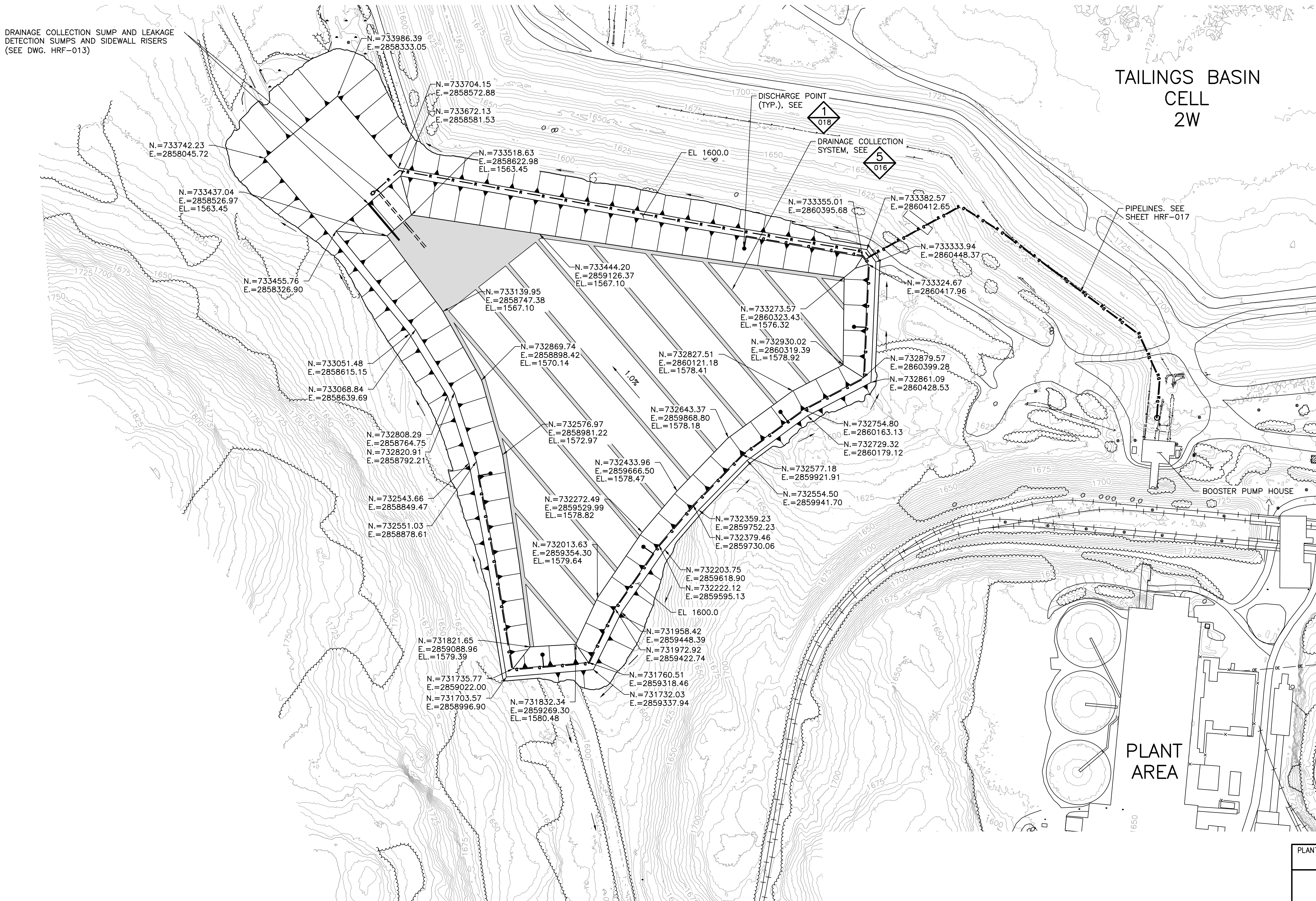
DWG. NO. HRF-005
REV A

INCHES 1 2



NOTES:

1. UPPER LINER SURFACE SHOWN.
2. DRAINAGE COLLECTION GEOCOMPOSITE SHOWN (SHADED AREA).
3. PLACE HRF LINER OVER BASE AND INTERIOR SLOPES OF CELL. SEE DWG. HRF-016.

1 — PLAN: LIFT 1 LAYOUT

0 200 400
SCALE IN FEET

VER NO	DATE	DESCRIPTION
1	10/14/11	RESIDUE MANAGEMENT PLAN – VERSION 1 – ATTACHMENT A
2	06/29/12	RESIDUE MANAGEMENT PLAN – VERSION 1 – RESPONSE TO COMMENTS
3	12/14/12	RESIDUE MANAGEMENT PLAN – VERSION 2 – ATTACHMENT A
4	05/19/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
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SIGNATURE Thomas J. Radue
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PLANT DRAWING NUMBER:

HYDROMETALLURGICAL RESIDUE FACILTY
LIFT 1 LAYOUT

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NORTHMET PROJECT
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Ph: 1-800-632-2277

DWG. NO. HRF-008
REV A

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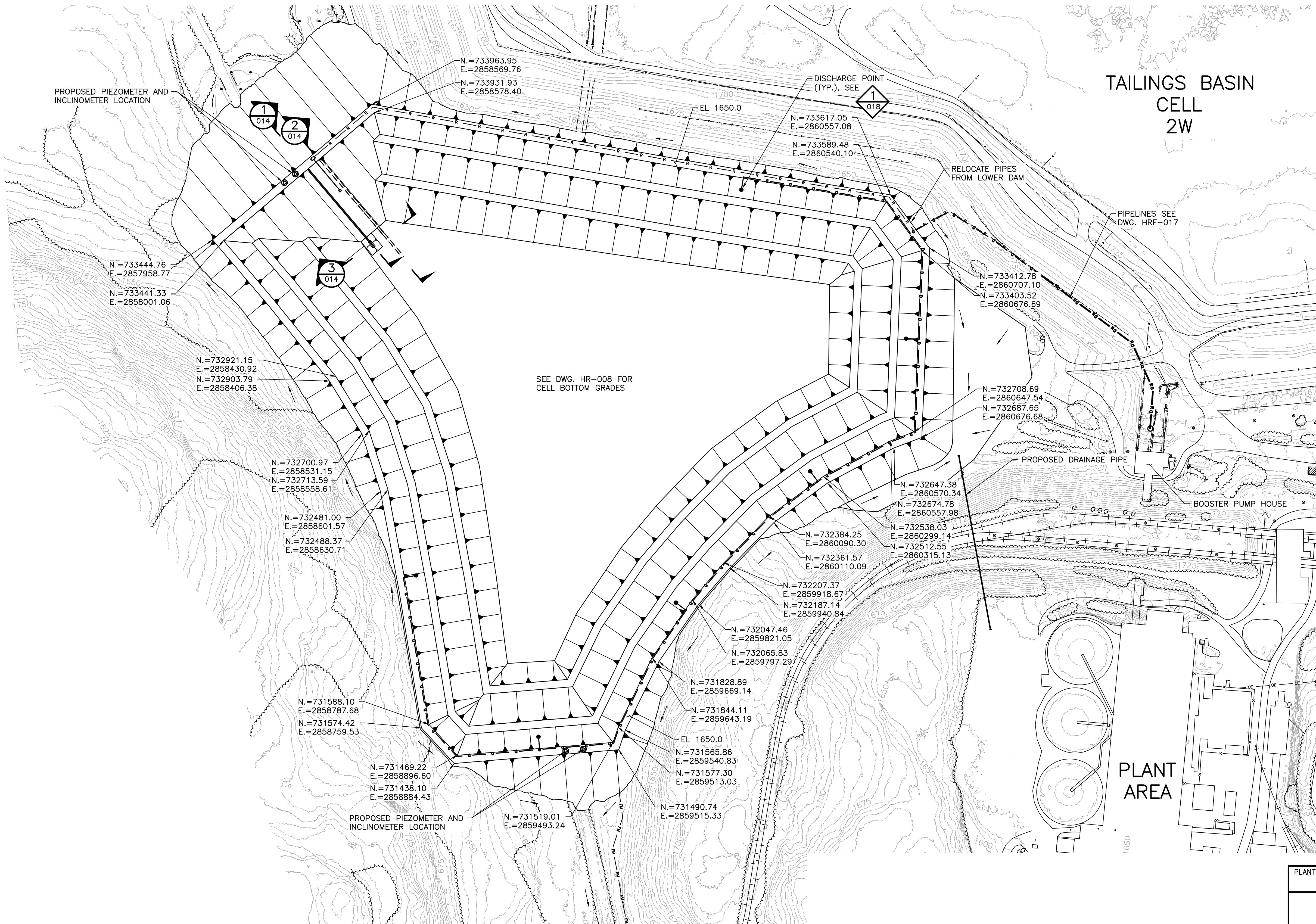
INCHES



NOTES:

1. LIFT 3 CONSTRUCTION YEAR TO BE BASED ON HRF CAPACITY CONSUMPTION RATE.

2. UPPER LINER SURFACE SHOWN.

3. PLACE HRF LINER OVER BASE AND INTERIOR SLOPES OF CELL. SEE DWG. HRF-016.

1 PLAN: LIFT 3 LAYOUT

0 200 400 SCALE IN FEET

VER NO	DATE	DESCRIPTION
1	10/14/11	RESIDUE MANAGEMENT PLAN - VERSION 1 - ATTACHMENT A
2	06/29/12	RESIDUE MANAGEMENT PLAN - VERSION 1 - RESPONSE TO COMMENTS
3	12/14/12	RESIDUE MANAGEMENT PLAN - VERSION 2 - ATTACHMENT A
4	05/19/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
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SIGNATURE Thomas J. Radue
DATE 5/15/17 LICENSE# 20951

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BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

HYDROMETALLURGICAL RESIDUE FACILTY
LIFT 3 LAYOUT

POLYMET MINING
POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR
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DWG. NO. HRF-010
REV A

INCHES 1 2

Errata Sheet

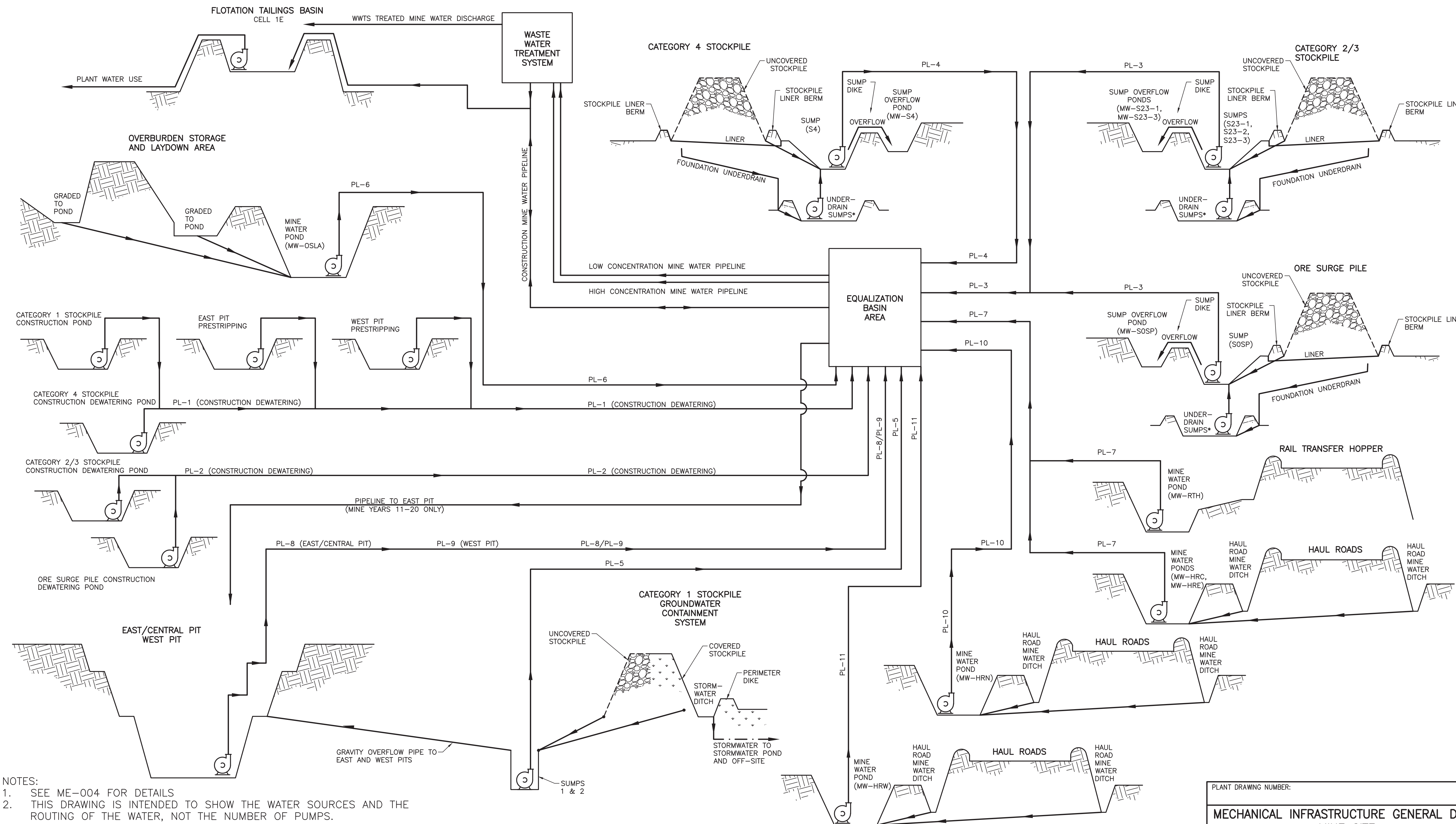
Poly Met Mining, Inc. NorthMet Project

Permit Application Support Drawings: Mechanical Infrastructure

November 2017 (version 4)

Engineering design is currently in progress. The table below lists changes that have been identified to-date and have not yet been incorporated in the attached permit application support drawings within this set. Final design will incorporate these changes along with additional site-specific information (e.g., supplementary geotechnical data); therefore, additional adjustments may be made during final design that will be incorporated into the final design drawing set.

Drawing Sheet(s)	Change
Global change to all sheets, as needed	The terminology “mine drainage” as noted in these drawings will be changed to “mine water”.
MPP-009	The berm over the MPP will be revised to match the contours of the road where it crosses the proposed access road near the Equalization Basin Area.
MPP-010	The option of 1” minus rock as the top berm surface was eliminated to minimize additional impervious surfaces. Remove “or 1” minus rock” text on Sections 1, 2, 4, & 5.
MW-001	An access road will be added adjacent to a Mine Water pipe for construction and maintenance purposes. This access road will follow the Mine Water pipe that connects the Category 1 Stockpile and Haul Road F (in a general north-south orientation).
MW-003	The grading for the access road from the Mine Site Fueling and Maintenance Facility (MSFMF) to Pond MW-SOSP & Sump SOSP will be revised to optimize drainage.
ME-002, MPP-001, MPP-007, MPP-008, MPP-009, MW-001, MW-002, MW-007, MW-008, MW-016	The “Mine Site Boundary” will be replaced by the “Mining Area Boundary” as shown on figures included in the Permit to Mine Application.
MW-016	Note 4 will be changed to: “Reclamation of the mine water sumps and ponds will require cleanout and removal of the geomembrane liner. Sediment removed from the ponds will be disposed of in the East Pit. The geomembrane liners will be recycled or properly disposed of at a permitted solid waste facility.”
MW-016	Note 6 will be added: “Mine water pipes and pumps needed in the reclamation, closure and postclosure maintenance phases include those used by the Category 1 Stockpile Groundwater Containment System and those used for the flooding of the West Pit or cycling of the East Pit water.”
ME-003	All references to “pre-stripping” will be changed to “stripping”



NOTES:
1. SEE ME-004 FOR DETAILS
2. THIS DRAWING IS INTENDED TO SHOW THE WATER SOURCES AND THE ROUTING OF THE WATER, NOT THE NUMBER OF PUMPS.

* ROUTING OF THIS WATER WILL BE TO THE WWTS OR CPS DEPENDING ON WATER QUALITY TESTING RESULTS.

LEGEND
- STORMWATER FLOW
- SITE MINE WATER FLOW
- COVERED STOCKPILE/GRASS
- UNCOVERED STOCKPILE
- UNCOVERED EARTHWORK
- PUMP

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1	5/18/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
2	6/07/17	PERMIT APPLICATION UPDATES

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PRINTED NAME JON M. MINNE
SIGNATURE
DATE 6/07/17 LICENSE# 25080

DRAWN: VJS
CHECKED: JMM3
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

MECHANICAL INFRASTRUCTURE GENERAL DWGS
MINE SITE
MINE WATER FLOW DIAGRAM

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DWG. NO. ME-003
REV B

CADD USER: Veronica Wourms FILE: K:\DESIGN\23690C29.10\PERMIT_NMM-50-MF-500.DWG PLOT SCALE: 1:2 PLOT DATE: 6/2/2017 9:07 AM

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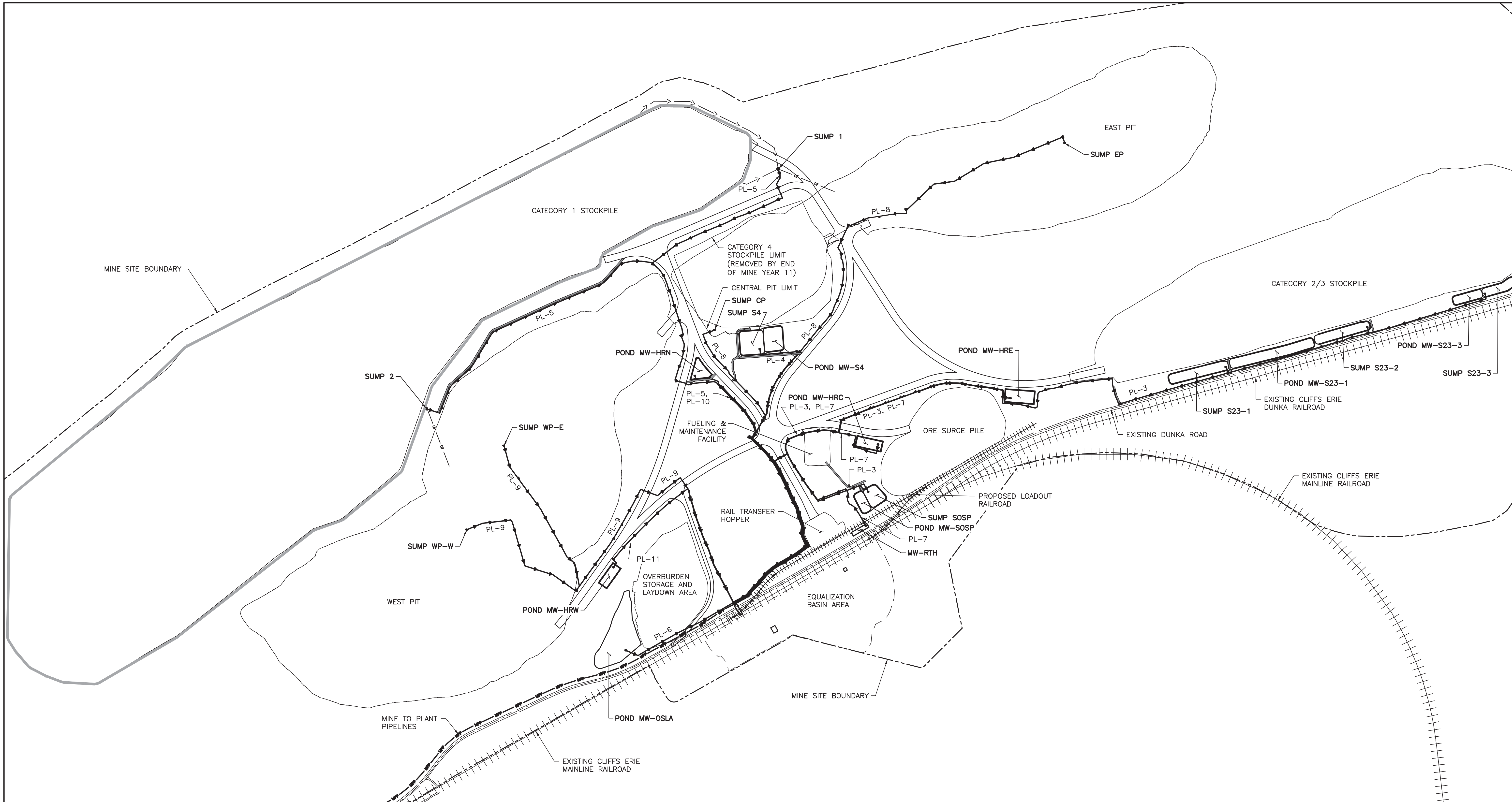

1 PLAN: GENERAL LAYOUT MINE YEAR 11

0 600 1200
SCALE IN FEET

CADD USER: Veronica Wourms FILE: K:\DESIGN\23690C29.10\PERMIT_NMM-55-CS-101.DWG PLOT SCALE: 1:2 PLOT DATE: 6/2/2017 3:09 PM

INCHES 1 2

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PRINTED NAME JON M. MINNE
SIGNATURE
DATE 6/07/17 LICENSE# 25080

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CHECKED: JMM3
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

MINE WATER INFRASTRUCTURE
MINE YEAR 11 GENERAL LAYOUT

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NORTHMET PROJECT
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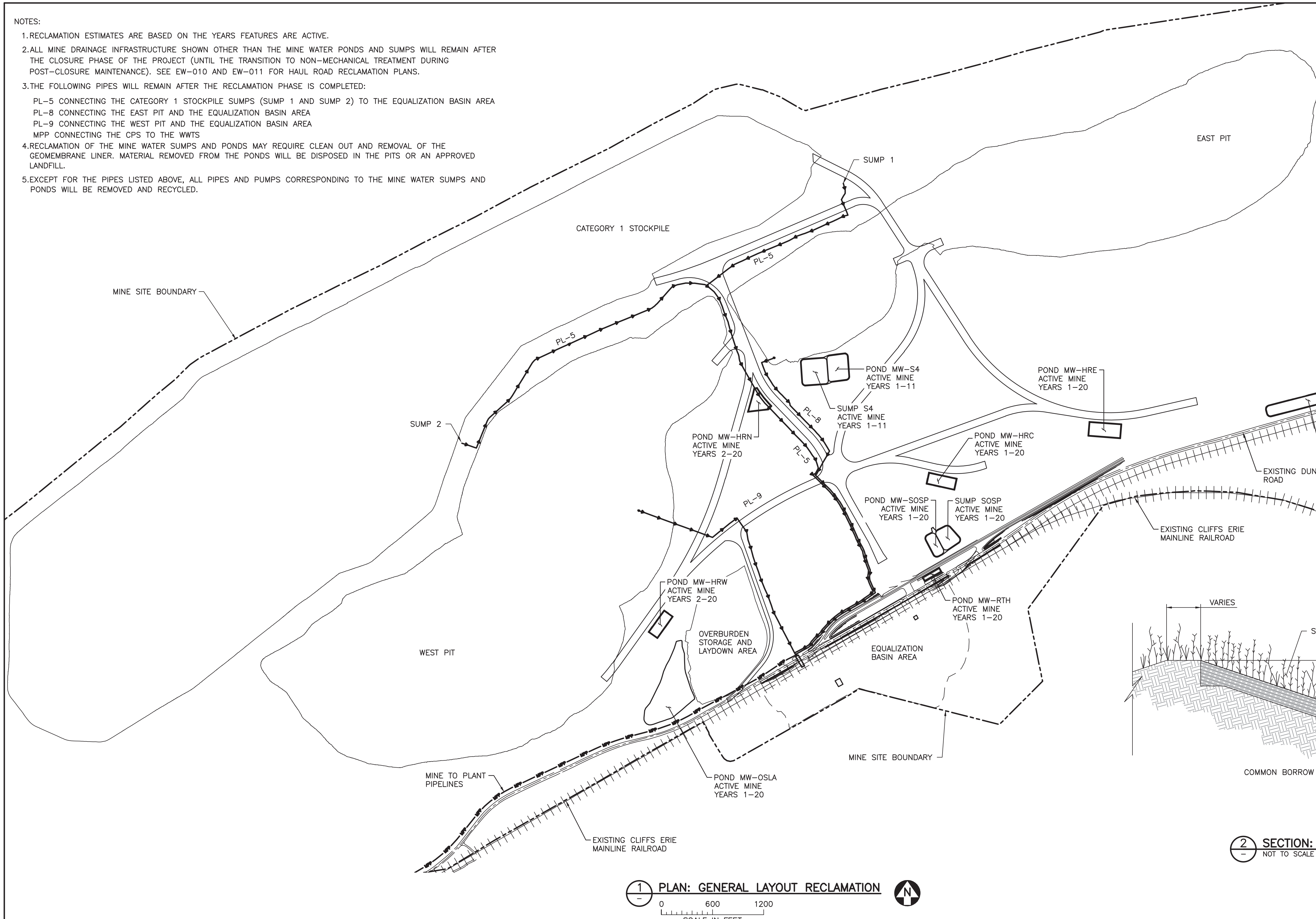
DWG. NO. MW-002

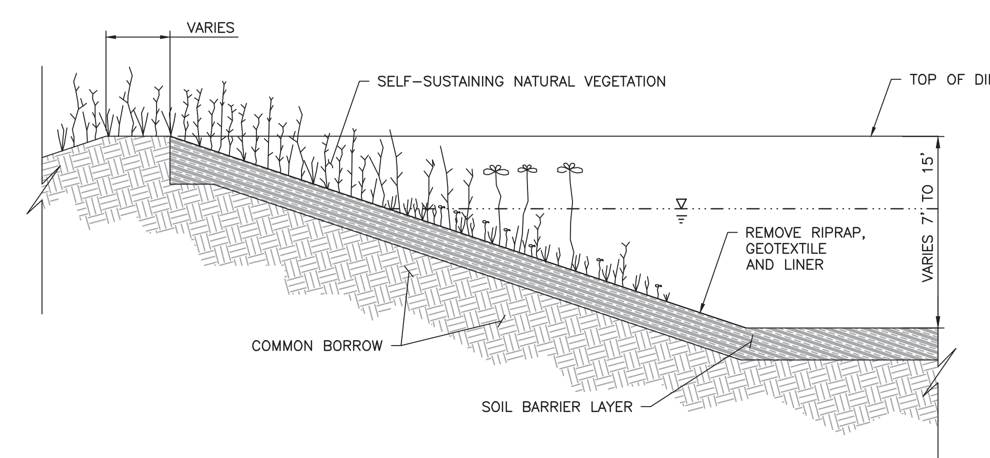
REV B

NOTES:

1. RECLAMATION ESTIMATES ARE BASED ON THE YEARS FEATURES ARE ACTIVE.
2. ALL MINE DRAINAGE INFRASTRUCTURE SHOWN OTHER THAN THE MINE WATER PONDS AND SUMPS WILL REMAIN AFTER THE CLOSURE PHASE OF THE PROJECT (UNTIL THE TRANSITION TO NON-MECHANICAL TREATMENT DURING POST-CLOSURE MAINTENANCE). SEE EW-010 AND EW-011 FOR HAUL ROAD RECLAMATION PLANS.
3. THE FOLLOWING PIPES WILL REMAIN AFTER THE RECLAMATION PHASE IS COMPLETED:
   - PL-5 CONNECTING THE CATEGORY 1 STOCKPILE SUMPS (SUMP 1 AND SUMP 2) TO THE EQUALIZATION BASIN AREA
   - PL-8 CONNECTING THE EAST PIT AND THE EQUALIZATION BASIN AREA
   - PL-9 CONNECTING THE WEST PIT AND THE EQUALIZATION BASIN AREA
   - MPP CONNECTING THE CPS TO THE WWTS
4. RECLAMATION OF THE MINE WATER SUMPS AND PONDS MAY REQUIRE CLEAN OUT AND REMOVAL OF THE GEOMEMBRANE LINER. MATERIAL REMOVED FROM THE PONDS WILL BE DISPOSED IN THE PITS OR AN APPROVED LANDFILL.
5. EXCEPT FOR THE PIPES LISTED ABOVE, ALL PIPES AND PUMPS CORRESPONDING TO THE MINE WATER SUMPS AND PONDS WILL BE REMOVED AND RECYCLED.



1 PLAN: GENERAL LAYOUT RECLAMATION



2 SECTION: TYPICAL SUMP AND POND RECLAMATION
NOT TO SCALE

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2	6/07/17	PERMIT APPLICATION UPDATES

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ISSUED	VERSION	DATE
FOR PERMITTING	2	6/07/17
FOR CONSTRUCTION		
NOT APPROVED FOR CONSTRUCTION		

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PRINTED NAME JON M. MINNE
SIGNATURE
DATE 6/07/17 LICENSE# 25080

DRAWN: VJS
CHECKED: JMM3
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

MINE WATER INFRASTRUCTURE RECLAMATION PLAN

POLYMET MINING

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR
BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. MW-016
REV B

INCHES 1 2

Errata Sheet

Poly Met Mining, Inc. NorthMet Project

Permit Application Support Drawings: Categories 1, 2/3, and 4 Stockpiles and Ore Surge Pile Design

August 2017 (version 3)

Engineering design is currently in progress. The table below lists changes that have been identified to-date and have not yet been incorporated in the attached permit application support drawings within this set. Final design will incorporate these changes along with additional site-specific information (e.g., supplementary geotechnical data); therefore, additional adjustments may be made during final design that will be incorporated into the final design drawing set.

Drawing Sheet(s)	Change
Global change to all sheets, as needed	The terminology "mine drainage" as noted in these drawings will be changed to "mine water".
SKP-002, SKP-003, SKP-004, SKP-005, SKP-006, SKP-007, SKP-008, SKP-009, SKP-010, SKP-011, SKP-012, SKP-014, SKP-015, SKP-016, SKP-017, SKP-018, SKP-026, SKP-027, SKP-028, SKP-029, SKP-030	The "Mine Site Boundary" will be replaced by the "Mining Area Boundary" as shown on figures included in the Permit to Mine Application.

LEGEND

EXISTING GROUND TOPOGRAPHY

PROPOSED STOCKPILE LAYOUTS

HAUL ROADS

MINE SITE BOUNDARY

MINE YEAR 1 PIT BOUNDARY (SEE NOTE 1)

MINE YEAR 1 ORE, WASTE ROCK STOCKPILE OUTLINES (SEE NOTE 2)

MAXIMUM ORE, WASTE ROCK STOCKPILE OUTLINES (SEE NOTE 2)

CROSS SECTION IDENTIFIER

SHEET WHERE SECTION IS LOCATED

NOTES

1. OPEN PIT AND HAUL ROAD LAYOUTS PROVIDED BY BARR ENGINEERING IN OCTOBER 2011.
2. STOCKPILE LAYOUTS PROVIDED BY BARR ENGINEERING IN APRIL 2011 AND MODIFIED BY GOLDER.
3. SEE GENERAL NOTES AND LEGEND ON DRAWING 002.
4. CATEGORY 2/3 AND CATEGORY 4 STOCKPILES SHOWN BASED ON WASTE ROCK SCHEDULE ONLY, I.E. WITHOUT OVERBURDEN. SEE DRAWINGS 018 AND 024 SHOWING MAXIMUM CAPACITY LAYOUTS FOR THESE STOCKPILES.

REFERENCES

1. EXISTING GROUND TOPOGRAPHY PROVIDED BY BARR ENGINEERING, AUGUST 2011.
2. COORDINATE SYSTEM REFERENCE IS NAD83 MINNESOTA STATE PLANE NORTH.
3. VERTICAL DATUM REFERENCE IS FEET ABOVE MEAN SEA LEVEL (AMSL).

PLANT DRAWING NUMBER:

STOCKPILE LAYOUTS – MINE YEAR 1 LIMITS

N

0 800 1600

SCALE IN FEET

VER NO	DATE	DESCRIPTION
A	12/02/11	ISSUED FOR REVIEW FOR INCLUSION IN ROCK AND OVERBURDEN MANAGEMENT PLAN (ROMP)
B	2/15/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
C	5/29/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
D	1/14/14	ISSUED FOR AGENCY REVIEW
E	4/10/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
F	5/22/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
G	8/21/17	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	G	8/21/17
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SIGNATURE

PRINTED NAME BRENT R. BRONSON

DATE 8/21/17 LICENSE # 46492

DRAWN: MTM

CHECKED:

GOLDER PROJECT NO.: 113-2209

SCALE: AS SHOWN

POLYMET MINING

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

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REV

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LEGEND

EXISTING GROUND TOPOGRAPHY

PROPOSED GRADING TOPOGRAPHY

HAUL ROADS

MINE SITE BOUNDARY

PIT BOUNDARIES AT MINE YEAR 2 (SEE NOTE 1)

MINE YEAR 1 AND 2 ORE, WASTE ROCK STOCKPILE OUTLINES (SEE NOTE 2)

MAXIMUM ORE, WASTE ROCK STOCKPILE OUTLINES (SEE NOTE 2)

CROSS SECTION IDENTIFIER

SHEET WHERE SECTION IS LOCATED

NOTES

1. OPEN PIT AND HAUL ROAD LAYOUTS PROVIDED BY BARR ENGINEERING IN OCTOBER 2011.
2. STOCKPILE LAYOUTS PROVIDED BY BARR ENGINEERING IN APRIL 2011 AND MODIFIED BY GOLDER.
3. SEE GENERAL NOTES AND LEGEND ON DRAWING 002.
4. CATEGORY 2/3 AND CATEGORY 4 STOCKPILES SHOWN BASED ON WASTE ROCK SCHEDULE ONLY, I.E. WITHOUT OVERBURDEN. SEE DRAWINGS 018 AND 024 SHOWING MAXIMUM CAPACITY LAYOUTS FOR THESE STOCKPILES.

REFERENCES

1. EXISTING GROUND TOPOGRAPHY PROVIDED BY BARR ENGINEERING, AUGUST 2011.
2. COORDINATE SYSTEM REFERENCE IS NAD83 MINNESOTA STATE PLANE NORTH.
3. VERTICAL DATUM REFERENCE IS FEET ABOVE MEAN SEA LEVEL (AMSL).

0 800 1600
SCALE IN FEET

VER NO	DATE	DESCRIPTION
A	12/02/11	ISSUED FOR REVIEW FOR INCLUSION IN ROCK AND OVERBURDEN MANAGEMENT PLAN (ROMP)
B	2/15/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
C	5/29/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
D	1/14/14	ISSUED FOR AGENCY REVIEW
E	4/10/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
F	5/22/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
G	8/21/17	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS

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ISSUED	VERSION	DATE
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DATE 8/21/17 LICENSE # 46492

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CHECKED:
GOLDER PROJECT NO.: 113-2209
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

STOCKPILE LAYOUTS – MINE YEAR 2 LIMITS

POLYMET MINING

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

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DWG. NO. SKP-004
REV

INCHES 1 2

LEGEND

- EXISTING GROUND TOPOGRAPHY
- PROPOSED LAYOUTS
- HAUL ROADS
- MINE SITE BOUNDARY
- PIT BOUNDARIES AT MINE YEAR 11 (SEE NOTE 1)
- MINE YEAR 1 ORE, WASTE ROCK STOCKPILE OUTLINES (SEE NOTE 2)
- MAXIMUM ORE, WASTE ROCK STOCKPILE OUTLINES (SEE NOTE 2)
- A / 025 CROSS SECTION IDENTIFIER
- SHEET WHERE SECTION IS LOCATED

NOTES

1. OPEN PIT AND HAUL ROAD LAYOUTS PROVIDED BY BARR ENGINEERING IN OCTOBER 2011.
2. STOCKPILE LAYOUTS PROVIDED BY BARR ENGINEERING IN APRIL 2011 AND MODIFIED BY GOLDER.
3. SEE GENERAL NOTES AND LEGEND ON DRAWING 002.
4. CATEGORY 2/3 AND CATEGORY 4 STOCKPILES SHOWN BASED ON WASTE ROCK SCHEDULE ONLY, I.E. WITHOUT OVERBURDEN. SEE DRAWINGS 018 AND 024 SHOWING MAXIMUM CAPACITY LAYOUTS FOR THESE STOCKPILES.
5. PLANNED UTILIZATION LIMITS FOR CATEGORY 1 STOCKPILE REACHED IN MINE YEAR 13, PLANNED UTILIZATION LIMITS FOR CATEGORY 2/3 AND CATEGORY 4 STOCKPILES REACHED IN MINE YEAR 11.

REFERENCES

1. EXISTING GROUND TOPOGRAPHY PROVIDED BY BARR ENGINEERING, AUGUST 2011.
2. COORDINATE SYSTEM REFERENCE IS NAD83 MINNESOTA STATE PLANE NORTH.
3. VERTICAL DATUM REFERENCE IS FEET ABOVE MEAN SEA LEVEL (AMSL).

PLANT DRAWING NUMBER:

STOCKPILE LAYOUTS – AT PLANNED UTILIZATION LIMITS

0 800 1600
SCALE IN FEET

VER NO	DATE	DESCRIPTION
A	12/02/11	ISSUED FOR REVIEW FOR INCLUSION IN ROCK AND OVERBURDEN MANAGEMENT PLAN (ROMP)
B	2/15/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
C	5/29/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
D	1/14/14	ISSUED FOR AGENCY REVIEW
E	4/10/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
F	5/22/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
G	8/21/17	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS

ISSUED	VERSION	DATE
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DATE 8/21/17 LICENSE # 46492

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GOLDER PROJECT NO.: 113-2209
SCALE: AS SHOWN

POLYMET MINING

POLY MET MINING, INC.
NORTHMET PROJECT
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Golder Associates

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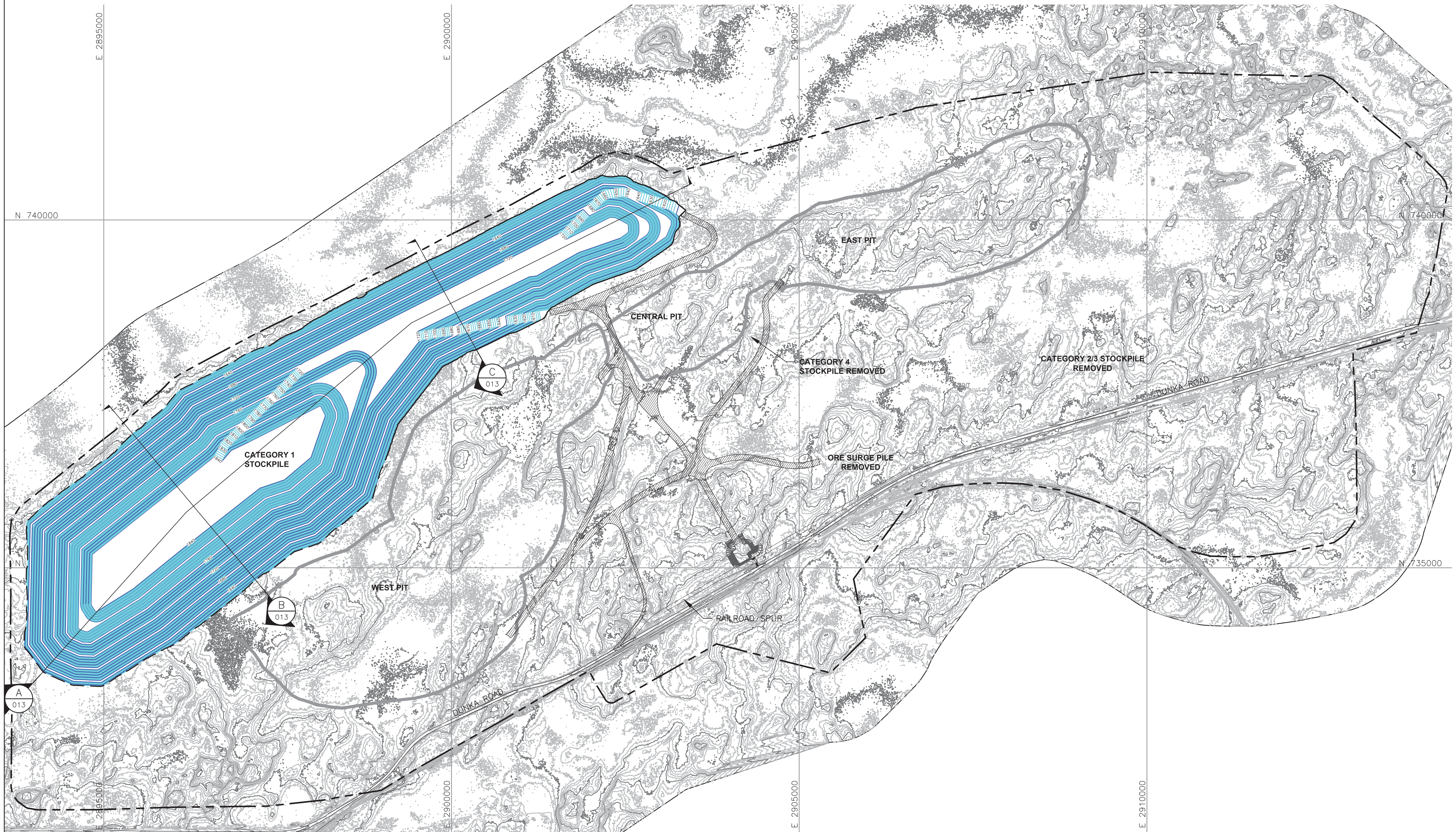

LEGEND

- EXISTING GROUND TOPOGRAPHY
- PROPOSED LAYOUT CONTOURS
- HAUL ROADS
- MINE SITE BOUNDARY
- ULTIMATE PIT BOUNDARIES (SEE NOTE 1)
- MINE YEAR 1 ORE, WASTE ROCK STOCKPILE OUTLINES (SEE NOTE 2)
- MAXIMUM ORE, WASTE ROCK STOCKPILE OUTLINES (SEE NOTE 2)
- A / 013: CROSS SECTION IDENTIFIER; SHEET WHERE SECTION IS LOCATED

NOTES

1. OPEN PIT AND HAUL ROAD LAYOUTS PROVIDED BY BARR ENGINEERING IN OCTOBER 2011.
2. STOCKPILE LAYOUTS PROVIDED BY BARR ENGINEERING IN APRIL 2011 AND MODIFIED BY GOLDER.
3. SEE GENERAL NOTES AND LEGEND ON DRAWING 002.

REFERENCES

1. EXISTING GROUND TOPOGRAPHY PROVIDED BY BARR ENGINEERING, AUGUST 2011.
2. COORDINATE SYSTEM REFERENCE IS NAD83 MINNESOTA STATE PLANE NORTH.
3. VERTICAL DATUM REFERENCE IS FEET ABOVE MEAN SEA LEVEL (AMSL).

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B	2/15/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
C	5/29/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
D	1/14/14	ISSUED FOR AGENCY REVIEW
E	4/10/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
F	5/22/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
G	8/21/17	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS

ISSUE STATUS		
ISSUED	VERSION	DATE
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DATE 8/21/17 LICENSE # 46492

DRAWN: MTM
CHECKED:
GOLDER PROJECT NO.: 113-2209
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

STOCKPILE LAYOUTS
MINE YEAR 21 LIMITS
CLOSURE CONFIGURATION

POLYMET MINING

POLY MET MINING, INC.
NORTHMET PROJECT
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DWG. NO. SKP-006

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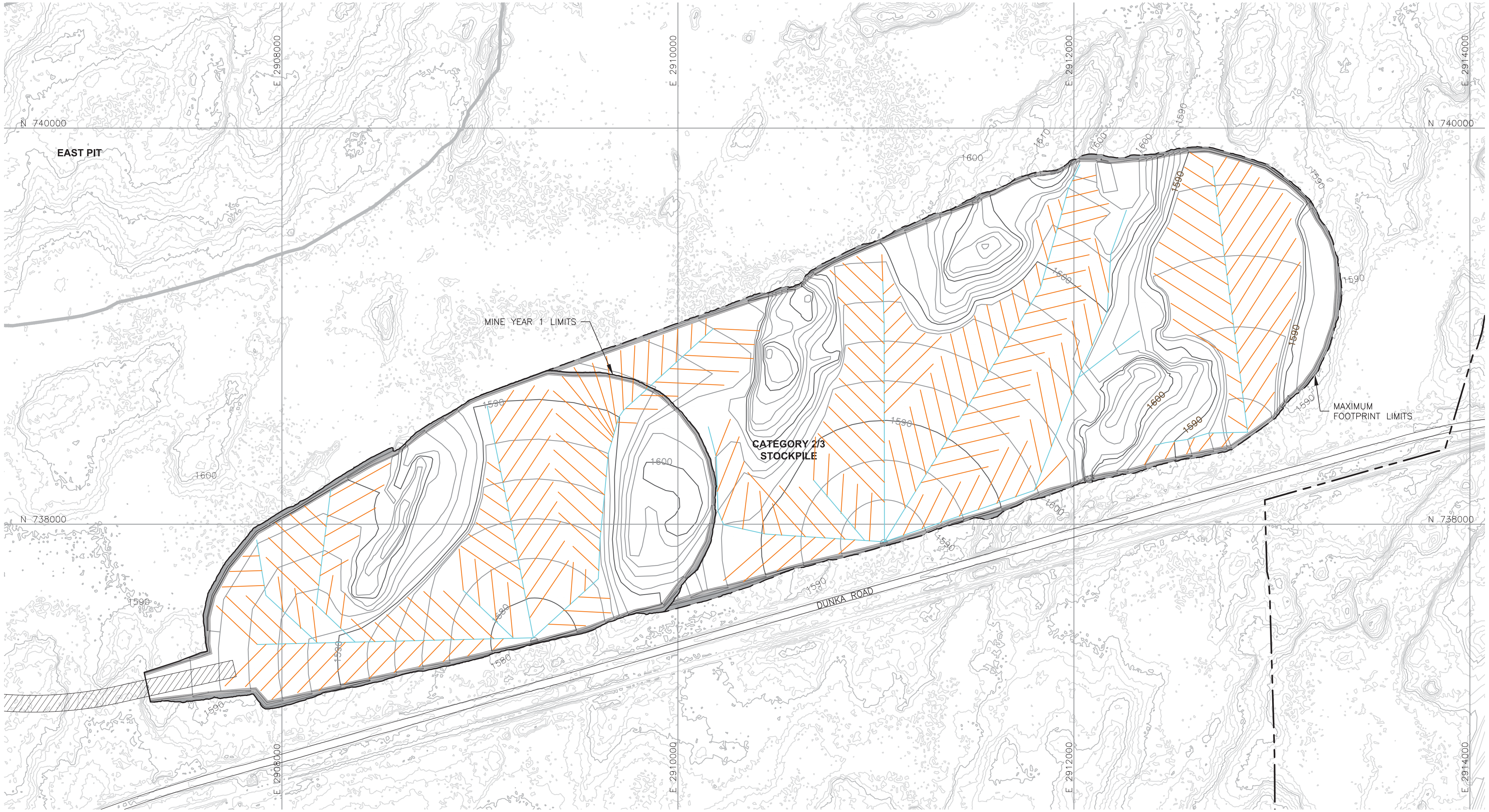

LEGEND

EXISTING GROUND TOPOGRAPHY

PROPOSED GRADING TOPOGRAPHY

MINE SITE BOUNDARY

MINE YEAR 11 PIT BOUNDARIES (SEE NOTE 1)

MINE YEAR 1 WASTE ROCK STOCKPILE OUTLINES (SEE NOTE 2)

MAXIMUM WASTE ROCK STOCKPILE OUTLINES (SEE NOTE 2)

HAUL ROADS

TERTIARY COLLECTION PIPING (SEE NOTE 3)
4-INCH

SECONDARY COLLECTION PIPING (SEE NOTE 3)
6-INCH

NOTES

1. OPEN PIT AND HAUL ROAD LAYOUTS PROVIDED BY BARR ENGINEERING IN OCTOBER 2011.
2. STOCKPILE LAYOUTS PROVIDED BY BARR ENGINEERING IN APRIL 2011 AND MODIFIED BY GOLDER.
3. ACTUAL NUMBER AND LOCATION OF UNDERDRAIN PIPES AND SUMPS WILL NEED TO BE DETERMINED DURING CONSTRUCTION BASED ON ENCOUNTERED FIELD CONDITIONS. SEE DETAIL 5 ON DRAWING 035 FOR UNDERDRAIN.
4. SEE GENERAL NOTES AND LEGEND ON DRAWING 002.

REFERENCES

1. EXISTING GROUND TOPOGRAPHY PROVIDED BY BARR ENGINEERING, AUGUST 2011.
2. COORDINATE SYSTEM REFERENCE IS NAD83 MINNESOTA STATE PLANE NORTH.
3. VERTICAL DATUM REFERENCE IS FEET ABOVE MEAN SEA LEVEL (AMSL).

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SCALE IN FEET

VER NO	DATE	DESCRIPTION
A	12/02/11	ISSUED FOR REVIEW FOR INCLUSION IN ROCK AND OVERBURDEN MANAGEMENT PLAN (ROMP)
B	2/15/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
C	5/29/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
D	1/14/14	ISSUED FOR AGENCY REVIEW
E	4/10/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
F	5/22/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
G	8/21/17	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	G	8/21/17
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SIGNATURE

PRINTED NAME BRENT R. BRONSON

DATE 8/21/17 LICENSE # 46492

DRAWN: MTM

CHECKED:

GOLDER PROJECT NO.: 113-2209

SCALE: AS SHOWN

PLANT DRAWING NUMBER:

CATEGORY 2/3 STOCKPILE
UNDERDRAIN PIPING PLAN
MINE YEAR 1 AND MAXIMUM

POLYMET MINING

POLY MET MINING, INC.
NORTHMET PROJECT
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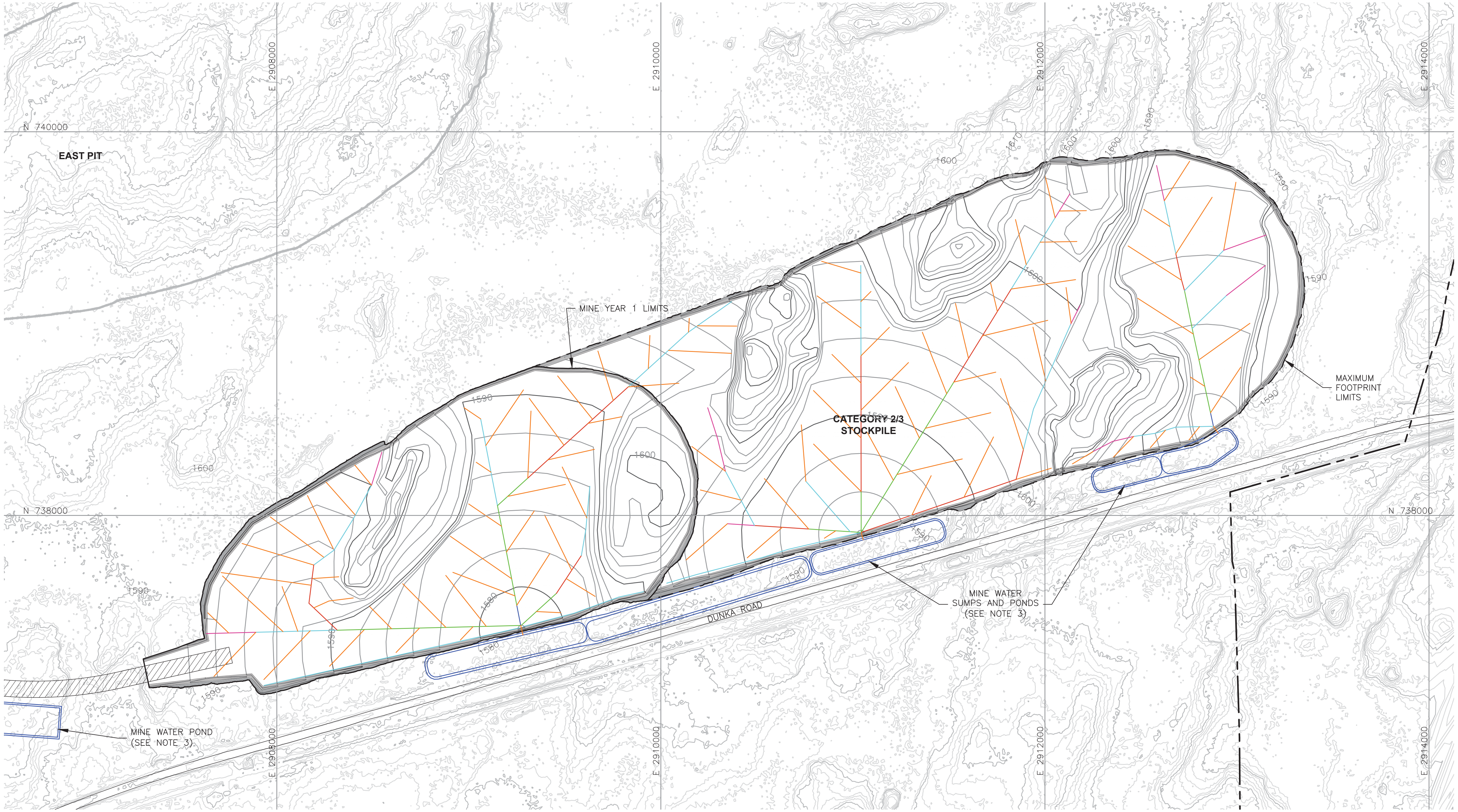

LEGEND

EXISTING GROUND TOPOGRAPHY

PROPOSED GRADING TOPOGRAPHY

MINE SITE BOUNDARY

MINE YEAR 11 PIT BOUNDARIES (SEE NOTE 1)

MINE YEAR 1 ORE, WASTE ROCK STOCKPILE OUTLINES (SEE NOTE 2)

MAXIMUM ORE, WASTE ROCK STOCKPILE OUTLINES (SEE NOTE 2)

HAUL ROADS

MINE WATER SUMP/POND (SEE NOTE 3)

TERTIARY COLLECTION PIPING
- 4-INCH

PRIMARY AND SECONDARY COLLECTION PIPING
- 4-INCH
- 6-INCH
- 8-INCH
- 10-INCH
- 12-INCH

NOTES

1. OPEN PIT AND HAUL ROAD LAYOUTS PROVIDED BY BARR ENGINEERING IN OCTOBER 2011.
2. STOCKPILE LAYOUTS PROVIDED BY BARR ENGINEERING IN APRIL 2011 AND MODIFIED BY GOLDER.
3. SEE MECHANICAL INFRASTRUCTURE PERMIT SUPPORT DRAWINGS.
4. SEE GENERAL NOTES AND LEGEND ON DRAWING 002.

REFERENCES

1. EXISTING GROUND TOPOGRAPHY PROVIDED BY BARR ENGINEERING, AUGUST 2011.
2. COORDINATE SYSTEM REFERENCE IS NAD83 MINNESOTA STATE PLANE NORTH.
3. VERTICAL DATUM REFERENCE IS FEET ABOVE MEAN SEA LEVEL (AMSL).

PLANT DRAWING NUMBER:

CATEGORY 2/3 STOCKPILE
OVERLINER DRAINAGE PIPING PLAN
MINE YEAR 1 AND MAXIMUM

N

0 200 400
SCALE IN FEET

VER NO	DATE	DESCRIPTION
A	12/02/11	ISSUED FOR REVIEW FOR INCLUSION IN ROCK AND OVERBURDEN MANAGEMENT PLAN (ROMP)
B	2/15/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
C	5/29/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
D	1/14/14	ISSUED FOR AGENCY REVIEW
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F	5/22/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
G	8/21/17	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS

ISSUE STATUS

ISSUED	VERSION	DATE
FOR PERMITTING	G	8/21/17
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PRINTED NAME BRENT R. BRONSON
DATE 8/21/17 LICENSE # 46492

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GOLDER PROJECT NO.: 113-2209
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POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

Golder Associates

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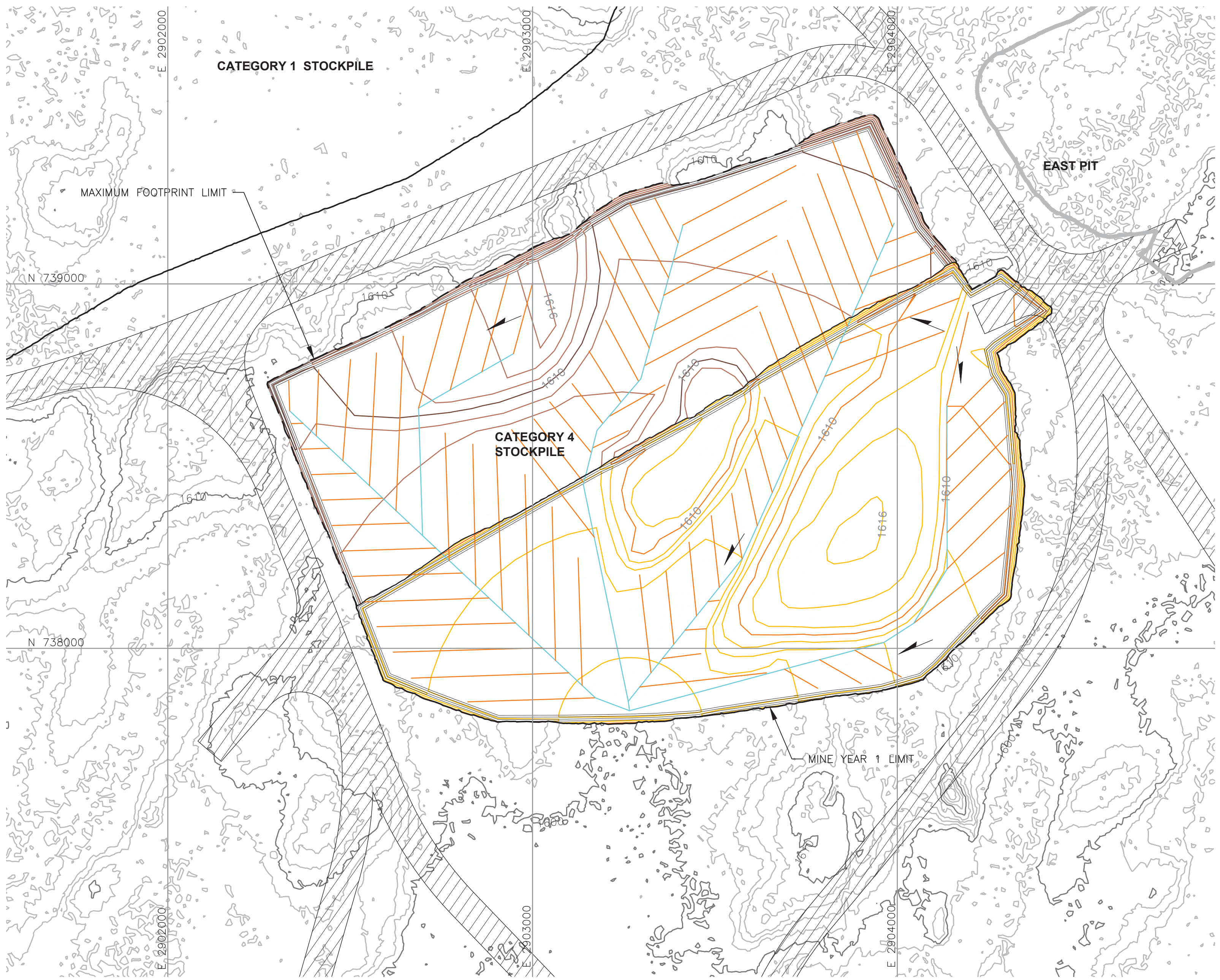

LEGEND

EXISTING GROUND TOPOGRAPHY

PROPOSED MINE YEAR 1 GRADING TOPOGRAPHY

PROPOSED MAXIMUM FOOTPRINT GRADING TOPOGRAPHY

MINE SITE BOUNDARY

MINE YEAR 2 PIT BOUNDARIES (SEE NOTE 1)

SLOPE

MINE YEAR 1 WASTE ROCK STOCKPILE OUTLINES (SEE NOTE 2)

MAXIMUM WASTE ROCK STOCKPILE OUTLINES (SEE NOTE 2)

HAUL ROADS

TERTIARY COLLECTION PIPING (SEE NOTE 3)
4-INCH

SECONDARY COLLECTION PIPING (SEE NOTE 3)
6-INCH

NOTES

1. OPEN PIT AND HAUL ROAD LAYOUTS PROVIDED BY BARR ENGINEERING IN OCTOBER 2011.
2. STOCKPILE LAYOUTS PROVIDED BY BARR ENGINEERING IN APRIL 2011 AND MODIFIED BY GOLDER.
3. ACTUAL NUMBER AND LOCATION OF UNDERDRAIN PIPES AND SUMPS WILL NEED TO BE DETERMINED DURING CONSTRUCTION BASED ON ENCOUNTERED FIELD CONDITIONS. SEE DETAIL 5 ON DRAWING 035 FOR UNDERDRAIN.
4. SEE GENERAL NOTES AND LEGEND ON DRAWING 002.

REFERENCES

1. EXISTING GROUND TOPOGRAPHY PROVIDED BY BARR ENGINEERING, AUGUST 2011.
2. COORDINATE SYSTEM REFERENCE IS NAD83 MINNESOTA STATE PLANE NORTH.
3. VERTICAL DATUM REFERENCE IS FEET ABOVE MEAN SEA LEVEL (AMSL).

PLANT DRAWING NUMBER:

CATEGORY 4 STOCKPILE
UNDERDRAIN PIPING PLAN
MINE YEAR 1 AND MAXIMUM

N

0 200 400
SCALE IN FEET

VER NO	DATE	DESCRIPTION
A	12/02/11	ISSUED FOR REVIEW FOR INCLUSION IN ROCK AND OVERBURDEN MANAGEMENT PLAN (ROMP)
B	2/15/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
C	5/29/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
D	1/14/14	ISSUED FOR AGENCY REVIEW
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F	5/22/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
G	8/21/17	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	G	8/21/17
FOR CONSTRUCTION		
NOT APPROVED FOR CONSTRUCTION.		

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SIGNATURE

PRINTED NAME BRENT R. BRONSON

DATE 8/21/17 LICENSE # 46492

DRAWN: MTM

CHECKED:

GOLDER PROJECT NO.: 113-2209

SCALE: AS SHOWN

POLYMET MINING

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

Golder Associates

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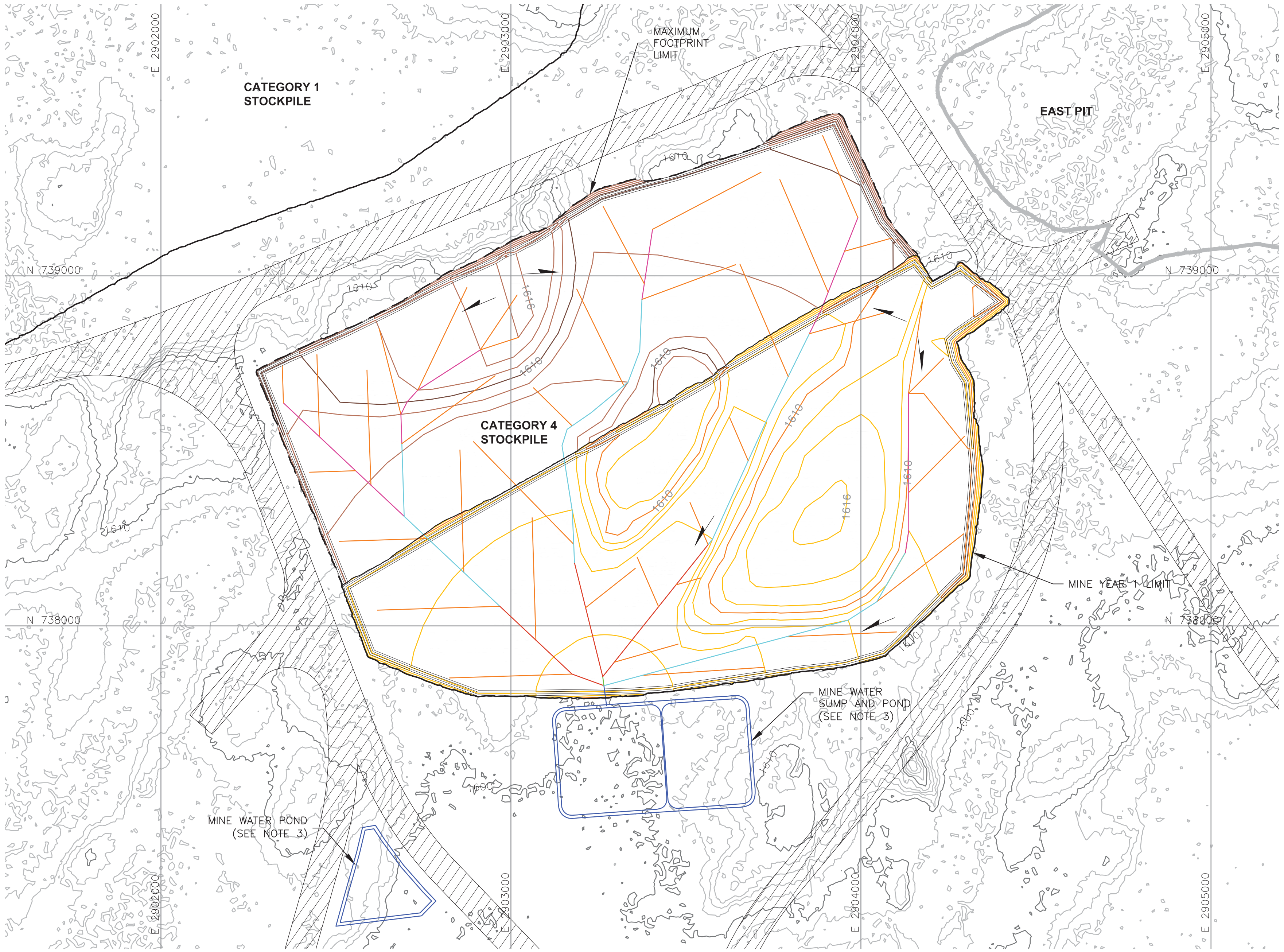
DWG. NO. SKP-022

REV



N

0 200 400
SCALE IN FEET

LEGEND

- EXISTING GROUND TOPOGRAPHY
- PROPOSED MINE YEAR 1 GRADING TOPOGRAPHY
- PROPOSED MAXIMUM FOOTPRINT GRADING TOPOGRAPHY
- MINE SITE BOUNDARY
- MINE YEAR 2 PIT BOUNDARIES (SEE NOTE 1)
- SLOPE
- MINE YEAR 1 WASTE ROCK STOCKPILE OUTLINES (SEE NOTE 2)
- MAXIMUM WASTE ROCK STOCKPILE OUTLINES (SEE NOTE 2)
- HAUL ROADS
- MINE WATER SUMP/POND (SEE NOTE 3)

MINE YEAR 1 – TERTIARY COLLECTION PIPING
- 4–INCH

MINE YEAR 1 – PRIMARY AND SECONDARY COLLECTION PIPING
- 4–INCH
- 6–INCH
- 8–INCH
- 10–INCH
- 12–INCH

NOTES

1. OPEN PIT AND HAUL ROAD LAYOUTS PROVIDED BY BARR ENGINEERING IN OCTOBER 2011.
2. STOCKPILE LAYOUTS PROVIDED BY BARR ENGINEERING IN APRIL 2011 AND MODIFIED BY GOLDER.
3. SEE MECHANICAL INFRASTRUCTURE PERMIT SUPPORT DRAWINGS.
4. SEE GENERAL NOTES AND LEGEND ON DRAWING 002.

REFERENCES

1. EXISTING GROUND TOPOGRAPHY PROVIDED BY BARR ENGINEERING, AUGUST 2011.
2. COORDINATE SYSTEM REFERENCE IS NAD83 MINNESOTA STATE PLANE NORTH.
3. VERTICAL DATUM REFERENCE IS FEET ABOVE MEAN SEA LEVEL (AMSL).

PLANT DRAWING NUMBER:

CATEGORY 4 STOCKPILE
OVERLINER DRAINAGE PIPING PLAN
MINE YEAR 1 AND MAXIMUM

VER NO	DATE	DESCRIPTION
A	12/02/11	ISSUED FOR REVIEW FOR INCLUSION IN ROCK AND OVERBURDEN MANAGEMENT PLAN (ROMP)
B	2/15/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
C	5/29/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
D	1/14/14	ISSUED FOR AGENCY REVIEW
E	4/10/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
F	5/22/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
G	8/21/17	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	G	8/21/17
FOR CONSTRUCTION		
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SIGNATURE B. Bronson
PRINTED NAME BRENT R. BRONSON
DATE 8/21/17 LICENSE # 46492

DRAWN: MTM
CHECKED: GG
GOLDER PROJECT NO.: 113-2209
SCALE: AS SHOWN

POLYMET MINING

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

Golder Associates

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DWG. NO. SKP–023
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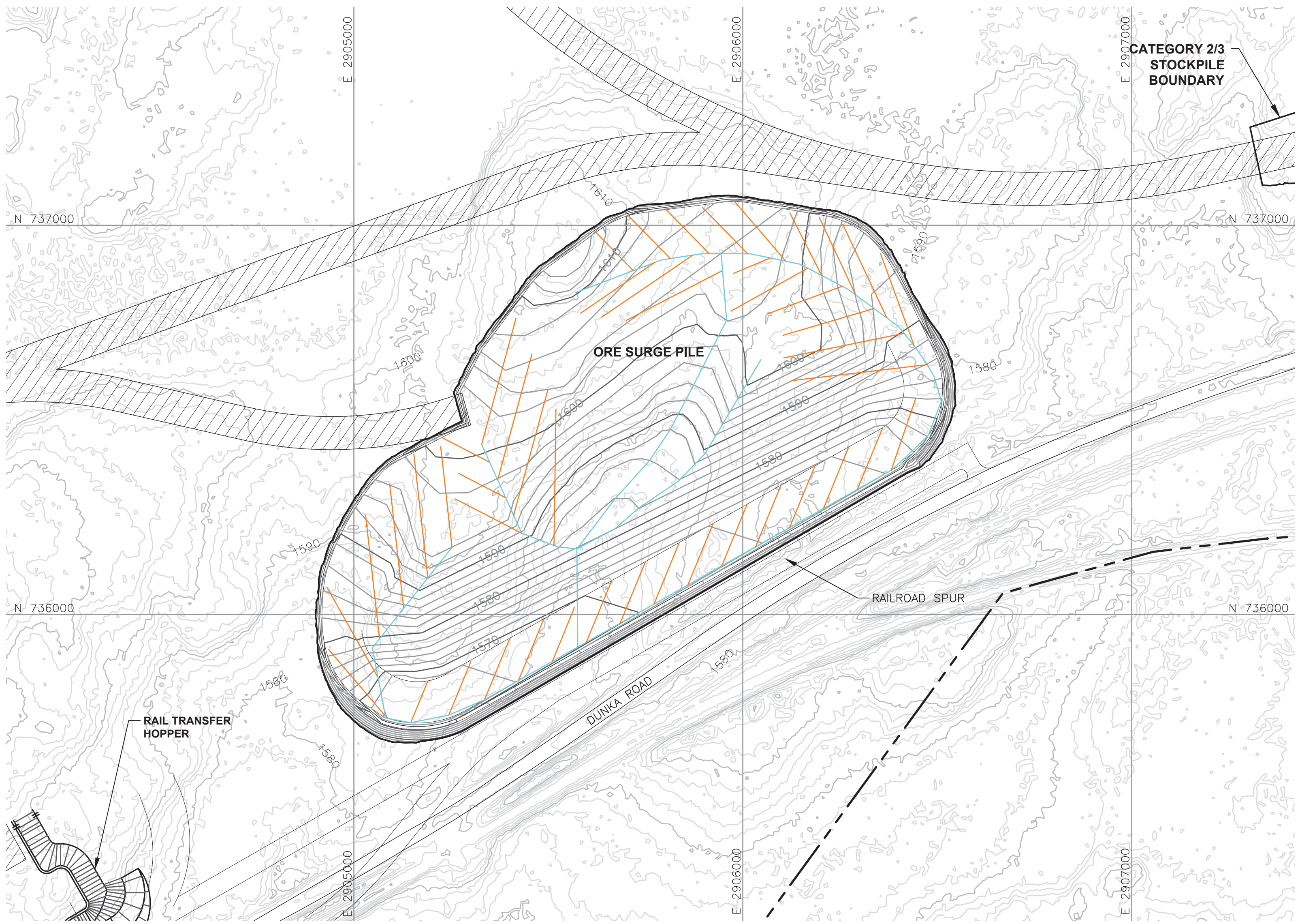

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LEGEND

EXISTING GROUND TOPOGRAPHY

PROPOSED GRADING TOPOGRAPHY

MINE SITE BOUNDARY

MINE YEAR 1 ORE, WASTE ROCK STOCKPILE OUTLINES (SEE NOTE 2)

HAUL ROADS

TERTIARY COLLECTION PIPING (SEE NOTE 3)
4-INCH

SECONDARY COLLECTION PIPING (SEE NOTE 3)
6-INCH

NOTES

1. OPEN PIT AND HAUL ROAD LAYOUTS PROVIDED BY BARR ENGINEERING IN OCTOBER 2011.
2. STOCKPILE LAYOUTS PROVIDED BY BARR ENGINEERING IN APRIL 2011 AND MODIFIED BY GOLDER.
3. ACTUAL NUMBER AND LOCATION OF UNDERDRAIN PIPES AND SUMPS WILL NEED TO BE DETERMINED DURING CONSTRUCTION BASED ON ENCOUNTERED FIELD CONDITIONS. SEE DETAIL 5 ON DRAWING 035 FOR UNDERDRAIN.
2. SEE GENERAL NOTES AND LEGEND ON DRAWING 002.

REFERENCES

1. EXISTING GROUND TOPOGRAPHY PROVIDED BY BARR ENGINEERING, AUGUST 2011.
2. COORDINATE SYSTEM REFERENCE IS NAD83 MINNESOTA STATE PLANE NORTH.
3. VERTICAL DATUM REFERENCE IS FEET ABOVE MEAN SEA LEVEL (AMSL).

PLANT DRAWING NUMBER:

ORE SURGE PILE
UNDERDRAIN PIPING PLAN

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F	5/22/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
G	8/21/17	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS

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DWG. NO. SKP-028

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INCHES 1 2

LEGEND

EXISTING GROUND TOPOGRAPHY

PROPOSED GRADING TOPOGRAPHY

MINE SITE BOUNDARY

MINE YEAR 1 ORE, WASTE ROCK STOCKPILE OUTLINES (SEE NOTE 2)

HAUL ROADS

MINE WATER SUMP/POND (SEE NOTE 3)

MINE YEAR 1 – TERTIARY COLLECTION PIPING

4–INCH

MINE YEAR 1 – PRIMARY AND SECONDARY COLLECTION PIPING

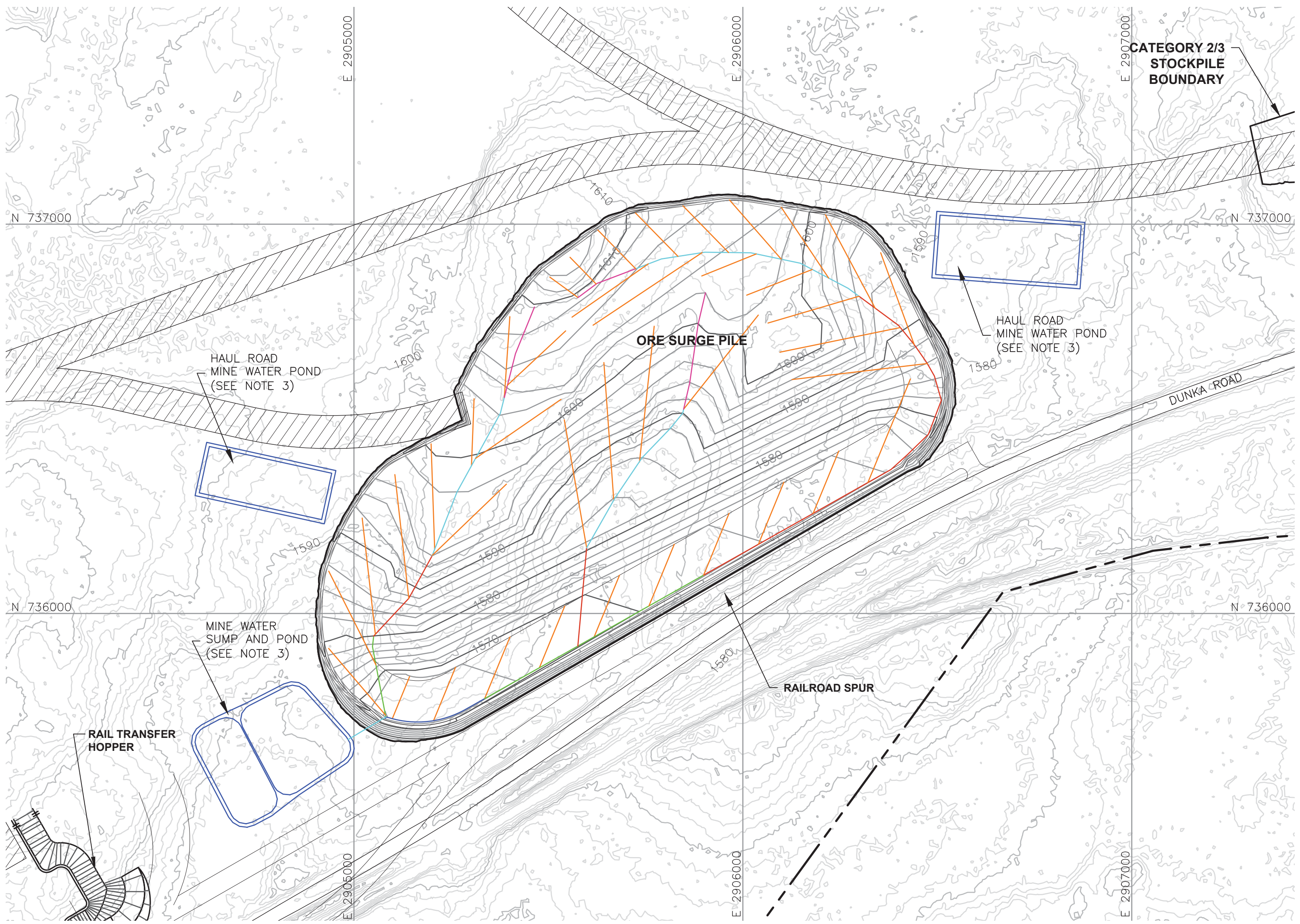
4–INCH

6–INCH

8–INCH

10–INCH

12–INCH



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NOTES

1. OPEN PIT AND HAUL ROAD LAYOUTS PROVIDED BY BARR ENGINEERING IN OCTOBER 2011.
2. STOCKPILE LAYOUTS PROVIDED BY BARR ENGINEERING IN APRIL 2011 AND MODIFIED BY GOLDER.
3. SEE MECHANICAL INFRASTRUCTURE PERMIT SUPPORT DRAWINGS.
4. SEE GENERAL NOTES AND LEGEND ON DRAWING 002.

REFERENCES

1. EXISTING GROUND TOPOGRAPHY PROVIDED BY BARR ENGINEERING, AUGUST 2011.
2. COORDINATE SYSTEM REFERENCE IS NAD83 MINNESOTA STATE PLANE NORTH.
3. VERTICAL DATUM REFERENCE IS FEET ABOVE MEAN SEA LEVEL (AMSL).

PLANT DRAWING NUMBER:

ORE SURGE PILE
OVERLINER DRAINAGE PIPING PLAN

VER NO	DATE	DESCRIPTION
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INCHES 1 2

Errata Sheet

Poly Met Mining, Inc. NorthMet Project

Permit Application Support Drawings: Mine Site Stormwater

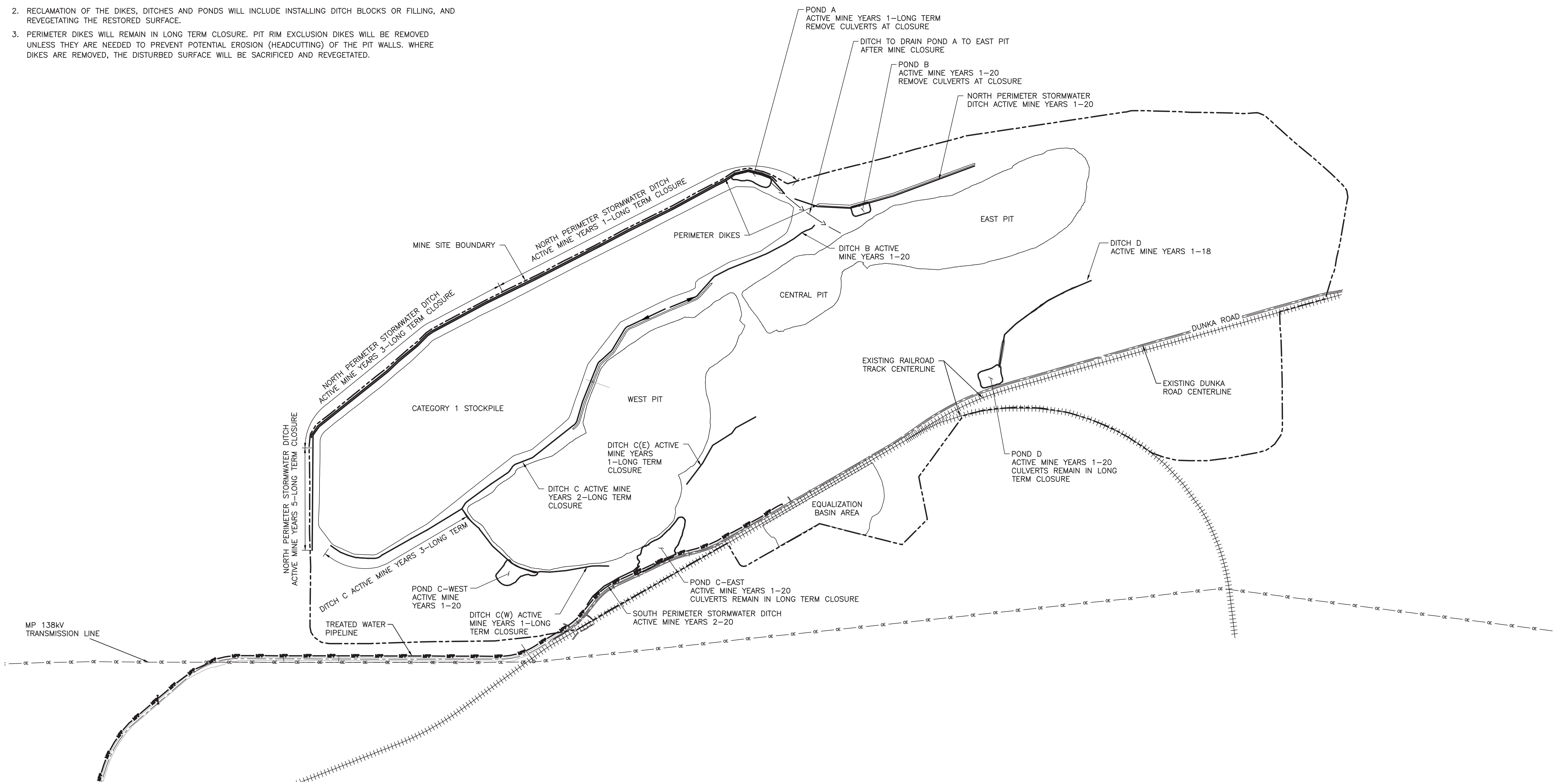
August 2017 (version 3)

Engineering design is currently in progress. The table below lists changes that have been identified to-date and have not yet been incorporated in the attached permit application support drawings within this set. Final design will incorporate these changes along with additional site-specific information (e.g., supplementary geotechnical data); therefore, additional adjustments may be made during final design that will be incorporated into the final design drawing set.

Drawing Sheet(s)	Change
Global change to all sheets, as needed	The terminology "mine drainage" as noted in these drawings will be changed to "mine water".
SW-003, SW-004, SW-005, SW-006, SW-031	Temporary sedimentation basins or stormwater infiltration basins may be added to meet construction stormwater requirements. These construction stormwater features require additional site-specific data and will be evaluated in final design.
SW-002, SW-003, SW-004, SW-005, SW-006, SW-008, SW-009, SW-010, SW-013, SW-014, SW-015, SW-016, SW-017, SW-018, SW-019, SW-021, SW-031	The "Mine Site Boundary" will be replaced by the "Mining Area Boundary" as shown on figures included in the Permit to Mine Application.

NOTES:

1. ALL FEATURES SHOWN WILL REMAIN IN LONG-TERM CLOSURE UNLESS OTHERWISE NOTED.
2. RECLAMATION OF THE DIKES, DITCHES AND PONDS WILL INCLUDE INSTALLING DITCH BLOCKS OR FILLING, AND REVEGETATING THE RESTORED SURFACE.
3. PERIMETER DIKES WILL REMAIN IN LONG TERM CLOSURE. PIT RIM EXCLUSION DIKES WILL BE REMOVED UNLESS THEY ARE NEEDED TO PREVENT POTENTIAL EROSION (HEADCUTTING) OF THE PIT WALLS. WHERE DIKES ARE REMOVED, THE DISTURBED SURFACE WILL BE SACRIFICED AND REVEGETATED.



1 PLAN: STORMWATER DIKES, DITCHES, AND PONDS RECLAMATION PLAN

0 1000 2000
SCALE IN FEET

VER NO	DATE	DESCRIPTION
1	5/26/15	ISSUED FOR INCLUSION IN PERMIT APPLICATION
2	6/7/2017	PERMIT APPLICATION UPDATES

ISSUE STATUS		
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FOR PERMITTING	2	6/7/2017
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SIGNATURE
DATE 5/26/17 LICENSE# 20533

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CHECKED: ATS
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

MINE SITE STORMWATER
DIKES, DITCHES, AND PONDS
RECLAMATION PLAN

POLYMET MINING
POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR
BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. SW-031
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CADD USER: Kate K. Brown FILE: K:\DESIGN\23690C29.10\PERMIT_NMM-05-SW-031.DWG PLOT SCALE: 1:2 PLOT DATE: 6/9/2017 7:28 AM

INCHES 1 2

Appendix 15.5

O&M for Water Treatment During Reclamation and Postclosure Maintenance After Mine Year 1 – 10 mg/L WWTS Sulfate Target Memo

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engineering and environmental consultants

BARR

Technical Memorandum

To: Jennifer Saran
From: Jeff Ubl, Alison Ling, Bryan Oakley, and Don Richard
Subject: NorthMet Project – O&M for water treatment during reclamation and postclosure maintenance after Mine Year 1 – 10 mg/L WWTS Sulfate Target
Date: December 8, 2017
Project: 23690862.04
c: Jim Scott, Tina Pint

1.0 Overview

This memo outlines the process used to develop an estimate of the operating costs for water treatment associated with the NorthMet Project (Project) that can be used to support the calculation of projected reclamation costs for closure at the end of Mine Year 1. In the event of closure at the end of Mine Year 1, the Waste Water Treatment System (WWTS) – consisting of equalization basins, the tailings basin seepage treatment train, the mine water treatment trains (comprised of the mine water filtration train and mine water chemical precipitation train), as well as all pumps and pipes to and from these components - will continue to operate so that that any water discharged from the Project to the environment meets applicable standards. For the purpose of this cost estimate, the controlling parameter for establishing equipment needs and operating costs is the proposed target of 10 mg/L for sulfate in water discharged from the Project.

Table 1 provides a high-level summary of operating, equipment modification, and equipment replacement costs for the WWTS in the event that mining operations cease after Mine Year 1. The detailed estimated operating costs for Mine Years[1] 2, 4, 7, and 15 for the WWTS are provided in Appendix A. Appendix B provides the basis for water treatment equipment replacement costs and the value of equipment in service. Documentation to support the unit quantities and unit costs used in the cost estimate are included in Appendix C and Appendix D. The following paragraphs document the water management and water treatment strategies upon which the operating costs are based.

[1] The term "Mine Years" are the years after blasting commences to access ore. For example the start of Mine Year 1 is when blasting commences to access ore.

Table 1 Water Treatment Costs for Closure at the End of Mine Year 1 – Tailings Basin Seepage

Mine Year of Closure Period	Activity	Tailings Basin Seepage Treatment Train						
		OPEX ($/1000 gal.)	P50 Annual Average Flow (gpm)	OPEX ($)		Equipment Replacement (S)		Equipment Additions for Long-Term Configuration CAPEX ($)
				Annual	Total for Period	Annual*	Total for Period	
2	Hold Year	$2.77	2,000	$2,910,240	$2,910,240	$0	$0	$0
3-4	Treat FTB seepage capture system water and discharge	$2.77	2,000	$2,910,240	$5,820,479	$1,804,316	$3,608,633	$0
4	Expand tailings basin seepage treatment train filtration and stabilization equipment							$11,783,623
5-6	Treat FTB seepage capture system water and discharges	$3.71	2,973	$5,804,160	$11,608,320	$1,804,316	$3,608,633	$0
7-10	Treat FTB seepage capture system water and discharges	$4.23	2,941	$6,543,329	$26,173,316	$1,804,316	$7,217,266	$0
11-101	Treat FTB seepage capture system water and Mine Site water and discharges	$3.99	2,534	$5,315,501	$483,710,551	$1,804,316	$164,192,799	$0
				subtotals	**$530,222,906**	**NA**	**$178,627,331**	**$11,783,623**

Notes:
Staffing not included – to be included with overall staff
Process Monitoring not included – to be included with overall water quality monitoring
(1) Annual Equipment Replacement based on long-term configuration, because other equipment will be phased out within its useful life.

Table 2 Water Treatment Costs for Closure at the End of Mine Year 1 – Mine Water

Mine Year of Closure Period	Activity	Mine water treatment trains						
		OPEX ($/1000 gal.)(1)	P50 Annual Average Flow (gpm)(1)	OPEX ($)(1)		Equipment Replacement (S)		Equipment Additions for Long-Term Configuration CAPEX ($)
				Annual	Total for Period	Annual(2)	Total for Period	
2	Hold Year	$13.15	355	$2,452,740	$2,452,740	$0	$0	$0
3-4	Treat mine water and discharge to East Pit while East Pit backfilled	$13.15	355	$2,452,740	$4,905,479	$969,079	$1,938,158	$0
5-7	Treat mine water to remove flushing load from East Pit	$2.66	886	$1,237,709	$3,713,126	$969,079	$2,907,238	$0
8-10	No flow for treatment (Category 1 Stockpile Groundwater Containment System to pit and pit not overflowing) - mine water filtration train decommissioned	$0.00	0	$0	$0	$969,079	$2,907,238	$0
11-101	Mine Site water conveyed to WWTS via Central Pumping Station and Mine to Plant Pipelines - OPEX for conveyance included in tailings basin seepage treatment train OPEX, mine water chemical precipitation train still operates to treat membrane concentrate	$0.00	0	$0	$0	$969,079	$88,186,207	$0
				subtotals	**$11,071,345**	**NA**	**$95,938,841**	**$0**

Notes:
Staffing not included – to be included with overall staff
Process Monitoring not included – to be included with overall water quality monitoring
(1) Flows and costs for treating VSEP concentrate from tailings basin seepage treatment train are included in this table for Mine Years 2-4, but not for Mine Years 5-7, when these costs are included in tailings basin seepage treatment costs.
(2) Annual Equipment Replacement based on long-term configuration, because other equipment will be phased out within its useful life.

2.0 Water Management Strategy for Closure after Mine Year 1

The overall water management strategy for the Project is modeled using GoldSim. Two linked models are used to describe the water quality and quantity at all locations throughout the Project. These models were developed for the Final Environmental Impact Statement (FEIS). To develop the cost estimates for water treatment after Mine Year 1 closure, the FEIS models described below were used with modifications to represent changes to operations during two phases: reclamation (Mine Years 2 - 10) and closure (starting in Mine Year 11).

After Mine Year 1 closure, it is assumed that Mine Year 2 will be a "hold year'. During the "hold year" the WWTS will continue to operate and contractual arrangements will be made to begin reclamation for the rest of the Project. Therefore, except for operation of the WWTS, reclamation for the remainder of the Project will start at the beginning of Mine Year 3.

2.1 Mine Site

The Mine Site conditions that effect water management in the event that operations cease after Mine Year 1 include:

- The West Pit has not been developed—only the East Pit will exist at the end of Mine Year 1.
- The Category 1 Stockpile Groundwater Containment System will be approximately 50% complete and will need to be completed during the second year after the end of operations (complete by end of Mine Year 3).
- The Category 1 Waste Rock Stockpile geomembrane cover will be completed in the first 4 years of closure (complete by end of Mine Year 5).
- The Ore Surge Pile (OSP) and the Category 4 rock will be backfilled into the East Pit using the same tons per year rate as Mine Year 20 closure. Backfilling will be completed by end of Mine Year 3.
- Category 2/3 rock will be backfilled into the East Pit using the same tons per year rate as Mine Year 20 closure. Backfilling will be completed by end of Mine Year 4.

The following conditions were used to model reclamation and closure after Mine Year 1 in the GoldSim model.

- Mine Site features are consistent with the proposed plan of operations at the end of Mine Year 1.
- Flows to the mine water treatment trains will include the Category 1 Stockpile Groundwater Containment System and the East Pit.
- Mine water treatment trains capacity at the end of Mine Year 1 is 1,440 gpm through the filtration train and 810 gpm through the chemical precipitation train.

- The mine water treatment trains will be used in Reclamation (Mine Years 2-7).
- The East Pit will be backfilled in Mine Years 3 and 4 and flushing will occur in Mine Years 5 - 7.
- Off-site disposal of sludge.
- The mine water filtration train will not be used in Closure (starting in Mine Year 8). Mine Site water will be pumped to tailings basin seepage treatment train for treatment when the East Pit begins to overflow (approximately Mine Year 11).
- Low Concentration Equalization Basins will be decommissioned and reclaimed before Mine Year 15

2.2 Plant Site

If operations cease after Mine Year 1, the following actions will occur at the Plant Site:

- The Beneficiation Plant will stop running at the end of Mine Year 1.
- The Hydrometallurgical Facility does not exist and will not be constructed.
- No Construction Mine Water will be conveyed from the Mine Site to the Flotation Tailings Basin (FTB) Pond after Mine Year 1 and Construction Mine Water pumping equipment will be moved from the Mine Site to the Plant site to pump Treated Mine Water to the East Pit during Mine Years 2 - 10.
- Two separate ponds will exist at the FTB.
  - Only Cell 2E will be developed (north dam, north buttress, north beach).
    - The Flotation Tailings north beach will be completed at the end of Mine Year 1 and will be amended with bentonite by the end of Mine Year 2.
    - The pond bottom in Cell 2E will be amended with bentonite after the end of operations (by end of Mine Year 3). The amendment will be completed 2 years after the end of operations (in sync with the upsizing of the tailings basin seepage treatment train described below).
  - No improvements will be completed at Cell 1E (other dams, beaches, and the south buttress).
    - The pond bottom in Cell 1E will not be amended with bentonite and will continue to seep at a relatively high rate.
  - The drainage swale to the east of the FTB exists because it is constructed at the beginning of operations.

Based on the above plan of operations, the GoldSim water model for the Plant Site was modified to model closure at the end of Mine Year 1 as follows:

- Input tables were adjusted to account for the early end of operations, such as the seepage directions through the Flotation Tailings Basin (FTB) and depths to water table as noted above.
- The tailings basin seepage treatment train will be upsized to 3,000 gpm. This will be completed during the second year of Reclamation (Mine Year 3) and will be available for treatment at the beginning of Mine Year 4.
- During Reclamation and Closure, the pond in Cell 2E will be maintained at a target level by adding WWTS discharge as needed, and the pond level in Cell 1E will be allowed to fluctuate on its own within safe limits. If the upper safe limit is reached, excess water will flow to the Cell 2E pond. If the lower safe limit is reached, needed water will be provided from the Cell 2E pond.
- The tailings basin seepage treatment train will continue operating during both Reclamation and Closure.
- The mine water chemical precipitation train will continue to be used to treat concentrate generated from the tailings basin seepage treatment train.
- Mine water will be pumped to tailings basin seepage treatment train for treatment during Closure (starting in Mine Year 11). Treatment of mine water at the tailings basin seepage treatment train will begin when flooding of the East Pit has been completed and the Pit begins to overflow (Mine Year 11).
- Off-site disposal of sludge.

3.0 Water Treatment Strategy for Closure after Mine Year 1

Waste water treatment is an integrated strategy that includes both the Mine Site and the Plant Site during the operating phase of the Project. If operations cease after Mine Year 1, this integrated process will be maintained throughout Reclamation. Beginning in Mine Year 8, a portion of secondary membrane equipment from the mine water filtration train will be repurposed for use in the tailings basin seepage treatment train. The mine water chemical precipitation train will be used for treatment of tailings basin seepage treatment train VSEP concentrate. Then, during Closure (after Mine Year 10), the mine water filtration train will no longer be used and all mine water will be treated by the tailings basin seepage treatment train and repurposed mine water chemical precipitation train. During Closure the WWTS will include:

- Media filtration
- Primary and secondary membrane separation
- Chemical precipitation

- Water conditioning (tailings basin seepage treatment train only, to prevent toxicity prior to discharge)

When operating as an integrated system (through Mine Year 3), chemical precipitation will be performed at the mine water treatment trains and water conditioning will be performed at the tailings basin seepage treatment train.

Treated water from the mine water treatment trains will be returned to the East Pit during Mine Years 2 through 7. The tailings basin seepage treatment train will discharge to the environment.

3.1 Influent Flow and Loads

Because the GoldSim models provide a probabilistic output for the water management system, the basis for design of the water treatment systems begins with the selection of the appropriate range of outputs. Two separate values have been used for:

- The design of the equipment for use in and the development of capital costs
- Estimation of operation and maintenance costs

The operating capacity of all of the water treatment process units for Mine Year 1 of the operations phase of the Project were designed using at least the 90th percentile (P90) projected flows and influent constituent concentrations or greater to meet the operating constraints of the Project. The equipment designed for operations will continue to be used if operations cease after Mine Year 1, and will be supplemented with additional and repurposed equipment at the WWTS as noted in Section 2.2 based on the P50 annual average flow and influent constituent concentrations.

For the estimation of power consumption, chemical usage, sludge generation, and related operating expenses for the projected reclamation cost estimate scenario described above, the P50 of the annual average flow and influent constituent concentrations were used.

3.2 Treatment Modeling Approach

The cost to operate the WWTS has been modeled at multiple points throughout the reclamation and closure phases using an equilibrium-chemistry based treatment model.

Modeling at multiple time points was needed to characterize the different operating scenarios described above as well as the variable flows to the treatment systems and the variable load of dissolved constituents. A modeling approach was also needed because the costs for treatment are not linear in proportion to the flow. The load varies independent of flow, which results in costs for chemical usage, sludge management, and disposal that are also independent of the flow rate. Power costs are also independent of the influent flow rate because a primary power user within the treatment systems is the operation and cleaning of the secondary membrane separation unit, which is dependent on both the flow rates and the influent load.

4.0 Reclamation Water Treatment Process Descriptions and Timelines

If operations cease after Mine Year 1, all non-waste water treatment related reclamation will start at the beginning of Mine Year 3. The water treatment system used during the first three years of Reclamation will be the same as the system used during operations. Figure 1 shows the combined process flow diagram for the WWTS during the first three years of Reclamation.

During the first three years of Reclamation (Mine Years 2 and 4), the WWTS will operate as an integrated system with media filtration, primary and secondary membrane units, and chemical precipitation.

Also during the first three years of Reclamation, additional membrane capacity will be added to the tailings basin seepage treatment train. The existing chemical precipitation from the mine water chemical precipitation train will continue to be used to treat concentrate. Then, starting in Mine Year 5 and continuing through Mine Year 7, the water treatment system will continue to operate as an integrated system, as shown on Figure 2 but treated Mine Water will be conveyed to the East Pit. Figure 3 shows the water treatment system for Mine Years 8-10 when there is not Mine Water treatment needed. Figure 4 provides the water treatment system for Mine Years 11 and later.

The only discharge to the environment during Reclamation will be from the tailings basin seepage treatment train after the water has been conditioned. Water treated at the mine water treatment trains will be returned to the East Pit. Additional details on the operation of the water treatment system during Reclamation are provided below.

4.1 Mine Water Treatment Trains Use during Reclamation

The mine water treatment trains will be used during Reclamation (Mine Years 2 - 7) to treat the load of dissolved constituents flushed into the water from backfilled rocks when the East Pit is flooded at the Mine Site and to treat water from the Category 1 Stockpile Groundwater Containment System. The time required to remove the load of dissolved constituents (flush) from the East Pit was also developed using the GoldSim model assuming Reclamation will start at the beginning of Mine Year 2.

However, because it assumed that Mine Year 2 will be a holding year, an extra year of East Pit flushing was added (3 years of flushing total) to treat the additional load of dissolved constituents that could occur due to reclamation of the waste rock stockpiles not starting until Mine Year 3. This time was set at approximately 5 years based on removing the P50 load flushed from the backfilled rock. Thus, for the last three years of Reclamation (from Mine Year 8 - Mine Year 10) the mine water filtration train will be idle and water from the Category 1 Stockpile Groundwater Containment System will flow by gravity to the East Pit.

The projected flow to the mine water treatment trains during Reclamation will be significantly lower than their required design capacity for the first year of operations. Thus, no additional capital costs are needed to upgrade or modify the mine water treatment trains for the reclamation phase, and some equipment can be taken out of service to reduce maintenance costs. Additionally, a portion of the secondary membrane equipment from the mine water filtration train will be repurposed for use as part of the tailings basin seepage treatment train.

From Mine Year 5 - Mine Year 7, a single, combined influent flow consisting of water from the East Pit and Category 1 Stockpile Groundwater Containment System will report to the mine water treatment trains. This flow will have higher concentrations than those expected in the Low Concentration Equalization Basin during operations, but lower than the concentrations expected for the High Concentration Equalization Basin. In Reclamation, all of the mine water treatment trains influent flow will initially report to the mine water filtration train. Unlike the operations phase, no mine water will report directly to the mine water chemical precipitation train during Reclamation. Because the concentrations entering the membrane separation units will be higher during Reclamation than during operations, the recovery through the primary separation units is expected to decrease, which results in a greater percentage of the flow into the secondary membrane separation units.

During Reclamation, the primary membrane permeate will be directed to the East Pit. Secondary membrane permeate will also be directed to the East Pit. Chemical precipitation effluent is expected to have concentrations greater than the influent from the East Pit, so rather than return this water to the East Pit it will be directed to the secondary membrane units, in a closed loop.

4.2 Tailings Basin Seepage Treatment Train Use during Reclamation

Reclamation will include treating the water seeping from the toe of the FTB until the flows stabilize and concentrations meet discharge limits. In addition, water from the FTB Pond will be treated until it can be discharged as stormwater during Closure. To treat these flows, the capacity of the tailings basin seepage treatment train will need to be increased from 2,000 gpm to 3,000 gpm in the first three years of Reclamation. The tailings basin seepage treatment train will be operated at its design capacity of 2,000 gpm for the first three years of Reclamation and then operated at the increased design capacity of approximately 3,000 gpm for the remainder of the reclamation phase.

During the end of the reclamation phase, the influent flow and concentrations are expected to trend downward toward the values used for Closure (Section 5.0).

For the first three years of Reclamation, the tailings basin seepage treatment train operations will include primary membrane separation, secondary membrane separation, and effluent conditioning. The primary effluent will be conditioned and discharged to the environment, while the concentrate will be treated by the mine water chemical precipitation train.

5.0 Closure Water Treatment Process Descriptions and Timelines

During Closure, all water from the Mine Site will continue to be conveyed to the WWTS for treatment prior to discharge to the environment. When the water elevation in the East Pit no longer allows the water from the Category 1 Stockpile Groundwater Containment System to flow by gravity to the East Pit, that water will be pumped to the East Pit. When the East Pit water reaches its designed long-term elevation it will be pumped to the Central Pumping Station and then to the WWTS via the Mine to Plant Pipelines to prevent pit overflow. The mine water chemical precipitation train will continue to be used at the WWTS but the other portions of the mine water treatment trains will be decommissioned and taken out of service, with some equipment and parts stored for future use/replacement within the WWTS.

Water treatment during Closure at the Plant Site will consist of mechanical treatment, using primarily the same tailings basin seepage treatment train systems employed during the final years of Reclamation. The capacity of the tailings basin seepage treatment train from Reclamation will be sufficient to treat the modeled flows for Closure.

6.0 Operating Costs

Detailed estimates for the operating costs are provided in Appendix A. The costs for operation include the following items:

- Maintenance costs for routine replacement of membranes.
- Miscellaneous operations costs.
- Energy costs for the major water treatment operations, as well as an overall cost for heating, lighting, and other operations. Electrical costs for the unit operations are based on operating flow rates estimated from modeling and vendor data provided in response to a preliminary request for information from potential equipment vendors, which is similar to the currently planned equipment, although some modifications have been made to the operations and others are expected during the continuing design process. Energy costs are calculated on a separate worksheet for each modeled WWT train.

Costs for chemicals consumed are estimated individually for each of the major unit operations and are also based on the results of water treatment modeling and vendor data included with preliminary equipment proposals. This information is included in Appendix D. The cost for disposal of solids generated during the treatment process is based on information from local licensed disposal facilities. This information is included in Appendix D.

The following items are excluded from the cost estimates:

- Periodic replacement of all capital equipment over an extended period of time. The estimated cost of the equipment in service is provided, so that a reasonable percentage of this cost could be applied on an annual basis to account for replacement of capital items.
- Labor costs for management and operation of the WWT system are not included with the treatment costs because they are included in other portions of the projected reclamation costs, per instructions from PolyMet Mining, Inc. (PolyMet).

6.1 Cost Uncertainties

Uncertainties are built into the cost estimating process due the nature of the information used to develop the tailings basin seepage treatment train and mine water treatment trains model. In particular, the influent information for the WWT modeling is derived from the GoldSim modeling of the water management strategy for the Project in the FEIS. The FEIS GoldSim modeling was developed to provide a probabilistic range of potential outcomes to evaluate the full spectrum of potential environmental effects. The use of this information as influent to the WWT system first requires an initial conversion of the probabilistic output into a deterministic input for the WWT system. Then, the resulting deterministic input values need to be adjusted to allow chemical balance modeling in support of chemical usage and sludge generation calculations. The uncertainties attributed to these two steps in the cost estimating process are described in the following paragraphs.

6.1.1 Development of Deterministic Input values

As noted previously, the P50 water quality and quantity values were selected from the FEIS models for use as the influent to the mine water treatment trains and the tailings basin seepage treatment train for MY1 Closure. Selecting the median value provides an overall estimate of the likely flows and loads to the mine water treatment trains and the tailings basin seepage treatment train, but does not necessarily account for the variability in the operation of the systems over the course of hours, days, or weeks due to the inherent variability of the influent flows. The design strategy of the WWTS accounts for this variability, as it is based on the P90 water quality and quantity values for the initial MY1 buildouts.

6.1.2 Charge Balancing of Deterministic WWT Inputs

Selecting the median expected value for each water quality parameter from the FEIS model as the input to the waste water treatment model results in an initial water quality that does not contain equal amounts of cations and anions. Thus, the charge balance of the WWTS influent water quality needs to be adjusted prior to use in the process model. To complete this charge balance, alkalinity was added when additional anions were needed and calcium was added when additional cations were needed. These constituents were chosen based on their limited effect on treatment processes. Both alkalinity and calcium affect the chemical requirements and sludge production in the chemical precipitation train at the WWTS. The costs of influent charge balancing are included in the O&M costs shown on Table 1 represents approximately 1 to 10% of the total O&M cost.

7.0 Equipment Replacement Costs

The cost estimates for equipment replacement for the WWTS are provided in Appendix B.

The approach used was to use the detailed capital cost estimate developed by PolyMet in 2014 for the Mine Year 1 buildouts for the WWTS at that time and update them for inflation to 2016 dollars. The 2016 estimate was then grouped into categories and a service life assigned to each category.

The capital cost for each category was divided by the service life to calculate the annual equipment replacement cost for each category. The total annualized equipment replacement cost was divided by the total capital cost to calculate the overall equipment replacement percentages for the WWTS.

The overall equipment replacement percentages were then multiplied by the estimated cost of the equipment in service for Mine Year 15 to calculate annualized equipment replacement costs. See Appendix B for more details on development of equipment replacement costs.

8.0 Cost Assumptions

The cost estimates provided in this memorandum are made on the basis of Barr's experience and represent our best judgment as experienced and qualified professionals familiar with the Project. The estimated costs are based on modeling information available to Barr and are subject to change as site-specific information is considered. In addition, because Barr has no control over the cost of labor, materials, equipment, or services furnished by others, or over contractors' methods of determining prices, or over competitive bidding or market conditions, Barr cannot and does not guarantee that the actual costs will not vary from the referenced estimates, proposals, or bids used for the preparation of this estimate.

9.0 Water Management Strategy for Closure After Selected Mine Years

PolyMet will update its reclamation costs for water treatment annually based on Project features, as well as other regulatory and technological changes that may occur. Table 3 provides a summary of estimated P50 annual average flows and associated estimated durations for Mine Water Treatment Trains pit flushing, pit flooding and for Tailings Basin Seepage Treatment train closure and postclosure maintenance if closure were to occur after Mine Years 1, 3, 11, or 20.

Table 3 Water Treatment Changes Over Time – Flows to Treatment Trains

Activity	Mine Year 1 Closure (6)	Mine Year 3 Closure	Mine Year 11 Closure	Mine Year 20 Closure
Mine Water Treatment Trains East Pit Backfilling and Flushing (P50 annual average, gpm)	621	1,094	1,925	1,925(1)(4)
Mine Water Treatment Trains East Pit Backfilling and Flushing Duration (Years)	6	8	14	14(1)(4)
Mine Water Treatment Trains West Pit Overflow (P50 annual average, gpm)	110	150	300	300(1)
Mine Water Treatment Trains Duration from Closure to West Pit Overflow (Years)	10	14	32	32(1)(2)
Tailings Basin Treatment Train Closure (P50 annual average, gpm)	2,634	3,066	3,500	3,500(3)
Tailings Basin Treatment Train Closure Duration (Years)	9	13	35	35(3)
Tailings Basin Treatment Train Postclosure Maintenance (P50 annual average, gpm) (5)	2,424	2,450	2,450	2,450(3)

(1) Poly Met Mining Inc. NorthMet Project Water Modeling Data Package Volume 1 - Mine Site (Refernce (1)).
(2) Mine Year 20 value assumes pumping from Plant Site to West Pit to accelerate flooding (Section 6.1.2.3.2 of Reference (1)), Mine Year 1 assumes no Plant Site water.
(3) NorthMet Project Water Modeling Data Package Volume 2 - Plant Site (Refernece (2)).
(4) Flushing only. Backfilling complete prior to Mine Year 20 Closure.
(5) Excludes pit overflow.
(6) Mine Year 1 Closure based on information from Table 1 and Table 2.

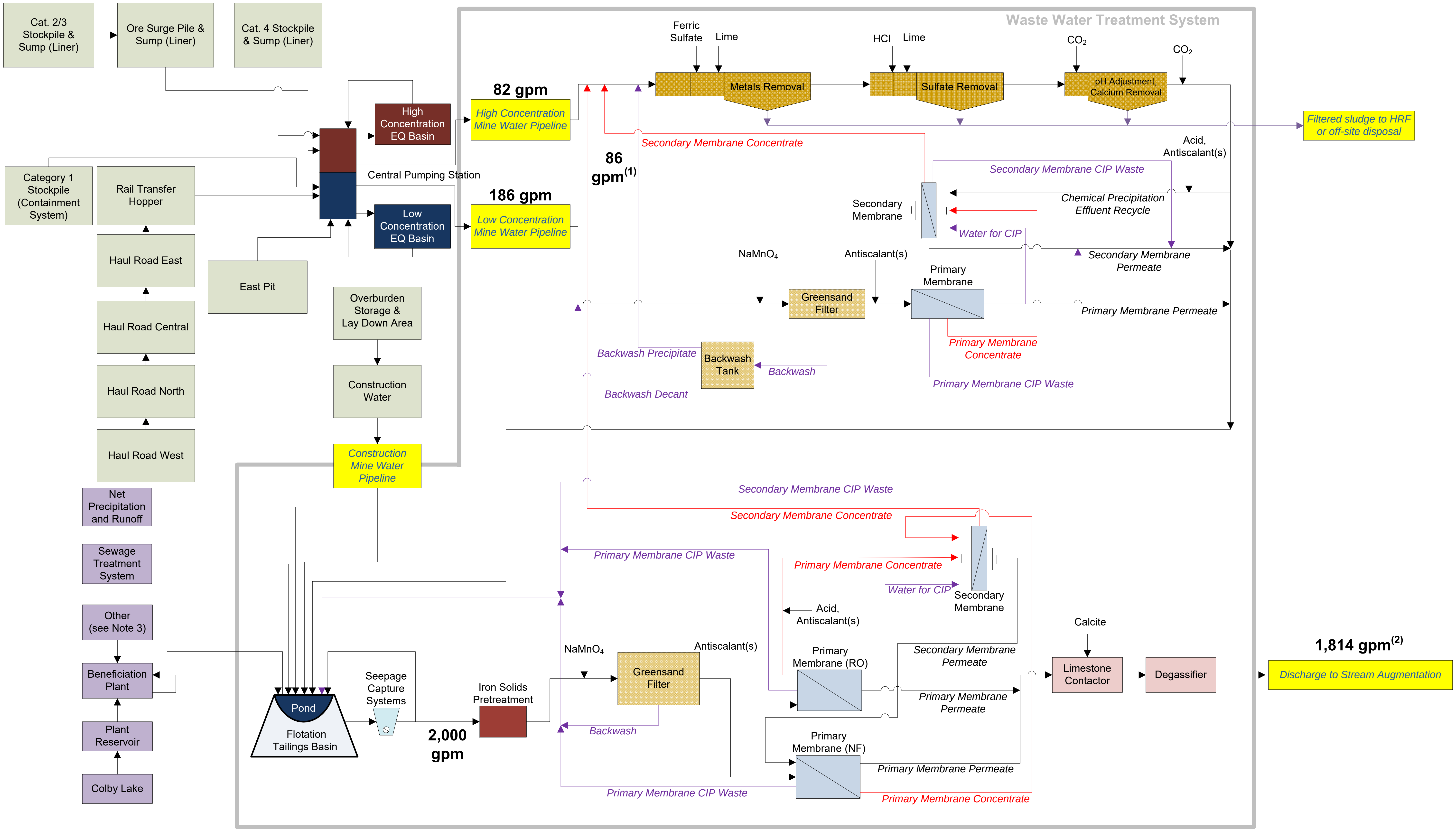
Water treatment flow rates for Mine Year 20 were calculated by water modeling efforts conducted for the Final Environmental Impact Statement. Based on preliminary modeling of closure after Mine Year 11, water treatment quantities for Mine Year 11 were set equal to those calculated for Mine Year 20. Water treatment quantities for Mine Year 3 were interpolated from Mine Year 1 and Mine Year 11 values, which is reasonable given fairly consistent projected yearly mine excavation rates.

References

1. **Poly Met Mining, Inc.** NorthMet Project Water Modeling Data Package Volume 1 - Mine Site (v14). February 2015.

2. —. NorthMet Project Water Modeling Data Package Volume 2 - Plant Site (v11). March 2015.

Figures



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Legend	
XX →	Forward flow
XX →	Membrane concentrate flow
XX →	Intermittent flows for filter cleaning

Flows shown here reflect modeling results for Mine Year 2 following Mine Year 1 closure with no hold year

See power sheets in Appendix A for flows from each Mine Site source

(1) Flows and costs for treatment of VSEP concentrate from tailings basin seepage treatment train are included in mine water train costs for this scenario.
(2) Difference between tailings basin seepage treatment train influent and effluent flows is due to 86 gpm of VSEP concentrate routed to mine water treatment train and 100 gpm GSF backwash routed to FTB.

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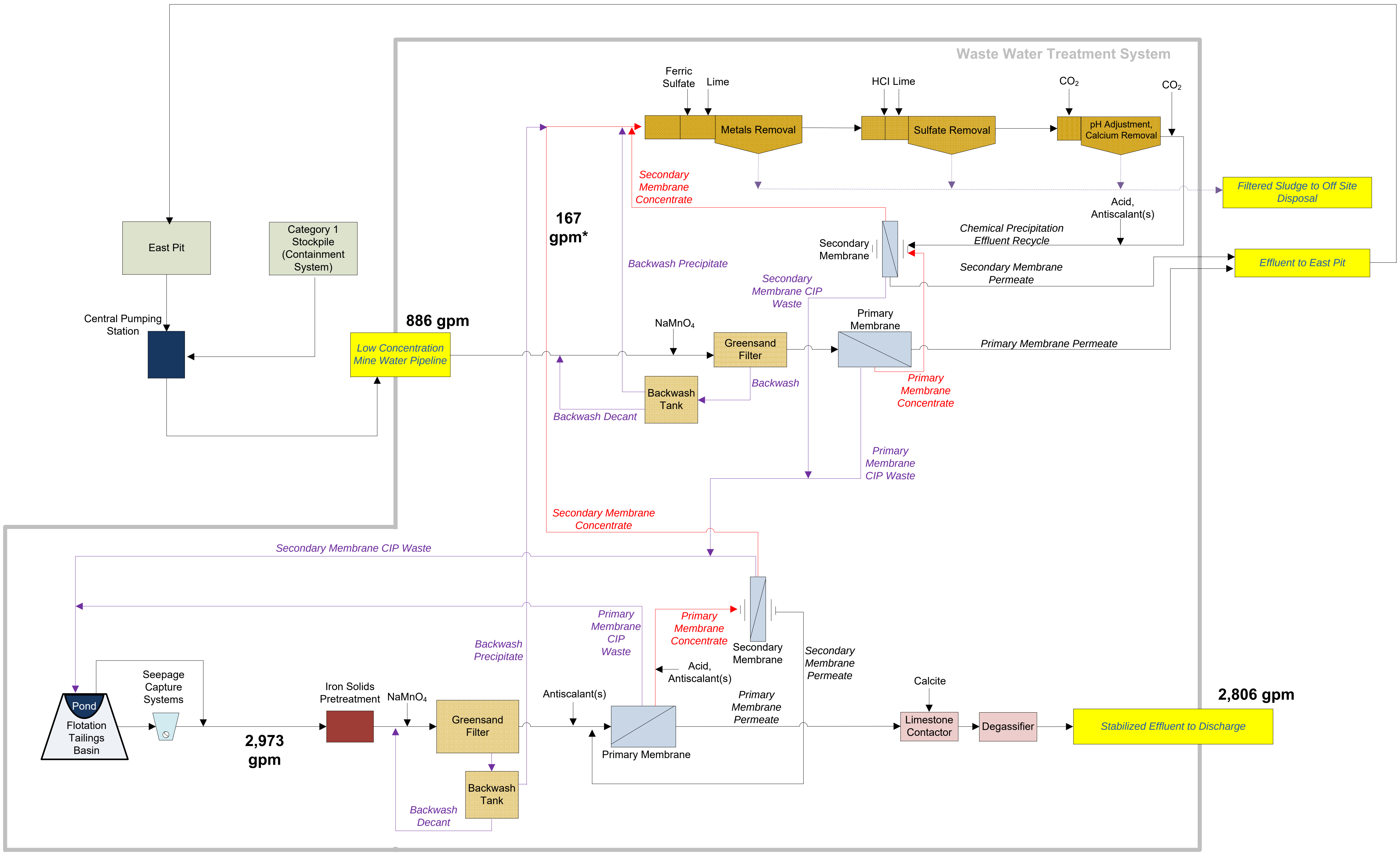
Large Figure 1
Water Treatment
Overall Flow Sheet – Mine Years 1-4
NorthMet Project, MY1 Closure with Hold Year
Poly Met Mining, Inc.
Hoyt Lakes, MN



Legend	
XX →	Forward flow
XX →	Membrane concentrate flow
XX →	Intermittent flows for filter cleaning

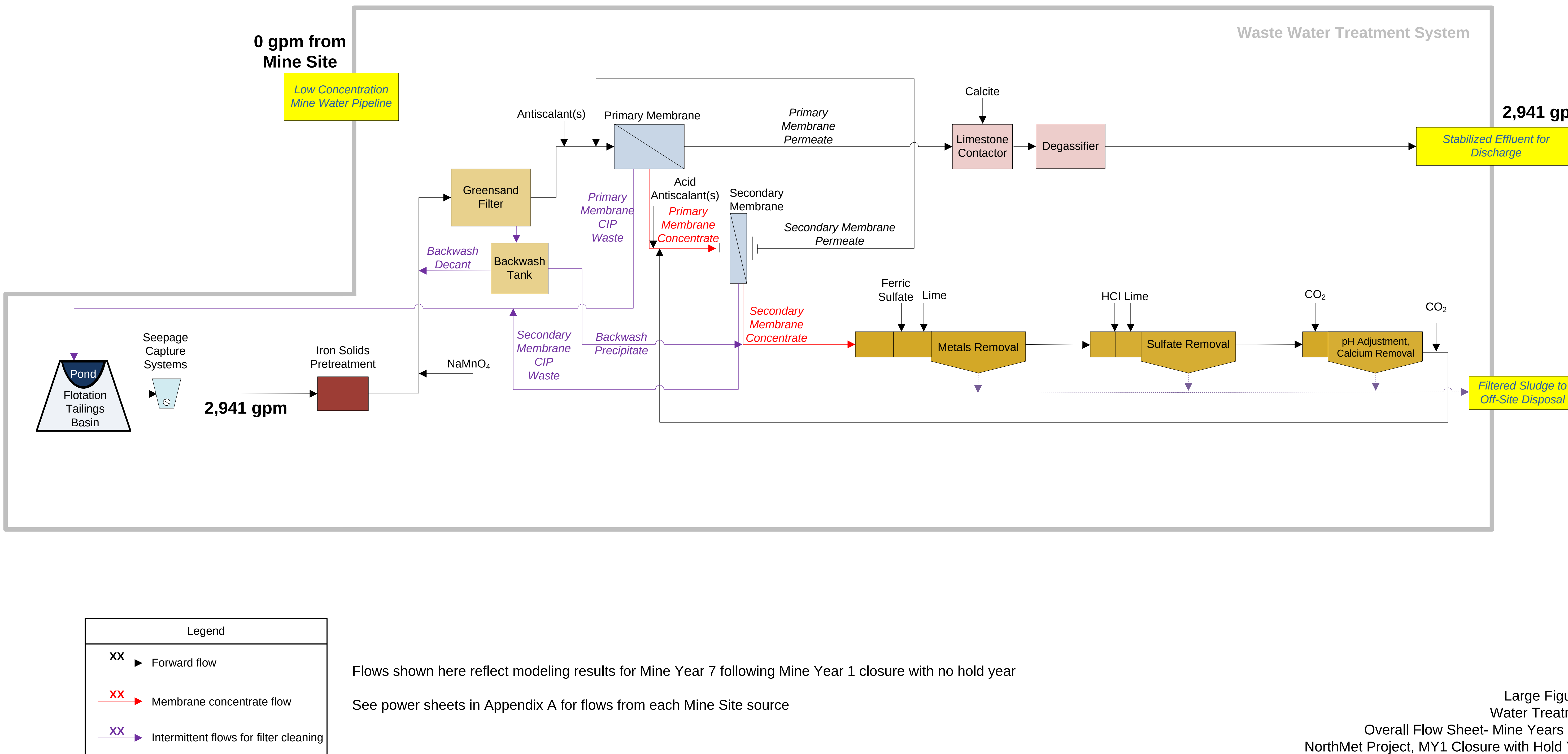
Flows shown here reflect modeling results for Mine Year 4 following Mine Year 1 closure with no hold year

See power sheets in Appendix A for flows from each Mine Site source

*VSEP concentrate flows from tailings basin seepage train not included in mine water train influent, because costs for chemical precipitation treatment of this flow are included in tailings basin seepage treatment costs.

Large Figure 2
Water Treatment
Overall Flow Sheet – Mine Years 5-7
NorthMet Project, MY1 Closure with Hold Year
Poly Met Mining, Inc.
Hoyt Lakes, MN

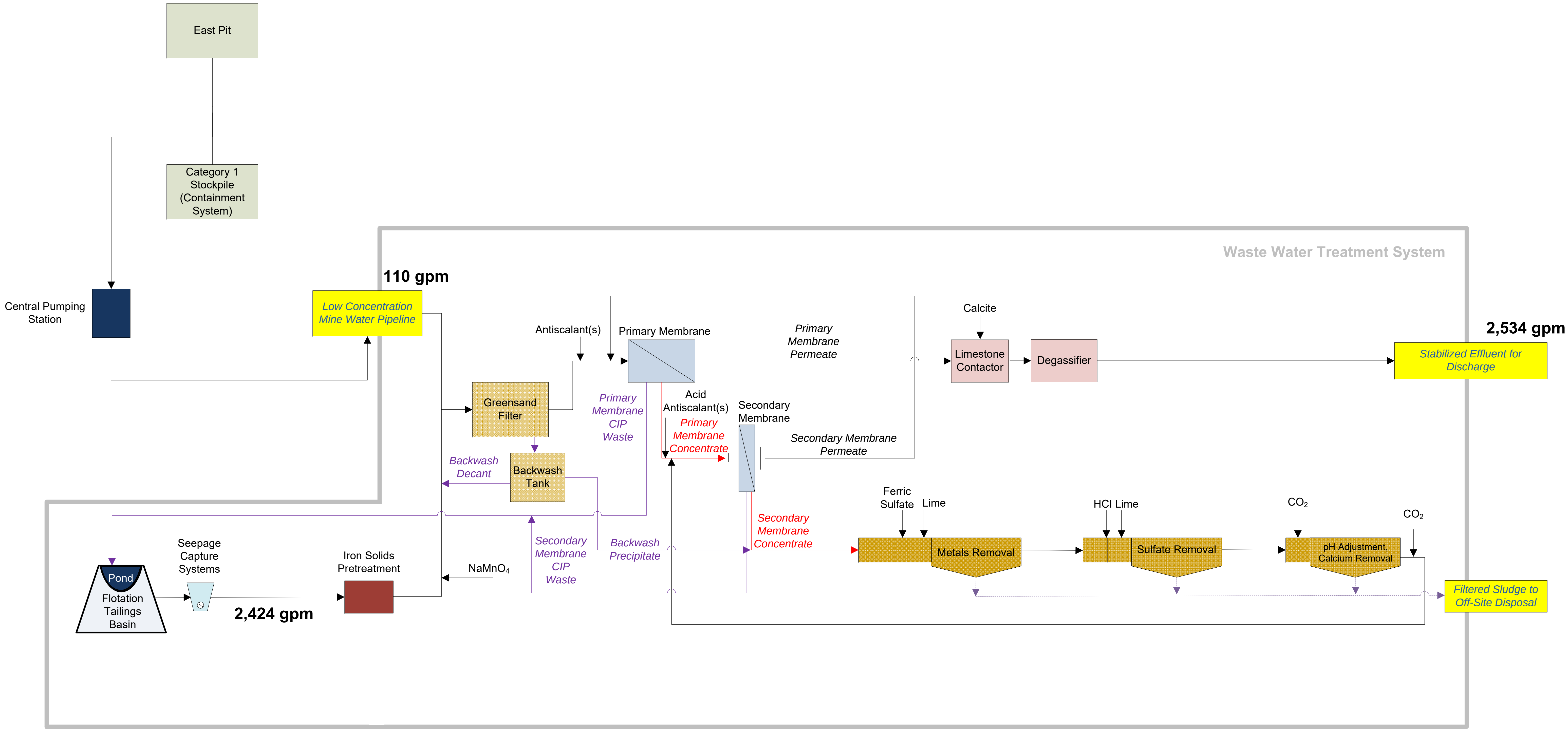
10/18/17



Flows shown here reflect modeling results for Mine Year 7 following Mine Year 1 closure with no hold year

See power sheets in Appendix A for flows from each Mine Site source

Large Figure 3
Water Treatment
Overall Flow Sheet- Mine Years 8-10
NorthMet Project, MY1 Closure with Hold Year
Poly Met Mining, Inc.
Hoyt Lakes, MN



Legend	
XX →	Forward flow
XX →	Membrane concentrate flow
XX →	Intermittent flows for filter cleaning

Flows shown here reflect modeling results for Mine Year 15 following Mine Year 1 closure with no hold year

See power sheets in Appendix A for flows from each Mine Site source

Large Figure 4
Water Treatment
Overall Flow Sheet- Mine Year 11 and Later
NorthMet Project, MY1 Closure with Hold Year
Poly Met Mining, Inc.
Hoyt Lakes, MN

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10/18/17

Appendices

Appendix A

Updated Operations Cost Estimates – Mine Year 1 Closure Scenario

Phase		P50 Average Annual Flow (gpm)	$/1000 gal
Tailings Basin Seepage Treatment Train Mine Year 2, MY1 Closure Scenario		2,000	$2.77

Item	Description	Unit	Quantity	Unit Cost	Cost Extension	Comments/References for Quantity	Comments/References for Unit Cost
1	Operations Management	LS	0		$0		Manpower covered in Staffing - Closure tab
2	Operations Labor	FTE	0		$0		Manpower covered in Staffing - Closure tab
3	Miscellaneous Operations Costs	day	365	$100	$36,500		Allowance
4	Equipment Maintenance	LS	3.59%	--	$0		Cost of equipment in service less membranes - capital for replacement covered elsewhere in SRK estimate
5	Electrical Cost	KW-Hr	8,672,000	$0.078	$676,416	based on process model flows and assumed pump information	Power costs from Jim Scott's edits
6	Building Heating	KW-Hr	495,000	$0.078	$38,610	Heating and light for 69,000 sf building	
8	NF Membrane Replacement	LS	1	$260,100	$260,100	Based on 5/1/13 vendor cost estimate spreadsheet from GE - module replacement every 3 years	Based on 5/1/13 vendor cost estimate spreadsheet from GE, and 3/31/16 e-mail update - $550 per 4.4 gpm module every 3 years
9	VSEP Module Replacement	LS	1	$476,000	$476,000	Based on 5/9/13 vendor cost estimate spreadsheet from NLR	Based on 5/9/13 vendor cost estimate spreadsheet from NLR - $78,000 per 40 gpm module
	O&M Quantities						
10a	Limestone (Granular Calcite)	ton/year	442	$47	$20,758	based on process model to stabilize LSI	From Jim Tieberg in 3/29/16 e-mail, cost from Terry Spooner at Graymont
10b	CO2 (VSEP)	ton/year	1,004	$129	$129,484	based on process model to adjust pH	From Jim Tieberg in 3/29/16 e-mail, cost from David Stanaway at Praxair
10c	Sodium Permanganate	lb/year	21,881	$14.50	$317,270	2.5 ppm in GSF feed, based on from Area 5 WWTF pilot	From Hawkins quote e-mail 4/1/16
10d	Sodium Bisulfite	lb/year	12,939	$1.50	$19,408	2 ppm in HDS influent when used, in range of manufacturer recommendations	From Hawkins quote e-mail 4/1/16
10e	Anionic Polymer (Standby)	lbs/year	0	$1.49	$0	2 ppm in HDS influent when used, based on typical polymer feed rates	From Jim Tieberg in 3/29/16 e-mail, cost from David Leingang at Nalco
10f	GE Hypersperse	lbs/year	22,966	$3.22	$73,951	2.2 ppm in membrane feeds, based on 5/1/13 cost estimate spreadsheet from GE	per GE e-mail 11/19/15, 2.5% solution S.G. = 1.025
10g	Membrane Cleaner 1	lbs/year	7,430	$5.35	$39,751	16.25 gal/year per gpm, from GE e-mail 3/26/15	per GE e-mail 11/19/15, 2.5% solution S.G. = 1.025
10h	Membrane Cleaner 4	lbs/year	7,430	$3.07	$22,810	16.25 gal/year per gpm, from GE e-mail 3/26/15	per GE e-mail 11/19/15, 2.5% solution S.G. = 1.025
10i	NLR 759	gal/yr	3,002	$44	$132,085	10 ppm in secondary feed based on 5/9/13 pre-treatment specs from NLR	From NLR cost estimating spreadsheet
10j	NLR 404	gal/yr	20,847	$16	$333,548	4 gal/cleaning per 40 gpm module, 1 cleaning/day based on 11/11/13 specs from NLR	From NLR e-mail update 3/25/16 from Mark Galimberti
10k	NLR 505	gal/yr	20,847	$16	$333,548	4 gal/cleaning per 40 gpm module, 1 cleaning/day based on 11/11/13 specs from NLR	From NLR e-mail update 3/25/16 from Mark Galimberti
	Total Cost				$2,910,240		

CRE Mine Year 1 Closure Scenario
Tailings Basin Seepage Treatment Train in Mine Year 2

	Average Annual Flow (gpm)	TDH (ft)	Pump Efficiency (%)	Average Annual Power (HP)	Operation (Hours/year)	Energy Use (kW-hr/Year)	Comments
Pretreatment Basin							
Lift Station Pumps	2000	70	60	58.92	8760	380,000	
GS Filters							
Backwash Tank Pump	100	60	60	2.53	8760	17,000	GS Backwash + CIP + % Stabilization Influent
Primary Membranes							
RO Feed Pumps	1881	330	80	195.94	8760	1,262,000	
NF Feed Pumps	504	160	80	25.48	8760	165,000	
Flush Water Pumps	3.3	100	80	0.10	8760	1,000	
CIP Pumps	0.7	100	80	0.02	8760	1,000	From GE info 5/3/13, 200 gal/year per gpm
Secondary Membranes							
Feed Pumps	571	1200	70	247.25	8760	1,592,000	
Flush Water Pumps	0.8	100	80	0.03	8760	1,000	
CIP Pumps	34	100	70	1.22	8760	8,000	VSEP 11/13 32,100 gpd for 375 gpm system
CIP Tank Heaters	34				8760	3,516,000	
Limestone Contactors							
Feed Pump	1814	40	80	22.91	8760	148,000	
Degasifier Blower				0.75	8760	5,000	
Miscellaneous							
Carbon Dioxide Carrier Water	229	180	80	13.02	8760	-	1 gpm per lb/hr CO2, per 1/15/16 call with Greg Brysacz at TomCO
Concentrate Load-Out Pump	86	60	60	2.16	8760	14,000	
Fractional HP Chemical Feed Pumps				10.00	8760	65,000	Assume total of 10 HP required at 2000 gpm and proportion to influent
Local Control Panels				2	8760	13,000	
Air Compressor				10.00	8760	65,000	Assume 20 HP at 50% use at 2000 gpm and proportion to influent
Plant Water (blended permeate)	39	140	80	1.71	8760	12,000	VSEP CIP plus 5 gpm
Plant Water (blended permeate)	5.7	130	80	0.23	8760	2,000	Primary CIP plus 5 gpm
Pumping to and from Plant							
Treated Water Storage Pump (unnamed creek)	1814	50	80	28.64	8760	185,000	all treated effluent pumps assumed to be low head
Treated Water Storage Pump (FTB Pond)	0	50	80	0.00	8760	-	treated effluent discharge to FTB assumed to be insignificant
Treated Water Storage Pump (Trimble Creek)	0	50	80	0.00	8760	-	
Pump Water from FTB Cont Sys to WWTS	2000	300	80	189.39	8760	1,220,000	TDH from SOW 12
Plant Site Total						8,672,000	

		P50 Average Annual Flow (gpm)	$/1000 gal			
Tailings Basin Seepage Treatment Train Mine Year 4, MY1 Closure Scenario		2,973	$3.71			

Item	Description	Unit	Quantity	Unit Cost	Cost Extension	Comments/References for Quantity	Comments/References for Unit Cost
1	Operations Management	LS	0		$0		Manpower covered in Staffing - Closure tab
2	Operations Labor	FTE	0		$0		Manpower covered in Staffing - Closure tab
3	Miscellaneous Operations Costs	day	365	$100	$36,500		Allowance
4	Equipment Maintenance	LS	3.59%	--	$0		Cost of equipment in service less membranes - capital for replacement covered elsewhere in SRK estimate
5	Electrical Cost	KW-Hr	12,264,000	$0.078	$956,592	based on process model flows and assumed pump information	Power costs from Jim Scott's edits
6	Building Heating	KW-Hr	495,000	$0.078	$38,610	Heating and light for 69,000 sf building	Power costs from Jim Scott's edits
8	Filter and RO/NF Membrane Replacement	LS	1	$410,100	$410,100	Based on 5/1/13 vendor cost estimate spreadsheet from GE - module replacement every 3 years	Based on 5/1/13 vendor cost estimate spreadsheet from GE, and 3/31/16 e-mail update - $550 per 4.4 gpm module every 3 years
9	VSEP Module Replacement	LS	1	$860,000	$860,000	Based on 5/9/13 vendor cost estimate spreadsheet from NLR	Based on 5/9/13 vendor cost estimate spreadsheet from NLR - $78,000 per 40 gpm module
	O&M Quantities						
10a	Limestone (Granular Calcite)	ton/year	402	$47	$18,871	based on process model to stabilize LSI	From Jim Tieberg in 3/29/16 e-mail, cost from Terry Spooner at Graymont
10a	Hydrated Lime (Chem Precip)	ton/year	4,243	$153	$649,116	based on process model to remove metals and sulfate	From Jim Tieberg in 3/29/16 e-mail, cost from Terry Spooner at Graymont
10b	CO2 (Chem Precip and VSEP)	ton/year	1,205	$129	$155,381	based on process model to adjust pH	From Jim Tieberg in 3/29/16 e-mail, cost from David Stanaway at Praxair
10c	Hydrochloric Acid (standby)	lbs/year	0	$0.80	$0	based on process model to remove sulfate	From Hawkins quote e-mail 4/1/16
10d	Ferric Sulfate	lbs/year	1,204,500	$0.26	$313,170	based on process model to remove metals	From Hawkins quote e-mail 4/1/16
10e	Sodium Permanganate	lbs/year	32,526	$14.50	$471,622	2.5 ppm in GSF feed, based on from Area 5 WWTF pilot	From Hawkins quote e-mail 4/1/16
10f	MetClear MR2405 (Standby)	lbs/year	0	$4.64	$0	2 ppm in HDS influent when used, in range of manufacturer recommendations	Based on 3/31/16 e-mail from Paul Dillalo at GE
10g	Anionic Polymer (Standby)	lbs/year	0	$1.49	$0	2 ppm in HDS influent when used, based on typical polymer feed rates	From Jim Tieberg in 3/29/16 e-mail, cost from David Leingang at Nalco
10h	Sodium Bisulfite	lbs/year	19,912	$1.50	$29,867	1 ppm in membrane feeds, based on 5/1/13 cost estimate spreadsheet from GE	From Hawkins quote e-mail 4/1/16
10i	GE Hypersperse	lbs/year	36,214	$3.22	$116,609	2.2 ppm in membrane feeds, based on 5/1/13 cost estimate spreadsheet from GE	per GE e-mail 11/19/15
10j	Membrane Cleaner 1	lbs/year	11,716	$5.35	$62,681	16.25 gal/year per gpm, from GE e-mail 3/26/15	per GE e-mail 11/19/15, 2.5% solution S.G. = 1.025
10k	Membrane Cleaner 4	lbs/year	11,716	$3.07	$35,968	16.25 gal/year per gpm, from GE e-mail 3/26/15	per GE e-mail 11/19/15, 2.5% solution S.G. = 1.025
10l	NLR 759	gal/yr	4,144	$44	$182,354	10 ppm in secondary feed based on 5/9/13 pre-treatment specs from NLR	From NLR cost estimating spreadsheet
10m	NLR 404	gal/yr	28,781	$16	$460,491	4 gal/cleaning per 40 gpm module, 1 cleaning/day based on 11/11/13 specs from NLR	From NLR e-mail update 3/25/16 from Mark Galimberti
10n	NLR 505	gal/yr	28,781	$16	$460,491	4 gal/cleaning per 40 gpm module, 1 cleaning/day based on 11/11/13 specs from NLR	From NLR e-mail update 3/25/16 from Mark Galimberti
10o	Sludge Management	ton/year	15159	$36	$545,737	based on process model, assumes 50% solids	From Waste Management Quote 4/5/16 from Trevor Long
	Total Cost				$5,804,160		

CRE Mine Year 1 Closure Scenario
Tailings Basin Seepage Treatment Train in Mine Year 4

			Average Annual Flow (gpm)	TDH (ft)	Pump Efficiency (%)	Average Annual Power (HP)	Operation (Hours/year)	Energy Use (kW-hr/Year)	Comments
Chemical Precipitation									
	Chem Precip Feed Pumps		243	40	60	4.09	8760	27,000	
	HDS Metals removal								
		Rapid Mix (4)				4	8760	26,000	
		Metals Removal Reaction Mixer (2)				4	8760	26,000	
		HDS Drive (2)				6	8760	39,000	
		HDS Recycle	85	40	50	1.71	8760	12,000	
		HDS Waste	6	50	50	0.15	8760	1,000	
	Sulfate Removal								
		Rapid Mix (4)				4	8760	26,000	
		Sulfate Removal Reaction Mixer (2)				4	8760	26,000	
		Sulfate Drive (2)				6	8760	39,000	
		Sludge Recycle	0	40	50	0.00	8760	-	
		Sludge Waste	14	50	50	0.34	8760	3,000	
	Recarbonation								
		Rapid Mix (2)				2	8760	13,000	
		Recarb Drive (2)				2	8760	13,000	
		Sludge Waste	4	50	50	0.11	8760	1,000	
Lime Feed									
	Bag House blower					5.25	8760	34,000	
	Bin Activator					3	8760	20,000	
	Screw Feeder					1	8760	7,000	
	Slurry Tank Mixer					3	8760	20,000	
	Slurry Pump		200	125	50	12.63	8760	82,000	
Filter Press									
	Feed Pump		24	320	50	3.83	8760	25,000	
	Flush Water		1.19	3350	80	1.25	8760	9,000	5% of feed (assumed) at 1450 psi (per MW Watermark proposal)
	Hydraulic Pump					50	1460	54,000	4 hours per day based on 50% of cycle time and 8 hour operation at 90 dry tons per day. Proportion Operation (hrs/year) with Feed Pump Flow
Pretreatment Basin									
	Lift Station Pumps		2973	70	60	87.59	8760	564,000	
GS Filters									
	Backwash Tank Pump		152	60	60	3.85	8760	25,000	GS Backwash + CIP + % Stabilization Influent
Primary Membranes									
	RO Feed Pumps		724	330	80	75.44	8760	486,000	
	NF Feed Pumps		3037	160	80	153.40	8760	988,000	
	Flush Water Pumps		5.2	100	80	0.16	8760	2,000	
	CIP Pumps		0.3	100	80	0.01	8760	1,000	From GE info 5/3/13, 200 gal/year per gpm
Secondary Membranes									
	Feed Pumps		789	1200	70	341.35	8760	2,198,000	
	Flush Water Pumps		1.1	100	80	0.03	8760	1,000	
	CIP Pumps		47	100	70	1.68	8760	11,000	VSEP 11/13 32,100 gpd for 375 gpm system
	CIP Tank Heaters		47				8760	4,854,000	
Limestone Contactors									
	Feed Pump		2973	40	80	37.54	8760	242,000	
	Degasifier Blower					0.75	8760	5,000	
Miscellaneous									
	Waste Pumping Station		177	50	60	3.72	8760	24,000	Assumes filter press goes from 25% to 60% solids
	Carbon Dioxide Carrier Water		106	180	80	6.04	8760	39,000	1 gpm per lb/hr CO2, per 1/15/16 call with Greg Brysacz at TomCO
	Fractional HP Chemical Feed Pumps					14.87	8760	96,000	Assume total of 10 HP required at 2000 gpm and proportion to influent
	Local Control Panels					2	8760	13,000	
	Air Compressor					14.87	8760	96,000	Assume 20 HP at 50% use at 2000 gpm and proportion to influent
	Plant Water (blended permeate)		52	140	80	2.28	8760	15,000	VSEP CIP plus 5 gpm
	Plant Water (blended permeate)		5.3	130	80	0.22	8760	2,000	Primary CIP plus 5 gpm
Pumping to and from Plant									
	Treated Water Storage Pump (unnamed creek)		2806	50	80	44.29	8760	286,000	all treated effluent pumps assumed to be low head
	Treated Water Storage Pump (FTB Pond)		0	50	80	0.00	8760	-	treated effluent discharge to FTB assumed to be insignificant
	Treated Water Storage Pump (Trimble Creek)		0	50	80	0.00	8760	-	
	Pump Water from FTB Cont Sys to WWTS		2973	300	80	281.53	8760	1,813,000	TDH from SOW 12
Total								**12,264,000**	

		P50 Average Annual Flow (gpm)	$/1000 gal
Tailings Basin Seepage Treatment Train Mine Year 7, MY1 Closure Scenario		2,941	$4.23

Item	Description	Unit	Quantity	Unit Cost	Cost Extension	Comments/References for Quantity	Comments/References for Unit Cost
1	Operations Management	LS	0		$0		Manpower covered in Staffing - Closure tab
2	Operations Labor	FTE	0		$0		Manpower covered in Staffing - Closure tab
3	Miscellaneous Operations Costs	day	365	$100	$36,500		Allowance
4	Equipment Maintenance	LS	3.59%	--	$0		Cost of equipment in service less membranes - capital for replacement covered elsewhere in SRK estimate
5	Electrical Cost	KW-Hr	13,316,000	$0.078	$1,038,648	based on process model flows and assumed pump information	Power costs from Jim Scott's edits
6	Building Heating	KW-Hr	495,000	$0.078	$38,610	Heating and light for 69,000 sf building	Power costs from Jim Scott's edits
8	Filter and RO/NF Membrane Replacement	LS	1	$414,400	$414,400	Based on 5/1/13 vendor cost estimate spreadsheet from GE - module replacement every 3 years	Based on 5/1/13 vendor cost estimate spreadsheet from GE, and 3/31/16 e-mail update - $550 per 4.4 gpm module every 3 years
9	VSEP Module Replacement	LS	1	$930,000	$930,000	Based on 5/9/13 vendor cost estimate spreadsheet from NLR	Based on 5/9/13 vendor cost estimate spreadsheet from NLR - $78,000 per 40 gpm module
	O&M Quantities						
10a	Limestone (Granular Calcite)	ton/year	402	$47	$18,871	based on process model to stabilize LSI	From Jim Tieberg in 3/29/16 e-mail, cost from Terry Spooner at Graymont
10a	Hydrated Lime (Chem Precip)	ton/year	6,364	$153	$973,674	based on process model to remove metals and sulfate	From Jim Tieberg in 3/29/16 e-mail, cost from Terry Spooner at Graymont
10b	CO2 (Chem Precip and VSEP)	ton/year	2,008	$129	$258,968	based on process model to adjust pH	From Jim Tieberg in 3/29/16 e-mail, cost from David Stanaway at Praxair
10c	Hydrochloric Acid (standby)	lbs/year	0	$0.80	$0	based on process model to remove sulfate	From Hawkins quote e-mail 4/1/16
10d	Ferric Sulfate	lbs/year	803,000	$0.26	$208,780	based on process model to remove metals	From Hawkins quote e-mail 4/1/16
10e	Sodium Permanganate	lbs/year	32,176	$14.50	$466,546	2.5 ppm in GSF feed, based on from Area 5 WWTF pilot	From Hawkins quote e-mail 4/1/16
10f	MetClear MR2405 (Standby)	lbs/year	0	$4.64	$0	2 ppm in HDS influent when used, in range of manufacturer recommendations	Based on 3/31/16 e-mail from Paul Dillalo at GE
10g	Anionic Polymer (Standby)	lbs/year	0	$1.49	$0	2 ppm in HDS influent when used, based on typical polymer feed rates	From Jim Tieberg in 3/29/16 e-mail, cost from David Leingang at Nalco
10h	Sodium Bisulfite	lbs/year	20,403	$1.50	$30,604	1 ppm in membrane feeds, based on 5/1/13 cost estimate spreadsheet from GE	From Hawkins quote e-mail 4/1/16
10i	GE Hypersperse	lbs/year	36,600	$3.22	$117,852	2.2 ppm in membrane feeds, based on 5/1/13 cost estimate spreadsheet from GE	per GE e-mail 11/19/15
10j	Membrane Cleaner 1	lbs/year	11,841	$5.35	$63,349	16.25 gal/year per gpm, from GE e-mail 3/26/15	per GE e-mail 11/19/15, 2.5% solution S.G. = 1.025
10k	Membrane Cleaner 4	lbs/year	11,841	$3.07	$36,352	16.25 gal/year per gpm, from GE e-mail 3/26/15	per GE e-mail 11/19/15, 2.5% solution S.G. = 1.025
10l	NLR 759	gal/yr	4,523	$44	$199,030	10 ppm in secondary feed based on 5/9/13 pre-treatment specs from NLR	From NLR cost estimating spreadsheet
10m	NLR 404	gal/yr	31,413	$16	$502,602	4 gal/cleaning per 40 gpm module, 1 cleaning/day based on 11/11/13 specs from NLR	From NLR e-mail update 3/25/16 from Mark Galimberti
10n	NLR 505	gal/yr	31,413	$16	$502,602	4 gal/cleaning per 40 gpm module, 1 cleaning/day based on 11/11/13 specs from NLR	From NLR e-mail update 3/25/16 from Mark Galimberti
10o	Sludge Management	ton/year	19,609	$36	$705,942	based on process model, assumes 50% solids	From Waste Management Quote 4/5/16 from Trevor Long
	Subtotal Cost				$6,543,329		

CRE Mine Year 1 Closure Scenario
Tailings Basin Seepage Treatment Train in Mine Year 7

			Average Annual Flow (gpm)	TDH (ft)	Pump Efficiency (%)	Average Annual Power (HP)	Operation (Hours/year)	Energy Use (kW-hr/Year)	Comments
Chemical Precipitation									
	Chem Precip Feed Pumps		255.6289864	40	60	4.30	8760	28,000	
	HDS Metals removal								
		Rapid Mix (4)				4	8760	26,000	
		Metals Removal Reaction Mixer (2)				4	8760	26,000	
		HDS Drive (2)				6	8760	39,000	
		HDS Recycle	75	40	50	1.51	8760	10,000	
		HDS Waste	10	50	50	0.26	8760	2,000	
	Sulfate Removal								
		Rapid Mix (4)				4	8760	26,000	
		Sulfate Removal Reaction Mixer (2)				4	8760	26,000	
		Sulfate Drive (2)				6	8760	39,000	
		Sludge Recycle	0	40	50	0.00	8760	-	
		Sludge Waste	8	50	50	0.21	8760	2,000	
	Recarbonation								
		Rapid Mix (2)				2	8760	13,000	
		Recarb Drive (2)				2	8760	13,000	
		Sludge Waste	6	50	50	0.16	8760	2,000	
Filter Press									
	Feed Pump		25	320	50	4.06	8760	27,000	
	Flush Water		1.26	3350	80	1.33	8760	9,000	5% of feed (assumed) at 1450 psi (per MW Watermark proposal)
	Hydraulic Pump					50	1460	54,000	4 hours per day based on 50% of cycle time and 8 hour operation at 90 dry tons per day. Proportion Operation (hrs/year) with Feed Pump Flow
Pretreatment Basin									
	Lift Station Pumps		2941	70	60	86.65	8760	558,000	
GS Filters									
	Backwash Tank Pump		151	60	60	3.81	8760	25,000	GS Backwash + CIP + % Stabilization Influent
Primary Membranes									
	RO Feed Pumps		2006	330	80	208.95	8760	1,346,000	
	NF Feed Pumps		1796	160	80	90.69	8760	584,000	
	Flush Water Pumps		5.3	100	80	0.17	8760	2,000	
	CIP Pumps		0.8	100	80	0.02	8760	1,000	From GE info 5/3/13, 200 gal/year per gpm
Secondary Membranes									
	Feed Pumps		861	1200	70	372.56	8760	2,399,000	
	Flush Water Pumps		1.2	100	80	0.04	8760	1,000	
	CIP Pumps		51	100	70	1.83	8760	12,000	VSEP 11/13 32,100 gpd for 375 gpm system
	CIP Tank Heaters		51				8760	5,298,000	
Limestone Contactors									
	Feed Pump		2941	40	80	37.13	8760	240,000	
	Degasifier Blower					0.75	8760	5,000	
Lime Silo									
	Bag House blower					5.25	8760	34,000	
	Bin Activator					3	8760	20,000	
	Screw Feeder					1	8760	7,000	
	Slurry Tank Mixer					3	8760	20,000	
	Slurry Pump		200	125	50	12.63	8760	82,000	
Miscellaneous									
	Waste Pumping Station		191	50	60	4.01	8760	26,000	Assumes filter press goes from 25% to 60% solids
	Carbon Dioxide Carrier Water		70	180	80	3.96	8760	-	1 gpm per lb/hr CO2, per 1/15/16 call with Greg Brysacz at TomCO
	Fractional HP Chemical Feed Pumps					14.71	8760	95,000	Assume total of 10 HP required at 2000 gpm and proportion to influent
	Local Control Panels					2	8760	13,000	
	Air Compressor					14.71	8760	95,000	Assume 20 HP at 50% use at 2000 gpm and proportion to influent
	Plant Water (blended permeate)		56	140	80	2.47	8760	16,000	VSEP CIP plus 5 gpm
	Plant Water (blended permeate)		5.8	130	80	0.24	8760	2,000	Primary CIP plus 5 gpm
Pumping to and from Plant									
	Treated Water Storage Pump (unnamed creek)		2941	50	80	46.42	8760	299,000	all treated effluent pumps assumed to be low head
	Treated Water Storage Pump (FTB Pond)		0	50	80	0.00	8760	-	treated effluent discharge to FTB assumed to be insignificant
	Treated Water Storage Pump (Trimble Creek)		0	50	80	0.00	8760	-	
	Pump Water from FTB Cont Sys to WWTS		2941	300	80	278.50	8760	1,794,000	TDH from SOW 12
Total								**13,316,000**	

		P50 Average Annual Flow (gpm)	$/1000 gal
Tailings Basin Seepage Treatment Train Mine Year 15, MY1 Closure Scenario		2,534	$3.99

Item	Description	Unit	Quantity	Unit Cost	Cost Extension	Comments/References for Quantity	Comments/References for Unit Cost
1	Operations Management	LS	0		$0		Manpower covered in Staffing - Closure tab
2	Operations Labor	FTE	0		$0		Manpower covered in Staffing - Closure tab
3	Miscellaneous Operations Costs	day	365	$100	$36,500		Allowance
4	Equipment Maintenance	LS	0		$0		Cost of equipment in service less membranes - capital for replacement covered elsewhere in SRK estimate
5	Electrical Cost	KW-Hr	11,202,000	$0.078	$873,756	based on process model flows and assumed pump information	Power costs from Jim Scott's edits
6	Building Heating	KW-Hr	495,000	$0.078	$38,610	Heating and light for 69,000 sf building	Power costs from Jim Scott's edits
8	Filter and RO/NF Membrane Replacement	LS	1	$355,400	$355,400	Based on 5/1/13 vendor cost estimate spreadsheet from GE - module replacement every 3 years	Based on 5/1/13 vendor cost estimate spreadsheet from GE, and 3/31/16 e-mail update - $550 per 4.4 gpm module every 3 years
9	VSEP Module Replacement	LS	1	$786,000	$786,000	Based on 5/9/13 vendor cost estimate spreadsheet from NLR	Based on 5/9/13 vendor cost estimate spreadsheet from NLR - $78,000 per 40 gpm module
	O&M Quantities						
10a	Limestone (Granular Calcite)	ton/year	1,104	$47	$51,894	based on process model to stabilize LSI	From Jim Tieberg in 3/29/16 e-mail, cost from Terry Spooner at Graymont
10a	Hydrated Lime (Chem Precip)	ton/year	3,712	$153	$567,977	based on process model to remove metals and sulfate	From Jim Tieberg in 3/29/16 e-mail, cost from Terry Spooner at Graymont
10b	CO2 (Chem Precip and VSEP)	ton/year	1,124	$129	$145,022	based on process model to adjust pH	From Jim Tieberg in 3/29/16 e-mail, cost from David Stanaway at Praxair
10c	Hydrochloric Acid (standby)	lbs/year	0	$0.80	$0	based on process model to remove sulfate	From Hawkins quote e-mail 4/1/16
10d	Ferric Sulfate	lbs/year	1,405,250	$0.26	$365,365	based on process model to remove metals	From Hawkins quote e-mail 4/1/16
10e	Sodium Permanganate	lbs/year	27,723	$14.50	$401,981	2.5 ppm in GSF feed, based on from Area 5 WWTF pilot	From Hawkins quote e-mail 4/1/16
10f	MetClear MR2405 (Standby)	lbs/year	0	$4.64	$0	2 ppm in HDS influent when used, in range of manufacturer recommendations	Based on 3/31/16 e-mail from Paul Dillalo at GE
10g	Anionic Polymer (Standby)	lbs/year	0	$1.49	$0	2 ppm in HDS influent when used, based on typical polymer feed rates	From Jim Tieberg in 3/29/16 e-mail, cost from David Leingang at Nalco
10h	Sodium Bisulfite	lbs/year	17,444	$1.50	$26,166	1 ppm in membrane feeds, based on 5/1/13 cost estimate spreadsheet from GE	From Hawkins quote e-mail 4/1/16
10i	GE Hypersperse	lbs/year	31,387	$3.22	$101,065	2.2 ppm in membrane feeds, based on 5/1/13 cost estimate spreadsheet from GE	per GE e-mail 11/19/15
10j	Membrane Cleaner 1	lbs/year	10,154	$5.35	$54,325	16.25 gal/year per gpm, from GE e-mail 3/26/15	per GE e-mail 11/19/15, 2.5% solution S.G. = 1.025
10k	Membrane Cleaner 4	lbs/year	10,154	$3.07	$31,174	16.25 gal/year per gpm, from GE e-mail 3/26/15	per GE e-mail 11/19/15, 2.5% solution S.G. = 1.025
10l	NLR 759	gal/yr	3,816	$44	$167,918	10 ppm in secondary feed based on 5/9/13 pre-treatment specs from NLR	From NLR cost estimating spreadsheet
10m	NLR 404	gal/yr	26,502	$16	$424,036	4 gal/cleaning per 40 gpm module, 1 cleaning/day based on 11/11/13 specs from NLR	From NLR e-mail update 3/25/16 from Mark Galimberti
10n	NLR 505	gal/yr	26,502	$16	$424,036	4 gal/cleaning per 40 gpm module, 1 cleaning/day based on 11/11/13 specs from NLR	From NLR e-mail update 3/25/16 from Mark Galimberti
10o	Sludge Management	ton/year	12897	$36	$464,277	based on process model, assumes 50% solids	From Waste Management Quote 4/5/16 from Trevor Long
	Total Cost				$5,315,501		

CRE Mine Year 1 Closure Scenario
Tailings Basin Seepage Treatment Train in Mine Year 15

Item	Sub-item	Average Annual Flow (gpm)	TDH (ft)	Pump Efficiency (%)	Average Annual Power (HP)	Operation (Hours/year)	Energy Use (kW-hr/Year)	Comments
Chemical Precipitation								
Feed Pumps		217.3595353	40	60	3.66	8760	24,000	
HDS Metals removal								
	Rapid Mix (4)				4	8760	26,000	
	Metals Removal Reaction Mixer (2)				4	8760	26,000	
	HDS Drive (2)				6	8760	39,000	
	HDS Recycle	78	40	50	1.59	8760	11,000	
	HDS Waste	5	50	50	0.13	8760	1,000	
Sulfate Removal								
	Rapid Mix (4)				4	8760	26,000	
	Sulfate Removal Reaction Mixer (2)				4	8760	26,000	
	Sulfate Drive (2)				6	8760	39,000	
	Sludge Recycle	0	40	50	0.00	8760	-	
	Sludge Waste	9	50	50	0.22	8760	2,000	
Recarbonation								
	Rapid Mix (2)				2	8760	13,000	
	Recarb Drive (2)				2	8760	13,000	
	Sludge Waste	6	50	50	0.16	8760	2,000	
Lime Feed								
Bag House blower					5.25	8760	34,000	
Bin Activator					3	8760	20,000	
Screw Feeder					1	8760	7,000	
Slurry Tank Mixer					3	8760	20,000	
Slurry Pump		200	125	50	12.63	8760	82,000	
Filter Press								
Feed Pump		20	320	50	3.25	8760	21,000	
Flush Water		1.01	3350	80	1.06	8760	7,000	5% of feed (assumed) at 1450 psi (per MW Watermark prop
Hydraulic Pump					50	82	4,000	4 hours per day based on 50% of cycle time and 8 hour oper
Pretreatment Basin								
Lift Station Pumps		2424	70	60	71.41	8760	460,000	
GS Filters								
Backwash Tank Pump		130	60	60	3.28	8760	22,000	GS Backwash + CIP + % Stabilization Influent
Primary Membranes								
RO Feed Pumps		1481	330	80	154.31	8760	994,000	
NF Feed Pumps		1779	160	80	89.83	8760	579,000	
Flush Water Pumps		4.5	100	80	0.14	8760	1,000	
CIP Pumps		0.6	100	80	0.02	8760	1,000	From GE info 5/3/13, 200 gal/year per gpm
Secondary Membranes								
Feed Pumps		726	1200	70	314.32	8760	2,024,000	
Flush Water Pumps		1.0	100	80	0.03	8760	1,000	
CIP Pumps		43	100	70	1.55	8760	10,000	VSEP 11/13 32,100 gpd for 375 gpm system
CIP Tank Heaters		43				8760	4,470,000	
Limestone Contactors								
Feed Pump		2534	40	80	31.99	8760	207,000	
Degasifier Blower					0.75	8760	5,000	
Miscellaneous								
Waste Pumping Station		161	50	60	3.38	8760	22,000	Assumes filter press goes from 25% to 60% solids
Carbon Dioxide Carrier Water		9	180	80	0.50	8760	-	1 gpm per lb/hr CO2, per 1/15/16 call with Greg Brysacz at T
Fractional HP Chemical Feed Pumps					12.12	8760	79,000	Assume total of 10 HP required at 2000 gpm and proportion
Local Control Panels					2	8760	13,000	
Air Compressor					12.12	8760	79,000	Assume 20 HP at 50% use at 2000 gpm and proportion to inf
Plant Water (blended permeate)		48	140	80	2.11	8760	14,000	VSEP CIP plus 5 gpm
Plant Water (blended permeate)		5.6	130	80	0.23	8760	2,000	Primary CIP plus 5 gpm
Pumping to and from Plant								
Pump Water from FTB Cont Sys to WWTP		2424	300	80	229.55	8760	1,478,000	TDH from SOW 12
Pump Water from East Pit to EBA		110	70	60	3.24	8760	21,000	From GoldSim model, TDH from ME-004 is 120', assume shallower pit
Pump LS Mine Water from CPS to WWTS		110	58.52	60	2.71	8760	18,000	TDH from SOW 7
Treated Water Storage Pump (receiving streams)		2534	50	80	39.99	8760	258,000	all treated effluent pumps assumed to be low head
Treated Water Storage Pump (FTB Pond)		0	50	80	0.00	8760	-	treated effluent discharge to FTB assumed to be insignificant
Bar screens					5.00	91.25	1,000	Assume two 5 hp motors run 15 minutes/day
Total							**11,202,000**	

		P50 Annual Average Flow to Chem Precip (gpm)	P50 Annual Average Flow to Membranes (gpm)	$/1000 gal			
Mine Water Treatment Train Mine Year 2, MY1 Closure Scenario		168	187	$13.15			
Item	**Description**	**Unit**	**Quantity**	**Unit Cost**	**Cost Extension**	**Comments/References for Quantity**	**Comments/References for Unit Cost**
1	Operations Management	LS	0		$0		Manpower covered in Staffing - Closure tab
2	Operations Labor	FTE	0		$0		Manpower covered in Staffing - Closure tab
3	Miscellaneous Operations Costs	day	365	$100	$36,500		Allowance
4	Equipment Maintenance	LS	3.72%	--	$0	Annualized cost based on capex plus service life, see Appendix B	Cost of equipment in service less membranes, see Appendix B
5	Electrical Cost	KW-Hr	2,483,000	$0.078	$193,674	based on process model flows and assumed pump information	Power costs from Jim Scott's edits
6	Building Heating	KW-Hr	0	$0.078	$0	WWTS heating costs included in Plant Site sheet	Power costs from Jim Scott's edits
8	Filter and RO/NF Membrane Replacement	LS	1	$19,900	$19,900	Based on 5/1/13 vendor cost estimate spreadsheet from GE - module replacement every 3 years	Based on 5/1/13 vendor cost estimate spreadsheet from GE, and 3/31/16 e-mail update - $550 per 4.4 gpm module every 3 years
9	VSEP Module Replacement	LS	1	$162,000	$162,000	Based on 5/9/13 vendor cost estimate spreadsheet from NLR	Based on 5/9/13 vendor cost estimate spreadsheet from NLR - $78,000 per 40 gpm module
	<u>O&M Quantities</u>						
10a	Hydrated Lime (Chem Precip)	ton/year	4,508	$153	$689,686	based on process model to remove metals and sulfate	From Jim Tieberg in 3/29/16 e-mail, cost from Terry Spooner at Graymont
10b	CO2 (Chem Precip and VSEP)	ton/year	1,044	$129	$134,663	based on process model to adjust pH	From Jim Tieberg in 3/29/16 e-mail, cost from David Stanaway at Praxair
10c	Hydrochloric Acid	lbs/year	200,750	$0.80	$160,600	based on process model to remove sulfate	From Hawkins quote e-mail 4/1/16
10d	Ferric Sulfate	lbs/year	160,600	$0.26	$41,756	based on process model to remove metals	From Hawkins quote e-mail 4/1/16
10e	Sodium Permanganate	lbs/year	2,098	$14.50	$30,425	2.5 ppm in GSF feed, based on from Area 5 WWTF pilot	From Hawkins quote e-mail 4/1/16
10f	MetClear MR2405 (Standby)	lbs/year	0	$4.64	$0	2 ppm in HDS influent when used, in range of manufacturer recommendations	Based on 3/31/16 e-mail from Paul Dillalo at GE
10g	Anionic Polymer (Standby)	lbs/year	0	$1.49	$0	2 ppm in HDS influent when used, based on typical polymer feed rates	From Jim Tieberg in 3/29/16 e-mail, cost from David Leingang at Nalco
10h	Sodium Bisulfite	lbs/year	1,644	$1.50	$2,465	1 ppm in membrane feeds, based on 5/1/13 cost estimate spreadsheet from GE	From Hawkins quote e-mail 4/1/16
10i	GE Hypersperse	lbs/year	1,754	$3.22	$5,648	2.2 ppm in membrane feeds, based on 5/1/13 cost estimate spreadsheet from GE	per GE e-mail 11/19/15
10j	Membrane Cleaner 1	lbs/year	568	$5.35	$3,036	16.25 gal/year per gpm, from GE e-mail 3/26/15	per GE e-mail 11/19/15, 2.5% solution S.G. = 1.025
10k	Membrane Cleaner 4	lbs/year	568	$3.07	$1,742	16.25 gal/year per gpm, from GE e-mail 3/26/15	per GE e-mail 11/19/15, 2.5% solution S.G. = 1.025
10l	NLR 759	gal/yr	1,016	$44	$44,716	10 ppm in secondary feed based on 5/9/13 pre-treatment specs from NLR	From NLR cost estimating spreadsheet
10m	NLR 404	gal/yr	7,057	$16	$112,919	4 gal/cleaning per 40 gpm module, 1 cleaning/day based on 11/11/13 specs from NLR	From NLR e-mail update 3/25/16 from Mark Galimberti
10n	NLR 505	gal/yr	7,057	$16	$112,919	4 gal/cleaning per 40 gpm module, 1 cleaning/day based on 11/11/13 specs from NLR	From NLR e-mail update 3/25/16 from Mark Galimberti
10o	Sludge Management	ton/year	19,447	$36	$700,088	based on process model, assumes 50% solids	From Waste Management Quote 4/5/16 from Trevor Long
	Total Cost				$2,452,740		

CRE Mine Year 1 Closure Scenario
Mine Water Treatment Train, Mine Year 2

		Average Annual Flow (gpm)	TDH (ft)	Pump Efficiency (%)	Average Annual Power (HP)	Operation (Hours/year)	Energy Use (kW-hr/Year)	Comments
GS Filters								
Backwash Decant Pump		5	40	60	0.08	8760	1,000	2.5% of GS Influent
Backwash Precipitate Pump		5	60	60	0.12	8760	1,000	2.5% of GS Influent
Primary Membranes								
NF Feed Pumps		182	160	80	9.20	8760	60,000	
Flush Water Pumps		0.06	100	80	0.00	8760	1,000	200% of required membrane pressure vessel volume every 24 hours (0.5 gpd/gpm)
CIP Pumps		0.07	100	70	0.00	8760	1,000	From GE info 5/3/13, 200 gal/year per gpm
Secondary Membranes								
Recycle from Chem Precip		193	40	60	3.26	8760	21,000	All of VSEP B feed is from Chem Precip Recycle
Feed Pumps		193	1200	70	83.70	8760	539,000	
Flush Water Pumps		0.27	100	80	0.01	8760	1,000	
CIP Pumps		11	100	70	0.41	8760	3,000	
CIP Tank Heaters		11				8760	1,199,000	assume 70 deg F temperature rise, 85% efficiency
Chemical Precipitation								
Chem Precip Feed Pumps		206	40	60	3.48	8760	23,000	
HDS Metals removal								
	Rapid Mix (4)				4	8760	26,000	
	Metals Removal Reaction Mixer (2)				4	8760	26,000	
	HDS Drive (2)				6	8760	39,000	
	HDS	75	40	50	1.51	8760	10,000	
	HDS	8	50	50	0.20	8760	2,000	
Sulfate Removal								
	Rapid Mix (4)				4	8760	26,000	
	Sulfate Removal Reaction Mixer (2)				4	8760	26,000	
	Sulfate Drive (2)				6	8760	39,000	
	Sludg	23	40	50	0.46	8760	3,000	
	Sludg	13	50	50	0.33	8760	3,000	
Recarbonation								
	Rapid Mix (2)				2	8760	13,000	
	Recarb Drive (2)				2	8760	13,000	
	Sludg	8	50	50	0.21	8760	2,000	
Lime Feed								
Bag House blower					5.25	8760	34,000	
Bin Activator					3	8760	20,000	
Screw Feeder					1	8760	7,000	
Slurry Tank Mixer					3	8760	20,000	
Slurry Pump		200	125	50	12.63	8760	82,000	
Filter Press								
Feed Pump		30	320	50	4.77	8760	31,000	
Flush Water		1.48	3350	80	1.56	8760	11,000	5% of feed (assumed) at 1450 psi (per MW Watermark proposal)
Hydraulic Pump					50	120	5,000	4 hours per day based on 50% of cycle time and 8 hour operation at 90 dry tons per day. Proportion Operation (hrs/year) with Feed Pump Flow
Miscellaneous								
Waste Pumping Station		132	50	60	2.78	8760	18,000	Assumes filter press goes from 25% to 60% solids
Effluent Blend Pump		350	40	80	4.42	8760	29,000	
Carbon Dioxide Carrier Water		59	180	80	3.33	8760	22,000	
Local Control Panels					2	8760	13,000	
Plant Water (blended permeate)		17	140	80	0.75	8760	5,000	lime water plus VSEP CIP plus 5 gpm, assumes 35% of lime mass needed as water
Plant Water (blended permeate)		5.1	130	80	0.21	8760	2,000	Primary CIP plus 5 gpm
Pumping to and from the Plant								
Pump Water from Cat 1 Cont Syst to EBA		121	50	60	2.55	8760	17,000	From GoldSim model, TDH from ME-004
Pump Water from Cat 2/3 Cont Syst to EBA		43	225	60	4.07	8760	27,000	From GoldSim model, TDH is weighted average of 3 sumps from ME-004
Pump Water Ore Surge Pile to EBA		19	90	60	0.72	8760	5,000	From GoldSim model, TDH from ME-004
Pump Water from Cat 4 Cont Syst to EBA		20	50	60	0.42	8760	3,000	From GoldSim model, TDH from ME-004
Pump Water from East Pit to EBA		11	70	60	0.32	8760	3,000	From GoldSim model, TDH from ME-004 is 120', assume shallower pit
Pump Water from Central Pit to EBA		0	60	60	0.00	8760	-	From GoldSim model, TDH from ME-004
Pump Water from Haul Road Runoff to EBA		52	100	60	2.19	8760	15,000	From GoldSim model, TDH is weighted average of 3 sumps from ME-004
Pump Water from Rail Transfer Hopper to EBA		1	60	60	0.03	8760	1,000	From GoldSim model, TDH from ME-004
Pump LS Mine Water from CPS to WWTS		192	48.31816	60	3.90	2414	7,000	TDH from SOW 7
Pump HS Mine Water from CPS to WWTS		82	133.0378	60	4.59	7808	27,000	TDH from SOW 7
Bar screens					10.00	91.3	1,000	Assume two 5 hp motors run 15 minutes/day
Mine Site Total							**2,483,000**	

			P50 Annual Average Flow (gpm)	$/1000 gal			
Mine Water Treatment Train Mine Year 4, MY1 Closure Scenario			886	$2.66			
Item	**Description**	**Unit**	**Quantity**	**Unit Cost**	**Cost Extension**	**Comments/References for Quantity**	**Comments/References for Unit Cost**
1	Operations Management	LS	0		$0		Manpower covered in Staffing - Closure tab
2	Operations Labor	FTE	0		$0		Manpower covered in Staffing - Closure tab
3	Miscellaneous Operations Costs	day	365	$100	$36,500		Allowance
4	Equipment Maintenance	LS	3.72%	--	$0	Annualized cost based on capex plus service life, see Appendix B	Cost of equipment in service less membranes, see Appendix B
5	Electrical Cost	KW-Hr	1,106,000	$0.078	$86,268	based on process model flows and assumed pump information	Power costs from Jim Scott's edits
6	Building Heating	KW-Hr	0	$0.078	$0	WWTS heating costs included in Plant Site sheet	Power costs from Jim Scott's edits
8	Filter and RO/NF Membrane Replacement	LS	1	$120,800	$120,800	Based on 5/1/13 vendor cost estimate spreadsheet from GE - module replacement every 3 years	Based on 5/1/13 vendor cost estimate spreadsheet from GE, and 3/31/16 e-mail update - $550 per 4.4 gpm module every 3 years
9	VSEP Module Replacement	LS	1	$243,000	$243,000	Based on 5/9/13 vendor cost estimate spreadsheet from NLR	Based on 5/9/13 vendor cost estimate spreadsheet from NLR - $78,000 per 40 gpm module
	O&M Quantities						
10a	Limestone (Granular Calcite)	ton/year	0	$47	$0	based on process model to stabilize LSI	From Jim Tieberg in 3/29/16 e-mail, cost from Terry Spooner at Graymont
10a	Hydrated Lime (Chem Precip)	ton/year	530	$153	$81,140	based on process model to remove metals and sulfate	From Jim Tieberg in 3/29/16 e-mail, cost from Terry Spooner at Graymont
10b	CO2 (Chem Precip and VSEP)	ton/year	40	$129	$5,179	based on process model to adjust pH	From Jim Tieberg in 3/29/16 e-mail, cost from David Stanaway at Praxair
10c	Hydrochloric Acid (standby)	lbs/year	0	$0.80	$0	based on process model to remove sulfate	From Hawkins quote e-mail 4/1/16
10d	Ferric Sulfate	lbs/year	40,150	$0.26	$10,439	based on process model to remove metals	From Hawkins quote e-mail 4/1/16
10e	Sodium Permanganate	lbs/year	9,693	$14.50	$140,551	2.5 ppm in GSF feed, based on from Area 5 WWTF pilot	From Hawkins quote e-mail 4/1/16
10f	MetClear MR2405 (Standby)	lbs/year	0	$4.64	$0	2 ppm in HDS influent when used, in range of manufacturer recommendations	Based on 3/31/16 e-mail from Paul Dillalo at GE
10g	Anionic Polymer (Standby)	lbs/year	0	$1.49	$0	2 ppm in HDS influent when used, based on typical polymer feed rates	From Jim Tieberg in 3/29/16 e-mail, cost from David Leingang at Nalco
10h	Sodium Bisulfite	lbs/year	5,816	$1.50	$8,724	1 ppm in membrane feeds, based on 5/1/13 cost estimate spreadsheet from GE	From Hawkins quote e-mail 4/1/16
10i	GE Hypersperse	lbs/year	10,662	$3.22	$34,333	2.2 ppm in membrane feeds, based on 5/1/13 cost estimate spreadsheet from GE	per GE e-mail 11/19/15
10j	Membrane Cleaner 1	lbs/year	3,450	$5.35	$18,455	16.25 gal/year per gpm, from GE e-mail 3/26/15	per GE e-mail 11/19/15, 2.5% solution S.G. = 1.025
10k	Membrane Cleaner 4	lbs/year	3,450	$3.07	$10,590	16.25 gal/year per gpm, from GE e-mail 3/26/15	per GE e-mail 11/19/15, 2.5% solution S.G. = 1.025
10l	NLR 759	gal/yr	1,164	$44	$51,225	10 ppm in secondary feed based on 5/9/13 pre-treatment specs from NLR	From NLR cost estimating spreadsheet
10m	NLR 404	gal/yr	8,085	$16	$129,356	4 gal/cleaning per 40 gpm module, 1 cleaning/day based on 11/11/13 specs from NLR	From NLR e-mail update 3/25/16 from Mark Galimberti
10n	NLR 505	gal/yr	8,085	$16	$129,356	4 gal/cleaning per 40 gpm module, 1 cleaning/day based on 11/11/13 specs from NLR	From NLR e-mail update 3/25/16 from Mark Galimberti
10o	Sludge Management	ton/year	3661	$36	$131,793	based on process model, assumes 50% solids	From Waste Management Quote 4/5/16 from Trevor Long
	Total Cost				$1,237,709		

CRE Mine Year 1 Closure Scenario
Mine Water Treatment Train, Mine Year 4

	Average Annual Flow (gpm)	TDH (ft)	Pump Efficiency (%)	Average Annual Power (HP)	Operation (Hours/year)	Energy Use (kW-hr/Year)	Comments
GS Filters							
Backwash Decant Pump	22	40	60	0.37	8760	3,000	2.5% of GS Influent
Backwash Precipitate Pump	22	60	60	0.56	8760	4,000	2.5% of GS Influent
Primary Membranes							
RO Feed Pumps	0	330	80	0.00	8760	-	
NF Feed Pumps	1107	160	80	55.93	8760	361,000	
Flush Water Pumps	1.5	100	80	0.05	8760	1,000	
CIP Pumps	0.4	100	80	0.01	8760	1,000	From GE info 5/3/13, 200 gal/year per gpm
Secondary Membranes							
Recycle from Chem Precip	70	40	60	1.18	8760	8,000	
Feed Pumps	221	1200	70	95.89	8760	618,000	
Flush Water Pumps	0.3	100	80	0.01	8760	1,000	
CIP Pumps	13	100	70	0.47	8760	4,000	VSEP 11/13 32,100 gpd for 375 gpm system
CIP Tank Heaters	13				8760	1,364,000	
Chemical Precipitation							
Chem Precip Feed Pumps	70	40	60	1.18	8760	8,000	
HDS Metals removal							
Rapid Mix (4)				4	8760	26,000	
Metals Removal Reaction Mixer (2)				4	8760	26,000	
HDS Drive (2)				6	8760	39,000	
HDS Recy	90	40	50	1.81	8760	12,000	
HDS Wast	3	50	50	0.07	8760	1,000	
Sulfate Removal							
Rapid Mix (4)				4	8760	26,000	
Sulfate Removal Reaction Mixer (2)				4	8760	26,000	
Sulfate Drive (2)				6	8760	39,000	
Sludge Re	8	40	50	0.16	8760	2,000	
Sludge Wa	0	50	50	0.00	8760	1,000	
Recarbonation							
Rapid Mix (2)				2	8760	13,000	
Recarb Drive (2)				2	8760	13,000	
Sludge Wa	0	50	50	0.00	8760	1,000	
Lime Feed							
Bag House blower				5.25	8760	34,000	
Bin Activator				3	8760	20,000	
Screw Feeder				1	8760	7,000	
Slurry Tank Mixer				3	8760	20,000	
Slurry Pump	200	125	50	12.63	8760	82,000	
Filter Press							
Feed Pump	3	320	50	0.47	8760	4,000	
Flush Water	0.15	3350	80	0.15	8760	1,000	5% of feed (assumed) at 1450 psi (per MW Watermark proposal)
Hydraulic Pump				50	1460	54,000	4 hours per day based on 50% of cycle time and 8 hour operation at 90 dry tons per day. Proportion Operation (hrs/year) with Feed Pump Flow
Miscellaneous							
Waste Pumping Station	90	50	60	1.90	8760	13,000	Assumes filter press goes from 25% to 60% solids
Effluent Blend Pump	886	40	80	11.19	8760	73,000	
Carbon Dioxide Carrier Water	106	180	80	6.04	8760	39,000	
Local Control Panels				2	8760	13,000	
Plant Water (blended permeate)	18	140	80	0.80	8760	6,000	lime water plus VSEP CIP plus 5 gpm, assumes 35% of lime mass needed as water
Plant Water (blended permeate)	5.4	130	80	0.22	8760	2,000	Primary CIP plus 5 gpm
Pumping to and from the Mine Site							
Pump Water from Cat 1 Cont Syst to EBA	26	50	60	0.55	8760	4,000	From GoldSim model, TDH from ME-004
Pump Water from Cat 2/3 Cont Syst to EBA		225	60	0.00	8760	-	From GoldSim model, TDH is weighted average of 3 sumps from ME-004
Pump Water Ore Surge Pile to EBA	0	90	60	0.00	8760	-	From GoldSim model, TDH from ME-004
Pump Water from Cat 4 Cont Syst to EBA	0	50	60	0.00	8760	-	From GoldSim model, TDH from ME-004
Pump Water from East Pit to EBA	860	120	60	43.43	8760	280,000	From GoldSim model, TDH from ME-004
Pump Water from Central Pit to EBA	0	60	60	0.00	8760	-	From GoldSim model, TDH from ME-004
Pump Water from Haul Road Runoff to EBA	0	100	60	0.00	8760	-	From GoldSim model, TDH is weighted average of 3 sumps from ME-004
Pump Water from Rail Transfer Hopper to EBA	0	60	60	0.00	8760	-	From GoldSim model, TDH from ME-004
WWTS Treated Mine Water to East Pit	886	45.1	60	16.80	6354	79,000	Assuming gravity flow from high point
Pump LS Mine Water from CPS to WWTS	886	58.5	60	21.82	8760	141,000	TDH from SOW 7
Bar screens				5.00	91.3	1,000	Assume two 5 hp motors run 15 minutes/day
Total						**1,106,000**	

Appendix B

Equipment Replacement Cost Estimate – Mine Year 1 Closure Scenario

Technical Memorandum

To: Jennifer Saran
From: Alison Ling, Bailey Hadnott, Bryan Oakley, Jeff Ubl, and Don Richard
Subject: Mine Year 1 Closure - Waste Water Treatment Basis for Equipment Replacement Costs
Date: December 5, 2017
Project: 23/69-0862.00
C: Jim Scott

This memorandum describes the process used to develop equipment replacement cost estimates for the Plant Site Waste Water Treatment System (WWTS) and associated water conveyance infrastructure for the proposed NorthMet Project (Project) by Poly Met Mining, Inc.. These estimates will be used to calculate a portion of the overall operating costs for Mine Year 1 closure.

Background

The Project has facilities that will continue to operate after mine closure. These facilities include:

- The WWTS at Mine Year 1 build out levels
- The Category 1 Stockpile Groundwater Containment System and pumps/piping to convey to the Central Pumping Station (CPS)
- Pumps/piping to convey water from the East Pit to the CPS (when flushing and when pit fully flooded)
- Pumps/piping to convey water from the CPS to the mine water treatment trains at the WWTS
- The Flotation Tailings Basin (FTB) Seepage Capture Systems water conveyance to the tailings basin seepage treatment train at the WWTS
- Pumps and piping to convey treated water from the WWTS to discharge points for stream augmentation and discharge to East Pit

Objective and Approach

The objective of this task was to develop equipment replacement cost estimates for the WWTS and associated water conveyance infrastructure for the reclamation phase in the event of Mine Year 1 closure.

The first step was to use the best available capital costs estimate to develop overall annual equipment replacement percentage that could be applied to the various equipment configurations. The 2014 Definitive Estimate is the most comprehensive capital cost estimate available but because it was developed more than two years ago, it was adjusted for inflation by using the Engineering News Record–Construction Cost Index (ENR-CCI) to bring the estimate to March 2016 dollars. It should be noted that replacement of the membrane filters is included in the waste water treatment operating costs and therefore not included in the WWTS equipment replacement costs.

Next, the March 2016 Definitive Estimate, Level-3 costs were grouped into categories such as laboratory equipment, tanks, pumping equipment, concrete and foundation, structural steel, piping, building electrical, etc. A service life was then assigned to each category based on the list of resources below. When a range was given for a category, the average number within that range was chosen as the appropriate service life.

1. Information published by the USEPA in "Asset Management: A Handbook for Small Water Systems", September, 2003 (EPA 816-R-03-016)
2. An Excel Spreadsheet Tool published by the USEPA in their "Asset Management Workshops" webpage, January 2017

The March 2016 Mine Year 1 capital costs were then divided by the assigned service life in years to calculate the annual equipment replacement costs for Mine Year 1 for each category. No adjustments were made for investment interest rate, future inflation, or future cost discounting.

The total annualized equipment replacement cost was divided by the total March 2016 Mine Year 1 capital cost to calculate the overall annualized equipment replacement percentages for the WWTS.

During the reclamation phase for Mine Year 1 closure, water conveyance from the Mine Site Category 1 Stockpile Groundwater Containment System and the East Pit to the WWTS mine water treatments train via the CPS and Mine to Plant Pipelines will continue and these costs are included in the Mine Year 1 capital equipment cost estimate. At the Plant Site, water conveyance from the FTB Seepage Capture Systems to the WWTS tailings basin seepage treatment train and the WWTS discharge for stream augmentation will also continue. Pipe costs for WWTS discharge and Mine to Pipe Pipelines are also included in the calculation of annual replacement costs.

Conveyance of treated water from the WWTS to the East Pit will occur for only approximately 4 years, so one of the existing Mine to Plant Pipelines and existing pumping equipment will be repurposed for this use. Then, after the East Pit is flooded and begins to overflow, this water will be conveyed to the WWTS via the Mine to Plant Pipelines as designed. Therefore, no additional capital costs are expected for these items.

Tables 1 and 2 show calculation of the annualized equipment replacement percentages. The service life, equipment capital cost and annualized replacement costs with the resulting overall annualized equipment replacement percentages for the WWTS tailings basin seepage treatment train (3.23%) and WWTS mine water treatment trains (3.58%), including associated water conveyance systems are provided in Tables 1 and 2. The capital costs shown in these tables are based on 2014 design and flows and loads and therefore do not represent the capital cost for the current flows and loads and the WWTS approach.

The overall annualized equipment replacement percentages were then multiplied by the capital cost of the equipment in service for Mine Year 15 using the WWTS approach which represents the planned long-term configuration to get annual long-term equipment replacement costs. These costs are assumed to be constant throughout closure. Because the Mine Year 7 influent flow to the tailings basin seepage treatment train is higher than the long-term influent flow, the equipment in service for that Mine Year and train were also determined to estimate the amount of additional capital required.

Table 3 is a description of projected process flows and expected equipment capacity for the relevant Mine Years. P50 flows for each WWTS process were estimated based on the influent P50 flows projected for each treatment train during each mine year analyzed. Number of units in service for each mine year for each process was estimated based on the P50 estimated flows

The estimate of the capital cost of equipment expected to be in service during those years is provided in Tables 4 and 5. These costs do not include installed membrane modules or elements, because the replacement of these items is covered separately in the O&M cost estimate. The overall annualized equipment replacement percentages from Tables 1 and 2 was multiplied by the expected equipment to be in service, to calculate the annualized equipment replacement costs for Mine Year 15. The difference between the Mine Year 1 and Mine Year 7 tailings basin seepage treatment train capital cost of equipment expected to be in service was used to determine the additional capital required to handle maximum influent flow.

These costs were estimated based on the 2014 definitive cost estimate adjusted for inflation to 2016 dollars according to the following method:

- P50 flows for each process for each train were estimated based on the influent P50 flows projected for each train during each mine year analyzed.
- Number of units in service for each mine year for each process was estimated based on the P50 estimated process flows
- Process equipment costs for each package, train, and mine year were estimated by scaling 2014 bid package costs by the anticipated number of units divided by the number of units assumed for the 2014 bid packages.
- Ancillary equipment costs at the tailings basin seepage treatment train were scaled from the 2014 estimate to the anticipated 3,000 gpm flow. Water conveyance costs for seepage collection is expected to remain the same after Mine Year 1, and was calculated by scaling the 2014 estimate to the anticipated Mine Year 1 design value of 4,000 gpm.
- Building costs for the WWTS building were based on individual WWTP and WWTF building costs from the 2014 estimate. These costs were divided into those that scale with building size and those that are relatively fixed with building size. Fixed costs were summed and scaling costs were scaled to the new building footprint (68,930 SF) and added. Building costs were split between tailings basin seepage treatment train and mine water treatment trains based on the floor space occupied by equipment during operations and during long-term configuration. This approach divides building space that is unused during long-term configuration based on the footprint used by each train’s equipment at that time.

- Ancillary equipment costs at the mine water treatment trains were based on the 2014 cost estimate. During Mine Years 2 through 5 when treated mine water is being conveyed to the East Pit, water conveyance costs for pumping from the WWTS to the Mine Site are expected to be similar to water conveyance costs for pumping water from the Mine Site to the WWTS. For Mine Years 10 through 51, the mine water will be pumped to the WWTS for treatment using the CPS and one pipeline. Waste water treatment equipment for filtration at the WWTS mine water treatment trains is assumed to be decommissioned and all mine water is conveyed to the tailings basin seepage treatment train for treatment. Because only one chemical precipitation train will be in use at the mine water treatment trains during closure, the ancillary equipment cost for this train were scaled using a ratio of the bid package capital costs in service during closure to bid package capital costs originally installed (approximately 0.27). Water conveyance costs at the Mine Site for the long-term configuration were scaled to the ratio of flow in Mine Year 15 to maximum flow (110 gpm/886 gpm) to reflect decommissioning of the majority of mine water collection equipment.
- CPS and Construction Mine Water Pumping Station costs were estimated by scaling the Splitter Structure costs from the 2014 definitive estimate to the square footage of the planned CPS and Construction Mine Water Pumping Station. Pumping equipment costs for these structures was estimated by scaling the cost of 2014 splitter pumps to the required horsepower of new pumps.
- Equalization basins and Construction Mine Water Basin costs were assumed to be the same as reflected in the 2014 definitive estimate, plus additional soil fill. Additional costs for soil fill were estimated from the proposed grading plan for the Equalization Basin Area and the unit cost for fill from the 2014 definitive estimate. Equalization basin costs during long-term configuration only include the High Concentration Equalization Basin, as the other two basins will be reclaimed early in closure.
- Capital expenses for required equipment additions were determined by subtracting the cost of equipment in service for the maximum equipment requirements (Mine Year 7) from the cost of equipment in service for Mine Year 1. Because the mine water filtration train will be taken offline after Mine Year 5, its VSEP modules can be repurposed for use in the tailings basin seepage treatment train. For this reason, the required VSEP equipment additions at the tailings basin seepage treatment train are based on Mine Year 4 instead of Mine Year 7.

The annualized equipment replacement costs are $1,804,316 for the WWTS tailings basin seepage treatment train and $969,079 for the WWTS mine water treatment trains including associated water conveyance systems. The WWTS tailings basin seepage treatment train requires addition capital of $11,783,623 to be able to handle that maximum influent flow in Mine Year 7.

Table 1 - Seepage Treatment Annualized Equipment Cost Summary (Based on 2014 Flows and Loads)

Area		Category	Service Life[g,h]	Footnote	Total Capital Cost (2016 $)[a]	Annualized Equipment Replacement Cost (2016 $)[b]	Annualized Equipment Replacement Percentage
Tailings Basin Seepage Treatment Train	**Bid Equipment Packages**	CO2 Injection	15	c	$ 245,444	$ 16,362.94	7%
		Limestone Contactor	15	c	$ 517,866	$ 34,524	7%
		Degasifier	15	c	$ 76,701	$ 5,113	7%
		VSEP	15	c, d	$ 4,090,121	$ 272,675	7%
		GS Filter and RO	15	c, d	$ 2,308,705	$ 153,914	7%
	Ancillary Equipment	Laboratory	7	c, e	$ 44,419	$ 6,345.57	14%
		Instrumentation	7	c	$ 143,828	$ 20,547	14%
		Equipment	15	c	$ 1,361,880	$ 90,792	7%
		Tanks	60	c	$ 805,671	$ 13,428	2%
		Pumping Equipment	15	c	$ 435,950	$ 29,063	7%
		Concrete and Foundation	75	f	$ 5,336,475	$ 71,153	1%
		Structural Steel	75	f	$ 1,669,068	$ 22,254	1%
		Finishes	40	c	$ 474,501	$ 11,863	3%
		Plumbing	40	c	$ 196,217	$ 4,905	3%
		HVAC	40	c	$ 661,695	$ 16,542	3%
		Switchgear and Power Equipment	40	f	$ 129,806	$ 3,245	3%
		Building Electrical	35	f	$ 1,908,121	$ 54,518	3%
		Electrical Controls	35	f	$ 285,806	$ 8,166	3%
		Motor Control Center	35	f	$ 607,837	$ 17,367	3%
		Piping	40	c	$ 2,940,583	$ 73,515	3%
		Valves	40	c	$ 516,092	$ 12,902	3%
		Bid Equipment Package Subtotal:			$ 7,238,837	$ 482,589	7%
		Ancillary Equipment Subtotal:			$ 17,517,949	$ 456,606	3%
		Subtotal:			$ 24,756,787	$ 939,195	3.79%
Water transport from FTB seepage capture systems to WWTS and from WWTS to discharge	**Seepage Collection**	Pumping Equipment	15	c	$ 143,881	$ 9,592	7%
		Piping	40	c	$ 2,492,527	$ 62,313	3%
		Valves	40	c	$ 279,298	$ 6,982	3%
		Instrumentation	7	c	$ 52,897	$ 7,557	14%
	Discharge	Pumping Equipment	15	c	$ 371,023	$ 24,735	7%
		Piping	40	c	$ 2,153,137	$ 53,828	3%
		Valves	40	c	$ 142,526.8	$ 3,563	3%
	Pre-Treatment Basin	Pond	60	c	$ 1,322,727	$ 22,045	2%
		Subtotal:			$ 6,958,017	$ 86,444	1.24%
		Total:			$ 31,714,804	$ 1,025,639	3.23%

[a] Cost includes installation costs, in March 2016 dollars
[b] Annualized costs include labor, in March 2016 dollars
[c] Service life from EPA publication *"Asset Management: A Handbook for Small Water Systems", EPA 816-R-03-016 Sept. 2003*
[d] Capital cost and annualized replacement costs do not include the price of membranes (which are accounted for in operational costs)
[e] "Laboratory Equipment" includes safety shower, eye wash, and analytical equipment associated with facility operation
[f] Asset Management Workshop Spreadsheet, USEPA, Jan. 2017
[g] when given a range of service lives, the average number was chosen (for example, 15-25 years will result in a 20 year service life assumption)
[h] service life estimates for systems were based on components' service lives as well as components' percentage of package

Table 2 - Mine Water Treatment Annualized Equipment Cost Summary (Based on 2014 Flows and Loads except where noted)

Area		Category	Service Life	Footnote	Total Capital Cost (2016 $)[a]	Annualized Equipment Replacement Cost (2016 $)[b]	Annualized Equipment Replacement Percentage
Mine Water Treatment Trains	**Bid Equipment Packages**	Nanofiltration	15	c, d	$ 1,364,270	$ 90,951	7%
		Lime Equipment	15	c	$ 571,217	$ 38,081	7%
		Chemical Precipitation	15	c	$ 3,290,840	$ 219,389	7%
		VSEP	15	c, d	$4,155,867	$ 277,058	7%
	Ancillary Equipment	Laboratory	7	c, e	$ 31,149	$ 4,450	14%
		Instrumentation	7	c	$ 234,840	$ 33,549	14%
		Equipment	15	c	$ 3,703,219	$ 246,881	7%
		Tanks	60	c	$ 567,573	$ 9,460	2%
		Pumping Equipment	15	c	$ 405,325	$ 27,022	7%
		Concrete and Foundation	75	f	$ 9,447,801	$ 125,971	1%
		Structural Steel	75	f	$ 1,239,573	$ 16,528	1%
		Finishes	40	c	$ 2,258,590	$ 56,465	3%
		Plumbing	40	c	$ 57,866	$ 1,447	3%
		HVAC	40	c	$ 545,226	$ 13,631	3%
		Switchgear and Power Equipment	40	f	$ 285,318	$ 7,133	3%
		Building Electrical	35	f	$ 2,226,325	$ 63,609	3%
		Electrical Controls	35	f	$ 295,151	$ 8,433	3%
		Motor Control Center	35	f	$ 628,139	$ 17,947	3%
		Piping	40	c	$ 3,003,763	$ 75,094	3%
		Valves	40	c	$ 738,506	$ 18,463	3%
	Bid Equipment Package Subtotal:				$ 9,382,194	$ 625,480	7%
	Ancillary Equipment Subtotal:				$ 25,668,368	$ 726,080	3%
	Subtotal:				$ 35,050,562	$ 1,351,560	4%
Water transport from Mine Site to CPS and from CPS to Plant Site, plus Equalization Basins	**Mine Water Collection and Conveyance**	Pumping Equipment	15	c	$ 303,404	$ 20,226.91	7%
		Piping	40	c	$ 1,235,430	$ 30,885.75	3%
		Valves	40	c	$ 130,248	$ 3,256	3%
		Instrumentation	7	c	$ 198,431	$ 28,347	14%
	Mine to Plant Pipelines[1]	Piping and Route Prep	40	c	$ 8,599,404	$ 214,985.10	3%
	Central Pumping Station[1]	Concrete and Steel	75	f	$ 774,260	$ 10,323	1%
		Plumbing and HVAC	40	c	$ 261,425	$ 6,536	3%
		Electrical, Controls, Instrumentation	35	f	$ 142,397	$ 4,068	3%
		Pumping/Equipment	15	c	$ 768,737	$ 51,249	7%
		Piping and Valves	40	c	$ 1,869,121	$ 46,728	3%
	Construction Mine Water Pumping Station[1]	Concrete and Steel	75	f	$ 500,000	$ 6,667	1%
		Plumbing and HVAC	40	c	$ 167,316	$ 4,183	3%
		Electrical, Controls, Instrumentation	35	f	$ 13,392	$ 383	3%
		Pumping/Equipment	15	c	$ 350,972	$ 23,398	7%
		Piping and Valves	40	c	$ 134,369	$ 3,359	3%
	Construction Mine Water Basin	Pond	60	c	$ 812,521	$ 13,542	2%
	Equalization Basins	Pond	60	c	$ 5,192,597	$ 86,543	2%
	Subtotal:				$ 15,448,906	$ 454,596	3%
Total:					$ 50,499,468	$ 1,806,155	3.58%

[1] These items significantly different in 2017 design for WWTS, so current design reflected instead of 2014 design
[a] Cost includes installation costs, in March 2016 dollars
[b] Annualized costs include labor, in March 2016 dollars
[c] Service life from EPA publication "*Asset Management: A Handbook for Small Water Systems*", *EPA 816-R-03-016 Sept. 2003*
[d] Capital cost and annualized replacement costs do not include the price of membranes (which are accounted for in operational costs)
[e] "Laboratory Equipment" includes safety shower, eye wash, and analytical equipment associated with facility operation
[f] Asset Management Workshop Spreadsheet, USEPA, Jan. 2017
[g] when given a range of service lives, the average number was chosen (for example, 15-25 years will result in a 20 year service life assumption)
[h] service life estimates for systems were based on components' service lives as well as components' percentage of package

Table 3 - Process flows and equipment capacity used for estimation of equipment in service

Treatment Train	Beginning of Mine Year	Treatment Sub-Train	Influent Process Flow to Equipment (gpm)[1]	Equipment Capacity (gpm)[2],[3]	Description of Equipment in Service
Tailings Basin Seepage Treatment Train	1 (initial build-out)	Filtration	1,937	NA	Influent P90 annual average flow
			1,985	2,100	Greensand filter (loading rate: 3.5 gpm/sf); 2 filters @ 1,050 gpm each)
			2,311	2,880	Primary membrane RO/NF (loading rate: 16 gfd; 4 skids @ 720 gpm each)
			553	560	Secondary membrane (loading rate: 60 gfd; 15 modules a@ 40 gpm each)
			1,757	2,160	Effluent stabilization (loading rate: 3 gpm/sf); 3 contactors @ 720 gpm each)
	2	Filtration	2,000	NA	Influent P50 annual average flow
			2,000	2,100	Greensand filter
			2,385	2,880	Primary membrane RO/NF
			571	600	Secondary membrane
			1,814	2,160	Effluent stabilization
	4	Filtration	2,973	NA	Influent P50 annual average flow
			2,973	3,150	Greensand filter
			3,762	4,320	Primary membrane RO/NF
			1032	1040	Secondary membrane
			2973	3,600	Effluent stabilization
	7	Filtration	2,941	NA	Influent P50 annual average flow
			2,941	3,150	Greensand filter
			3,802	4,320	Primary membrane RO/NF
			1,116	1,120	Secondary membrane
			2,941	3,600	Effluent stabilization
	15	Filtration	2,534	NA	Influent P50 annual average flow
			2,599	3,150	Greensand filter
			3,260	3,600	Primary membrane RO/NF
			943	960	Secondary membrane
			2,534	2,880	Effluent stabilization
Mine Water Treatment Trains	1 (initial build-out)	Filtration	495	NA	Influent P90 spring peak flow
			507	1820	Greensand filter (loading rate: 3.7 gpm/sf); 2 filter @ 910 gpm)
			471	1440	Primary membrane NF (loading rate: 16 gfd; 2 skids @ 720 gpm each)
			287	320	Secondary membrane (loading rate: 60 gfd; 8 modules a@ 40 gpm each)
		Chemical Precipitation	254	810	Metals, sulfate, and calcium chemical precipitation equipment (2 trains at 405 gpm each)
	2	Filtration	192	NA	Influent P50 annual average flow
			192	910	Greensand filter
			182	720	Primary membrane NF
			193	200	Secondary membrane
		Chemical Precipitation	207	405	Chem precip
	4	Filtration	886	NA	Influent P50 annual average flow
			886	910	Greensand filter
			1107	1440	Primary membrane NF
			291	320	Secondary membrane
		Chemical Precipitation	70	405	Chem precip
	7	Filtration	0	NA	No mine water flow in Years 7 and 8
		Chemical Precipitation	256	405	Chem precip only after Year 5
	15	Filtration	0	NA	Mine Site water conveyed directly to Tailings Basin Seepage Treatment Train
		Chemical Precipitation	217	405	Chem precip only after Year 5

[1] Process flows were estimated using annual average P90 influent flows for initial buildouts and P50 influent flows thereafter and process modeling using conservative assumptions for recycle loops (i.e., all primary membrane influent flow to RO at tailings basin seepage treatment train after Mine Year 2)

[2] Equipment capacities for Mine Year 1 are based on peak flow rates expected during P90 spring flood event conditions, which are higher than the listed annual average P90 flows. In later years, spring and summer flows will be equalized in the East Pit, so annual average flows are appropriate design flows.

[3] Equipment capacities were used to select number of units in service for each process for each Mine Year. Equipment unit loadings and capacities are based on pilot-test results. Primary membrane unit capacity 720gpm/skid, including 10% redundancy. Secondary membrane unit capacity is 40 gpm/module, not including redundancy, so one redundant module was included per 12-module skid.

Table 4 - Tailings Basin Seepage Treatment Train Equipment in Service and Annualized Equipment Replacement Costs Summary

		Mine Year	1 (Operations Configuration)		7 (Maximum Equipment Requirements)		15 (Long-Term Configuration)		Additions Required for Maximum Equipment[1]
		P50 Annual Average Flow (all to filtration) [6]	1937 gpm		2941 gpm		2534 gpm		CAPEX (2016 $)
		Unit Description	Units	Capex Cost (2016 $)	Units	Capex Cost (2016 $)	Units	Capex Cost (2016 $)	
Process Equipment Packages	Greensand Filter	1050 gpm filters	2	$ 1,179,014	3	$ 1,768,521	3	$ 1,768,521	$ 589,507
	Primary Membrane, RO and NF[2]	720 gpm skids	4	$ 3,382,253	6	$ 5,073,380	5	$ 4,227,817	$ 1,691,127
	Secondary Membrane, VSEP[2],[5]	40 gpm modules	15	$ 5,112,651	29	$ 9,884,459	25	$ 8,521,085	$ 4,090,121
	CO2 Injection	Lump Sum	1	$ 320,144	1	$ 320,144	1	$ 320,144	
	Stabilization	720 gpm contactors	3	$ 891,851	5	$ 1,486,418	4	$ 1,189,134	$ 594,567
	Process Equipment Subtotal			$ 10,885,913		$ 18,532,922		$ 16,026,701	$ 6,965,321
Building and Ancillary Equipment	WWTS Building[3]	Lump Sum	1	$ 10,484,000	1	$ 16,475,000	1	$ 16,475,000	
	Pre-Treatment Basin	Lump Sum	1	$ 1,322,727	1	$ 1,322,727	1	$ 1,322,727	
	Ancillary Equipment Base	Lump Sum	1	$ 9,636,604	1	$ 14,454,906	1	$ 14,454,906	$ 4,818,302
	Water Conveyance Total[4]	Lump Sum	1	$ 7,513,720	1	$ 7,513,720	1	$ 7,513,720	
	Ancillary Equipment and Water Conveyance Subtotal			$ 28,957,051		$ 39,766,353		$ 39,766,353	$ 4,818,302
Total Cost for Required Capital Additions									$ 11,783,623
Total Equipment in Service Less Membranes				$ 39,842,964		$ 58,299,275		$ 55,793,054	
Annualized Equipment Replacement Cost (3.23% of Service)				$ 1,288,499		$ 1,885,366		$ 1,804,316	

Costs are based on 2014 definitive cost estimate. Bid equipment package costs are scaled to account for the number of treatment units currently planned. Ancillary costs are scaled according to design flow for the given year. Water Transport costs planned for 2014 were already designed to accommodate 3,000 gpm and were not scaled up.

[1] Capital equipment additions reflect the capital cost of equipment required to treat the maximum loading year (Mine Year 7).

[2] Capital costs do not include individual membrane units. These replacement costs are included separately in the O&M cost estimate.

[3] Building space allocated based on percent of floor space used for equipment of each treatment train during operations (65% Mine Water Trains; 35% TB Seepage Train) and postclosure maintenance (45% Mine Water Trains; 55% TB Seepage Train) configurations.

[4] Water conveyance cost scaled from 2014 definitive cost estimate to allow for 4,000 gpm initial buildout in Mine Year 1.

[5] Two VSEP modules from the mine water treatment train will be re-purposed for use in the tailings basin seepage treatment train, so additional capital costs for only 12 module additions are included.

[6] Flow for MY1 relects peak annual average flows and P90 concentrations used to size equipment planned for full equipment buildout.

Table 5 - Mine Water Treatment Trains Equipment in Service and Annualized Equipment Replacement Costs Summary

		Mine Year	1 (Operations Configuration)		15 (Long-Term Configuration)		Additions Required for Maximum Equipment
		P50 Annual Average Flow [6]	495 gpm to filtration, 184 gpm to chem precip		110 gpm to WWTP filtration		CAPEX (2016 $)
		Unit Description	Units	Capex Cost (2016 $)	Units	Capex Cost (2016 $)	
Process Equipment Packages	Greensand Filter	910 gpm filters	2	$ 1,021,812	0	$ -	
	Primary Membrane, Nanofiltration[1]	720 gpm skids	2	$ 1,691,127	0	$ -	
	Secondary Membrane, VSEP[1]	40 gpm modules	9	$ 3,400,255	0	$ -	
	Chemical Precipitation[7]	405 gpm/40 gpm trains[2]	2	$ 4,803,141	1	$ 2,824,511	
	Process Equipment Subtotal			$ 10,916,335		$ 2,824,511	$ -
Building and Ancillary Equipment	WWTS Building[2]	Lump Sum	1	$ 19,470,000	1	$ 13,479,000	
	Equalization and CMW Basins[3]	Lump Sum	1	$ 6,005,118	1	$ 978,707	
	Ancillary Equipment [4]	Lump Sum	1	$ 9,861,836	0	$ 2,551,669	
	Conveyance to and from Mine Site[5]	Lump Sum	1	$ 13,331,393	1	$ 6,966,070	
	Water Conveyance at Mine Site [8]	Lump Sum	1	$ 2,377,358		$ 295,157	
	Ancillary Equipment and Water Conveyance Subtotal			$ 51,045,706		$ 24,270,603	$ -
Total Cost for Required Capital Additions							$ -
Total Equipment in Service Less Membranes				$ 61,962,041		$ 27,095,115	
Annualized Equipment Replacement Cost (3.58% of Service)				$ 2,216,124		$ 969,079	

Costs are based on 2014 definitive cost estimate. Bid equipment package costs are scaled to account for the number of treatment units currently planned. Ancillary and water transport costs are equal to Mine Year 1 design values, because flows following Mine Year 1 Closure will be less than the Mine Year 1 installed capacity.

[1] Capital costs do not include individual membrane units. These replacement costs are included separately in the O&M cost estimate.

[2] Building space allocated based on percent of floor space used for equipment of each treatment train during operations (65% Mine Water Trains; 35% TB Seepage Train) and postclosure maintenance (45% Mine Water Trains; 55% TB Seepage Train) configurations.

[3] Only High Concentration Equalization Basin included for long-term configuration. Other Mine Site basins will be reclaimed.

[4] Ancillary equipment after Mine Year 5 will only include equipment associated with chemical precipitation, costs scaled to the ratio of the cost of one chemical precip train to the total equipment package costs in Mine Year 1.

[5] Includes CPS, Construction Mine Water Pumping Station, and Mine to Plant Pipelines. During postclosure, maintenance only CPS and HS and LS pipelines included.

[6] Flow for MY1 relects Peak Annual Average Flows used to size equipment planned for full equipment buildout.

[7] Chemical precipitation costs include filter press, which was not included in definitive cost estimate.

[8] Water conveyance to Mine Site during closure only includes piping to carry 110 gpm from East Pit. Costs scaled to this flow divided by the maximum flow (886 in Mine Year 4).

Appendix C

Updated Process Model Outputs – Mine Year 1 Closure Scenario

Tailings Basin Seepage Treatment Train - Year 2
CRE Mine Year 1 Closure Scenario

Qualities and Quantities	Preliminary Water Quality Targets	(1) Influent	(2) Green Sand Effluent	(3) RO Feed	NF Rejection	(4) NF Feed	RO Rejection	(5) RO Permeate	VSEP Rejection	(6) NF Permeate	(7) RO Concentrate	(8) NF Concentrate	(9) NF/RO Concentrate w/CO2	(10) VSEP Permeate	(11) VSEP Concentrate	(12) Stabilization Influent	(13) Stabilized Effluent	System Mass Balance	Target Met?
Flow Rate, gpm		2000	1900	1881		504		1411		404	470	101	571	485	86	1814	1814	N/A	
[Ag] [mg/L]	0.001	1.20E-04	1.20E-04	1.20E-04	5.35E-01	2.31E-05	9.96E-01	1.76E-06	9.60E-01	9.73E-06	4.76E-04	7.68E-05	4.06E-04	1.93E-05	2.65E-03	3.53E-06	3.53E-06	100.0%	Target Met
[Al] [mg/L]	0.125	1.33E-02	1.33E-02	1.33E-02	9.51E-01	8.21E-04	9.91E-01	1.41E-04	9.94E-01	6.76E-05	5.28E-02	3.85E-03	4.42E-02	3.32E-04	2.98E-01	1.25E-04	1.25E-04	100.0%	Target Met
[As] [mg/L]	0.01	4.41E-03	3.25E-05	3.25E-05	9.89E-01	1.18E-04	9.92E-01	5.63E-07	5.06E-01	2.35E-06	1.29E-04	5.83E-04	2.09E-04	1.21E-04	7.17E-04	9.60E-07	9.60E-07	100.0%	Target Met
[B] [mg/L]	0.5	3.07E-01	3.07E-01	3.07E-01	2.08E-01	7.40E-01	6.14E-01	1.58E-01	1.50E-01	7.32E-01	7.56E-01	7.70E-01	7.58E-01	7.57E-01	7.72E-01	2.85E-01	2.85E-01	100.1%	Target Met
[Ba] [mg/L]	2	1.89E-01	1.89E-01	1.89E-01	9.35E-01	5.41E-02	1.00E+00	0.00E+00	9.38E-01	1.24E-02	7.60E-01	2.22E-01	6.65E-01	4.88E-02	4.23E+00	2.76E-03	2.76E-03	100.0%	Target Met
[Be] [mg/L]	0.004	2.68E-04	2.68E-04	2.68E-04	9.51E-01	4.12E-03	9.96E-01	2.49E-06	1.50E-01	3.34E-04	1.07E-03	1.93E-02	4.29E-03	4.28E-03	4.36E-03	7.61E-05	7.61E-05	99.1%	Target Met
[C] [mg/L]		4.05E+02	4.05E+02	4.05E+02	4.88E-01	2.03E+03	9.78E-01	7.01E+00	4.00E-01	1.30E+03	1.60E+03	4.98E+03	3.30E+03	2.09E+03	8.07E+03	2.94E+02	3.60E+02	100.0%	NA
[Ca] [mg/L]		4.47E+01	4.47E+01	4.47E+01	9.26E-01	2.12E+01	9.96E-01	4.77E-01	8.93E-01	5.11E+00	1.78E+02	8.61E+01	1.62E+02	2.03E+01	9.83E+02	1.51E+00	4.60E+01	100.1%	NA
[Cd] [mg/L]	0.0025	1.37E-04	1.37E-04	1.37E-04	9.50E-01	1.87E-05	9.99E-01	1.64E-06	9.74E-01	1.57E-06	5.44E-04	8.79E-05	4.64E-04	1.41E-05	3.07E-03	1.62E-06	1.62E-06	100.0%	Target Met
[Cl] [mg/L]	230	2.17E+01	2.17E+01	2.17E+01	9.40E-02	7.65E+01	9.83E-01	2.89E-01	1.33E-01	8.66E+01	8.61E+01	3.62E+01	7.74E+01	7.87E+01	7.00E+01	1.94E+01	1.94E+01	100.0%	Target Met
[Co] [mg/L]	0.005	2.77E-03	4.29E-05	4.29E-05	9.75E-01	9.88E-06	9.99E-01	4.57E-07	9.51E-01	3.94E-07	1.71E-04	4.81E-05	1.49E-04	8.58E-06	9.63E-04	4.43E-07	4.43E-07	100.0%	Target Met
[Cr] [mg/L]	0.011	5.77E-04	5.77E-04	5.77E-04	9.51E-01	2.78E-04	9.99E-01	6.15E-06	8.93E-01	2.29E-05	2.30E-03	1.31E-03	2.12E-03	2.66E-04	1.29E-02	9.87E-06	9.87E-06	100.0%	NA
[Cu] [mg/L]	0.0093	5.67E-03	3.47E-04	3.47E-04	9.38E-01	5.85E-05	9.91E-01	4.62E-06	9.66E-01	4.53E-06	1.38E-03	2.76E-04	1.18E-03	4.72E-05	7.76E-03	4.60E-06	4.60E-06	100.0%	Target Met
[F] [mg/L]	2	3.92E+00	3.92E+00	3.92E+00	6.50E-01	1.85E+01	9.81E-01	5.74E-02	4.00E-01	3.02E+00	1.56E+01	8.08E+01	2.71E+01	1.91E+01	7.35E+01	7.16E-01	7.16E-01	100.1%	Target Met
[Fe] [mg/L]	0.3	2.31E+00	2.43E-02	2.43E-02	9.52E-01	4.71E-03	1.00E+00	0.00E+00	9.60E-01	1.12E-03	9.77E-02	1.92E-02	8.39E-02	3.94E-03	5.47E-01	2.49E-04	2.49E-04	100.0%	Target Met
[K] [mg/L]		9.84E+00	9.84E+00	9.84E+00	5.90E-01	1.79E+01	9.94E-01	1.31E-01	6.27E-01	9.17E+00	3.91E+01	5.31E+01	4.16E+01	1.82E+01	1.77E+02	2.14E+00	2.14E+00	100.1%	NA
[Mg] [mg/L]		7.75E+01	7.75E+01	7.75E+01	9.48E-01	9.31E+01	9.96E-01	6.19E-01	7.60E-01	6.85E+00	3.09E+02	4.40E+02	3.32E+02	9.37E+01	1.71E+03	2.00E+00	2.00E+00	100.1%	NA
[Mn] [mg/L]	0.05	3.12E-01	4.93E-02	4.93E-02	9.59E-01	6.30E-02	1.00E+00	0.00E+00	7.45E-01	8.89E-03	1.98E-01	2.81E-01	2.13E-01	6.36E-02	1.08E+00	1.97E-03	1.97E-03	100.0%	Target Met
[Na] [mg/L]		6.98E+01	6.98E+01	6.98E+01	5.76E-01	1.10E+02	9.91E-01	9.30E-01	6.67E-01	5.81E+01	2.78E+02	3.18E+02	2.85E+02	1.11E+02	1.29E+03	1.36E+01	1.36E+01	100.1%	NA
[Ni] [mg/L]	0.052	1.58E-02	2.18E-03	2.18E-03	9.74E-01	4.48E-04	9.99E-01	2.32E-05	9.57E-01	1.90E-05	8.67E-03	2.17E-03	7.53E-03	3.80E-04	4.89E-02	2.23E-05	2.23E-05	100.0%	Target Met
[Pb] [mg/L]	0.0032	1.25E-03	1.37E-04	1.37E-04	9.72E-01	1.91E-05	9.99E-01	1.64E-06	9.73E-01	8.84E-07	5.43E-04	9.27E-05	4.64E-04	1.45E-05	3.07E-03	1.47E-06	1.47E-06	100.0%	Target Met
[Sb] [mg/L]	0.031	6.33E-04	6.33E-04	6.33E-04	9.51E-01	1.57E-04	9.99E-01	6.74E-06	9.47E-01	1.25E-05	2.52E-03	7.38E-04	2.21E-03	1.38E-04	1.42E-02	8.02E-06	8.02E-06	100.0%	Target Met
[Se] [mg/L]	0.005	5.73E-04	5.73E-04	5.73E-04	9.72E-01	7.22E-05	9.98E-01	3.81E-06	9.77E-01	2.79E-06	2.29E-03	3.52E-04	1.95E-03	5.26E-05	1.29E-02	3.59E-06	3.59E-06	100.0%	Target Met
[SiO2] [mg/L]		3.48E+01	3.48E+01	3.48E+01	2.21E-01	1.37E+01	9.94E-01	2.78E-01	9.07E-01	1.33E+01	1.39E+02	1.52E+01	1.17E+02	1.28E+01	7.21E+02	3.17E+00	3.17E+00	100.0%	NA
[SO4] [mg/L]	10	2.28E+02	2.28E+02	2.28E+02	9.71E-01	1.55E+02	9.93E-01	1.52E+00	8.53E-01	6.18E+00	9.10E+02	7.54E+02	8.82E+02	1.52E+02	5.11E+03	2.55E+00	2.55E+00	100.1%	Target Met
[Tl] [mg/L]	0.00056	1.57E-04	1.57E-04	1.57E-04	9.51E-01	3.89E-05	9.95E-01	1.67E-06	9.47E-01	3.15E-06	6.26E-04	1.83E-04	5.48E-04	3.42E-05	3.52E-03	2.00E-06	2.00E-06	100.0%	Target Met
[V] [mg/L]		4.26E-03	4.26E-03	4.26E-03	9.51E-01	2.59E-03	9.95E-01	4.54E-05	8.67E-01	2.13E-04	1.70E-02	1.22E-02	1.61E-02	2.52E-03	9.49E-02	8.27E-05	8.27E-05	100.1%	NA
[Zn] [mg/L]	0.12	1.16E-02	2.68E-04	2.68E-04	9.67E-01	6.64E-05	9.98E-01	3.21E-06	9.47E-01	3.40E-06	1.07E-03	3.20E-04	9.34E-04	5.85E-05	6.00E-03	3.25E-06	3.25E-06	100.0%	Target Met
[Alkalinity] [mg/L] as CaCO3	250	3.15E+02	3.15E+02	3.15E+02	5.10E-01	7.84E+02	9.78E-01	5.45E+00	5.00E-01	5.01E+02	1.25E+03	1.92E+03	1.37E+03	8.03E+02	4.64E+03	1.16E+02	2.27E+02	113.9%	Target Met
Hardness** [mg/L]	100	430.9	430.8	430.8	0.0	436.3	0.0	3.7	0.0	41.0	1718.7	2028.4	1773.8	436.5	9516.1	12.0	123.2	N/A	Target not Met
[Ionic_Strength] [M]		0.016	0.016	0.016	0.000	0.022	0.000	0.000	0.000	0.009	0.058	0.068	0.060	0.022	0.23731	0.00206	0.00524	N/A	NA
[Charge_pct_err]		0.493	0.234	0.234	0.000	-23.947	0.000	-12.302	0.000	-56.489	0.384	-3.809	-0.490	-24.541	14.53389	-53.84528	-25.38486	N/A	NA
[pH] [std units]	6.5-8.5	7.4	7.4	7.4	0.0	6.2	0.0	7.5	0.0	6.2	7.3	6.2	6.2	6.2	6.5	6.3	6.8	N/A	Target Met
mEQ-Na^+/mEQ-∑Cations	0.6	25%	26%	26%	0%	34%	0%	34%	0%	71%	25%	25%	25%	35%	22%	67%	19%	N/A	Target Met
CO2 [mg/L]		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	803.0	0.0	0.0	0.0	0.0	N/A	
CO2 [kg/d]		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2500.0	0.0	0.0	0.0	0.0	N/A	
CaCO3 [mg/L]		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	111.2	N/A	
CaCO3 [kg/day]		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1100.0	N/A	

Temp 7.55 degrees C

222.56

****Calculated as the sum of Ca and Mg as CaCO3**

Tailings Basin Seepage Treatment Train - Year 4
CRE Mine Year 1 Closure Scenario

Qualities and Quantities	Preliminary Water Quality Targets	(1) Influent	(2) Green Sand Effluent	(3) RO Feed	Percent RO Rejection	(5) RO Permeate	(7) RO Concentrate	(4) NF Feed	Percent NF Rejection	(6) NF Permeate	(8) NF Concentrate	(9) NF/RO Concentrate w/CO2	Percent VSEP Rejection	(10) VSEP A Permeate	(11) VSEP A Concentrate	(14) VSEP B Permeate	(15) VSEP B Concentrate	(16)Chem Precip Influent	(17) HDS Effluent	(18) Sulfate Effluent	(19) CO2-1 Effluent	(20) CO2-2 Effluent	(12) Stabilization Influent	(13) Stabilized Effluent	Target Met?
Flow Rate, gpm		2973	2897	724		543	181	3037		2430	607	789		670	118	195	49	243	243	243	243	0	2973	2973	
[Ag] [mg/L]	0.001	1.14E-04	1.11E-04	1.11E-04	98.90%	1.63E-06	4.41E-04	2.75E-04	39.20%	3.49E-05	2.75E-04	3.13E-04	95.96%	1.48E-05	2.06E-03	3.86E-07	2.06E-03	1.00E-03	3.91E-05	7.74E-06	7.74E-06	7.72E-06	2.88E-05	2.88E-05	Target Met
[Al] [mg/L]	0.125	1.59E-02	1.55E-02	1.55E-02	99.20%	1.65E-04	6.16E-02	5.23E-02	94.40%	9.19E-04	5.23E-02	5.45E-02	99.36%	4.09E-04	3.70E-01	1.41E-06	3.70E-01	1.79E-01	1.79E-01	1.78E-01	1.78E-04	1.77E-04	7.81E-04	7.81E-04	Target Met
[As] [mg/L]	0.01	3.38E-03	2.43E-05	2.43E-05	98.70%	4.20E-07	9.62E-05	1.94E-04	98.90%	7.85E-07	1.94E-04	1.72E-04	50.60%	9.95E-05	5.94E-04	1.58E-08	5.94E-04	2.88E-04	2.61E-08	2.59E-08	2.59E-08	2.58E-08	7.18E-07	7.18E-07	Target Met
[B] [mg/L]	0.5	3.36E-01	3.28E-01	3.28E-01	61.40%	1.68E-01	8.09E-01	3.71E-01	29.20%	3.53E-01	3.71E-01	4.71E-01	15.00%	4.70E-01	4.84E-01	2.87E-01	4.84E-01	2.75E-01	2.76E-01	2.73E-01	2.73E-01	2.72E-01	3.19E-01	3.19E-01	Target Met
[Ba] [mg/L]	2	1.28E-01	1.25E-01	1.25E-01	100.00%	0.00E+00	5.03E-01	3.95E-01	90.30%	2.21E-02	3.95E-01	4.20E-01	93.75%	3.08E-02	2.69E+00	1.80E-04	2.69E+00	1.30E+00	2.35E-03	2.33E-03	2.33E-03	2.32E-03	1.81E-02	1.81E-02	Target Met
[Be] [mg/L]	0.004	3.29E-04	3.21E-04	3.21E-04	99.30%	2.99E-06	1.28E-03	1.23E-02	94.50%	2.12E-04	1.23E-02	9.76E-03	15.00%	9.73E-03	1.00E-02	3.96E-03	1.00E-02	5.41E-03	3.81E-03	3.77E-03	3.77E-03	3.77E-03	1.74E-04	1.74E-04	Target Met
[C] [mg/L]		5.08E+02	4.95E+02	4.95E+02	98.70%	8.57E+00	1.96E+03	1.81E+03	48.80%	4.73E+02	1.81E+03	2.48E+03	40.00%	1.75E+03	6.80E+03	1.26E+01	6.80E+03	3.29E+03	2.21E+01	7.20E-01	1.76E+01	1.69E+01	3.88E+02	4.25E+02	NA
[Ca] [mg/L]		5.75E+01	5.60E+01	5.60E+01	99.20%	5.97E-01	2.23E+02	1.85E+02	88.60%	1.10E+01	1.85E+02	1.94E+02	89.33%	2.42E+01	1.18E+03	2.05E+00	1.18E+03	5.87E+02	1.93E+01	6.91E+02	1.55E+01	1.55E+01	9.08E+00	3.38E+01	NA
[Cd] [mg/L]	0.0025	1.32E-04	1.28E-04	1.28E-04	99.10%	1.54E-06	5.12E-04	4.45E-04	94.40%	7.95E-06	4.45E-04	4.61E-04	97.41%	1.40E-05	3.07E-03	4.13E-07	3.07E-03	1.50E-03	1.30E-05	1.29E-05	1.29E-05	1.29E-05	6.78E-06	6.78E-06	Target Met
[Cl] [mg/L]	230	2.05E+01	2.00E+01	2.00E+01	99.00%	2.66E-01	7.96E+01	9.92E+00	9.40%	2.38E+01	9.92E+00	2.59E+01	13.33%	2.63E+01	2.36E+01	1.40E+01	2.36E+01	3.14E+02	1.32E+01	1.31E+01	1.31E+01	1.30E+01	1.95E+01	1.95E+01	Target Met
[Co] [mg/L]	0.005	2.65E-03	3.99E-05	3.99E-05	99.20%	4.25E-07	1.59E-04	1.48E-04	97.20%	1.22E-06	1.48E-04	1.51E-04	95.10%	8.66E-06	9.81E-04	1.17E-12	9.81E-04	4.75E-04	2.96E-08	1.94E-11	1.94E-11	1.93E-11	1.07E-06	1.07E-06	Target Met
[Cr] [mg/L]	0.011	5.73E-04	5.58E-04	5.58E-04	99.20%	5.95E-06	2.23E-03	4.96E-03	94.50%	8.69E-05	4.96E-03	4.33E-03	89.33%	5.42E-04	2.65E-02	8.58E-03	2.65E-02	7.05E-02	6.57E-02	6.50E-02	6.50E-02	6.49E-02	7.21E-05	7.21E-05	NA
[Cu] [mg/L]	0.0093	5.74E-03	3.42E-04	3.42E-04	99.00%	4.56E-06	1.36E-03	1.23E-03	93.80%	2.03E-05	1.23E-03	1.26E-03	96.60%	5.03E-05	8.33E-03	9.11E-05	8.33E-03	6.13E-03	2.20E-03	2.18E-03	2.17E-03	2.17E-03	1.74E-05	1.74E-05	Target Met
[F] [mg/L]	2	2.61E+00	2.54E+00	2.54E+00	98.90%	3.72E-02	1.01E+01	2.12E+01	38.60%	7.94E-01	2.12E+01	1.86E+01	40.00%	1.31E+01	5.10E+01	2.26E+00	5.10E+01	2.59E+01	2.59E+01	3.05E+00	3.05E+00	3.04E+00	6.56E-01	6.56E-01	Target Met
[Fe] [mg/L]	0.3	3.11E+00	3.19E-02	3.19E-02	100.00%	0.00E+00	1.28E-01	9.71E-02	100.00%	5.70E-03	9.71E-02	1.04E-01	96.00%	4.89E-03	6.84E-01	1.02E-04	6.84E-01	1.58E+02	2.09E-03	2.07E-03	2.07E-03	2.07E-03	4.66E-03	4.66E-03	Target Met
[K] [mg/L]		9.43E+00	9.20E+00	9.20E+00	99.00%	1.22E-01	3.66E+01	6.36E+01	59.00%	1.10E+01	6.36E+01	5.74E+01	62.67%	2.51E+01	2.46E+02	1.46E+02	2.46E+02	3.19E+02	3.20E+02	3.17E+02	3.17E+02	3.16E+02	9.00E+00	9.00E+00	NA
[Mg] [mg/L]		9.84E+01	9.59E+01	9.59E+01	99.40%	7.66E-01	3.83E+02	4.52E+02	94.60%	7.05E+00	4.52E+02	4.36E+02	76.00%	1.23E+02	2.27E+03	1.08E-03	2.27E+03	1.10E+03	2.42E+02	1.88E-01	3.65E-03	3.65E-03	5.90E+00	5.90E+00	NA
[Mn] [mg/L]	0.05	5.47E-01	8.42E-02	8.42E-02	100.00%	0.00E+00	3.38E-01	3.77E-01	91.10%	1.19E-02	3.77E-01	3.68E-01	74.53%	1.10E-01	1.88E+00	2.86E-03	1.88E+00	9.15E-01	9.16E-01	9.07E-03	9.07E-03	9.06E-03	9.76E-03	9.76E-03	Target Met
[Na] [mg/L]		6.22E+01	6.07E+01	6.07E+01	99.00%	8.08E-01	2.41E+02	3.96E+02	48.58%	7.25E+01	3.96E+02	3.60E+02	66.67%	1.41E+02	1.64E+03	9.77E+02	1.64E+03	2.39E+03	2.39E+03	2.37E+03	2.37E+03	2.37E+03	5.94E+01	5.94E+01	NA
[Ni] [mg/L]	0.052	1.36E-02	1.83E-03	1.83E-03	99.20%	1.95E-05	7.29E-03	6.72E-03	97.10%	5.88E-05	6.72E-03	6.86E-03	95.70%	3.46E-04	4.49E-02	2.64E-10	4.49E-02	2.17E-02	8.89E-07	4.97E-09	4.97E-09	4.96E-09	5.16E-05	5.16E-05	Target Met
[Pb] [mg/L]	0.0032	9.09E-04	9.67E-05	9.67E-05	99.10%	1.16E-06	3.85E-04	3.47E-04	96.90%	3.31E-06	3.47E-04	3.56E-04	97.33%	1.11E-05	2.37E-03	4.66E-08	2.37E-03	1.15E-03	1.42E-06	1.41E-06	1.41E-06	1.41E-06	2.92E-06	2.92E-06	Target Met
[Sb] [mg/L]	0.031	5.78E-04	5.63E-04	5.63E-04	99.20%	6.00E-06	2.25E-03	2.04E-03	94.50%	3.46E-05	2.04E-03	2.09E-03	94.67%	1.30E-04	1.35E-02	2.24E-05	1.35E-02	6.86E-03	6.86E-03	6.80E-03	3.40E-04	3.39E-04	2.94E-05	2.94E-05	Target Met
[Se] [mg/L]	0.005	5.31E-04	5.18E-04	5.18E-04	99.50%	3.45E-06	2.07E-03	1.89E-03	96.80%	1.50E-05	1.89E-03	1.93E-03	97.70%	5.21E-05	1.29E-02	9.36E-05	1.29E-02	9.49E-03	9.50E-03	6.58E-03	3.29E-03	3.29E-03	1.29E-05	1.29E-05	Target Met
[SiO2] [mg/L]		3.48E+01	3.39E+01	3.39E+01	99.40%	2.71E-01	1.36E+02	4.62E+01	24.10%	4.05E+01	4.62E+01	6.67E+01	90.67%	7.30E+00	4.14E+02	2.48E+02	4.14E+02	2.16E+03	2.16E+03	2.15E+03	2.15E+03	2.15E+03	3.31E+01	3.31E+01	NA
[S] [mg/L]	10	251.49	245.20	245.20	99.50%	1.63	980.21	1317.22	86.70%	1.08E+01	1.32E+03	1.24E+03	8.53E-01	2.13E+02	7.24E+03	7.62E+02	7.24E+03	7.11E+03	7.93E+03	4.20E+03	4200.02	4192.36	9.14E+00	9.14E+00	Target Met
[Tl] [mg/L]	0.00056	1.27E-04	1.24E-04	1.24E-04	99.20%	1.32E-06	4.92E-04	1.26E-03	94.70%	2.17E-05	1.26E-03	1.08E-03	94.68%	6.75E-05	7.01E-03	2.65E-03	7.01E-03	4.09E-02	4.10E-02	4.03E-02	4.03E-02	4.02E-02	1.80E-05	1.80E-05	Target Met
[V] [mg/L]		3.08E-03	3.00E-03	3.00E-03	99.20%	3.20E-05	1.20E-02	1.20E-02	94.50%	2.11E-04	1.20E-02	1.20E-02	86.67%	1.88E-03	7.12E-02	7.67E-08	7.12E-02	3.44E-02	4.70E-07	4.65E-07	4.65E-07	4.64E-07	1.78E-04	1.78E-04	NA
[Zn] [mg/L]	0.12	9.20E-03	2.07E-04	2.07E-04	99.10%	2.48E-06	8.23E-04	8.94E-04	98.40%	9.51E-06	8.94E-04	8.78E-04	94.67%	5.49E-05	5.69E-03	4.07E-04	5.69E-03	8.59E-03	6.23E-03	6.17E-03	6.17E-03	6.16E-03	8.22E-06	8.22E-06	Target Met
[Alkalinity] [mg/L] as HCO3-*	250	4.83E+02	4.71E+02	4.71E+02	97.80%	4.39E+00	1.88E+03	1.99E+03	70.00%	2.12E+02	1.99E+03	1.96E+03	60.00%	2.30E+02	1.21E+04	2.81E+03	1.21E+04	8.92E+03	2.21E+03	7.75E+03	5.68E+03	5.66E+03	1.74E+02	2.49E+02	Target Met
Hardness** [mg/L]	100	548.6	534.9	534.9	0.0	4.6	2135.0	2324.0	0.0	56.5	2324.0	2281.0	0.0	566.4	12299.3	5.1	12299.3	5987.1	1042.9	1727.2	38.8	38.7	47.0	108.7	Target not Met
[Ionic_Strength] [M]		0.019	0.018	0.018	0.00	0.00019	0.06606	0.07326	0.00	0.00509	0.1	0.1	0.00	0.07326	0.25490	0.06196	0.25490	0.25292	0.21683	0.21577	0.18795	0.18760	0.00420	0.00595	NA
[Charge_pct_err]		0.537	0.221	0.221	0.00	6.39279	0.18908	4.03437	0.00	1.73443	4.03437	3.08311	0.00	33.71585	-9.04700	-14.97455	-9.04700	-20.84387	-24.00463	-21.64908	-24.74796	-24.74358	1.76130	1.33066	NA
[pH] [std units]	6.5-8.5	7.4	7.4	7.4	0.0	6.4	7.4	8.5	0.0	6.2	8.5	6.8	0.0	8.5	9.7	12.5	9.7	10.6	10.8	12.7	12.5	12.5	6.2	6.4	Target Met
mEQ-Na⁺/mEQ-∑Cations	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Target Met
Lime, mg/L				0%	0.00			0%	0.00		0%	0%	0.00						2263.6	3772.7					
Lime, kg/day				0%	0.00			0%	0.00		0%	0%	0.00						3000.0	5000.0					
Sulfuric Acid [mg/L]		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Sulfuric Acid [kg/d]		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
CO2 [mg/L]		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	754.5	0.0	0.0	0.0	
CO2 [kg/d]		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2000.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1000.0	0.0	0.0	0.0	
CaCO3 [mg/L]		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	61.70629118	
CaCO3 [kg/day]		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1000	

*Converted from as CaCO3 to as HCO3-
**Calculated as the sum of Ca and Mg as CaCO3

Temp 7.55
286.76

Tailings Basin Seepage Treatment Train - Year 7
CRE Mine Year 1 Closure Scenario

Qualities and Quantities	Preliminary Water Quality Targets	(1) Influent	(2) Green Sand Effluent	(3) RO Feed	Percent RO Rejection	(5) RO Permeate	(7) RO Concentrate	(4) NF Feed	Percent NF Rejection	(6) NF Permeate	(8) NF Concentrate	(9) NF/RO Concentrate w/CO2	Percent VSEP Rejection	(10) VSEP A Permeate	(11) VSEP A Concentrate	(14) VSEP B Permeate	(15) VSEP B Concentrate	(16)Chem Precip Influent	(17) HDS Effluent	(18) Sulfate Effluent	(19) CO2-1 Effluent	(20) CO2-2 Effluent	(12) Stabilization Influent	(13) Stabilized Effluent	Target Met?
Flow Rate, gpm		2941	2866	2006		1504	501	1796		1437	359	861		732	129	205	51	256	256	256	256	0	2941	2941	
[Ag] [mg/L]	0.001	2.20E-04	2.15E-04	2.15E-04	98.90%	1.14E-06	8.59E-04	3.09E-04	39.20%	6.69E-05	3.09E-04	6.30E-04	95.96%	2.99E-05	4.13E-03	6.92E-07	6.85E-05	2.09E-03	6.99E-05	1.38E-05	1.38E-05	1.38E-05	3.32E-05	3.32E-05	Target Met
[Al] [mg/L]	0.125	1.39E-02	1.35E-02	1.35E-02	99.20%	1.62E-04	5.37E-02	3.16E-02	94.40%	4.04E-04	3.16E-02	4.45E-02	99.36%	3.34E-04	3.02E-01	1.19E-06	7.72E-04	1.52E-01	1.52E-01	1.50E-01	1.51E-04	1.50E-04	2.80E-04	2.80E-04	Target Met
[As] [mg/L]	0.01	5.45E-03	3.91E-05	3.91E-05	98.70%	4.17E-07	1.56E-04	3.91E-04	98.90%	1.08E-06	3.91E-04	2.54E-04	50.60%	1.47E-04	8.77E-04	9.52E-08	4.07E-07	4.41E-04	1.57E-07	1.56E-07	1.56E-07	1.55E-07	7.41E-07	7.41E-07	Target Met
[B] [mg/L]	0.5	3.01E-01	2.94E-01	2.94E-01	61.40%	1.51E-01	7.24E-01	4.52E-01	29.20%	4.28E-01	4.52E-01	6.11E-01	15.00%	6.09E-01	6.26E-01	3.86E-01	2.84E-01	3.70E-01	3.70E-01	3.67E-01	3.67E-01	3.66E-01	2.86E-01	2.86E-01	Target Met
[Ba] [mg/L]	2	3.79E-02	3.70E-02	3.70E-02	100.00%	0.00E+00	1.48E-01	1.01E-01	90.30%	1.75E-03	1.01E-01	1.29E-01	93.75%	9.45E-03	8.25E-01	3.22E-04	2.01E-02	4.18E-01	4.20E-03	4.16E-03	4.16E-03	4.15E-03	8.56E-04	8.56E-04	Target Met
[Be] [mg/L]	0.004	4.03E-04	3.93E-04	3.93E-04	99.30%	2.09E-06	1.57E-03	3.80E-02	94.50%	4.84E-04	3.80E-02	1.68E-02	15.00%	1.67E-02	1.72E-02	9.78E-03	7.20E-03	1.00E-02	9.39E-03	9.29E-03	9.30E-03	9.27E-03	2.38E-04	2.38E-04	Target Met
[C] [mg/L]		2.49E+02	2.43E+02	2.43E+02	98.70%	7.11E+00	9.53E+02	1.97E+03	48.80%	5.13E+02	1.97E+03	2.25E+03	40.00%	1.58E+03	6.14E+03	3.66E+02	1.02E+03	3.28E+03	7.71E-01	5.14E-01	2.18E+00	4.91E+02	2.54E+02	2.92E+02	NA
[Ca] [mg/L]		6.84E+01	6.67E+01	6.67E+01	99.20%	3.55E-01	2.67E+02	2.13E+02	88.60%	4.23E+00	2.13E+02	2.44E+02	89.33%	3.06E+01	1.49E+03	1.31E+01	4.57E+02	8.30E+02	5.20E+02	1.08E+03	9.93E+01	9.90E+01	2.24E+00	2.72E+01	NA
[Cd] [mg/L]	0.0025	3.03E-04	2.96E-04	2.96E-04	99.10%	3.94E-07	1.19E-03	7.36E-04	94.40%	9.63E-06	7.36E-04	9.99E-04	97.41%	3.03E-05	6.64E-03	1.51E-06	2.36E-04	3.38E-03	4.75E-05	4.70E-05	4.71E-05	4.69E-05	4.90E-06	4.90E-06	Target Met
[Cl] [mg/L]	230	1.99E+01	1.94E+01	1.94E+01	99.00%	4.38E-01	7.64E+01	1.59E+01	9.40%	3.82E+01	1.59E+01	5.12E+01	13.33%	5.20E+01	4.66E+01	2.86E+01	1.84E+01	2.18E+02	2.70E+01	2.67E+01	2.67E+01	2.66E+01	1.89E+01	1.89E+01	Target Met
[Co] [mg/L]	0.005	6.14E-03	9.27E-05	9.27E-05	99.20%	1.23E-07	3.72E-04	2.54E-04	97.20%	1.62E-06	2.54E-04	3.23E-04	95.10%	1.86E-05	2.10E-03	1.10E-11	8.87E-10	1.05E-03	4.87E-08	1.81E-10	1.81E-10	1.80E-10	8.55E-07	8.55E-07	Target Met
[Cr] [mg/L]	0.011	1.56E-03	1.52E-03	1.52E-03	99.20%	2.03E-06	6.12E-03	2.34E-02	94.50%	2.98E-04	2.34E-02	1.33E-02	89.33%	1.67E-03	8.13E-02	3.25E-02	1.13E+00	2.52E-01	2.49E-01	2.46E-01	2.46E-01	2.45E-01	1.46E-04	1.46E-04	NA
[Cu] [mg/L]	0.0093	8.27E-02	4.93E-03	4.93E-03	99.00%	5.91E-05	1.96E-02	1.27E-02	93.80%	2.09E-04	1.27E-02	1.67E-02	96.60%	6.66E-04	1.10E-01	5.39E-04	6.39E-02	6.78E-02	1.30E-02	1.28E-02	1.28E-02	1.28E-02	1.32E-04	1.32E-04	Target Met
[F] [mg/L]	2	1.28E+00	1.25E+00	1.25E+00	98.90%	3.16E-02	4.92E+00	4.12E+00	38.60%	1.59E+00	4.12E+00	4.59E+00	40.00%	3.23E+00	1.25E+01	1.61E+00	4.49E+00	7.17E+00	7.18E+00	2.17E+00	2.18E+00	2.17E+00	7.95E-01	7.95E-01	Target Met
[Fe] [mg/L]	0.3	6.90E+00	7.08E-02	7.08E-02	100.00%	0.00E+00	2.84E-01	1.85E-01	100.00%	2.31E-03	1.85E-01	2.43E-01	96.00%	1.14E-02	1.59E+00	2.39E-04	2.39E-02	1.01E+02	4.88E-03	4.83E-03	4.83E-03	4.81E-03	1.13E-03	1.13E-03	Target Met
[K] [mg/L]		1.01E+01	9.82E+00	9.82E+00	99.00%	7.84E-02	3.92E+01	1.14E+02	59.00%	1.96E+01	1.14E+02	7.02E+01	62.67%	3.08E+01	3.01E+02	1.86E+02	1.30E+03	4.05E+02	4.06E+02	4.02E+02	4.02E+02	4.01E+02	9.62E+00	9.62E+00	NA
[Mg] [mg/L]		1.08E+02	1.05E+02	1.05E+02	99.40%	5.62E-01	4.22E+02	4.85E+02	94.60%	6.62E+00	4.85E+02	4.48E+02	76.00%	1.26E+02	2.33E+03	4.11E-03	5.43E-02	1.17E+03	3.30E+01	2.76E-01	1.39E-02	1.38E-02	3.52E+00	3.52E+00	NA
[Mn] [mg/L]	0.05	8.49E-01	1.31E-01	1.31E-01	100.00%	0.00E+00	5.25E-01	6.40E-01	91.10%	6.80E-03	6.40E-01	5.73E-01	74.53%	1.71E-01	2.92E+00	4.61E-03	5.63E-02	1.48E+00	1.48E+00	1.46E-02	1.46E-02	1.46E-02	3.32E-03	3.32E-03	Target Met
[Na] [mg/L]		5.48E+01	5.34E+01	5.34E+01	99.00%	6.40E-01	2.12E+02	5.76E+02	48.58%	1.05E+02	5.76E+02	3.64E+02	66.67%	1.42E+02	1.66E+03	1.03E+03	8.59E+03	2.50E+03	2.50E+03	2.50E+03	2.50E+03	2.49E+03	5.17E+01	5.17E+01	NA
[Ni] [mg/L]	0.052	4.77E-02	6.41E-03	6.41E-03	99.20%	8.54E-06	2.57E-02	1.73E-02	97.10%	1.15E-04	1.73E-02	2.22E-02	95.70%	1.12E-03	1.45E-01	5.31E-09	4.93E-07	7.28E-02	3.63E-06	9.98E-08	9.98E-08	9.95E-08	6.03E-05	6.03E-05	Target Met
[Pb] [mg/L]	0.0032	3.80E-03	4.05E-04	4.05E-04	99.10%	5.39E-07	1.62E-03	1.03E-03	96.90%	7.40E-06	1.03E-03	1.38E-03	97.33%	4.32E-05	9.16E-03	1.30E-06	1.98E-04	4.64E-03	3.98E-05	3.94E-05	3.94E-05	3.93E-05	3.89E-06	3.89E-06	Target Met
[Sb] [mg/L]	0.031	1.57E-03	1.54E-03	1.54E-03	99.20%	2.04E-06	6.16E-03	4.20E-03	94.50%	5.37E-05	4.20E-03	5.34E-03	94.67%	3.34E-04	3.45E-02	5.96E-05	4.41E-03	1.82E-02	1.82E-02	1.80E-02	9.03E-04	9.00E-04	2.73E-05	2.73E-05	Target Met
[Se] [mg/L]	0.005	9.98E-04	9.73E-04	9.73E-04	99.50%	2.59E-06	3.90E-03	2.55E-03	96.80%	1.83E-05	2.55E-03	3.34E-03	97.70%	9.01E-05	2.23E-02	1.68E-04	2.97E-02	1.70E-02	1.70E-02	1.18E-02	5.90E-03	5.89E-03	1.02E-05	1.02E-05	Target Met
[SiO2] [mg/L]		3.48E+01	3.39E+01	3.39E+01	99.40%	2.71E-01	1.35E+02	6.11E+01	24.10%	5.33E+01	6.11E+01	1.04E+02	90.67%	1.14E+01	6.47E+02	3.09E+02	1.25E+04	2.71E+03	2.71E+03	2.68E+03	2.68E+03	2.67E+03	2.62E+01	2.62E+01	NA
[S] [mg/L]	10	505.67	493.01	493.01	99.50%	4.60	1965.53	2073.48	86.70%	1.54E+01	2.07E+03	2.01E+03	8.53E-01	3.46E+02	1.17E+04	4.20E+02	1.02E+04	7.89E+03	4.34E+03	2.31E+03	2313.96	2306.84	9.87E+00	9.87E+00	Target Met
[Tl] [mg/L]	0.00056	1.59E-04	1.55E-04	1.55E-04	99.20%	1.03E-06	6.20E-04	1.37E-03	94.70%	1.74E-05	1.37E-03	9.32E-04	94.68%	5.82E-05	6.03E-03	1.74E-03	1.29E-01	2.71E-02	2.72E-02	2.65E-02	2.65E-02	2.64E-02	9.02E-06	9.02E-06	Target Met
[V] [mg/L]		3.11E-03	3.03E-03	3.03E-03	99.20%	2.02E-05	1.21E-02	1.04E-02	94.50%	1.33E-04	1.04E-02	1.14E-02	86.67%	1.78E-03	6.75E-02	1.93E-07	5.24E-06	3.39E-02	1.18E-06	1.17E-06	1.17E-06	1.17E-06	7.54E-05	7.54E-05	NA
[Zn] [mg/L]	0.12	1.81E-02	4.06E-04	4.06E-04	99.10%	1.08E-06	1.63E-03	2.68E-03	98.40%	2.26E-05	2.68E-03	2.06E-03	94.67%	1.29E-04	1.33E-02	2.82E-03	2.09E-01	4.56E-02	4.31E-02	4.27E-02	4.27E-02	4.26E-02	1.16E-05	1.16E-05	Target Met
[Alkalinity] [mg/L] as HCO3-*	250	2.38E+02	2.32E+02	2.32E+02	97.80%	5.57E+00	9.16E+02	1.06E+03	70.00%	2.63E+02	1.06E+03	9.77E+02	60.00%	2.29E+02	5.34E+03	1.97E+03	1.23E+04	4.82E+03	2.90E+03	6.98E+03	3.99E+03	3.97E+03	1.31E+02	2.07E+02	Target Met
Hardness** [mg/L]	100	616.3	600.9	600.9	0.0	3.2	2402.9	2530.5	0.0	37.8	2530.5	2456.7	0.0	596.4	13305.2	32.8	1142.4	6886.9	1435.1	2707.8	248.0	247.2	20.1	82.5	Target Met
[Ionic_Strength] [M]		0.021	0.021	0.021	0.00	0.00023	0.07201	0.08466	0.00	0.00629	0.1	0.1	0.00	0.08466	0.32067	0.05264	0.43435	0.24968	0.16581	0.19585	0.13976	0.13537	0.00320	0.00498	NA
[Charge_pct_err]		0.275	-0.394	-0.394	0.00	-36.46273	-0.06944	16.10321	0.00	0.31417	16.10321	7.56771	0.00	22.66804	3.07797	9.44679	2.04350	2.58936	3.51043	3.23646	4.20536	4.35780	-0.63943	-0.45222	NA
[pH] [std units]	6.5-8.5	7.4	7.4	7.4	0.0	6.9	7.4	6.3	0.0	6.3	6.3	6.1	0.0	6.3	6.9	12.1	10.3	8.9	11.2	12.5	12.0	11.4	6.3	6.7	Target Met
mEQ-Na^{+}/mEQ-∑Cations	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Target Met
Lime, mg/L				0%	0.00			0%	0.00		0%	0%	0.00						5023.6	3588.3					
Lime, kg/day				0%	0.00			0%	0.00		0%	0%	0.00						7000.0	5000.0					
Sulfuric Acid [mg/L]		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Sulfuric Acid [kg/d]		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
CO2 [mg/L]		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1076.5	358.8	0.0	0.0	
CO2 [kg/d]		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3000.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1500.0	500.0	0.0	0.0	
CaCO3 [mg/L]		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	62.37769591	
CaCO3 [kg/day]		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1000	

*Converted from as CaCO3 to as HCO3-

**Calculated as the sum of Ca and Mg as CaCO3

Temp 7.55

246.06

Tailings Basin Seepage Treatment Train - Year 15
WIth Chemical Precipitation

Qualities and Quantities	Preliminary Water Quality Targets	(1) Influent	(2) Green Sand Effluent	(3) RO Feed	Percent RO Rejection	(5) RO Permeate	(7) RO Concentrate	(4) NF Feed	Percent NF Rejection	(6) NF Permeate	(8) NF Concentrate	(9) NF/RO Concentrate w/CO2	Percent VSEP Rejection	(10) VSEP A Permeate	(11) VSEP A Concentrate	(14) VSEP B Permeate	(15) VSEP B Concentrate	(16)Chem Precip Influent	(17) HDS Effluent	(18) Sulfate Effluent	(19) CO2-1 Effluent	(20) CO2-2 Effluent	(12) Stabilization Influent	(13) Stabilized Effluent	Target Met?
Flow Rate, gpm		**2534**	**2469**	**1481**		**1111**	**370**	**1779**		**1423**	**356**	**726**		**617**	**109**	**174**	**43**	**217**	**217**	**217**	**217**	**0**	**2534**	**2534**	
[Ag] [mg/L]	**0.001**	9.02E-05	9.25E-05	9.25E-05	98.90%	1.60E-06	3.67E-04	5.53E-05	39.20%	4.48E-05	9.78E-05	2.35E-04	95.96%	1.12E-05	1.53E-03	7.20E-07	1.53E-03	7.79E-04	7.24E-05	1.44E-05	1.44E-05	1.43E-05	2.58E-05	2.58E-05	Target Met
[Al] [mg/L]	**0.125**	1.37E-02	1.28E-02	1.28E-02	99.20%	1.54E-04	5.10E-02	7.23E-03	94.40%	6.23E-04	3.38E-02	4.26E-02	99.36%	3.20E-04	2.88E-01	1.13E-06	2.88E-01	1.44E-01	1.44E-01	1.43E-01	1.43E-04	1.42E-04	4.17E-04	4.17E-04	Target Met
[As] [mg/L]	**0.01**	3.83E-03	3.08E-05	3.08E-05	98.70%	2.95E-06	1.15E-04	5.63E-05	98.90%	1.12E-06	2.78E-04	1.95E-04	50.60%	1.13E-04	6.71E-04	1.64E-09	6.71E-04	3.34E-04	2.70E-09	2.68E-09	2.68E-09	2.67E-09	1.93E-06	1.93E-06	Target Met
[B] [mg/L]	**0.5**	2.77E-01	2.61E-01	2.61E-01	61.40%	1.50E-01	5.95E-01	3.32E-01	29.20%	3.35E-01	3.18E-01	4.60E-01	15.00%	4.59E-01	4.69E-01	2.88E-01	4.69E-01	2.75E-01	2.75E-01	2.73E-01	2.73E-01	2.72E-01	2.54E-01	2.54E-01	Target Met
[Ba] [mg/L]	**2**	2.48E-02	2.42E-02	2.42E-02	100.00%	0.00E+00	9.72E-02	1.54E-02	90.30%	6.15E-03	5.25E-02	7.53E-02	93.75%	5.53E-03	4.80E-01	3.74E-04	4.80E-01	2.44E-01	4.86E-03	4.82E-03	4.82E-03	4.81E-03	3.45E-03	3.45E-03	Target Met
[Be] [mg/L]	**0.004**	3.41E-04	3.35E-04	3.35E-04	99.30%	3.56E-06	1.33E-03	2.46E-03	94.50%	2.11E-04	1.14E-02	6.28E-03	15.00%	6.27E-03	6.41E-03	1.03E-03	6.41E-03	3.34E-03	9.88E-04	9.81E-04	9.81E-04	9.78E-04	1.20E-04	1.20E-04	Target Met
[C] [mg/L]		4.84E+02	4.67E+02	4.67E+02	98.70%	4.48E+01	1.74E+03	8.96E+02	48.80%	5.67E+02	2.22E+03	2.15E+03	40.00%	1.63E+03	6.29E+03	7.31E+02	6.29E+03	3.53E+03	8.29E-01	4.05E-01	6.31E-01	9.79E+02	3.38E+02	4.57E+02	NA
[Ca] [mg/L]		6.10E+01	5.82E+01	5.82E+01	99.20%	6.20E-01	2.32E+02	4.63E+01	88.60%	6.13E+00	2.08E+02	2.20E+02	89.33%	2.76E+01	1.34E+03	4.51E+01	1.34E+03	9.73E+02	5.62E+02	1.46E+03	3.41E+02	3.40E+02	3.71E+00	8.34E+01	NA
[Cd] [mg/L]	**0.0025**	1.50E-04	2.18E-04	2.18E-04	99.10%	2.61E-06	8.68E-04	1.29E-04	94.40%	1.11E-05	6.03E-04	7.38E-04	97.41%	2.25E-05	4.89E-03	4.31E-07	4.89E-03	2.45E-03	1.35E-05	1.34E-05	1.34E-05	1.34E-05	7.39E-06	7.39E-06	Target Met
[Cl] [mg/L]	**230.00**	1.38E+01	1.37E+01	1.37E+01	99.00%	1.64E-01	5.45E+01	5.24E+01	9.40%	2.36E+01	1.68E+02	1.10E+02	13.33%	1.12E+02	9.98E+01	6.10E+01	9.98E+01	4.50E+02	5.74E+01	5.69E+01	5.69E+01	5.66E+01	1.33E+01	1.33E+01	Target Met
[Co] [mg/L]	**0.005**	3.79E-03	7.90E-05	7.90E-05	99.20%	9.47E-07	3.14E-04	4.94E-05	97.20%	4.25E-06	2.31E-04	2.73E-04	95.10%	1.57E-05	1.77E-03	1.30E-12	1.77E-03	8.82E-04	9.02E-08	2.15E-11	2.15E-11	2.14E-11	2.80E-06	2.80E-06	Target Met
[Cr] [mg/L]	**0.011**	7.01E-04	7.37E-04	7.37E-04	99.20%	8.83E-06	2.93E-03	6.70E-04	94.50%	5.84E-05	3.12E-03	3.02E-03	89.33%	3.79E-04	1.84E-02	1.33E-03	1.84E-02	1.81E-02	1.01E-02	1.00E-02	1.00E-02	1.00E-02	3.67E-05	3.67E-05	NA
[Cu] [mg/L]	**0.0093**	4.14E-02	3.85E-03	3.85E-03	99.00%	4.61E-05	1.53E-02	2.34E-03	93.80%	1.81E-04	1.10E-02	1.32E-02	96.60%	5.27E-04	8.67E-02	1.86E-04	8.67E-02	4.75E-02	4.46E-03	4.42E-03	4.42E-03	4.40E-03	1.22E-04	1.22E-04	Target Met
[F] [mg/L]	**2**	3.10E-01	3.15E-01	3.15E-01	98.90%	0.00E+00	1.26E+00	5.67E-01	38.60%	4.78E-01	9.28E-01	1.10E+00	40.00%	7.75E-01	2.99E+00	1.27E+00	2.99E+00	2.18E+00	2.18E+00	1.70E+00	1.70E+00	1.70E+00	2.68E-01	2.68E-01	Target Met
[Fe] [mg/L]	**0.3**	2.89E+00	2.84E-02	2.84E-02	100.00%	4.92E-04	1.13E-01	1.72E-02	100.00%	5.38E-03	6.49E-02	8.92E-02	96.00%	4.19E-03	5.83E-01	5.98E-05	5.83E-01	2.07E+02	1.22E-03	1.21E-03	1.21E-03	1.20E-03	3.24E-03	3.24E-03	Target Met
[K] [mg/L]		7.48E+00	7.53E+00	7.53E+00	99.00%	1.30E-01	2.98E+01	1.62E+01	59.00%	1.30E+01	2.93E+01	2.96E+01	62.67%	1.30E+01	1.26E+02	7.74E+01	1.26E+02	1.69E+02	1.69E+02	1.67E+02	1.67E+02	1.67E+02	7.34E+00	7.34E+00	NA
[Mg] [mg/L]		9.28E+01	8.71E+01	8.71E+01	99.40%	8.12E-01	3.47E+02	8.47E+01	94.60%	7.30E+00	3.96E+02	3.71E+02	76.00%	1.05E+02	1.92E+03	1.11E-01	1.92E+03	9.57E+02	4.19E+02	3.74E-01	3.74E-01	3.73E-01	4.45E+00	4.45E+00	NA
[Mn] [mg/L]	**0.05**	8.26E-01	1.22E-01	1.22E-01	100.00%	2.12E-03	4.85E-01	1.16E-01	91.10%	3.60E-02	4.39E-01	4.63E-01	74.53%	1.38E-01	2.35E+00	3.69E-03	2.35E+00	1.18E+00	1.18E+00	1.17E-02	1.17E-02	1.17E-02	2.12E-02	2.12E-02	Target Met
[Na] [mg/L]		3.63E+01	3.65E+01	3.65E+01	99.00%	6.32E-01	1.45E+02	7.78E+01	48.58%	6.27E+01	1.38E+02	1.41E+02	66.67%	5.53E+01	6.41E+02	3.92E+02	6.41E+02	9.56E+02	9.57E+02	9.50E+02	9.50E+02	9.46E+02	3.55E+01	3.55E+01	NA
[Ni] [mg/L]	**0.052**	3.12E-02	6.08E-03	6.08E-03	99.20%	7.29E-05	2.42E-02	3.74E-03	97.10%	3.23E-04	1.75E-02	2.09E-02	95.70%	1.06E-03	1.36E-01	2.86E-10	1.36E-01	6.79E-02	3.44E-06	5.36E-09	5.36E-09	5.35E-09	2.13E-04	2.13E-04	Target Met
[Pb] [mg/L]	**0.0032**	2.13E-03	2.30E-04	2.30E-04	99.10%	2.75E-06	9.13E-04	1.36E-04	96.90%	1.17E-05	6.35E-04	7.77E-04	97.33%	2.44E-05	5.15E-03	2.13E-08	5.15E-03	2.57E-03	6.49E-07	6.44E-07	6.44E-07	6.42E-07	7.78E-06	7.78E-06	Target Met
[Sb] [mg/L]	**0.031**	1.03E-03	1.39E-03	1.39E-03	99.20%	1.67E-05	5.54E-03	8.83E-04	94.50%	7.61E-05	4.13E-03	4.85E-03	94.67%	3.03E-04	3.12E-02	5.36E-05	3.12E-02	1.63E-02	1.63E-02	1.62E-02	8.11E-04	8.08E-04	5.00E-05	5.00E-05	Target Met
[Se] [mg/L]	**0.005**	5.00E-04	5.46E-04	5.46E-04	99.50%	5.09E-06	2.18E-03	3.30E-04	96.80%	2.80E-05	1.54E-03	1.87E-03	97.70%	5.04E-05	1.24E-02	9.31E-05	1.24E-02	9.40E-03	9.40E-03	6.53E-03	3.27E-03	3.25E-03	1.80E-05	1.80E-05	Target Met
[SiO2] [mg/L]		3.48E+01	3.47E+01	3.47E+01	99.40%	3.70E-01	1.38E+02	5.17E+01	24.10%	5.07E+01	5.14E+01	9.58E+01	90.67%	1.05E+01	5.91E+02	2.95E+02	5.91E+02	2.56E+03	2.56E+03	2.55E+03	2.55E+03	2.54E+03	2.86E+01	2.86E+01	NA
[S] [mg/L]	**10.00**	214.41	204.55	204.55	99.50%	1.91	815.63	190.70	86.70%	1.62E+01	8.92E+02	8.53E+02	8.53E-01	1.47E+02	4.95E+03	2.67E+02	4.95E+03	3.73E+03	3.68E+03	1.47E+03	1468.87	1463.99	9.92E+00	9.92E+00	Target Met
[Tl] [mg/L]	**0.00056**	6.01E-05	6.03E-05	6.03E-05	99.20%	5.62E-07	2.41E-04	1.12E-04	94.70%	9.42E-06	5.05E-04	3.70E-04	94.68%	2.31E-05	2.38E-03	7.21E-04	2.38E-03	1.11E-02	1.11E-02	1.09E-02	1.09E-02	1.09E-02	5.53E-06	5.53E-06	Target Met
[V] [mg/L]		1.52E-03	1.84E-03	1.84E-03	99.20%	1.96E-05	7.35E-03	1.40E-03	94.50%	1.23E-04	6.54E-03	6.95E-03	86.67%	1.09E-03	4.10E-02	8.39E-09	4.10E-02	2.04E-02	5.12E-08	5.08E-08	5.08E-08	5.06E-08	7.74E-05	7.74E-05	NA
[Zn] [mg/L]	**0.12**	8.62E-03	3.34E-04	3.34E-04	99.10%	3.11E-06	1.33E-03	2.22E-04	98.40%	1.91E-05	1.04E-03	1.19E-03	94.67%	7.43E-05	7.64E-03	1.06E-04	7.64E-03	5.34E-03	1.62E-03	1.61E-03	1.61E-03	1.60E-03	1.21E-05	1.21E-05	Target Met
[Alkalinity] [mg/L] as HCO3-*	**250**	4.60E+02	4.34E+02	4.34E+02	97.80%	5.78E+00	1.73E+03	4.50E+02	70.00%	1.56E+02	1.62E+03	1.67E+03	60.00%	3.93E+02	9.10E+03	7.48E+02	9.10E+03	5.85E+03	2.42E+03	5.83E+03	2.41E+03	2.41E+03	9.03E+01	3.33E+02	Target not Met
Hardness [mg/L]**	**100**	534.5	504.2	504.2	0.0	4.9	2009.8	464.4	0.0	45.4	2148.5	2077.8	0.0	499.6	11244.5	113.2	11244.5	6370.3	3129.9	3640.1	853.7	850.9	27.6	226.7	Target not Met
[Ionic_Strength] [M]		0.017	0.017	0.017	0.00	0.00020	0.05867	0.01744	0.00	0.00434	0.1	0.1	0.00	0.06286	0.21130	0.02317	0.21130	0.16791	0.13158	0.15043	0.07883	0.07444	0.00254	0.00817	NA
[Charge_pct_err]		0.608	0.397	0.397	0.00	-3.80232	0.47947	0.93392	0.00	5.03932	-0.21273	0.12932	0.00	0.11402	0.22913	4.30079	0.22913	-4.25356	-5.46812	-4.49437	-7.54091	-8.26166	4.78443	1.73694	NA
[pH] [std units]	**6.5-8.5**	7.4	7.3	7.3	0.0	5.5	7.6	6.3	0.0	5.9	6.6	6.7	0.0	6.6	9.1	8.1	9.1	9.1	10.6	12.4	10.7	9.5	5.9	6.7	Target Met
mEQ-Na$^+$/mEQ-∑Cations	**60%**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Target Met
Lime, mg/L				0%	0.00			0%	0.00		0%	0%	0.00						3376.0	2532.0					
Lime, kg/day				0%	0.00			0%	0.00		0%	0%	0.00						4000.0	3000.0					
Sulfuric Acid [mg/L]		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Sulfuric Acid [kg/d]		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
CO2 [mg/L]		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1223.8	717.4	0.0	0.0	
CO2 [kg/d]		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	500.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1450.0	850.0	0.0	0.0	
CaCO3 [mg/L]		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	199.0904539	
CaCO3 [kg/day]		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2750	

***Converted from as CaCO3 to as HCO3-**

****Calculated as the sum of Ca and Mg as CaCO3**

Temp 7.55 degrees C

Mine Water Treatment Trains - Year 2
CRE Mine Year 1 Closure Scenario

Chem Precip Concentrations	Water Quality Targets (mg/L)	West EQ (12)	From Plant Site to HDS (2)	Media Filtration Backwash Solids	From VSEP A (4)	From VSEP B (5)	Combined HDS Influent (13)	HDS Effluent (14)	Sulfate Effluent (15)	pH Adjustment Effluent 1 (16)	pH Adjustment Effluent 2 (17)	Combined Discharge (18)	Effluent Target Met?
Flow Rate, GPM		82	81	5	7	31	206	206	206	206	206	350	
[Ag] [mg/L]	0.001	5.76E-03	2.72E-03	2.52E-06	2.51E-05	1.30E-02	5.32E-03	2.63E-03	2.63E-03	2.65E-03	2.64E-03	4.12E-04	Target Met
[Al] [mg/L]	0.125	7.33E+01	3.06E-01	1.30E-03	3.21E-02	1.48E-01	2.96E+01	2.91E+01	2.91E-02	2.93E-02	2.92E-02	4.24E-03	Target Met
[As] [mg/L]	0.01	1.10E-01	7.36E-04	1.18E+00	1.69E-01	8.56E-06	7.80E-02	3.32E-06	3.32E-06	3.35E-06	3.34E-06	3.36E-03	Target Met
[B] [mg/L]	0.5	2.53E-01	7.93E-01	8.90E-02	1.37E-01	4.93E-01	4.91E-01	4.83E-01	4.83E-01	4.87E-01	4.86E-01	2.86E-01	Target Met
[Ba] [mg/L]	2	3.38E-02	4.35E+00	2.11E-02	4.77E-01	2.14E-02	1.72E+00	4.42E-03	4.42E-03	4.46E-03	4.45E-03	2.30E-03	Target Met
[Be] [mg/L]	0.004	3.67E-03	4.48E-03	2.60E-04	2.33E-03	2.14E-03	3.63E-03	1.16E-03	1.16E-03	1.17E-03	1.17E-03	5.91E-04	Target Met
[C] [mg/L]		3.56E+03	8.29E+03	1.34E+03	1.59E+04	7.38E+02	5.34E+03	9.08E-01	4.00E-01	5.40E-01	4.85E+02	1.31E+03	NA
[Ca] [mg/L]		4.03E+02	1.01E+03	3.11E+02	6.84E+03	2.01E+03	1.08E+03	5.29E+02	1.39E+03	4.21E+02	4.20E+02	9.64E+01	NA
[Cd] [mg/L]	0.0051	3.32E-02	3.15E-03	6.77E-02	5.20E-03	1.20E-03	1.65E-02	2.40E-04	2.40E-04	2.42E-04	2.42E-04	4.48E-05	Target Met
[Cl] [mg/L]	230	1.39E+00	7.18E+01	9.94E-01	3.19E-01	1.78E+02	1.03E+02	5.45E+01	2.69E+02	2.71E+02	2.70E+02	1.44E+02	Target Met
[Co] [mg/L]	0.005	2.67E+00	9.89E-04	4.58E+00	4.61E-02	2.13E-07	1.18E+00	2.28E-04	4.39E-08	4.43E-08	4.42E-08	7.49E-05	Target Met
[Cr] [mg/L]	0.011	9.24E-03	1.32E-02	8.30E-03	1.89E-01	7.26E-02	2.66E-02	1.56E-02	1.56E-02	1.57E-02	1.57E-02	3.40E-03	Target Met
[Cu] [mg/L]	0.03	4.76E+00	7.95E-03	9.94E+00	4.05E-01	2.03E-02	2.17E+00	4.14E-03	4.13E-03	4.16E-03	4.15E-03	1.00E-03	Target Met
[F] [mg/L]	2	1.70E+00	7.54E+01	1.90E+00	1.00E+01	4.47E+00	3.11E+01	3.05E+01	1.69E+00	1.70E+00	1.70E+00	1.40E+00	Target Met
[Fe] [mg/L]	0.3	5.34E+01	5.61E-01	2.06E+00	1.44E-02	5.32E-03	4.65E+01	1.08E-03	1.08E-03	1.09E-03	1.08E-03	1.78E-04	Target Met
[K] [mg/L]		3.58E+01	1.82E+02	3.69E+01	3.90E+02	7.02E+02	2.05E+02	2.02E+02	2.02E+02	2.04E+02	2.03E+02	6.91E+01	NA
[Mg] [mg/L]		1.76E+02	1.76E+03	6.47E+01	1.30E+03	3.69E-01	8.01E+02	5.21E+02	3.39E-01	9.03E-02	9.01E-02	7.98E+00	NA
[Mn] [mg/L]	0.05	5.59E+00	1.10E+00	7.81E+00	2.17E-01	1.15E-01	2.88E+00	2.83E-02	2.83E-02	2.86E-02	2.85E-02	8.25E-03	Target Met
[Na] [mg/L]		9.05E+01	1.32E+03	8.23E+01	5.83E+02	2.75E+03	9.90E+02	9.72E+02	9.72E+02	9.81E+02	9.78E+02	3.65E+02	NA
[Ni] [mg/L]	0.113	1.34E+01	5.02E-02	6.34E+01	6.69E+00	4.10E-06	7.15E+00	6.56E-04	8.39E-07	8.47E-07	8.44E-07	1.00E-02	Target Met
[Pb] [mg/L]	0.0102	8.68E-02	3.15E-03	5.52E-02	4.37E-03	6.23E-05	3.75E-02	1.24E-05	1.24E-05	1.26E-05	1.25E-05	6.29E-06	Target Met
[Sb] [mg/L]	0.031	2.05E-01	1.46E-02	3.53E-02	8.41E-01	2.93E-02	1.22E-01	1.20E-01	6.00E-03	6.05E-03	6.03E-03	2.73E-03	Target Met
[Se] [mg/L]	0.005	4.16E-02	1.33E-02	9.93E-04	2.40E-02	5.07E-02	3.04E-02	2.09E-02	1.04E-02	1.05E-02	1.05E-02	1.76E-03	Target Met
[SiO2] [mg/L]		5.44E+01	7.40E+02	5.40E+01	3.17E+02	4.79E+03	1.03E+03	1.02E+03	1.01E+03	1.02E+03	1.02E+03	2.00E+02	NA
[SO4] [mg/L]	250	2.25E+03	5.25E+03	3.07E+02	6.85E+03	7.22E+03	4.29E+03	3.97E+03	1.44E+03	1.46E+03	1.45E+03	2.43E+02	Target Met
[Tl] [mg/L]	0.056	4.49E-04	3.62E-03	1.86E-05	4.43E-04	2.64E-02	5.51E-03	5.41E-03	5.40E-03	5.45E-03	5.43E-03	8.71E-04	Target Met
[V] [mg/L]		1.05E-02	9.75E-02	8.91E-03	1.98E-01	3.14E-06	4.91E-02	6.88E-07	6.88E-07	6.95E-07	6.93E-07	7.27E-04	NA
[Zn] [mg/L]	0.26	2.98E+00	6.16E-03	3.86E+00	5.82E-02	2.76E+00	1.71E+00	5.71E-01	5.71E-01	5.76E-01	5.74E-01	9.44E-02	Target Met
[Alkalinity] [mg/L as HCO3-]		2.06E+02	8.21E+03	1.14E+03	1.92E+04	7.95E+02	4,025	1,264	4,222	1,311	1.31E+03	913	NA
[Ionic_Strength] [mg/L]		0.06	0.25	0.00	0.35	0.21	0.18	0.13	0.13	0.08	0.07	0.03	NA
[Charge_pct_err] [mg/L]		**0.07**	**2.20**	**0.00**	**5.58**	**23.89**	**5.78**	**8.26**	**7.22**	**8.27**	**8.96**	**-2.26**	NA
[pH] [mg/L]		4.99	7.49	7.00	8.44	7.67	6.58	10.57	12.45	11.48	9.74	6.61	NA
Hardness	250.00	1728.0	9764.4	1042.4	22406.4	5012.1	6004.6	3463.0	3478.1	1051.4	1048.4	273.5	Target not Met
Sodium Ratio	60%	7.71%	22.34%	13.14%	5.24%	50.26%	24.66%	35.25%	36.13%	61.91%	61.91%	68.68%	Target not Met
Ferrihydrite [mg/L]		0						2666					
Lime [mg/L]		0						4443	3110				
Lime [kg/d]		0						5000	3500				
Sulfuric Acid [mg/L]		0											
Sulfuric Acid [kg/d]		0											
CO2 [mg/L]		0								1066	355		
CO2 [kg/d]		0								1200	400		
Ferric Sulfate [mg/L]								178	0				
Ferric Sulfage [kg/day]								200	0				
FeRT/HRT		0											

Filtration Concentrations	Water Quality Targets (mg/L)	East EQ Influent (1)	Media Filtration Permeate (2)	Media Filtration Aggregate Backwash (3)	Media Filtration Backwash Decant	NF Permeate (4)	NFConcentrate (5)	NF_Conc w Acid (6)	VSEP A Permeate (7)	VSEP A Concentrate (9)	VSEP B Permeate (10)	VSEP B Concentrate (11)	
Flow Rate, GPM		191.8	182.2	9.6	4.8	145.8	36.4	36.4	29.2	7.3	125.5	31.4	193.4
[Ag] [mg/L]	0.001	2.53E-06	2.53E-06	2.52E-06	2.52E-06	1.92E-06	5.00E-06	5.01E-06	2.00E-07	2.51E-05	1.05E-04	1.30E-02	
[Al] [mg/L]	0.125	1.31E-03	1.31E-03	1.30E-03	1.30E-03	9.12E-05	6.21E-03	6.22E-03	3.88E-05	3.21E-02	1.82E-04	1.48E-01	
[As] [mg/L]	10	4.28E-02	1.29E-02	6.96E-01	2.16E-01	1.77E-04	6.43E-02	6.45E-02	3.97E-02	1.69E-01	2.06E-06	8.56E-06	
[B] [mg/L]	0.5	8.93E-02	8.93E-02	8.90E-02	8.90E-02	7.89E-02	1.31E-01	1.32E-01	1.31E-01	1.37E-01	4.85E-01	4.93E-01	
[Ba] [mg/L]	2	2.12E-02	2.12E-02	2.11E-02	2.11E-02	2.57E-03	9.65E-02	9.67E-02	6.03E-03	4.77E-01	2.77E-04	2.14E-02	
[Be] [mg/L]	0.004	2.61E-04	2.61E-04	2.60E-04	2.60E-04	1.79E-05	1.24E-03	1.25E-03	9.94E-04	2.33E-03	9.35E-04	2.14E-03	
[C] [mg/L]		1.34E+03	1.34E+03	1.34E+03	1.34E+03	8.57E+02	3.30E+03	1.02E+04	8.89E+03	1.59E+04	4.24E+02	7.38E+02	
[Ca] [mg/L]		3.12E+02	3.12E+02	3.11E+02	3.11E+02	4.44E+01	1.39E+03	1.40E+03	9.93E+01	6.84E+03	2.98E+01	2.01E+03	
[Cd] [mg/L]	0.0051	1.95E-03	2.15E-04	3.66E-02	5.49E-03	1.50E-05	1.02E-03	1.02E-03	2.68E-05	5.20E-03	6.32E-06	1.20E-03	
[Cl] [mg/L]	230	9.97E-01	9.97E-01	9.94E-01	9.94E-01	1.13E+00	4.72E-01	4.73E-01	5.13E-01	3.19E-01	2.93E+02	1.78E+02	
[Co] [mg/L]	0.005	1.20E-01	1.90E-03	2.37E+00	1.54E-01	6.64E-05	9.32E-03	9.34E-03	5.71E-04	4.61E-02	2.70E-09	2.13E-07	
[Cr] [mg/L]	0.011	8.33E-03	8.33E-03	8.30E-03	8.30E-03	5.71E-04	3.97E-02	3.97E-02	4.21E-03	1.89E-01	1.66E-03	7.26E-02	
[Cu] [mg/L]	0.02	2.72E-01	1.71E-02	5.25E+00	5.68E-01	1.32E-03	8.08E-02	8.09E-02	3.43E-03	4.05E-01	1.76E-04	2.03E-02	
[F] [mg/L]	2	1.90E+00	1.90E+00	1.90E+00	1.90E+00	1.46E+00	3.70E+00	3.71E+00	2.22E+00	1.00E+01	1.02E+00	4.47E+00	
[Fe] [mg/L]	0.3	5.36E-02	5.67E-04	1.06E+00	6.37E-02	1.09E-19	2.86E-03	2.86E-03	1.14E-04	1.44E-02	4.33E-05	5.32E-03	
[K] [mg/L]		3.70E+01	3.70E+01	3.69E+01	3.69E+01	1.89E+01	1.10E+02	1.10E+02	4.37E+01	3.90E+02	8.05E+01	7.02E+02	
[Mg] [mg/L]		6.49E+01	6.49E+01	6.47E+01	6.47E+01	4.37E+00	3.09E+02	3.10E+02	7.42E+01	1.30E+03	2.15E-02	3.69E-01	
[Mn] [mg/L]	0.05	2.12E-01	1.14E-02	4.11E+00	4.11E-01	1.27E-03	5.24E-02	5.25E-02	1.34E-02	2.17E-01	7.21E-03	1.15E-01	
[Na] [mg/L]		8.26E+01	8.26E+01	8.23E+01	8.23E+01	5.30E+01	2.02E+02	2.03E+02	1.13E+02	5.83E+02	5.44E+02	2.75E+03	
[Ni] [mg/L]	0.113	1.90E+00	2.75E-01	3.48E+01	6.27E+00	9.94E-03	1.35E+00	1.35E+00	7.23E-02	6.69E+00	4.53E-08	4.10E-06	
[Pb] [mg/L]	0.0102	1.59E-03	1.75E-04	2.99E-02	4.48E-03	6.77E-06	8.55E-04	8.57E-04	1.92E-05	4.37E-03	2.81E-07	6.23E-05	
[Sb] [mg/L]	0.031	3.55E-02	3.55E-02	3.53E-02	3.53E-02	2.43E-03	1.69E-01	1.69E-01	9.07E-03	8.41E-01	3.24E-04	2.93E-02	
[Se] [mg/L]		9.96E-04	9.96E-04	9.93E-04	9.93E-04	3.98E-05	4.86E-03	4.87E-03	2.98E-04	2.40E-02	6.42E-04	5.07E-02	
[SiO2] [mg/L]		5.42E+01	5.42E+01	5.40E+01	5.40E+01	5.13E+01	6.58E+01	6.59E+01	6.13E+00	3.17E+02	9.49E+01	4.79E+03	
[SO4] [mg/L]	250	3.08E+02	3.08E+02	3.07E+02	3.07E+02	5.10E+01	1.34E+03	1.35E+03	3.36E+01	6.85E+03	3.62E+01	7.22E+03	
[Tl] [mg/L]	0.056	1.87E-05	1.87E-05	1.86E-05	1.86E-05	1.23E-06	8.91E-05	8.93E-05	4.79E-06	4.43E-04	2.91E-04	2.64E-02	
[V] [mg/L]		8.94E-03	8.94E-03	8.91E-03	8.91E-03	6.13E-04	4.26E-02	4.26E-02	5.69E-03	1.98E-01	9.25E-08	3.14E-06	
[Zn] [mg/L]	0.26	1.02E-01	2.38E-03	2.00E+00	1.44E-01	4.75E-05	1.18E-02	1.18E-02	7.51E-04	5.82E-02	3.65E-02	2.76E+00	
[Alkalinity] [mg/L as HCO3-]		1.14E+03	1.14E+03	1.14E+03	1.14E+03	2.85E+02	4.60E+03	4.61E+03	1.15E+03	1.92E+04	1.43E+03	7.95E+02	
[Ionic_Strength] [mg/L]		3.24E-02	3.24E-02	0.00E+00	0.00E+00	7.04E-03	9.05E-02	1.19E-01	2.25E-02	3.53E-01	3.37E-02	2.13E-01	
[Charge_pct_err] [mg/L]		**0.67**	**0.50**	**0.00**	**0.00**	**-4.40**	**2.66**	**1.86**	**-7.44**	**5.58**	**-9.64**	**23.89**	
[pH] [mg/L]		6.96	6.96	7.00	7.00	5.99	9.11	6.08	5.44	8.44	11.81	7.67	
Hardness	250 mg/L as CaCO3	1045.8	1045.8	1042.4	1042.4	128.8	4750.7	4760.5	553.1	22406.4	74.4	5012.1	
Sodium Ratio	60% of Cations	14.08%	14.11%	13.57%	14.03%	42.97%	8.25%	8.25%	28.69%	5.24%	86.96%	50.26%	
Ferrihydrite [mg/L]													
Lime [mg/L]		0	0	0		0	0	0	0	0	0	0	
Lime [kg/d]		0	0	0		0	0	0	0	0	0	0	
Sulfuric Acid [mg/L]		0	0	0		0	0	0	0	0	0	0	
Sulfuric Acid [kg/d]		0	0	0		0	0	0	0	0	0	0	
CO2 [mg/L]		0	0	0		0	0	5034.238209	0	0	0	0	
CO2 [kg/d]		0	0	0		0	0	1000	0	0	0	0	

Mine Water Treatment Trains - Year 4
CRE MY1 Closure Scenario

Qualities and Quantities	Preliminary Water Quality Targets	(1) Influent	(2) Green Sand Effluent	(3) RO Feed	Percent RO Rejection	(5) RO Permeate	(7) RO Concentrate	(4) NF Feed	Percent NF Rejection	(6) NF Permeate	(8) NF Concentrate	(9) NF/RO Concentrate w/CO2
Flow Rate, gpm		886	863	0		0	0	1107		886	221	221
[Ag] [mg/L]	0.001	1.63E-04	1.59E-04	0.00E+00	98.90%	0.00E+00	0.00E+00	2.34E-04	39.20%	9.93E-05	2.34E-04	2.34E-04
[Al] [mg/L]	0.125	5.59E-04	5.45E-04	0.00E+00	99.20%	0.00E+00	0.00E+00	2.03E-03	94.40%	3.04E-05	2.03E-03	2.03E-03
[As] [mg/L]	0.01	7.56E-02	5.43E-04	0.00E+00	98.70%	0.00E+00	0.00E+00	5.61E-03	98.90%	1.40E-05	5.61E-03	5.61E-03
[B] [mg/L]	0.5	9.17E-02	8.94E-02	0.00E+00	61.40%	0.00E+00	0.00E+00	1.43E-01	29.20%	8.70E-02	1.43E-01	1.43E-01
[Ba] [mg/L]	2	1.74E-02	1.70E-02	0.00E+00	100.00%	0.00E+00	0.00E+00	6.33E-02	90.30%	1.86E-03	6.33E-02	6.33E-02
[Be] [mg/L]	0.004	3.65E-04	3.55E-04	0.00E+00	99.30%	0.00E+00	0.00E+00	5.89E-03	94.50%	8.80E-05	5.89E-03	5.89E-03
[C] [mg/L]		1.73E+03	1.68E+03	0.00E+00	98.70%	0.00E+00	0.00E+00	5.15E+03	48.80%	1.42E+03	5.15E+03	5.20E+03
[Ca] [mg/L]		1.41E+02	1.37E+02	0.00E+00	99.20%	0.00E+00	0.00E+00	5.50E+02	88.60%	1.53E+01	5.50E+02	5.50E+02
[Cd] [mg/L]	0.0025	7.01E-03	6.83E-03	0.00E+00	99.10%	0.00E+00	0.00E+00	3.08E-02	94.40%	4.60E-04	3.08E-02	3.08E-02
[Cl] [mg/L]	230.00	5.98E+01	5.83E+01	0.00E+00	99.00%	0.00E+00	0.00E+00	2.38E+01	9.40%	5.67E+01	2.38E+01	2.38E+01
[Co] [mg/L]	0.005	2.91E-01	4.40E-03	0.00E+00	99.20%	0.00E+00	0.00E+00	2.41E-02	97.20%	1.78E-04	2.41E-02	2.41E-02
[Cr] [mg/L]	0.011	6.00E-03	5.84E-03	0.00E+00	99.20%	0.00E+00	0.00E+00	2.68E-02	94.50%	4.02E-04	2.68E-02	2.68E-02
[Cu] [mg/L]	0.0093	4.10E+00	2.45E-01	0.00E+00	99.00%	0.00E+00	0.00E+00	9.55E-01	93.80%	1.56E-02	9.55E-01	9.55E-01
[F] [mg/L]	2	2.16E+00	2.10E+00	0.00E+00	98.90%	0.00E+00	0.00E+00	4.59E+00	38.60%	2.04E+00	4.59E+00	4.59E+00
[Fe] [mg/L]	0.3	8.57E-02	8.80E-04	0.00E+00	100.00%	0.00E+00	0.00E+00	3.62E-03	100.00%	0.00E+00	3.62E-03	3.62E-03
[K] [mg/L]		4.14E+01	4.04E+01	0.00E+00	99.00%	0.00E+00	0.00E+00	1.92E+02	59.00%	3.55E+01	1.92E+02	1.92E+02
[Mg] [mg/L]		5.40E+01	5.26E+01	0.00E+00	99.40%	0.00E+00	0.00E+00	6.19E+02	94.60%	8.72E+00	6.19E+02	6.19E+02
[Mn] [mg/L]	0.05	5.80E-01	4.63E-01	0.00E+00	100.00%	0.00E+00	0.00E+00	2.38E+00	91.10%	1.33E-02	2.38E+00	2.38E+00
[Na] [mg/L]		1.90E+02	1.85E+02	0.00E+00	99.00%	0.00E+00	0.00E+00	6.13E+02	48.58%	1.68E+02	6.13E+02	6.13E+02
[Ni] [mg/L]	0.052	2.92E+00	3.93E-01	0.00E+00	99.20%	0.00E+00	0.00E+00	2.07E+00	97.10%	1.53E-02	2.07E+00	2.07E+00
[Pb] [mg/L]	0.0032	2.12E-03	2.26E-04	0.00E+00	99.10%	0.00E+00	0.00E+00	9.31E-04	96.90%	7.37E-06	9.31E-04	9.31E-04
[Sb] [mg/L]	0.031	3.93E-02	3.84E-02	0.00E+00	99.20%	0.00E+00	0.00E+00	1.50E-01	94.50%	2.25E-03	1.50E-01	1.50E-01
[Se] [mg/L]	0.005	6.04E-03	5.89E-03	0.00E+00	99.50%	0.00E+00	0.00E+00	2.32E-02	96.80%	1.90E-04	2.32E-02	2.32E-02
[SiO2] [mg/L]		5.42E+01	5.28E+01	0.00E+00	99.40%	0.00E+00	0.00E+00	5.77E+01	24.10%	4.50E+01	5.77E+01	5.77E+01
[S] [mg/L]	10.00	440.48	429.36	0.00	99.50%	0.00	0.00	2783.77	86.70%	23.49	2783.77	2783.82
[Tl] [mg/L]	0.00056	1.55E-04	1.51E-04	0.00E+00	99.20%	0.00E+00	0.00E+00	8.07E-04	94.70%	1.21E-05	8.07E-04	8.07E-04
[V] [mg/L]		9.17E-03	8.94E-03	0.00E+00	99.20%	0.00E+00	0.00E+00	6.52E-02	94.50%	9.74E-04	6.52E-02	6.52E-02
[Zn] [mg/L]	0.12	7.58E-01	1.70E-02	0.00E+00	99.10%	0.00E+00	0.00E+00	9.67E-02	98.40%	3.89E-04	9.67E-02	9.67E-02
[Alkalinity] [mg/L] as HCO3-*	250	6.07E+02	4.36E+02	4.23E-05	97.80%	4.23E-05	4.23E-05	1.42E+03	70.00%	3.53E+02	1.42E+03	1.42E+03
Hardness** [mg/L]	100	573.5	559.1	0.0	0.0	0.0	0.0	3924.6	0.0	74.2	3924.6	3924.6
[Ionic_Strength] [M]		0.027	0.025	0.000	0.00	0.00000	0.00000	0.11270	0.00	0.00965	0.1	0.1
[Charge_pct_err]		0.440	7.361	-0.345	0.00	-0.34539	-0.34539	19.93058	0.00	9.80315	19.93058	19.93055
[pH] [std units]	6.5-8.5	6.0	5.8	7.0	0.0	7.0	7.0	5.8	0.0	5.8	5.8	5.8
mEQ-Na$^+$/mEQ-∑Cations	60%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00000	0.0
Lime, mg/L				0%	0.00			0%	0.00		0%	0%
Lime, kg/day				0%	0.00			0%	0.00		0%	0%
Sulfuric Acid [mg/L]		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sulfuric Acid [kg/d]		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CO2 [mg/L]		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CO2 [kg/d]		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	50.0
CaCO3 [mg/L]		0	0	0	0	0	0	0	0	0	0	0
CaCO3 [kg/day]		0	0	0	0	0	0	0	0	0	0	0

Qualities and Quantities	Percent VSEP Rejection	(10) VSEP A Permeate	(11) VSEP A Concentrate	(14) VSEP B Permeate	(15) VSEP B Concentrate	(16)Chem Precip Influent	(17) HDS Effluent	(18) Sulfate Effluent	(19) CO2-1 Effluent	(20) CO2-2 Effluent	(12) Stabilization Influent	(13) Stabilized Effluent	Target Met?
Flow Rate, gpm		188	33	56	14	70	70	70	70	0	886	886	
[Ag] [mg/L]	95.96%	1.11E-05	1.55E-03	8.95E-06	1.55E-03	9.16E-04	9.16E-04	1.82E-04	1.82E-04	1.82E-04	9.93E-05	9.93E-05	Target Met
[Al] [mg/L]	99.36%	1.52E-05	1.39E-02	5.14E-08	1.39E-02	6.64E-03	6.65E-03	6.59E-03	6.59E-06	6.59E-06	3.04E-05	3.04E-05	Target Met
[As] [mg/L]	50.60%	3.24E-03	1.96E-02	4.18E-03	1.96E-02	1.24E-02	7.00E-03	6.93E-03	6.93E-03	6.94E-03	1.40E-05	1.40E-05	Target Met
[B] [mg/L]	15.00%	1.42E-01	1.48E-01	8.52E-02	1.48E-01	8.29E-02	8.29E-02	8.22E-02	8.22E-02	8.23E-02	8.70E-02	8.70E-02	Target Met
[Ba] [mg/L]	93.75%	4.63E-03	4.10E-01	1.88E-04	4.10E-01	1.98E-01	2.49E-03	2.47E-03	2.47E-03	2.47E-03	1.86E-03	1.86E-03	Target Met
[Be] [mg/L]	15.00%	5.86E-03	6.10E-03	2.66E-05	6.10E-03	2.91E-03	2.59E-05	2.56E-05	2.56E-05	2.56E-05	8.80E-05	8.80E-05	Target Met
[C] [mg/L]	40.00%	3.65E+03	1.44E+04	4.67E+03	1.44E+04	9.38E+03	6.26E+03	6.21E+03	6.38E+03	6.39E+03	1.42E+03	1.42E+03	NA
[Ca] [mg/L]	89.33%	6.87E+01	3.39E+03	5.45E+01	3.39E+03	2.01E+03	4.23E+02	4.19E+02	4.19E+02	4.19E+02	1.53E+01	1.53E+01	NA
[Cd] [mg/L]	97.41%	9.33E-04	2.07E-01	2.23E-02	2.07E-01	7.17E-01	7.17E-01	7.07E-01	7.07E-01	7.08E-01	4.60E-04	4.60E-04	Target Met
[Cl] [mg/L]	13.33%	2.41E+01	2.19E+01	1.26E+01	2.19E+01	4.69E+01	1.20E+01	1.19E+01	1.19E+01	1.19E+01	5.67E+01	5.67E+01	Target Met
[Co] [mg/L]	95.10%	1.38E-03	1.58E-01	2.86E-02	1.58E-01	4.83E-01	4.83E-01	4.79E-01	4.79E-01	4.79E-01	1.78E-04	1.78E-04	Target Met
[Cr] [mg/L]	89.33%	3.35E-03	1.66E-01	1.06E-02	1.66E-01	1.52E-01	1.45E-01	8.11E-02	8.11E-02	8.11E-02	4.02E-04	4.02E-04	NA
[Cu] [mg/L]	96.60%	3.79E-02	6.36E+00	9.45E-02	6.36E+00	5.25E+00	2.31E+00	2.29E+00	2.29E+00	2.28E+00	1.56E-02	1.56E-02	Target not Met
[F] [mg/L]	40.00%	3.23E+00	1.27E+01	7.28E+00	1.27E+01	1.00E+01	1.00E+01	9.95E+00	9.95E+00	9.96E+00	2.04E+00	2.04E+00	Target not Met
[Fe] [mg/L]	96.00%	1.70E-04	2.40E-02	8.25E-05	2.40E-02	1.83E+01	1.71E-03	1.69E-03	1.69E-03	1.69E-03	0.00E+00	0.00E+00	Target Met
[K] [mg/L]	62.67%	8.38E+01	8.31E+02	4.45E+02	8.31E+02	9.86E+02	9.86E+02	9.78E+02	9.78E+02	9.78E+02	3.55E+01	3.55E+01	NA
[Mg] [mg/L]	76.00%	1.74E+02	3.25E+03	1.38E+03	3.25E+03	4.78E+03	4.78E+03	4.72E+03	4.73E+03	4.73E+03	8.72E+00	8.72E+00	NA
[Mn] [mg/L]	74.53%	7.09E-01	1.22E+01	1.81E-02	1.22E+01	5.87E+00	5.88E+00	5.82E-02	5.82E-02	5.83E-02	1.33E-02	1.33E-02	Target Met
[Na] [mg/L]	66.67%	2.39E+02	2.83E+03	1.50E+03	2.83E+03	3.73E+03	3.73E+03	3.69E+03	3.69E+03	3.70E+03	1.68E+02	1.68E+02	NA
[Ni] [mg/L]	95.70%	1.04E-01	1.37E+01	2.23E+00	1.37E+01	4.30E+01	4.29E+01	4.25E+01	4.26E+01	4.26E+01	1.53E-02	1.53E-02	Target Met
[Pb] [mg/L]	97.33%	2.91E-05	6.26E-03	2.03E-04	6.26E-03	8.62E-03	6.31E-03	6.25E-03	6.25E-03	6.25E-03	7.37E-06	7.37E-06	Target Met
[Sb] [mg/L]	94.67%	9.36E-03	9.81E-01	1.58E-03	9.81E-01	4.91E-01	4.91E-01	4.86E-01	2.43E-02	2.43E-02	2.25E-03	2.25E-03	Target Met
[Se] [mg/L]	97.70%	6.24E-04	1.57E-01	1.10E-03	1.57E-01	1.13E-01	1.13E-01	7.86E-02	3.93E-02	3.93E-02	1.90E-04	1.90E-04	Target Met
[SiO2] [mg/L]	90.67%	6.30E+00	3.61E+02	1.14E+02	3.61E+02	1.01E+03	1.02E+03	1.01E+03	1.01E+03	1.01E+03	4.50E+01	4.50E+01	NA
[S] [mg/L]	0.85	477.89	16410.31	3523.11	16410.31	23071.59	19873.31	19693.56	19694.60	19709.00	2.35E+01	2.35E+01	Target not Met
[Tl] [mg/L]	94.68%	5.02E-05	5.28E-03	9.89E-04	5.28E-03	1.54E-02	1.55E-02	1.52E-02	1.52E-02	1.53E-02	1.21E-05	1.21E-05	Target Met
[V] [mg/L]	86.67%	1.02E-02	3.91E-01	1.14E-01	3.91E-01	7.37E-01	7.06E-01	7.00E-01	7.00E-01	7.00E-01	9.74E-04	9.74E-04	NA
[Zn] [mg/L]	94.67%	6.03E-03	6.32E-01	1.18E-01	6.32E-01	1.84E+00	1.83E+00	1.82E+00	1.82E+00	1.82E+00	3.89E-04	3.89E-04	Target Met
[Alkalinity] [mg/L] as HCO3-*	60.00%	6.67E+02	5.90E+03	2.38E+03	5.90E+03	4.66E+03	3.94E+03	3.91E+03	3.91E+03	3.91E+03	3.53E+02	3.53E+02	Target not Met
Hardness** [mg/L]	0.0	887.9	21870.7	5831.2	21870.7	24706.0	20757.6	20505.5	20506.5	20521.5	74.2	74.2	Target Met
[Ionic_Strength] [M]	0.00	0.11270	0.43506	0.17493	0.43506	0.49493	0.45911	0.45571	0.45573	0.45596	0.00965	0.00965	NA
[Charge_pct_err]	0.00	18.81572	25.74750	34.48433	25.74750	19.93019	21.37090	21.08753	21.08775	21.09321	9.80315	9.80315	NA
[pH] [std units]	0.0	5.8	5.9	6.2	5.9	6.0	6.3	6.3	6.2	6.2	5.8	5.8	Target Met
mEQ-Na$^+$/mEQ-∑Cations	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Target Met
Lime, mg/L	0.00						2623.4	0.0					
Lime, kg/day	0.00						1000.0	0.0					
Sulfuric Acid [mg/L]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Sulfuric Acid [kg/d]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
CO2 [mg/L]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	131.2	0.0	0.0	0.0	
CO2 [kg/d]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	50.0	0.0	0.0	0.0	
CaCO3 [mg/L]	0	0	0	0	0	0	0	0	0	0	0	0	
CaCO3 [kg/day]	0	0	0	0	0	0	0	0	0	0	0	0	

*Converted from as CaCO3 to as HCO3-

**Calculated as the sum of Ca and Mg as CaCO3

Temp 7.55

521.13

Appendix D

Water Treatment Cost Support

Water Treatment Operations Cost Support

April 2016

Contents

NorthMet Waste Water Treatment Cost Support
April 2016

File	Sheet	Date	Item	Detail	Unit Cost	Unit	Unit Cost Response	Support Document	Quantity Response	Support Document
[3]	blue tabs	2016	NF Membrane Replacement	NF Membrane Replacement		LS	Based on 5/1/13 vendor cost estimate spreadsheet from GE - $550 per 4.4 gpm module every 3 years, and 3/31/16 e-mail from Paul Dillalo	Attachment A, Attachment J	Based on 5/1/13 vendor cost estimate spreadsheet from GE - module replacement every 3 years	Attachment A
[3]	blue tabs	2016	VSEP Module Replacement	VSEP Module Replacement		LS	Based on 5/9/13 vendor cost estimate spreadsheet from NLR - $78,000 per 40 gpm module	Attachment B	Based on 5/9/13 vendor cost estimate spreadsheet from NLR	Attachment B
[3]	blue tabs	2016	Limestone (Granular Calcite)	Limestone (Granular Calcite)	$ 47.00	$/ton	From Graymont via Jim Tieberg e-mail 3/29/16	Attachment I	Based on process model to stabilize effluent LSI	
[3]	blue tabs	2016	CO2 (VSEP)	CO2 (VSEP)	$ 120.00	$/ton	From Praxair via Jim Tieberg e-mail 3/29/16	Attachment I	Based on procss model to adjust pH (VSEP influent <6.2, recarbonation 1 ~10.5, recarbonation 2 ~ 7-9)	
[3]	blue tabs	2016	Sodium Permanganate	Sodium Permanganate	$ 14.50	$/lb	From Hawkins quote e-mail 4/1/16	Attachment K	2.5 ppm in GSF feed based on SD033 (Area 5) Pilot	Attachment G
[3]	blue tabs	2016	Sodium Bisulfite	Sodium Bisulfite	$ 1.50	$/lb	From Hawkins quote e-mail 4/1/16	Attachment K	1 ppm in primary and secondary membrane feeds based on 5/1/13 vendor cost estimate spreadsheet from GE	Attachment B
[3]	blue tabs	2016	Anionic Polymer (Standby)	Anionic Polymer (Standby)	$ 1.49	$/lb	From Nalco via Jim Tieberg e-mail 3/29/16	Attachment I	2 ppm, based on typical polymer feed rates	
[3]	blue tabs	2016	GE Hypersperse	GE Hypersperse	$ 3.22	$/lb	Based on 11/19/15 e-mail from Paul Dillalo at GE	Attachment C	2.2 ppm in Primary feed based on 5/1/13 vendor cost estimate spreadsheet from GE	Attachment B
[3]	blue tabs	2016	Membrane Cleaner 1	Membrane Cleaner 1	$ 5.35	$/lb	Based on 11/19/15 e-mail from Paul Dillalo at GE	Attachment C	Based on GE vendor estimates 3/26/15 e-mail	Attachment D
[3]	blue tabs	2016	Membrane Cleaner 4	Membrane Cleaner 4	$ 3.07	$/lb	Based on 11/19/15 e-mail from Paul Dillalo at GE	Attachment C	Based on GE vendor estimates 3/26/15 e-mail	Attachment D
[3]	blue tabs	2016	Hydrated Lime (Chem Precip)	Hydrated Lime (Chem Precip)	$ 153.00	$/lb	From Graymont via Jim Tieberg e-mail 3/29/16	Attachment I	Based on water quality modeling to meet metals and sulfate targets	

NorthMet Waste Water Treatment Cost Support
April 2016

File	Sheet	Date	Item	Detail	Unit Cost	Unit	Unit Cost Response	Support Document	Quantity Response	Support Document
[3]	blue tabs	2016	Hydrochloric Acid (standby)	Hydrochloric Acid (standby)	$0.80	$/lb	From Hawkins quote e-mail 4/1/16	Attachment K	Based on water quality modeling to meet sulfate targets	
[3]	blue tabs	2016	Ferric Sulfate	Ferric Sulfate	$0.26	$/lb	From Hawkins quote e-mail 4/1/16	Attachment K	Based on water quality modeling to achieve HDS recycle flow of <25% HDS influent	
[3]	blue tabs	2016	MetClear MR2405 (Standby)	MetClear MR2405 (Standby)	$4.94	$/lb	Based on 3/31/16 e-mail from Paul Dillalo at GE	Attachment J	2 ppm in HDS influent, in range of manufacturer recommendations	
[3]	blue tabs	2016	Anionic Polymer (Standby)	Anionic Polymer (Standby)	$1.49	$/lb	From Nalco via Jim Tieberg e-mail 3/29/16	Attachment I	2 ppm in HDS influent, based on typical polymer feed rates	
[3]	blue tabs	2016	NLR 759	NLR 759	$ 44.00	$/gal	Based on 5/9/13 vendor cost estimate spreadsheet from NLR	Attachment B	10 ppm in secondary feed based on 11/11/13 specs from NLR	Attachment F
[3]	blue tabs	2016	NLR 404	NLR 404	$ 16.00	$/gal	Based on 3/31/16 e-mail update from NLR	Attachment H	4 gal/cleaning per 40 gpm module, 1 cleaning/day based on 11/11/13 specs from NLR	Attachment F
[3]	blue tabs	2016	NLR 505	NLR 505	$ 16.00	$/gal	Based on 3/31/16 e-mail update from NLR	Attachment H	4 gal/cleaning per 40 gpm module, 1 cleaning/day based on 11/11/13 specs from NLR	Attachment F
[3]	blue tabs	2016	Transport concentrate to WWTF	Transport concentrate to WWTF	$ 1,400.00	$/day	Conversation with local hauler	Attachment M	Based on process model estimate of WWTP VSEP concentrate production rate	
[3]	blue tabs	2016	Sludge hauling and disposal	Sludge hauling and disposal	$ 36.00	$/ton	Quote from waste management 4/5/16, assuming 18-24 tons/load	Attachment L	Based on process model total sludge production, assuming pressed to 50% solids	

Attachment A:

GE Cost Spreadsheet,
5/1/2013,
GE, Paul Dillallo

792240 PolyMet Mining - Estimated OPEX Summary @ Average Operating Conditions

	Year 1 (450 gpm)		Year 5 (900 gpm)		Year 10 (1,100 gpm)		Year 14 (1,350 gpm)		Year 15 (1,350 gpm)		Year 20 (650 gpm)	
	Coldest	Warmest	Coldest	Warmest	Coldest	Warmest	Coldest	Warmest	Coldest	Warmest	Coldest	Warmest
Power Cost (US$/Year)	$ 53,319	$ 36,617	$ 102,813	$ 69,438	$ 129,560	$ 86,578	$ 152,891	$ 102,842	$ 152,891	$ 102,842	$ 80,066	$ 53,757
Chemical Costs (US$/Year)	$ 45,251	$ 45,251	$ 160,460	$ 153,603	$ 179,194	$ 181,964	$ 418,880	$ 405,765	$ 453,201	$ 442,398	$ 134,848	$ 130,853
Consumables Cost (US$/Year)	$ 71,460	$ 71,460	$ 106,635	$ 106,635	$ 175,455	$ 175,455	$ 175,455	$ 175,455	$ 175,455	$ 175,455	$ 175,455	$ 175,455
Total Annual Cost (US$/Year)	$ 170,031	$ 153,328	$ 369,908	$ 329,676	$ 484,209	$ 443,997	$ 747,226	$ 684,062	$ 781,547	$ 720,696	$ 390,369	$ 360,065

Note: Consumables based on full system replacement

792240 PolyMet Mining

Preliminary Estimates at Average Flow Conditions Producing 450 GPM, YEAR 1, COLDEST TEMP

DESCRIPTION	*CONSUMPTION*	*UNIT*	*UNIT COST*	*TOTAL COST*	*Comments*
	UF+RO+EDI		*US$*	*US$/yr*	
Utilities					
Power (at coldest temp, 35ºF)	1826	kwh/day	$ 0.08	**$ 53,319**	
Chemicals					
Potassium Permanganate **(100%)**	5.3	lbs/day	$ 2.25	$ 4,353	Continuous
Antiscalant **(100% MDC706)**	0	lbs/day	$ 5.76	$ -	Continuous
Antiscalant **(100% MSI410)**	13.2	lbs/day	$ 3.55	$ 17,104	Continuous
Sodium Bisulfite **(38%, DCL30)**	17.5	lbs/day	$ 0.79	$ 5,046	Continuous
RO Cleaning Chemicals - **MCT 103 (100%)**	270	lbs/cleaning	$ 3.02	$ 6,523	8 cleans per year per RO (every 45 days)
RO Cleaning Chemicals - **MCT 511 (100%)**	270	lbs/cleaning	$ 5.66	$ 12,226	8 cleans per year per RO (every 45 days)
Sub-Total				**$ 45,251**	
Consumables					
Greensand Media	116	#/year	$ 225.00	$ 26,100	Replacement every 5 years
Cartridge filter element replacement	336	#/year	$ 10.00	$ 3,360	Replacement every month
RO Membrane Replacement (Muni-NF-300)	48	#/year	$ 500.00	$ 24,000	Replacement every 3 years
RO Membrane Replacement (Muni-NF-450)	36	#/year	$ 500.00	$ 18,000	Replacement every 3 years
Sub-Total				**$ 71,460**	

Preliminary Estimates at Average Flow Conditions Producing 450 GPM, YEAR 1, WARMEST TEMP

DESCRIPTION	*CONSUMPTION*	*UNIT*	*UNIT COST*	*TOTAL COST*	*Comments*
	UF+RO+EDI		*US$*	*US$/yr*	
Utilities					
Power (at coldest temp, 75ºF)	1254	kwh/day	$ 0.08	**$ 36,617**	
Chemicals					
Potassium Permanganate **(100%)**	5.3	lbs/day	$ 2.25	$ 4,353	Continuous
Antiscalant **(100% MDC706)**	0	lbs/day	$ 5.76	$ -	Continuous
Antiscalant **(100% MSI410)**	13.2	lbs/day	$ 3.55	$ 17,104	Continuous
Sodium Bisulfite **(38%, DCL30)**	17.5	lbs/day	$ 0.79	$ 5,046	Continuous
RO Cleaning Chemicals - **MCT 103 (100%)**	270	lbs/cleaning	$ 3.02	$ 6,523	8 cleans per year per RO (every 45 days)
RO Cleaning Chemicals - **MCT 511 (100%)**	270	lbs/cleaning	$ 5.66	$ 12,226	8 cleans per year per RO (every 45 days)
Sub-Total				**$ 45,251**	
Consumables					
Greensand Media	116	#/year	$ 225.00	$ 26,100	Replacement every 5 years
Cartridge filter element replacement	336	#/year	$ 10.00	$ 3,360	Replacement every month
RO Membrane Replacement (Muni-NF-300)	48	#/year	$ 500.00	$ 24,000	Replacement every 3 years
RO Membrane Replacement (Muni-NF-450)	36	#/year	$ 500.00	$ 18,000	Replacement every 3 years
Sub-Total				**$ 71,460**	

792240 PolyMet Mining

Preliminary Estimates at Average Flow Conditions Producing 900 GPM, YEAR 5, COLDEST TEMP

DESCRIPTION	*CONSUMPTION UF+RO+EDI*	*UNIT*	*UNIT COST US$*	*TOTAL COST US$/yr*	*Comments*
Utilities					
Power (at coldest temp, 35ºF)	3521	kwh/day	$ 0.08	**$ 102,813**	
Chemicals					
Potassium Permanganate **(100%)**	12.9	lbs/day	$ 2.25	$ 10,594	Continuous
Antiscalant **(100% MDC706)**	31.3	lbs/day	$ 5.76	$ 65,805	Continuous
Antiscalant **(100% MSI410)**	26.5	lbs/day	$ 3.55	$ 34,337	Continuous
Sodium Bisulfite **(38%, DCL30)**	42.4	lbs/day	$ 0.79	$ 12,226	Continuous
RO Cleaning Chemicals **- MCT 103 (100%)**	270	lbs/cleaning	$ 3.02	$ 13,046	8 cleans per year per RO (every 45 days)
RO Cleaning Chemicals **- MCT 511 (100%)**	270	lbs/cleaning	$ 5.66	$ 24,451	8 cleans per year per RO (every 45 days)
Sub-Total				**$ 160,460**	
Consumables					
Greensand Media	155	#/year	$ 225.00	$ 34,875	Replacement every 5 years
Cartridge filter element replacement	1176	#/year	$ 10.00	$ 11,760	Replacement every month
RO Membrane Replacement (Muni-NF-300)	48	#/year	$ 500.00	$ 24,000	Replacement every 3 years
RO Membrane Replacement (Muni-NF-450)	72	#/year	$ 500.00	$ 36,000	Replacement every 3 years
Sub-Total				**$ 106,635**	

Preliminary Estimates at Average Flow Conditions Producing 900 GPM, YEAR 5, WARMEST TEMP

DESCRIPTION	*CONSUMPTION UF+RO+EDI*	*UNIT*	*UNIT COST US$*	*TOTAL COST US$/yr*	*Comments*
Utilities					
Power (at coldest temp, 75ºF)	2378	kwh/day	$ 0.08	**$ 69,438**	
Chemicals					
Potassium Permanganate **(100%)**	12.9	lbs/day	$ 2.25	$ 10,594	Continuous
Antiscalant **(100% MDC706)**	28.1	lbs/day	$ 5.76	$ 59,077	Continuous
Antiscalant **(100% MSI410)**	26.4	lbs/day	$ 3.55	$ 34,208	Continuous
Sodium Bisulfite **(38%, DCL30)**	42.4	lbs/day	$ 0.79	$ 12,226	Continuous
RO Cleaning Chemicals **- MCT 103 (100%)**	270	lbs/cleaning	$ 3.02	$ 13,046	8 cleans per year per RO (every 45 days)
RO Cleaning Chemicals **- MCT 511 (100%)**	270	lbs/cleaning	$ 5.66	$ 24,451	8 cleans per year per RO (every 45 days)
Sub-Total				**$ 153,603**	
Consumables					
Greensand Media	155	#/year	$ 225.00	$ 34,875	Replacement every 5 years
Cartridge filter element replacement	1176	#/year	$ 10.00	$ 11,760	Replacement every month
RO Membrane Replacement (Muni-NF-300)	48	#/year	$ 500.00	$ 24,000	Replacement every 3 years
RO Membrane Replacement (Muni-NF-450)	72	#/year	$ 500.00	$ 36,000	Replacement every 3 years
Sub-Total				**$ 106,635**	

792240 PolyMet Mining

Preliminary Estimates at Average Flow Conditions Producing 1,100 GPM, YEAR 10, COLDEST TEMP

DESCRIPTION	CONSUMPTION	UNIT	UNIT COST	TOTAL COST	Comments
	UF+RO+EDI		US$	US$/yr	
Utilities					
Power (at coldest temp, 35ºF)	4437	kwh/day	$ 0.08	**$ 129,560**	
Chemicals					
Potassium Permanganate **(100%)**	16.5	lbs/day	$ 2.25	$ 13,551	Continuous
Antiscalant **(100% MDC706)**	32.4	lbs/day	$ 5.76	$ 68,118	Continuous
Antiscalant **(100% MSI410)**	27	lbs/day	$ 3.55	$ 34,985	Continuous
Sodium Bisulfite **(38%, DCL30)**	43.5	lbs/day	$ 0.79	$ 12,543	Continuous
RO Cleaning Chemicals **- MCT 103 (100%)**	270 + 180	lbs/cleaning	$ 3.02	$ 17,395	8 cleans per year per RO (every 45 days)
RO Cleaning Chemicals **- MCT 511 (100%)**	270 + 180	lbs/cleaning	$ 5.66	$ 32,602	8 cleans per year per RO (every 45 days)
Sub-Total				**$ 179,194**	
Consumables					
Greensand Media	271	#/year	$ 225.00	$ 60,975	Replacement every 5 years
Cartridge filter element replacement	1848	#/year	$ 10.00	$ 18,480	Replacement every month
RO Membrane Replacement (Muni-NF-300)	48	#/year	$ 500.00	$ 24,000	Replacement every 3 years
RO Membrane Replacement (Muni-NF-450)	144	#/year	$ 500.00	$ 72,000	Replacement every 3 years
Sub-Total				**$ 175,455**	

Preliminary Estimates at Average Flow Conditions Producing 1,100 GPM, YEAR 10, WARMEST TEMP

DESCRIPTION	CONSUMPTION	UNIT	UNIT COST	TOTAL COST	Comments
	UF+RO+EDI		US$	US$/yr	
Utilities					
Power (at coldest temp, 75ºF)	2965	kwh/day	$ 0.08	**$ 86,578**	
Chemicals					
Potassium Permanganate **(100%)**	16.5	lbs/day	$ 2.25	$ 13,551	Continuous
Antiscalant **(100% MDC706)**	32.3	lbs/day	$ 5.76	$ 67,908	Continuous
Antiscalant **(100% MSI410)**	29.3	lbs/day	$ 3.55	$ 37,965	Continuous
Sodium Bisulfite **(38%, DCL30)**	43.5	lbs/day	$ 0.79	$ 12,543	Continuous
RO Cleaning Chemicals **- MCT 103 (100%)**	270 + 180	lbs/cleaning	$ 3.02	$ 17,395	8 cleans per year per RO (every 45 days)
RO Cleaning Chemicals **- MCT 511 (100%)**	270 + 180	lbs/cleaning	$ 5.66	$ 32,602	8 cleans per year per RO (every 45 days)
Sub-Total				**$ 181,964**	
Consumables					
Greensand Media	271	#/year	$ 225.00	$ 60,975	Replacement every 5 years
Cartridge filter element replacement	1848	#/year	$ 10.00	$ 18,480	Replacement every month
RO Membrane Replacement (Muni-NF-300)	48	#/year	$ 500.00	$ 24,000	Replacement every 3 years
RO Membrane Replacement (Muni-NF-450)	144	#/year	$ 500.00	$ 72,000	Replacement every 3 years
Sub-Total				**$ 175,455**	

792240 PolyMet Mining

Preliminary Estimates at Average Flow Conditions Producing 1,350 GPM, YEAR 14, COLDEST TEMP

DESCRIPTION	CONSUMPTION UF+RO+EDI	UNIT	UNIT COST US$	TOTAL COST US$/yr	Comments
Utilities					
Power (at coldest temp, 35ºF)	5236	kwh/day	$ 0.08	**$ 152,891**	
Chemicals					
Potassium Permanganate **(100%)**	52	lbs/day	$ 2.25	$ 42,705	Continuous
Antiscalant **(100% MDC706)**	104.3	lbs/day	$ 5.76	$ 219,280	Continuous
Antiscalant **(100% MSI410)**	39.6	lbs/day	$ 3.55	$ 51,312	Continuous
Sodium Bisulfite **(38%, DCL30)**	171.1	lbs/day	$ 0.79	$ 49,337	Continuous
RO Cleaning Chemicals **- MCT 103 (100%)**	270	lbs/cleaning	$ 3.02	$ 19,570	8 cleans per year per RO (every 45 days)
RO Cleaning Chemicals **- MCT 511 (100%)**	270	lbs/cleaning	$ 5.66	$ 36,677	8 cleans per year per RO (every 45 days)
Sub-Total				**$ 418,880**	
Consumables					
Greensand Media	271	#/year	$ 225.00	$ 60,975	Replacement every 5 years
Cartridge filter element replacement	1848	#/year	$ 10.00	$ 18,480	Replacement every month
RO Membrane Replacement (Muni-NF-300)	48	#/year	$ 500.00	$ 24,000	Replacement every 3 years
RO Membrane Replacement (Muni-NF-450)	144	#/year	$ 500.00	$ 72,000	Replacement every 3 years
Sub-Total				**$ 175,455**	

Preliminary Estimates at Average Flow Conditions Producing 1,350 GPM, YEAR 14, WARMEST TEMP

DESCRIPTION	CONSUMPTION UF+RO+EDI	UNIT	UNIT COST US$	TOTAL COST US$/yr	Comments
Utilities					
Power (at coldest temp, 75ºF)	3522	kwh/day	$ 0.08	**$ 102,842**	
Chemicals					
Potassium Permanganate **(100%)**	52	lbs/day	$ 2.25	$ 42,705	Continuous
Antiscalant **(100% MDC706)**	98	lbs/day	$ 5.76	$ 206,035	Continuous
Antiscalant **(100% MSI410)**	39.7	lbs/day	$ 3.55	$ 51,441	Continuous
Sodium Bisulfite **(38%, DCL30)**	171.1	lbs/day	$ 0.79	$ 49,337	Continuous
RO Cleaning Chemicals **- MCT 103 (100%)**	270	lbs/cleaning	$ 3.02	$ 19,570	8 cleans per year per RO (every 45 days)
RO Cleaning Chemicals **- MCT 511 (100%)**	270	lbs/cleaning	$ 5.66	$ 36,677	8 cleans per year per RO (every 45 days)
Sub-Total				**$ 405,765**	
Consumables					
Greensand Media	271	#/year	$ 225.00	$ 60,975	Replacement every 5 years
Cartridge filter element replacement	1848	#/year	$ 10.00	$ 18,480	Replacement every month
RO Membrane Replacement (Muni-NF-300)	48	#/year	$ 500.00	$ 24,000	Replacement every 3 years
RO Membrane Replacement (Muni-NF-450)	144	#/year	$ 500.00	$ 72,000	Replacement every 3 years
Sub-Total				**$ 175,455**	

792240 PolyMet Mining

Preliminary Estimates at Average Flow Conditions Producing 1,350 GPM, YEAR 15, COLDEST TEMP

DESCRIPTION	CONSUMPTION UF+RO+EDI	UNIT	UNIT COST US$	TOTAL COST US$/yr	Comments
Utilities					
Power (at coldest temp, 35ºF)	5236	kwh/day	$ 0.08	**$ 152,891**	
Chemicals					
Potassium Permanganate **(100%)**	55.6	lbs/day	$ 2.25	$ 45,662	Continuous
Antiscalant **(100% MDC706)**	117.6	lbs/day	$ 5.76	$ 247,242	Continuous
Antiscalant **(100% MSI410)**	39.6	lbs/day	$ 3.55	$ 51,312	Continuous
Sodium Bisulfite **(38%, DCL30)**	182.9	lbs/day	$ 0.79	$ 52,739	Continuous
RO Cleaning Chemicals **- MCT 103 (100%)**	270	lbs/cleaning	$ 3.02	$ 19,570	8 cleans per year per RO (every 45 days)
RO Cleaning Chemicals **- MCT 511 (100%)**	270	lbs/cleaning	$ 5.66	$ 36,677	8 cleans per year per RO (every 45 days)
Sub-Total				**$ 453,201**	
Consumables					
Greensand Media	271	#/year	$ 225.00	$ 60,975	Replacement every 5 years
Cartridge filter element replacement	1848	#/year	$ 10.00	$ 18,480	Replacement every month
RO Membrane Replacement (Muni-NF-300)	48	#/year	$ 500.00	$ 24,000	Replacement every 3 years
RO Membrane Replacement (Muni-NF-450)	144	#/year	$ 500.00	$ 72,000	Replacement every 3 years
Sub-Total				**$ 175,455**	

Preliminary Estimates at Average Flow Conditions Producing 1,350 GPM, YEAR 15, WARMEST TEMP

DESCRIPTION	CONSUMPTION UF+RO+EDI	UNIT	UNIT COST US$	TOTAL COST US$/yr	Comments
Utilities					
Power (at coldest temp, 75ºF)	3522	kwh/day	$ 0.08	**$ 102,842**	
Chemicals					
Potassium Permanganate **(100%)**	55.6	lbs/day	$ 2.25	$ 45,662	Continuous
Antiscalant **(100% MDC706)**	112.4	lbs/day	$ 5.76	$ 236,310	Continuous
Antiscalant **(100% MSI410)**	39.7	lbs/day	$ 3.55	$ 51,441	Continuous
Sodium Bisulfite **(38%, DCL30)**	182.9	lbs/day	$ 0.79	$ 52,739	Continuous
RO Cleaning Chemicals **- MCT 103 (100%)**	270	lbs/cleaning	$ 3.02	$ 19,570	8 cleans per year per RO (every 45 days)
RO Cleaning Chemicals **- MCT 511 (100%)**	270	lbs/cleaning	$ 5.66	$ 36,677	8 cleans per year per RO (every 45 days)
Sub-Total				**$ 442,398**	
Consumables					
Greensand Media	271	#/year	$ 225.00	$ 60,975	Replacement every 5 years
Cartridge filter element replacement	1848	#/year	$ 10.00	$ 18,480	Replacement every month
RO Membrane Replacement (Muni-NF-300)	48	#/year	$ 500.00	$ 24,000	Replacement every 3 years
RO Membrane Replacement (Muni-NF-450)	144	#/year	$ 500.00	$ 72,000	Replacement every 3 years
Sub-Total				**$ 175,455**	

792240 PolyMet Mining

Preliminary Estimates at Average Flow Conditions Producing 650 GPM, YEAR 20, COLDEST TEMP

DESCRIPTION	CONSUMPTION UF+RO+EDI	UNIT	UNIT COST US$	TOTAL COST US$/yr	Comments
Utilities					
Power (at coldest temp, 35ºF)	2742	kwh/day	$ 0.08	**$ 80,066**	
Chemicals					
Potassium Permanganate **(100%)**	6.8	lbs/day	$ 2.25	$ 5,585	Continuous
Antiscalant **(100% MDC706)**	19.9	lbs/day	$ 5.76	$ 41,838	Continuous
Antiscalant **(100% MSI410)**	19.1	lbs/day	$ 3.55	$ 24,749	Continuous
Sodium Bisulfite **(38%, DCL30)**	22.3	lbs/day	$ 0.79	$ 6,430	Continuous
RO Cleaning Chemicals **- MCT 103 (100%)**	270	lbs/cleaning	$ 3.02	$ 19,570	8 cleans per year per RO (every 45 days)
RO Cleaning Chemicals **- MCT 511 (100%)**	270	lbs/cleaning	$ 5.66	$ 36,677	8 cleans per year per RO (every 45 days)
Sub-Total				**$ 134,848**	
Consumables					
Greensand Media	271	#/year	$ 225.00	$ 60,975	Replacement every 5 years
Cartridge filter element replacement	1848	#/year	$ 10.00	$ 18,480	Replacement every month
RO Membrane Replacement (Muni-NF-300)	48	#/year	$ 500.00	$ 24,000	Replacement every 3 years
RO Membrane Replacement (Muni-NF-450)	144	#/year	$ 500.00	$ 72,000	Replacement every 3 years
Sub-Total				**$ 175,455**	

Preliminary Estimates at Average Flow Conditions Producing 650 GPM, YEAR 20, WARMEST TEMP

DESCRIPTION	CONSUMPTION UF+RO+EDI	UNIT	UNIT COST US$	TOTAL COST US$/yr	Comments
Utilities					
Power (at coldest temp, 75ºF)	1841	kwh/day	$ 0.08	**$ 53,757**	
Chemicals					
Potassium Permanganate **(100%)**	6.8	lbs/day	$ 2.25	$ 5,585	Continuous
Antiscalant **(100% MDC706)**	18	lbs/day	$ 5.76	$ 37,843	Continuous
Antiscalant **(100% MSI410)**	19.1	lbs/day	$ 3.55	$ 24,749	Continuous
Sodium Bisulfite **(38%, DCL30)**	22.3	lbs/day	$ 0.79	$ 6,430	Continuous
RO Cleaning Chemicals **- MCT 103 (100%)**	270	lbs/cleaning	$ 3.02	$ 19,570	8 cleans per year per RO (every 45 days)
RO Cleaning Chemicals **- MCT 511 (100%)**	270	lbs/cleaning	$ 5.66	$ 36,677	8 cleans per year per RO (every 45 days)
Sub-Total				**$ 130,853**	
Consumables					
Greensand Media	271	#/year	$ 225.00	$ 60,975	Replacement every 5 years
Cartridge filter element replacement	1848	#/year	$ 10.00	$ 18,480	Replacement every month
RO Membrane Replacement (Muni-NF-300)	48	#/year	$ 500.00	$ 24,000	Replacement every 3 years
RO Membrane Replacement (Muni-NF-450)	144	#/year	$ 500.00	$ 72,000	Replacement every 3 years
Sub-Total				**$ 175,455**	

Attachment B:

VESP Cost Spreadsheet, 5/9/2013, VSEP, Mark Galimberti

VSEP Economic Analysis - Quote Version				
	70ºC, pH 11.5, 200 ml EDTA & 100 ml ABS/tote			
Alter Values in Blue to manipulate	US Standard Units		SI Units	
Total System Cost per 1000 gallons (Feed):	**$6.50**	$/1000 gal	**$2.29**	US$/m3
VSEP Cost per 1000 gallons (Permeate):	$7.65	$/1000 gal	$2.02	US$/m3
Variable Entered Values				
Feed Flow Rate	178	gpm	40	m3/hr
Average Testing Flux	25	gfd	From current Testing	
Amount of Pre-treatment chemical used	10	ml/250 gal	Actual data from first two runs	
Pretreatment Chemical Specific Gravity	1.00	g/ml	According to MSDS	
Cost for Pretreatment Chemical	$5.25	$/lb	Price we currently pay for small volumes	
Amount of Acid used	2,000	ml/1000 gal	Estimated, see pH Worksheet	
Specific Gravity	1.20	g/ml	According to MSDS	
Cost for Acid	$0.50	$/lb	Price we currently pay for small volumes	
Time between cleanings	1440	minutes	From actaul testing data	
Cleaning Solution Volume per module	100	gal	Estimated	
# of cleanings/cycle	1	each	Currently being used	
Concentrated Cleaner use	2%		Currently being used	
Power Cost	$0.05	$/kw-hr	Estimated, need to confirm	
Membrane Life	2.5	Years	Estimated from Historical data	
% Recovery	85%		Average of current testing	
Pressure	400	psi	From actual data	
Pump Efficiency	85%		Estimated	
Module Size	1400	SF		
Safety Factor	10%			
Calculated Values				
Design Flux	22.73	gfd	22.73	gfd
Number of Modules	7	modules	7	modules
Filtrate Rate	151	gpm	34	m3/hr
Feed Gallons/day	256,320	gpd	970	m3/day
Permeate Gallons/day	217,872	gpd	825	m3/day
Energy Cost (During Filtration Mode)				
Vibration Power Consumption	82	hp (@ 3/4")	82	hp (@ 3/4")
Pump Power Consumption	49	hp	49	hp
Total Energy Consumption	131	hp	131	hp
Rate of Kilowatt Usage	97.7	kW	97.7	kW
Daily Energy Cost (kw x 22hrs x .04$/kw)	$107	$/Day	$107	$/Day
Daily Cost ÷ Daily Capacity ÷ 1000	$0.42	$/1000 gal	$0.11	US$/m3
Membrane Replacement Cost				
Module Replacement Cost (ea module)	$78,000	$/ea	$78,000	$/ea
Total Membrane Repacement Cost	$534,098		$534,098	
Annual Membrane Cost	$213,639	$/yr	$213,639	$/yr
Daily Membrane Cost (365 day year)	$585	$/day	$585	$/day
Daily Cost ÷ Daily Capcity ÷ 1000	$2.28	$/1000 gal	$0.60	US$/m3
Pretreatment Chemical Cost				
Amount of Pretreatment Chemical used	0.04	kg/1000 gal	0.04	kg/1000 gal
Cost of Pretreatment Chemical	$11.55	$/kg USD	$11.55	$/kg USD
Daily Dispersant Cost	$118	$/day	$118	$/day
Daily Cost ÷ Daily Capacity ÷ 1000	$0.46	$/1000 gal	$0.12	$/m3
pH Adjusting Cost				
Amount of 50/50 Caustic used	2.40	kg/1000 gal	2.40	kg/1000 gal
Cost of 50/50 Caustic	$1.10	$/kg USD	1.1000	$/kg USD
Daily Caustic Cost	$677	$/day	$677	$/day
Daily Cost ÷ Daily Capacity ÷ 1000	$2.64	$/1000 gal	$0.70	$/m3
Chemical Cleaner Cost				
Concentrated Cleaner Consumption/Cycle/module	2.00	gal/cycle/module	2.00	gal/cycle/module
Daily Cleaner Consumption	2.00	gallons/day/module	2.00	gallons/day/module
Cost of Chemical Cleaner	$13.00	$/gallon	$13.00	$/gallon
Daily Cleaner Cost	$178	$/day	$178	$/day
Daily Cost ÷ Daily Capacity ÷ 1000	$0.69	$/1000 gal	$0.18	$/m3
Total Cost - Ct	$6.50	$/1000 gallons	$2.29	US$/m3
	$1,666	$/day	$1,666	US $/day
Annual Operating Costs	**608,067**	USD/year	**608,067**	USD/year

Attachment C:

GE Membrane Cleaning e-mail, 11/19/15, GE, Paul Dillallo

Teresa Kes

From: Dilallo, Paul M (GE Power & Water) <Paul.Dilallo@ge.com>
Sent: Thursday, November 19, 2015 8:53 AM
To: Alison L. Ling
Cc: Bryan T. Oakley
Subject: RE: PolyMet Chemical Info: Costs

Alison,
Budget pricing for the referenced chemicals are as follows.

Kleen MCT103 (low pH cleaner) – Totes - $5.35/lb
Kleen MCT515 (high pH cleaner) – Totes - $3.07/lb
Hypersperse MSI410 (antiscalant) – Totes - $3.22/lb

Please let me know whether you have any questions or require additional information.

Thanks,

Paul DiLallo
GE Water & Process Technologies

M 414 403 1897
E paul.dilallo@ge.com

From: Alison L. Ling [mailto:ALing@barr.com]
Sent: Tuesday, November 17, 2015 10:46 AM
To: Dilallo, Paul M (GE Power & Water)
Cc: Bryan T. Oakley
Subject: PolyMet Chemical Info: Costs

Paul,

In July, you provided us with guidelines for CIP chemical usage and concentrations. We are currently working on O&M cost estimates for the project. Can you send estimated costs for the following chemicals ($/ton)?

- GE Hypersperse
- MC1
- MC4

Are these items GE would provide, or would we have to source them elsewhere?

Thanks,

Alison L. Ling, PhD

Environmental Specialist
Minneapolis, MN office: 952.842.3568
ALing@barr.com

www.barr.com

resourceful. naturally. BARR

Attachment D:

GE Membrane Cleaning e-mail, 3/26/15
GE, Paul Dillallo

Teresa Kes

From: Dilallo, Paul M (GE Power & Water) <Paul.Dilallo@ge.com>
Sent: Thursday, March 26, 2015 6:59 AM
To: Jeff Ubl; Don E. Richard; Todd D. DeJournett
Cc: Hansen, Peter C (GE Power & Water)
Subject: PolyMet CIP Info

Gentlemen,
Thanks for taking the time to meet last week. As discussed, I am providing preliminary CIP volume/frequency information for the RO/NF Systems for PolyMet.

Mine Site
MUNI-300 – 72 membrane elements
~1,300 gallons cleaning solution per clean

MUNI-450 – 108 membrane elements
~1,950 gallons cleaning solution per clean

Plant Site
MUNI-1MGD - 180 membrane elements
~3,250 gallons cleaning solution per clean

Note that the volume per clean is based on each cleaning solution. i.e. a low-pH clean requires that volume and a high-pH clean requires that volume.

Based on feed water quality, we anticipate 4 cleanings per year (of both low-pH and high-pH) will be required per year per system. Note that this frequency could be higher or lower depending on actual feed water quality and operation.

Please let me know whether you have any questions or require additional information.

Thanks,

Paul DiLallo
GE Power & Water
Water & Process Technologies

T 262 200 2111
M 414 403 1897
E paul.dilallo@ge.com

Attachment E:

VSEP Pretreatment Requirements, 5/9/2013, VSEP, Mark Galimberti

Pre-treatment Requirements:

Polymet Mining
Membrane: ESPA
Estimated Recovery: 75%

VSEP does not have set concentration limits for individual constituents and the feed is evaluated as a whole for performance and economic feasibility. There are known problematic substances that will negatively impact the membrane such as polymers, solvents, and chlorine to name a few and is not recommended these substances be introduced in the system. Changes in water quality can affect the system performance and recovery in addition to membrane condition and maintenance.

Testing is required to determine the optimum pre-treatment needed. Based on the provided estimated feed water quality, the performance can probably benefit from pre-treatment. Anti-scalant can inhibit mineral scaling and increase flux stability. Adjusting the pH of the feed can increase solubility limits of common foulants and increase flux stability beyond the limits of anti-scalant.

Anti-scalant:

NLR-759 liquid membrane anti-scalant is designed to target scaling foulants, silica, fluoride magnesium, and calcium sulfate as well as scaling metal complexes including iron. This pretreatment chemical will inhibit fouling to maintain the membrane performance and extend the frequency of cleaning. The NLR-759 anti-scalant contains a unique blend of multiple prepackaged proprietary formula chemical ingredients and is a concentrated pretreatment chemical and is typically dosed at 10-20ppm.

Sulfuric Acid:

Decreasing the pH can increase the solubility limits of minerals that cause scaling t beyond the capability of a scale inhibitor. Adjusting the pH between 6-7 may possible improve flux and recovery performance. The amount of acid required will depend on the concentration of acid and can vary based on the feed quality. Testing would be required for an estimated acid dosage rate and the improvement in performance with pH adjusting.

mgalimberti@vsep.com

Attachment F:

VSEP Pretreatment Requirements, 11/11/2013, VSEP, Mark Galimberti

Clean In Place Requirements:

Polymet Mining
Membrane: ESPA
Recovery: 85%
Cleaning Chemicals: NLR 404, NLR 505, (pH adjust to 11 NaOH)

a. Cycle Details: Steps, time per step, flow per step:

Cleaner Description	Volume		Temperature	Time
	GPM	Total Gallons	(°C)	(Mins)
STEPS				
1. Rinsing/flush with water prior to cleaning (feed directly into the VSEP).	60	300	50-60	5
2. NLR 404 clean (Fill up CIP tank and make an acidic cleaning solution. Mix solution. Drain first 15% of concentrate and recirculate the rest). Record pH and temperature of cleaning solution.	60	200	50-60	30-45
3. CIP Tank Rinse.	60	50	50-60	5
4. Rinsing/flushing with water between caustic and acidic cleaning. (Feed directly into the VSEP).	60	600	50-60	10
5. NLR 505 clean (Fill up CIP tank and make an acidic cleaning solution. NaOH addition to reach desired 11.5 pH during mixing step. Drain first 15% of concentrate and recirculate the rest). Record pH and temperature of cleaning solution.	60	200	50-60	45-60
6. CIP Tank Rinse.	60	50	50-60	5
7. Final Flush (feed directly into the VSEP).	60	300	50-60	5
Miscellaneous steps inc prep time and mixing time				*20*
Totals		**1700**		**125-155**

b. Frequency

Typically a full cleaning cycle occurs once per day, but this may vary considering the system operation time. Regular cleaning schedules will depend on the performance of each VSEP on an individual basis. The frequency of cleaning is programmable and may vary from once per day to once per month depending on actual performance to be determined during startup. The cleaning frequency will also vary due to feed materials, operating conditions, and membrane life.

c. Water Volume per Cycle

To complete one standard cleaning cycle, 1700 gallons of water will be needed. For specific volumes utilized per cleaning step, please refer to the chart provided above.

d. Chemical Use.

Typically the best chemical cleaning procedure for this application is the use of NLR 404 and NLR 505 cleaners on an as needed basis. NLR 505 is a caustic cleaner containing mostly chelating agents and surfactants. Use of this cleaner will dissolve those foulants which are soluble in medium to high pH such as organics and silica. 404 is an acidic based cleaner and can be used to remove those things soluble in acid such as mineral scale. Warm water and pH adjusting are critical to the success of the cleaning.

Each cleaning cycle consumes between 4-6 gallons (2-3% solution) of the respective cleaning during each wash.

For alkaline washes, NaOH dosing to the cleaning solution is sometimes needed, based on pH level. The dosing occurs during tank preparation and the alkaline recirculation wash.

e. Temperature Requirements

For optimal results, the VSEP system requires cleaning water temperature to be at a minimum of 50°C, and a maximum of 60°C (temperature tolerance of membrane).

Pre-treatment Requirements:

Polymet Mining
Membrane: ESPA
Recovery: 85%
Pre-treatment: NLR 759 and pH 6.0

Piloting testing the TB WWTP determined pre-treatment is required for optimum flux and recovery. The addition of an anti-scalant and pH adjustment provided the desired performance. Chemical pre-treatment can reduce the amount of mineral scaling which affects membrane performance. VSEP does not have set concentration limits for individual constituents and the feed is evaluated as a whole for performance and economic feasibility. There are known problematic substances that will negatively impact the membrane such as polymers, solvents, and chlorine to name a few and is not recommended these substances be introduced in the system. These recommendations are based on the water quality and operating conditions tested during the field pilot. Changes in water quality can affect the system performance and recovery.

Anti-scalant:

NLR-759 liquid membrane anti-scalant is designed to target scaling foulants, silica, fluoride magnesium, and calcium sulfate as well as scaling metal complexes including iron. This pretreatment chemical will inhibit fouling to maintain the membrane performance and extend the frequency of cleaning. The NLR-759 anti-scalant contains a unique blend of multiple prepackaged proprietary formula chemical ingredients and is a concentrated pretreatment chemical and is estimated to be dosed at 10ppm based on pilot test data.

Sulfuric Acid:

The pH was adjusted to 6.0 to improve flux stability and increase recovery. Decreasing the pH can increase the solubility limits of minerals that cause scaling t beyond the capability of a scale inhibitor. Sulfuric acid was initially dosed on average at 2,672ppm of a 40% solution during pilot testing. The actual amount of acid required will depend on the concentration of acid and can vary based on the feed quality.

Attachment G:

SD033 (Area 5) WWTF Pilot Test Report,
September 2013,
Barr Engineering Co.

Reverse Osmosis Pilot Test Report

SD033 Active Treatment Evaluation

Prepared for
Cliffs Erie LLC and PolyMet Mining Inc.

September 2013

Reverse Osmosis Pilot Test Report

SD033 Active Treatment Evaluation

September 2013

Table of Contents

4.0 Reverse Osmosis Pilot Test Results

4.1 Pretreatment

4.1.1 Greensand Filtration

The greensand filter pilot unit for the pilot test was a pressure filter (see Figure 3). This filter is a 30-inch diameter unit filled with coarse gravel (5 inches), greensand filter media (30 inches), and anthracite (12 inches). The greensand media is silica sand coated with manganese oxide. Technical information on the greensand used during the pilot test and information on the pilot unit systems can be found in Appendix A.

For the pilot test, the influent was dosed continuously with potassium permanganate in order to (1) oxidize iron and manganese for removal by filtration and (2) regenerate the greensand media.

4.1.1.1 Filter Loading

Over the duration of the testing program, the influent flow rate ranged from around 15 to 22 gpm. The resultant range of hydraulic loading to the filter was 3.1 to 4.5 gpm per square foot (gpm/ft^2) of filter bed area.

4.1.1.2 Filter Removal Rates

The greensand filter removal rates for total suspended solids (TSS), iron, and manganese are presented in Table 3. During the complete period of testing (including startup and optimization phases), the TSS removal across the filter averaged > 41.9%. However, 15 of the 21 sampling events had TSS concentrations in both the influent and effluent from the greensand filter below the method reporting limit. Similarly, the removal of TSS was > 45% on average during Phase 3, but again the low observed removal may be related to the frequent influent concentrations below method reporting limits. Iron removal through the filter averaged > 73.1% over the course of the entire testing period. The concentration of iron in the filter effluent was never detected above the method reporting limit.

Greensand filter manganese removal averaged 86.0% over the course of the entire test. The greensand filter demonstrated the lowest manganese removal when the influent concentration dropped significantly during the three-week snow melt period. If those data points are removed from the average, manganese removal performance increases to 89.9% for the remainder of the testing period. Breakthrough of manganese to levels that could be problematic for operation of the RO membrane was not observed during the pilot test. Some variability in the effluent manganese was apparent, but effluent concentrations never exceeded 58 micrograms per liter (ug/L), a value similar to the alert level of 50 ug/L recommended by some membrane system vendors (Hydranautics, 2006). The variability in effluent manganese observed during the test can likely be attributed to varied uptake of the potassium permanganate across different regions of the filter media. Potassium permanganate dosing was held constant at 2.5 mg/L for the duration of the pilot test. Concentrations of manganese, iron, TSS, and all other parameters measured in the greensand filter effluent are displayed in Table 4.

4.1.1.3 Residuals

Periodically, accumulated solids must be removed from the greensand filter bed to maintain hydraulic capacity and performance. A filter backwash can be triggered based on filter run time, or more commonly, an increase in pressure drop across the filter. For the pilot unit, pressure drop was used to trigger backwash events. When the pressure drop across the unit reached approximately 10 psi, feed water was pumped up through the filter bed at a rate of 60 to 70 gpm (12 gpm/ft^2) to remove solids from the bed. During Phase 3 operations, the filter backwash frequency was approximately once every two days. Samples of the spent backwash water were collected and analyzed periodically. Greensand filter backwash water quality results are summarized in Table 5. In addition to containing elevated concentrations of TSS, iron, and manganese (the targeted constituents), the spent backwash water also contained elevated concentrations of organic material (as chemical oxygen demand), silica, and a few other trace metals.

4.1.1.4 Discussion

The primary purpose of the greensand filter was to protect the RO membranes by removing particulate matter, iron, and manganese upstream. The filter generally removed TSS and iron to concentrations below the method reporting limits and significantly reduced manganese concentrations. Although the RO membranes did exhibit signs of fouling during the seven-month pilot test, the reasons for this observed fouling were not likely due to the concentrations of iron, manganese, or other potential scalants or foulants in the RO feed water. The minimal fouling observed was due to the presence of microorganisms that result in biofouling, as discussed in more detail in Section 4.2. The greensand filter was a simple-to-operate, effective means of pretreatment for the feed water from Area 5NW.

In a full-scale application, one of the primary design criteria for greensand filters is the hydraulic loading rate. The loading rate for greensand filters has the potential to affect the manganese removal efficiency, the backwash frequency, and the number of filters required for filtration. For this pilot testing unit, the hydraulic loading rate was fixed by the unit supplier and was higher than typical hydraulic loadings for this type of filter (up to 4.5 gpm/ft^2 for the pilot compared to 3 gpm/ft^2 as a typical value). Influent concentrations of TSS, iron, and manganese for the Area 5 NW pit water were generally low compared to other greensand filter applications. Higher-than-typical loading rates can also be acceptable if demonstration testing shows acceptable treatment performance and backwash frequency, as was case during this pilot testing program.

4.1.2 Chemical Pretreatment

At the recommendation of the unit supplier, 3.9 ppm of Hypersperse MDC150, a scale inhibitor, was added to the process upstream of the RO membranes. As can be seen in Figure 2, the water at SD033 has generally contained slightly higher concentrations of bicarbonate alkalinity than was observed in the feed water from Area 5NW during the pilot testing program. For implementation of RO for the treatment of water from SD033, additional pretreatment of the water with a mineral acid may be required to mitigate scaling from calcium carbonate.

4.2 Reverse Osmosis

The RO pilot unit, as installed for this pilot testing application, is shown in the photograph on Figure 4. Manufacturer's information on the pilot unit can be found in Appendix A. The pilot used 18, 4-inch-diameter RO modules housed in six vessels, with the vessels oriented in a 4-stage (2-2-1-1) array. The 2-2-1-1 pattern provides treatment with two housings in parallel, two more housings in parallel, and the final two housings in series. Membranes employed in the pilot test were low-pressure RO membranes (GE model AG90). The pilot unit was operated continuously for approximately 8 hours per day, typically 5 days per week. At the end of each 8-hour shift, the RO system was flushed with permeate and shut down.

4.2.1 Flux and Recovery

Key operating variables for membrane treatment are recovery, the percentage of feed water volume that becomes permeate, and flux, or the flow rate through the system per unit area of membrane in service. In general, the higher the membrane flux, the lower the membrane area required for a given treatment capacity. However, operation at higher flux rates has the potential to increases the fouling rate of the membranes. For this application, the pilot flux and recovery targets were chosen during the initial period of testing and not changed during Phase 2 of testing. However, a substantial period of time during Phase 2 was dedicated to installing new mechanical components to allow the system to reach the target recovery and flux. Components changed included the pilot RO unit's flowmeter and concentrate orifice valve, which helps regulate concentrate flow and therefore recovery.

Attachment H:

VSEP Cost E-mail Update,
3/31/2016,
VSEP, Mark Galimberti

Teresa Kes

From:	Mark Galimberti <mgalimberti@vsep.com>
Sent:	Friday, March 25, 2016 3:16 PM
To:	Jeff Ubl
Cc:	Don E. Richard; Bryan T. Oakley; Alison L. Ling
Subject:	RE: PolyMet OPEX Update
Attachments:	Polymet_RO_Reject_Op_Costs.pdf

Hi Jeff, the only thing we see is the cleaners (404 & 505), which are $16 now. Everything else is the same. What is your feeling on the latest timeline on the project, or even the initial engineering work? Thanks for the question and review, Mark, tel 814 861 1506

From: Jeff Ubl [mailto:JUbl@barr.com]
Sent: Friday, March 25, 2016 2:44 PM
To: 'Mark Galimberti' <mgalimberti@vsep.com>
Cc: Don E. Richard <DRichard@barr.com>; Jeff Ubl <JUbl@barr.com>; Bryan T. Oakley <BOakley@barr.com>; Alison L. Ling <ALing@barr.com>
Subject: PolyMet OPEX Update

Hi Mark;

We are looking to get an update of unit costs for the items attached in red. These were from 5/9/13.

Can you provide within the next week?

Jeff Ubl, PE

Senior Environmental Engineer
Barr Engineering Co.
4300 MarketPointe Drive, Suite 200
Minneapolis, MN 55435

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office: 952.832.2647
toll-free: 800.632.2277

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jubl@barr.com
www.barr.com

resourceful. naturally.

VSEP Economic Analysis - Quote Version				
	70ºC, pH 11.5, 200 ml EDTA & 100 ml ABS/tote			
Alter Values in Blue to manipulate	US Standard Units		SI Units	
Total System Cost per 1000 gallons (Feed):	**$6.50**	$/1000 gal	**$2.29**	US$/m3
VSEP Cost per 1000 gallons (Permeate):	$7.65	$/1000 gal	$2.02	US$/m3
Variable Entered Values				
Feed Flow Rate	178	gpm	40	m3/hr
Average Testing Flux	25	gfd	From current Testing	
Amount of Pre-treatment chemical used	10	ml/250 gal	Actual data from first two runs	
Pretreatment Chemical Specific Gravity	1.00	g/ml	According to MSDS	
Cost for Pretreatment Chemical	$5.25	$/lb	Price we currently pay for small volumes	
Amount of Acid used	2,000	ml/1000 gal	Estimated, see pH Worksheet	
Specific Gravity	1.20	g/ml	According to MSDS	
Cost for Acid	$0.50	$/lb	Price we currently pay for small volumes	
Time between cleanings	1440	minutes	From actaul testing data	
Cleaning Solution Volume per module	100	gal	Estimated	
# of cleanings/cycle	1	each	Currently being used	
Concentrated Cleaner use	2%		Currently being used	
Power Cost	$0.05	$/kw-hr	Estimated, need to confirm	
Membrane Life	2.5	Years	Estimated from Historical data	
% Recovery	85%		Average of current testing	
Pressure	400	psi	From actual data	
Pump Efficiency	85%		Estimated	
Module Size	1400	SF		
Safety Factor	10%			
Calculated Values				
Design Flux	22.73	gfd	22.73	gfd
Number of Modules	7	modules	7	modules
Filtrate Rate	151	gpm	34	m3/hr
Feed Gallons/day	256,320	gpd	970	m3/day
Permeate Gallons/day	217,872	gpd	825	m3/day
Energy Cost (During Filtration Mode)				
Vibration Power Consumption	82	hp (@3/4")	82	hp (@3/4")
Pump Power Consumption	49	hp	49	hp
Total Energy Consumption	131	hp	131	hp
Rate of Kilowatt Usage	97.7	kW	97.7	kW
Daily Energy Cost (kw x 22hrs x .04$/kw)	$107	$/Day	$107	$/Day
Daily Cost ÷ Daily Capacity ÷ 1000	$0.42	$/1000 gal	$0.11	US$/m3
Membrane Replacement Cost				
Module Replacement Cost (ea module)	$78,000	$/ea	$78,000	$/ea
Total Membrane Repacement Cost	$534,098		$534,098	
Annual Membrane Cost	$213,639	$/yr	$213,639	$/yr
Daily Membrane Cost (365 day year)	$585	$/day	$585	$/day
Daily Cost ÷ Daily Capcity ÷ 1000	$2.28	$/1000 gal	$0.60	US$/m3
Pretreatment Chemical Cost				
Amount of Pretreatment Chemical used	0.04	kg/1000 gal	0.04	kg/1000 gal
Cost of Pretreatment Chemical	$11.55	$/kg USD	$11.55	$/kg USD
Daily Dispersant Cost	$118	$/day	$118	$/day
Daily Cost ÷ Daily Capacity ÷ 1000	$0.46	$/1000 gal	$0.12	$/m3
pH Adjusting Cost				
Amount of 50/50 Caustic used	2.40	kg/1000 gal	2.40	kg/1000 gal
Cost of 50/50 Caustic	$1.10	$/kg USD	1.1000	$/kg USD
Daily Caustic Cost	$677	$/day	$677	$/day
Daily Cost ÷ Daily Capacity ÷ 1000	$2.64	$/1000 gal	$0.70	$/m3
Chemical Cleaner Cost				
Concentrated Cleaner Consumption/Cycle/module	2.00	gal/cycle/module	2.00	gal/cycle/module
Daily Cleaner Consumption	2.00	gallons/day/module	2.00	gallons/day/module
Cost of Chemical Cleaner	$13.00	$/gallon	$13.00	$/gallon
Daily Cleaner Cost	$178	$/day	$178	$/day
Daily Cost ÷ Daily Capacity ÷ 1000	$0.69	$/1000 gal	$0.18	$/m3
Total Cost - Ct	$6.50	$/1000 gallons	$2.29	US$/m3
	$1,666	$/day	$1,666	US $/day
Annual Operating Costs	**608,067**	USD/year	**608,067**	USD/year

NLR 759. Converts to approximately $44/gallon.

Hydrochloric Acid

VSEP Module Replacement

NLR 404 and NLR 505 cleaner

Attachment I:

PolyMet Chemical Cost Update,
3/29/2016,
PolyMet, Jim Tieberg

Teresa Kes

From: Don E. Richard
Sent: Monday, March 28, 2016 4:28 PM
To: Jeff Ubl; Bryan T. Oakley; Alison L. Ling; Abby Morrisette
Subject: FW: Reagents & other items
Attachments: image001.png; ATT00001.htm; 2013 REAGENT UPDATE.xlsx; ATT00002.htm; Nalco Reagent pricing.pdf; ATT00003.htm; limestome products.pdf; ATT00004.htm; Hawkins reagent pricing.pdf; ATT00005.htm; liquid carbon dioxide.pdf; ATT00006.htm; Neosolutions antiscalant.pdf; ATT00007.htm; SIPX - Charles Tenant Co..pdf; ATT00008.htm; Quadra ca reagent pricing update.pdf; ATT00009.htm; grinding media.pdf; ATT00010.htm; Lubrication pricing update.pdf; ATT00011.htm; Diesel Fuel.pdf; ATT00012.htm; Ames Construction geotech liner update.pdf; ATT00013.htm; Mine Site power distribution update.pdf; ATT00014.htm

Some updated costs from PolyMet via Jim Tieberg.

From: Jim Tieberg [mailto:jtieberg@polymetmining.com]
Sent: Monday, March 28, 2016 12:46 PM
To: Don E. Richard
Cc: Jim Scott; Jennifer Saran
Subject: Fwd: Reagents & other items

Jim Tieberg
Mining Division Manager
Mobile: 218-248-0952 | Office: 218-471-2150 | Direct: 218-471-2165 | Fax: 218-471-2159
jtieberg@polymetmining.com | **www.polymetmining.com**

Begin forwarded message:

> **From:** Jim Tieberg <jtieberg@polymetmining.com>
> **Date:** January 29, 2016 at 7:43:35 AM CST
> **To:** Jon Cherry <jcherry@polymetmining.com>, Douglas Newby <dnewby@polymetmining.com>
> **Subject: FW: Reagents & other items**
>
> Good morning,
>
> Steve DeVaney has received all of the information he requested from vendors for use in updating the opex model. Please see the attachments for Steve's summary and back up.
>
> Jim

REAGENT	JAN 2016 PRICING USEAGE (STPY)		2015 PRICE/UNIT	2016 PRICE/UNIT	2015 EXTENDED PRICE	2016 EXTENDED PRICE	COMMENTS
FLOTATION CIRCUIT							
SIPX (SODIUM ISOPROPYL XANTHATE)	1,170	DRY	$1,250.00	$1,327.27	$1,462,500.00	$1,552,905.90	+ DELIVERY (DULUTH)
MIBC (METHYL ISOBUTYL CARBINOL)	1,007	100% SOLUTION	$2,180.00	$2,180.00	$2,195,260.00	$2,195,260.00	+ DELIVERY (GARYVILLE, LA)
COPPER SULPHATE ($CUSO_4$)	592	DRY	$2,358.70	$1,817.00	$1,396,350.40	$1,075,664.00	DELIVERED
MAGNAFLOC 10/455	6	DRY	$3,300.00	$2,980.00	$19,800.00	$17,880.00	+ DELIVERY (HOUSTON, TX)
CMC (CARBOXYL METHYL CELLULOSE)	1,072	DRY	$4,535.97	$4,535.97	$4,862,559.84	$4,862,559.84	+ DELIVERY (MONTREAL, CANADA)
LIME SLURRY	10,274	DRY	$151.48	$153.36	$1,556,305.52	$1,575,620.64	DELIVERED
WASTE WATER TREATMENT MINE SITE							
SODIUM METASILICATE @ 5%	25,000	GALLONS/YR	$1.00	$1.00	$25,000.00	$25,000.00	DELIVERED
FERRIC CHLORIDE @ 35%	14,400	GALLONS/YR	$1.65	$1.69	$23,760.00	$24,336.00	DELIVERED
SODIUM HYDROXIDE @ 50%	41,000	GALLONS/YR	$2.35	$2.10	$96,350.00	$86,100.00	DELIVERED
POLYMER FLOCULANT (LIQUID)	600	GALLONS/YR	$10.59	$10.59	$6,354.00	$6,354.00	DELIVERED
HYDRATED LIME	1,100	S/TONS/YR	$151.48	$153.36	$166,628.00	$168,696.00	DELIVERED
CARBON DIOXIDE LIQUID	1,000	S/TONS/YR	$144.00	$129.00	$144,000.00	$129,000.00	+ $900/MO IF WE NEED A TANK
CITRIC ACID	120	GALLONS/YR	$9.96	$9.96	$1,195.20	$1,195.20	DELIVERED
SODIUM HYPOCHLORITE	120	GALLONS/YR	$1.75	$1.70	$210.00	$204.00	DELIVERED
TAILINGS BASIN							
POTASSIUM PERMANGANATE	16,000	POUNDS/YR	$3.50	$4.00	$56,000.00	$64,000.00	DELIVERED
ANTISCALANT	4,000	GALLONS/YR	$7.50	$6.49	$30,000.00	$25,960.00	DELIVERED
CARBON DIOXIDE LIQUID	250	S/TONS/YR	$144.00	$129.00	$36,000.00	$32,250.00	+ $900/MO IF WE NEED A TANK
HYDRATED LIME	220	S/TONS/YR	$151.48	$153.36	$33,325.60	$33,739.20	DELIVERED
MISC							
					SAVINGS		
GRINDING BALLS (125MM or 5-1/2")	FORGED	/ST	$1,250.00	$901.00	$349.00		DELIVERED
GRINDING BALLS (50mm)	FORGED	/ST	$1,060.00	$770.00	$290.00		DELIVERED
	20% CHROME	/ST	$1,435.00	$1,292.00	$143.00		DELIVERED
GRINDING BALLS (38mm)	FORGED	/ST	NOT BID B4	$810.00			DELIVERED
	% CHROME	/ST	NOT BID B4	$1,292.00			DELIVERED
CERAMIC GRINDING MEDIA		/ST	$3,260.00	$3,100.00	$160.00		

LUBRICANTS — BASKET OF ITEMS SHOWS SAVINGS FROM 0.1% (SYNTHETICS AND HI PERFORMANCE LUBES) TO 19.6% (MINERAL OILS)
SEE ATTACHED FOR INFORMATION (INCLUDES 2013 & 2016 PRICING WITH EXAMPLES OF HIGHER USAGE OILS)

FUEL OIL — EDWARDS OIL - BASED ON FUTURES - ALL COSTS ADDED IN, LESS SALES TAX - SEE ATTACHED EXPLANATION
FEB - $1.7906 MAR - $1.7057 APR - $1.5073 MAY - $1.5224 JUN - $1.5446 JUL - $1.5646
AUG - $1.5851 SEP - $1.6143 OCT - $1.6380 NOV - $1.9733 DEC - $1.9805

GEOTECH FABRIC FOR MINE DUMPS AND TAILINGS — LITTLE CHANGE IN PRICE DUE TO: 1) LABOR INCREASES; 2) HIGH DEMANDS FOR LINER PROJECTS HAS INCREASED PRICING

MINE POWER DISTRIBUTION — ANY SAVINGS IN MATERIALS/EQUIPMENT IS OFFSET BY INCREASED LABOR COSTS

Steve DeVaney

From:	Martin Husnik <MartinHusnik@amesco.com>
Sent:	Thursday, January 21, 2016 10:45 AM
To:	Steve DeVaney
Cc:	Jim Tieberg; Butch Trebesch
Subject:	RE: Liners

Steve,

I spoke with the liner subcontractor we had from fall of 2013 and they told me that there is not much change from then to now due to a couple reasons:

- Labor has increased.
- Currently there are a lot of liner projects for this year and demand/price is up offsetting the low cost of oil.

He will contact the manufactures and said he would have some updated pricing next week so we can compare.

Let us know if you need anything else.

Marty

Ames Construction
2000 Ames Drive
Burnsville, MN 55306
Midwest: 952-435-7106

Martin Husnik, P. E.
Chief Estimator
MartinHusnik@amesco.com
Mobile: 612-919-3405

From: Steve DeVaney [mailto:sdevaney@polymetmining.com]
Sent: Wednesday, January 13, 2016 11:38 AM
To: Martin Husnik <MartinHusnik@amesco.com>
Subject: Liners

Martin,

I have been asked to find out from you if the pricing for the geotech liners for PolyMet's project has changed (hopefully less) due to the decrease in price for petroleum products.

Thank you,
Steve DeVaney
Procurement Manager
PolyMet Mining, Inc.

Steve DeVaney

From: Bob Skalko <rskalko@eoctrimark.com>
Sent: Wednesday, January 20, 2016 4:22 PM
To: Steve DeVaney
Cc: Scott Skalko
Subject: Fuel projections 2016
Attachments: Book1.xlsx

Hi Steve:

Attached are the fuel projections for 2016. Historically, this is the time of year for the seasonal low for diesel fuel. Prices for gas and diesel will most like go up from here. The risk is much greater to the upside than the downside. I could lock in these numbers for you today if you were able to commit. I added competitive rates for transport from Duluth/Superior to the Range, a fee for unit fill, MN taxes. I did not include sales tax as most likely Polymet will have an exemption.

Since you aren't able to commit today, I have added a standard deviation which represents what I think is reasonable upside potential. I looked at the 2-standard deviation calculation from a few months ago (which would provide a 95% confidence level) and divided it in half since we are only talking twelve months out vs 3 years in my previous work. If I remember my stats class, one standard deviation is about a 64% confindence level. You can double the amount that I show if you wanted to get back to 2 standard deviations and a higher degree of confidence.

For the months of Feb, Nov, Dec I added 24 cents per gallon to the #2 price to estimate a value for #1. I also used half the standard deviation amount for #1 that was calculated a few months ago. It differed slightly from #2.

I hope this works. If not let me know and I'll try to give you the information that you want for your projections.

Thx.

Bob Skalko
Edwards Oil Inc.

		Futures	Frt+Insp Fee	Unit Fill	MN Cleanu	1 Std Dev	Total
Feb	#1	1.2186	0.042	0.21	0.02	0.3	1.7906
Mar	#2	1.2337	0.042	0.21	0.02	0.2	1.7057
Apr	#2	1.0353	0.042	0.21	0.02	0.2	1.5073
May	#2	1.0504	0.042	0.21	0.02	0.2	1.5224
June	#2	1.0726	0.042	0.21	0.02	0.2	1.5446
July	#2	1.0926	0.042	0.21	0.02	0.2	1.5646
Aug	#2	1.1131	0.042	0.21	0.02	0.2	1.5851
Sept	#2	1.1423	0.042	0.21	0.02	0.2	1.6143
Oct	#2	1.166	0.042	0.21	0.02	0.2	1.638
Nov	#1	1.4013	0.042	0.21	0.02	0.3	1.9733
Dec	#1	1.4085	0.042	0.21	0.02	0.3	1.9805
	Avg	1.175855				Avg	1.675127

Steve DeVaney

From: Dave Pierson <David.Pierson@gerdau.com>
Sent: Monday, January 18, 2016 1:43 PM
To: Steve DeVaney
Subject: RE: Pricing

Hi Steve, sorry for late reply. Please see current budgetary pricing for FORGED Grinding Balls delivered to Hoyt Lakes, MN.
We manf in Duluth, MN.
Advise if questions or comments.
Thanks
Dave

David Pierson

Regional Sales SBQ/Grinding Media

david.pierson@gerdau.com
763.772.8491

From: Steve DeVaney [mailto:sdevaney@polymetmining.com]
Sent: Thursday, January 14, 2016 8:30 AM
To: Dave Pierson <David.Pierson@gerdau.com>
Subject: Pricing

Happy New Year Dave,

I have been asked by the banks looking into providing PolyMet with construction financing , to check into pricing for some of the commodities that may have changed, due to market forces.

Could you please provide me with pricing (delivered) for:

125mm forged balls (Sag Mill) - Do not produce at Duluth but can source and deliver at $985/ short ton.
50mm forged and chrome balls (ball mills) $770 / short ton
38mm forged and chrome balls (regrind mills) $810 / short ton.

Thank you,
Steve DeVaney
Procurement Manager
PolyMet Mining, Inc.
6500 County Road 666
Hoyt Lakes MN 55750

Monday, January 18, 2016

Mr. Steve Devaney
Manager- Purchasing
Polymet Mining
P.O. Box 475
Hoyt Lakes, MN 55750

Ref: Budget Ball Pricing

Dear Steve,

I am quoting Forged balls & chrome balls delivered to Polymet Mining in Hoyt Lakes. Our pricing includes the surcharges for Steel Scrap and Ferro-Chrome. Currently, we are reviewing the raw materials costs on a quarterly basis.

Budget Chrome Ball pricing: 38mm & 50 mm 20% Cr balls @ $1,292/ST delivered.

This reflects current Raw materials and freight costs.
We believe that the 20% chrome ball will be very beneficial to Polymet in their downstream process (flotation).

Foged balls:

125mm - $901/st delivered

38mm & 50mm - $883/st delivered

Ceramic Beads: 2-3 mm $3,492/st delivered

<u>Delivery</u>:

Chrome balls- in 90 ton railcars

Forged balls in 1 metric ton or 1 short ton bags by truck or rail car

Beads- in 1 metric ton or 1 short ton bags by truck

Sincerely,

Doug Halverson

Doug G. Halverson
Sales Engineer
Magotteaux

Steve DeVaney

From:	Phil Eason <Phil.Eason@HawkinsInc.com>
Sent:	Friday, January 15, 2016 3:46 PM
To:	Steve DeVaney
Subject:	RE: Reagents

Here are some current costs based on the volumes you provided earlier. We are checking with BASF on the Magnafloc items and also waiting on a copper sulfate price. What is the volume on the copper sulfate? Copper is down right now as you probably know.

Thanks, Phil

Magnafloc 10/455	$
Copper Sulphate	$
Sodium Metasilicate @ 5%	$1.00/gallon
Ferric Chloride @ 35%	$1.69/gallon
Sodium Hydroxide @ 50%	$2.10/gallon
Polymer Floculant	$14.86/gallon
Citric Acid 50%	$9.96/gallon
Sodium Hypochlorite	$1.70/gallon
Potassium Permanganate	$4.00/lb.

Phil Eason
Account Manager
Hawkins, Inc.
Direct 612-617-8534
Mobile 612-750-2221

From: Steve DeVaney [mailto:sdevaney@polymetmining.com]
Sent: Wednesday, January 13, 2016 1:11 PM
To: Phil Eason
Subject: Reagents

Happy New Year Phil,

I have been asked by the banks interested in providing construction financing to get updated pricing on our reagents.

Could you please provide me with delivered pricing for the following products that you have quoted in the past?
Magnafloc 10/455
Copper Sulphate
Sodium Metasilicate @ 5%
Ferric Chloride @ 35%
Sodium Hydroxide @ 50%
Polymer Floculant
Citric Acid
Sodium Hypochlorite

Steve DeVaney

From:	Terry Spooner <tspooner@graymont.com>
Sent:	Thursday, January 14, 2016 12:46 PM
To:	Steve DeVaney
Subject:	RE: Lime

Happy New Year to you as well, Steve. Here's the budget numbers for 2016.

High Calcium Hydrated Lime: $125.00
High Calcium Quicklime (1/4" minus sizing): $105.00
Pulverized High Calcium Limestone, 270 Mesh: $28.00
ADD Pneumatic Truck Freight, delivered to Polymet silos: $18.62 for PLS (Pulverized Limestone)
$23.00 for Quicklime
$28.36 for Hydrate

All prices are per short ton. If you need anything else, just let me know.

Terry

Terry Spooner
Account Manager
GRAYMONT

T +1 715-394-1714 M +1 218-348-4598
800 Hill Avenue
Superior, WI 54880

From: Steve DeVaney [mailto:sdevaney@polymetmining.com]
Sent: Wednesday, January 13, 2016 12:56 PM
To: Terry Spooner <tspooner@graymont.com>
Subject: Lime

Happy New Year Terry,

The banks that are interested in supplying construction financing to PolyMet have asked that I get current pricing on the lime/limestone products that you have quoted in the past.

Please provide a current pricing for: 1) High Calcium Hydrated Lime 2) High Calcium Quicklime and 3) pulverized High Calcium Limestone.

Thank you,

Steve DeVaney
Procurement Manager
PolyMet Mining, Inc.

Steve DeVaney

From: David_Stanaway@praxair.com
Sent: Friday, January 15, 2016 11:32 AM
To: Steve DeVaney
Subject: RE: Pricing

You would be around $129.00/ton. Hope this helps you out. Let us know if you need anything else. Thanks

David Stanaway
Praxair Distribution Inc
Branch Manager II
112 S. 15th Ave W
Virginia, MN 55792
218 749-4293
David_Stanaway@Praxair.com

From: Steve DeVaney <sdevaney@polymetmining.com>
To: "David_Stanaway@praxair.com" <David_Stanaway@praxair.com>
Date: 01/15/2016 10:02 AM
Subject: RE: Pricing

About 1,000 short tons/year

From: David_Stanaway@praxair.com [mailto:David_Stanaway@praxair.com]
Sent: Friday, January 15, 2016 9:26 AM
To: Steve DeVaney <sdevaney@polymetmining.com>
Subject: Re: Pricing

Happy New Year to you!!!

Can you refresh our memory as to the anticipated usage?

David Stanaway
Praxair Distribution Inc
Branch Manager II
112 S. 15th Ave W
Virginia, MN 55792
218 749-4293
David_Stanaway@Praxair.com

Steve DeVaney

From: Steve King <sking@petrochoice.com>
Sent: Friday, January 15, 2016 4:23 PM
To: Steve DeVaney
Cc: Mark Giese; Erik Modeen
Subject: Lubrication Budget and Outlook
Attachments: Polymet Budget numbers 2016.xlsx

Steve-

Mark mentioned you were looking for an update on the market. I attached a sampling of budgetary pricing based on today's market. For the most part, mineral oil pricing has dropped substantially while synthetics and high performance products have only dropped a little. We see today's pricing to hold firm for at least a year if not longer. I do not believe it will drop much more than it already has. Let me know if you need anything else.

Thanks

Steve King, CLS
Executive Vice-President West Zone
PetroChoice Lubrication Solutions
Cell: 218-348-4194
sking@petrochoice.com

PRICING IS LOWER
0.1% TO 19.6%
SEE FOLLOWING PAGE

'13

SHORT_DESC	Vendor	Feb-16		
Cummins Fleetcool EX 50/50: Bulk	Cummins	6.57		
Mobil Delvac MX 15w-40: Bulk	ExxonMobil	6.50		
Mobil DTE 10 Excel 32: Bulk	ExxonMobil	13.18	-$0.12 = -0.9%	$13,30
Mobil DTE Extra Heavy: Drum	ExxonMobil	459.25		
Mobil DTE Heavy Medium: Drum	ExxonMobil	447.70		
Mobil DTE Light: Drum	ExxonMobil	507.65	-$11,35 = -2,2%	$519
Mobil Gear 600 XP 68: Bulk	ExxonMobil	5.76		
Mobil Grease XHP 221: Drum	ExxonMobil	722.18	-$30,82 = -4,1%	$753
Mobil Grease XHP 321: Bulk	ExxonMobil	2.27		
Mobil Nuto H 68: Bulk	ExxonMobil	5.05	$1,23 = -19,6%	$6,28
Mobil SHC 626: Drum	ExxonMobil	2,230.80		
Mobil SHC 629: Drum	ExxonMobil	1,922.94	-$2,06 = -0,1%	$1925-
Mobil SHC 630: Drum	ExxonMobil	1,961.44		
Mobil Spartan EP 150: Bulk	ExxonMobil	5.38	-$1.03 = -16%	$6,41
Mobil Spartan EP 220: Bulk	ExxonMobil	5.38		
Mobil Spartan EP 320: Bulk	ExxonMobil	5.65		
Mobil Spartan EP 460: Bulk	ExxonMobil	6.68	-$0,73 = -9,9%	$7,41
Mobil Trans HD 10W: Bulk	ExxonMobil	6.06		
Mobil Trans HD 30: Bulk	ExxonMobil	6.27		
Mobil Trans HD 50: Bulk	ExxonMobil	6.74		
Mobil Univis N 32: Bulk	ExxonMobil	5.15		

Confidential - Budgetary pricing only

PetroChoice
Lubrication Solutions

Polymet Pricing for Budgetary Purposes **11/5/2013**

Product Description	**Bulk**	**Drum**
Mobil ATF D/M	6.75	400.00
✓Mobil DTE 10 Excel 32	13.30	748.00
Mobil DTE 10 Excel 68		960.00
✓Mobil DTE Light		519.00
Mobil Mobilgrease XHP Mine 320		988.00
Mobilith SHC 220-Drum		2,486.00
Mobilith SHC 221-Drum		2,486.00
✓Mobil Nuto 68	6.28	362.00
Petron Gearshield NC	2.13	984.00
Petron PK 140		860.00
✓Mobil SHC 629		1,925.00
Mobil SHC 634		2,020.00
✓Mobil Spartan EP 150	6.41	382.00
✓Mobil Spartan EP 460	7.41	438.00
✓Mobil XHP 221 Grease		753.00
Mobil XHP 222 Grease		753.00
	Keg	**Pail**
Mobil Grease XTC	604.00	187.00

*** Budgetary numbers only. Actual products and final costs to be determined.

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Lubrication Solutions

3/26/14 (2013 LUBE PRICING)

PolyMet Coarse Crusher

		Upgraded System			Lubrication Costs					
Project #	Project	Description	Est. Cost	Ref. Doc	Description	Est.Cost	Ref. Doc		Est.Cost	Ref. Doc
PMCC101	Coarse Crusher Car Dump Hydraulic Systems	Clean modify end plates, replace suction strainers, utilize existing high pressure filters, and existing kidney loop filtration system. Add soft shift to directional control valves, hydraulic jumper hoses between pump and DCV, rubber motor mount inserts. reseal hydraulic cylinders.	$101,824.70	PMCC101B	Product- Mobil Nuto H 68 1770 gallons ✓	$11,115.60 8938.50 → '16	PMCC101BL			
PMCC102	Coarse Crusher Lube Oil System	Replace the existing crusher lube oil system with individual day tanks. Day tanks will be equipped with heaters, coolers, and filtration. Install a 1500 gallon storage tank, install a new distribution pipe and plumbing.	$857,700.00	PMCC102A	Fill Crusher Oil System Product- Mobil Spartan EP150 - 4800 gallons	$30,768.00 25824 → '16	PMCC102AL			
PMCC103	60" and 36" Crusher Drive Motors	Remove drive couplings, clean and grease with Mobil Grease XTC. Drain, and flush electric drive motors; fill as required(AW68).	$3,200.00	PMCC103B	(1) 5-Gallon Pail Mobil Grease XTC (24) Gallons Mobil Nuto H68	$337.72	PMCC103BL		150.72 121.20	→ '13 → '16
PMCC104	60" Spyder Lube Systems	Replace grease pumps, install bulk grease tanks, replace Trabon blocks and replace existing lubricant supply lines to crusher. Purge lines, connect and purge spyder bushings.	$40,670.13	PMCC104A	Mobil Grease XHP 320 (400 lbs.)	$988.00	PMCC104AL			
PMCC105	36 " Spyder Lube Systems	Replace grease pumps, install bulk grease tanks, replace lube blocks and replace existing lubricant supply lines to crusher. Purge lines, connect and purge spyder bushings.	$91,493.13	PMCC105A	Mobil Grease XHP 320 (400 lbs.)	$988.00	PMCC105AL			
PMCC106	60" Hydrosets	Replace existing tanks (old tanks were cut open), install new breathers on tanks. Replace electric motor/pump assembly.Replace high pressure filter housings (2 each system, 4 total) with upgrades.	$24,227.48	PMCC106A	(500 gallons) Mobil Spartan EP 150	$3,205.00 2525 → '16	PMCC106AL			

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PMCC107	36" Hydrosets	Replace existing tanks (8) total, install new breathers on tanks. Install new electric motor/pump assembly. Replace high pressure filter housings (8 total-2 each system,) with upgrades.	$75,124.80	PMCC107A	(800) gallons Mobil Spartan EP 150	$5,128.00 4040 → 1/6	PMCC107AL			
PMCC108	Pan Feeders	Rescope								
PMCC109	1A & 1B Conveyors (Tail Pulleys)	Plumb out grease fittings for manually greasing the tail pulley bearings.	$337.00	PMCC109B	Grease (14 lbs.) Bulk Mobil Grease XHP 221	$24.50	PMCC109BL			
PMCC110	60" Lifting Cylinders	Replace existing pump with a rermanufactured pump. Drain oil, install sample tube, new breather and refill with new oil. Rebuild existing cylinder.	$17,521.86	PMCC110A	(60) Gallons Mobil Nuto H 68	$376.80	PMCC110AL			
PMCC111	30" Lifting Cylinders	Replace existing pump with a rermanufactured pump. Drain oil, install sample tube, new breather and refill with new oil. Rebuild existing cylinder.	$7,238.08	PMCC111A	(30) Gallons Mobil Nuto H 68	$188.40	PMCC111A			
PMCC112	Miscellaneous				(4) Kegs Mobil XTC Coupling Grease $604.00 Each	$2,416.00				
			$1,219,337.18			$55,536.02			$0.00	

PetroChoice
Lubrication Solutions

PolyMet Concentrator

Project #	Project	*Upgraded System* Description	Est. Cost	Ref. Doc	*Lubrication Costs* Description	Est.Cost	Ref. Doc		Est.Cost	Ref. Doc
PMC501	4A & 4 B Conveyor Head Pulley Lubrication	Install a Centromatic for conveyor pulleys and shaft bearings.	$23,904.32	PMC501A	Mobil Grease XHP 221 (400 lbs.)	$753.00	PMC501AL			
PMC502	5 N Primary and Secondary Drive Gear Boxes	Install sample valves, 3/8" sight glasses. Flush with portable filter cart, service couplings. Install an automatic lubrication system to supply grease to lube points. USE The 4A & 4B system	$23,480.70	PMC502A	Mobil Grease XHP 221 (400 lbs.) Mobil Spartan EP 150 85 gallons Mobil Nuto H 68 2 gallons	$1,310.41	PMC502AL			
PMC503	5 N Tripper Car	Replace breathers and sight glasses, flush with portable filter cart, service drive coupling. Install a QLS for carriage wheel, conveyor pulley and shaft bearings. Drain secondary drive gear reservoir, flush and refill with 460 gear oil.	$8,708.49	PMC503A	(5) Gallons Mobil Spartan EP 150 (2) Gallons Mobil Spartan EP 460 Grease (14 lbs.) Bulk Mobil Grease XHP 221	$71.37	PMC503AL			
PMC504	5N Head Pulley Lubrication	Install a (1) quick systems on the 5N conveyor head pulley.	$5,845.97	PMC504A	Mobil Grease XHP 221 (400 lbs.)	$753.00	PMC504AL			
PMC505	Feeder Belts	Install sample valves, install a new breathersand 3/8" sight glasses, flush with portable filter cart, service couplings. Install an automatic Lube system to grease lube points.	$40,467.61	PMC505A	IMobil Grease XHP 221 (400 lbs.) (82) Gallons Mobil Spartan EP 150	$1,278.62	PMC505AL			
PMC506	Mill Oil Systems	Install a new bulk storagepumping system. Install new day tank oil skids on the 440 deck at each mill. Install new supply lines from each day tanks to the rod and ball mills. Install new flow meters on each mill. Install new supply hoses,return hoses on the mills. Service drive couplings,.	$1,100,908.40	PMC506A	IMobil Spartan EP 150 3200 gallons (8) Mobil grease XTC Keg	$25,344.00 17,216 +	PMC506AL '16			
PMC507	Mill Drive Gear & Pinion Lubrication Systems	Install a new bulk storage system. Replace current storage tanks,install new grease pumps, replace lube blocks and supply hoses. Rebuild lube panels. Service mill and pinon gear lubricant.	$236,025.80	PMC507A	Petron Gearshield NC 9300 lbs.	$19,809.00	PMC507AL			

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PMC508	Regrind Mill Oil Systems	Install a new bulk storage system. Install new day tank oil skids under the regrind deck at each mill. Install new supply lines from each day tanks to the ball mills. Install new flow meters on each mill. Install new supply hoses,return hoses on the mills. Service drive couplings,.	$92,801.40	PMC508A	Mobil Spartan EP 320 1100 gallons (1) Mobil grease XTC Keg	$7,655.00	PMC508AL		
PMC509	Regrind Mill Drive Gear & Pinion Lubrication Systems	Install a new bulk storage system. Replace current storage tanks,install new grease pumps, replace lube blocks and supply hoses. Rebuild lube panels. Service mill and pinon gear lubricant.	$50,303.58	PMC509A	Petron Gearshield NC 2000	$4,260.00	PMC509AL		
TOTAL			$1,582,446.27			$61,234.40		$0.00	

Steve DeVaney

From: Shevich, George <George.Shevich@ParsonsCorp.com>
Sent: Wednesday, January 20, 2016 1:41 PM
To: Steve DeVaney
Cc: Zdon, Roger; Johnson, Denny
Subject: RE: Estimate

Steve, we have reviewed our proposal for the Mine site Power Distribution. The major materials/equipment was to be furnished by others. The balance of the material/equipment pricing did not change a great deal. Some went up and some went down. Any savings here would be offset be a labor rate increase. The next rate increase is May 31, 2016.

We would be more than happy to take another look at our proposal if there were any new information or drawings available.

Please let us know if there is anything else we can do for you. Thank you very much for the opportunity.

George Shevich | Project Manager
PARSONS ELECTRIC
(218) 725-3405 Direct
(218) 591-0282 Mobile
www.parsonscorp.com

JOURNEY TO ZERO
SAFETY STARTS WITH ME

From: Steve DeVaney [mailto:sdevaney@polymetmining.com]
Sent: Friday, January 15, 2016 9:10 AM
To: Shevich, George
Subject: Estimate

Happy New Year George,

I have been asked to contact you concerning the proposal (PR-0039) that you submitted in October, 2013. We are working with bankers interested in providing PolyMet with construction financing and they have asked us to provide them with updated estimates of various projects. They are inquiring if any of the estimates may have increased (or decreased) due to the decrease in metals and petroleum costs in the current marketplace. Could you please update the proposal (specifically for SOW 13 : Mine Site Power Distribution System : Year – 1)? The banks (and PolyMet) seem to be in a hurry for this information and are requesting that you return an updated estimate as soon as possible.

Thank you,
Steve DeVaney
Procurement Manager
PolyMet Mining, Inc.
218-471-2155

Steve DeVaney

From: Leingang, David <dleingang@nalco.com>
Sent: Wednesday, January 20, 2016 10:51 AM
To: Steve DeVaney
Subject: FW: Reagents

Steve,

For the sake of accuracy, I received an update on the MIBC density this morning, apparently my marketer gave me the standard MIBC density, not the FP 509 product in the table below. The FP 509 is slightly heavier and does change the cost per gallon slightly.

SPEC PRODUCT	NALCO PRODUCT	FORM	PRICE/LBS	#/gal	$/gal
SIPX	SIPX	Dry-Bulk Bag	$1.42		
MIBC	FP 509	Bulk Liquid	$1.09	7.3	$7.96
Antiscalant	DVS4O012	Bulk Liquid	$1.12	9.6	$10.75
Liquid Flocculant	83904	Bulk Liquid	$1.19	8.9	$10.59
Dry Flocculant	83949	Dry-Bulk Bag	$1.49		

MAGNAFLOC.
10/455

Hope this all make sense to you, if not let me know and I will do my best to clarify.

Thanks.

David Leingang
District Account Manager
Grand Rapids, MN

NALCO | an Ecolab Company
Cell: 218 259 6450
Dist Office: 304-965-7461
E: dleingang@nalco.com

From: Leingang, David
Sent: Tuesday, January 19, 2016 11:30 AM
To: 'Steve DeVaney'
Subject: FW: Reagents

Steve,

As per our discussion, the densities of the liquid products and the price per gallon were updated in the table below. Let me know if you have further questions.

SPEC PRODUCT	NALCO PRODUCT	FORM	PRICE/LBS	#/gal	$/gal
SIPX	SIPX	Dry-Bulk Bag	$1.42		
MIBC	FP 509	Bulk Liquid	$1.09	6.9	$7.52
Antiscalant	DVS4O012	Bulk Liquid	$1.12	9.6	$10.75

Steve DeVaney

From:	DKarkoska Neo Solutions <dkarkoska@neosolutionsinc.com>
Sent:	Tuesday, January 19, 2016 5:07 PM
To:	Steve DeVaney; KHovland Neo Solutions
Subject:	RE: Antiscalant

Steve, I assumed (maybe incorrectly) that the product was to be delivered in bulk. I got the updated product costings in freight and came up with $6.49 a gallon the only thing that would change that would be product in totes compared to product in bulk.

Dave Karkoska
Neo Solutions Inc.
218.780.3283

-------- Original message --------
From: Steve DeVaney <sdevaney@polymetmining.com>
Date: 1/19/2016 9:50 AM (GMT-06:00)
To: DKarkoska Neo Solutions <dkarkoska@neosolutionsinc.com>, KHovland Neo Solutions <khovland@neosolutionsinc.com>
Subject: Antiscalant

I have been asked to update the price of antiscalant (part of our construction financing). The last price from you was $7.50/gl in 2013.

Thanks,
Steve DeVaney
PolyMet Mining, Inc.

Steve DeVaney

From:	Catherine_Gagnon@quadra.ca
Sent:	Tuesday, January 26, 2016 4:08 PM
To:	Steve DeVaney
Cc:	Catherine_Gagnon@quadra.ca
Subject:	Re: FW: Considering Quadra Chemicals Regents & Technical Services
Attachments:	REAGENT UPDATE QUOTE SHEET (Jan 2016).xlsx

Steve,

Pleas find revisions on the reagents. There are some products where prices have not yet decreased. Please note that these are budgetary figures and prices are subject to change. As we get closer to the opening of the mine, then Quadra will be in a better position to provide true figures during that time.

If you need more information, please do not hesitate to contact me.

Regards,

Catherine Gagnon
Directrice des Comptes Stratégiques
Strategic Account Manager
Cellulaire/Cellular (613) 360-0016
Télécopieur / Fax: (450) 424-9458
Courriel / Email: Catherine_Gagnon@quadra.ca
http://www.quadrachemicals.com

From: Steve DeVaney <sdevaney@polymetmining.com>
To: "'catherine_gagnon@quadra.ca'" <catherine_gagnon@quadra.ca>
Date: 01/13/2016 02:24 PM
Subject: FW: Considering Quadra Chemicals Regents & Technical Services

---

Happy New Year Catherine,

I have been asked by the banks that are considering providing construction financing to PolyMet to update my reagent pricing.

Could you please look at the attached list (which you supplied to me last summer) and provide me with current pricing?

Thank you,
Steve DeVaney
Procurement Manager
PolyMet Mining, Inc.

From: Catherine_Gagnon@quadra.ca [mailto:Catherine_Gagnon@quadra.ca]
Sent: Thursday, June 11, 2015 9:17 PM

QUADRA PRICING 1/26/16

REAGENT PRICING

REAGENT	USEAGE (STPY)		PRICE/UNIT	EXTENDED PRICE	COMMENTS
HYDROMET CIRCUIT					
HYDROCHOLIC ACID	1,485	32% SOLUTION	$199.60	$296,406.00	ex-Toronto, Canada (for now. May quote out of Wisconcin).
SULFUR DIOXIDE (LIQUID)	1,254	100% LIQUID	$0.00	$0.00	no quote
SODIUM HYDROSULFIDE	334		$905.00	$302,270.00	1984 lb/bag of dry flakes delivered to mine & dissolved on-site.
LIMESTONE (LUMP)	87,341	DRY	$0.00	$0.00	
LIMESTONE (GROUND)	87,341	DRY	$0.00	$0.00	
LIME - DRY	5,181	DRY	$0.00	$0.00	May quote through support from our supplier
Mg HYDROXIDE	3,674	60% SOLUTION	$598.75	$2,199,807.50	bulk deliveried to site
CAUSTIC SODA (NaOH)	64	50% SOLUTION	$0.00	$0.00	
MAGNAFLOC 342 (NOW 155)	26	DRY/TANKER	$2,991.00	$77,766.00	POLYCLEAR A350L. 1653 lb/bags. Combined with other Polyclear for full truckload deliveries to site.
MAGNAFLOC 351	179	DRY/TANKER	$3,320.00	$594,280.00	Polyclear N103.
SULPHURIC ACID	138	93% SOLUTION	$390.10	$53,833.80	bulk delivered to site
FLOTATION CIRCUIT					
SIPX (SODIUM ISOPROPYL XANTHATE)	1,170	DRY	$1,770.00	$2,070,900.00	1873 lb/bag in wooden crates delivered in full truckloads
MIBC (METHYL ISOBUTYL CARBINOL)	1,007	100% SOLUTION	$2,140.00	$2,154,980.00	45,000 lb bulk delivered to site
COPPER SULPHATE ($CUSO_4$)	592	DRY	$1,817.00	$1,075,664.00	2755.75 lb/bag delivered to mine site. Price is based on an LME Cu price
MAGNAFLOC 10/455	6	DRY	$3,014.00	$18,084.00	Polyclear A2501.
CMC (CARBOXYL METHYL CELLULOSE)	1,072	DRY	$4,535.97	$4,862,559.84	2204 lb/bag ex-Montreal Warehouse
LIME SLURRY	10,274	DRY	$0.00	$0.00	May quote through support from our supplier.
WASTE WATER TREATMENT MINE SITE					
SODIUM METASILICATE @ 5%	25,000	GALLONS/YR	$0.27	$6,812.50	Assuming a density of 1.8. Need to add dissolving + freight rate.
FERRIC CHLORIDE @ 35%	14,400	GALLONS/YR	$5.67	$81,648.00	2676 lb non-returnable tote shipments del'd to site
SODIUM HYDROXIDE @ 50%	41,000	GALLONS/YR	$5.79	$237,431.00	IHS index
POLYMER FLOCULANT (LIQUID)	600	GALLONS/YR	$0.00	$0.00	may quote following better understanding of application
HYDRATED LIME	1,100	S/TONS/YR	$0.00	$0.00	recommended to install a slaking system
CARBON DIOXIDE LIQUID	1,000	S/TONS/YR	$0.00	$0.00	no quote
CITRIC ACID	120	GALLONS/YR	$0.00	$0.00	
SODIUM HYPOCHLORITE	120	GALLONS/YR	$5.98	$717.60	210 liter drums delivered. Drum deposit applicable.
TAILINGS BASIN					
POTASSIUM PERMANGANATE	16,000	POUNDS/YR	$3.86	$61,760.00	55 lb bag packaging
ANTISCALANT	4,000	GALLONS/YR	$12.17	$48,680.00	3000 lb tote shipments, delivered to site.
CARBON DIOXIDE LIQUID	250	S/TONS/YR	$0.00	$0.00	
HYDRATED LIME	220	S/TONS/YR	$0.00	$0.00	recommened to install a slaking system
GRINDING MEDIA					
CERAMIC MEDIA 3.0mm	UNDETERMINED		$1.55 $/lb	$0.00	Bulk bags. Product: Microbit Leonardo 2.5-3.5mm

Steve DeVaney

From: shuynh@ctc.ca
Sent: Thursday, January 28, 2016 11:30 AM
To: Steve DeVaney
Subject: Re: FW: Reagents
Attachments: SIPX PolyMet Quote Jan 28.pdf

Hey Steve,

I have a quote here for Chinese SIPX, similar to last time. The other products I've been chasing for freight and still waiting for response. I didn't want you to wait any longer without receiving anything. So, here is the quote for the SIPX at least to Duluth.

Hopefully, I'll have other numbers later in the day.

regards,

Steven
Steven Huynh
Project Engineer
Charles Tennant & Company (Canada) Ltd.
Tel: +1 647 962 1600
E-mail: shuynh@ctc.ca

Steve DeVaney <sdevaney@polymetmining.com>

01/26/16 10:23 AM

To "'shuynh@ctc.ca'" <shuynh@ctc.ca>
cc
Subject FW: Reagents

Steve,
Anything Yet?
Steve

-----Original Message-----
From: Steve DeVaney
Sent: Wednesday, January 20, 2016 11:40 AM
To: 'shuynh@ctc.ca' <shuynh@ctc.ca>
Subject: RE: Reagents

Yes

Steve

-----Original Message-----
From: shuynh@ctc.ca [mailto:shuynh@ctc.ca]
Sent: Wednesday, January 20, 2016 11:34 AM
To: Steve DeVaney <sdevaney@polymetmining.com>
Subject: Reagents

Hello Steve,

Eric Johnson forwarded me your message about the getting current pricing for some products. I can provide you current pricing, let me work on getting this for you.

Will I be quoting for the same volumes you requested before?

Regards,

Steven

Steven Huynh
Project Engineer
Charles Tennant & Company Ltd.
34 Clayson Road
Toronto, On. M9M 2G8
Tel: +16479621600
Email: shuynh@ctc.ca

CHARLES TENNANT
& Company/Compagnie

34 Clayson Road, Toronto, Ontario. M9M 2G8
Tel : (416) 741-9264. Fax: (416) 741-6475
www.ctcminechem.com

Att:
Steve DeVaney – Procurement Manager
PolyMet Mining, Inc.
6500 County Road 666
Hoyt Lakes, MN 55750
Tel: 218-471-2155
Email:sdevaney@polymetmining.com

28 January 2016

On behalf of Charles Tennant and Company, it is my pleasure to provide you with the following product pricing;

PRODUCT:	**Sodium Isopropyl Xanthate 85% Technical Grade**
PACKAGING:	850kg FIBC Bag-Box Combination
STOWAGE	20 Units of 850 kg box full container
TOTAL DELIVERY	**17.0 MT**
PRODUCT COST:	CIF Duluth, Minnesota **USD $1455.90/MT** USD $1.46/kg $0.664 /LB
TERMS:	CIF. 100% T/T or Wire Transfer in advance payment prior to shipment of products.
ORIGIN	Charles Tennant and Company – TC China
PRODUCT ORIGIN	Weifang, China
PRODUCTION TIME	4 weeks from receipt of purchase order.
LEAD TIME	2-3 weeks
Notes	Quote for SIPX is valid for one month. PO should be submitted before February 28th, 2016.

PAYMENT TERMS: NET 30 DAYS

CHARLES TENNANT
& Company/Compagnie

34 Clayson Road, Toronto, Ontario. M9M 2G8
Tel : (416) 741-9264. Fax: (416) 741-6475
www.ctcminechem.com

QUOTE VALIDITY This quote is deemed valid up to the 28th of February, 2016 and is subject to confirmation thereafter.

Should you require any further information, assistance or would like to discuss this quote, please contact me at your convenience.

Best regards,

Steven Huynh

Steven Huynh
Charles Tennant & Company Ltd.
Tel: 647 962 1600
Email: shuynh@ctc.ca

Attachment J:

GE OpEx Cost Update, 3/31/2016, GE, Paul Dillalo

From:	Dilallo, Paul M (GE Power)
To:	Jeff Ubl
Cc:	Don E. Richard; Bryan T. Oakley; Alison L. Ling
Subject:	RE: PolyMet GE OPEX Update
Date:	Thursday, March 31, 2016 5:33:06 PM
Attachments:	image001.png

Jeff,

Please use $550 per NF element as an updated cost. Let me know if you have any questions or require additional information.

Thanks,

Paul DiLallo
Regional Sales Manager
GE Water & Process Technologies

M 414 403 1897
E paul.dilallo@ge.com

From: Jeff Ubl [mailto:JUbl@barr.com]
Sent: Friday, March 25, 2016 1:53 PM
To: Dilallo, Paul M (GE Power)
Cc: Don E. Richard; Jeff Ubl; Bryan T. Oakley; Alison L. Ling
Subject: PolyMet GE OPEX Update

Hi Paul;

We are looking to get an update of unit costs for the items attached in red. These were from 4/30/13.

Can you provide within the next week?

Jeff Ubl, PE

Senior Environmental Engineer
Barr Engineering Co.
4300 MarketPointe Drive, Suite 200
Minneapolis, MN 55435
---
office: 952.832.2647
toll-free: 800.632.2277
---
jubl@barr.com
www.barr.com

From:	Dilallo, Paul M (GE Power)
To:	Alison L. Ling; Jeff Ubl
Cc:	Don E. Richard; Bryan T. Oakley
Subject:	RE: PolyMet GE OPEX Update
Date:	Thursday, March 31, 2016 5:35:29 PM
Attachments:	image001.png

Alison,

Unit cost for the MetClear MR2405 is $4.94/lb based on delivery in totes. Please let me know whether you have any questions or require additional information.

Thanks,

Paul DiLallo
Regional Sales Manager
GE Water & Process Technologies

M 414 403 1897
E paul.dilallo@ge.com

From: Alison L. Ling [mailto:ALing@barr.com]
Sent: Tuesday, March 29, 2016 2:34 PM
To: Dilallo, Paul M (GE Power); Jeff Ubl
Cc: Don E. Richard; Bryan T. Oakley
Subject: RE: PolyMet GE OPEX Update

Paul,

Can you also provide a unit cost for MetClear MR2405? This chemical will be on standby for addition to the metals removal process.

Thanks,

Alison L. Ling, PhD

Environmental Specialist
Minneapolis, MN office: 952.842.3568
ALing@barr.com
www.barr.com

From: Dilallo, Paul M (GE Power) [mailto:Paul.Dilallo@ge.com]
Sent: Monday, March 28, 2016 5:27 PM
To: Jeff Ubl <JUbl@barr.com>
Cc: Don E. Richard <DRichard@barr.com>; Bryan T. Oakley <BOakley@barr.com>; Alison L. Ling

<ALing@barr.com>
Subject: RE: PolyMet GE OPEX Update

Hi Jeff,
I will review and get back to you this week.

Thanks,

Paul DiLallo
Regional Sales Manager
GE Water & Process Technologies

M 414 403 1897
E paul.dilallo@ge.com

From: Jeff Ubl [mailto:JUbl@barr.com]
Sent: Friday, March 25, 2016 1:53 PM
To: Dilallo, Paul M (GE Power)
Cc: Don E. Richard; Jeff Ubl; Bryan T. Oakley; Alison L. Ling
Subject: PolyMet GE OPEX Update

Hi Paul;

We are looking to get an update of unit costs for the items attached in red. These were from 4/30/13.

Can you provide within the next week?

Jeff Ubl, PE

Senior Environmental Engineer
Barr Engineering Co.
4300 MarketPointe Drive, Suite 200
Minneapolis, MN 55435

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office: 952.832.2647
toll-free: 800.632.2277

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jubl@barr.com
www.barr.com

Attachment K:

Hawkins Chemical Unit Costs, 4/1/2016, Hawkins Chemical, Phil Eason

From: Phil Eason
To: Alison L. Ling
Subject: RE: Chemical unit costs for PolyMet
Date: Friday, April 01, 2016 3:01:33 PM
Attachments: image001.png

Alison, here you go. Prices are good for 90 days.

Ferric sulfate (up to 50,000 tons/year) – $.26/lb.

Sodium permanganate 20% (approximately 1 ton/year) – $2.80/lb. (product weighs 9.67 lbs./gallon) packaged in 536 lb. drums. We cannot supply the higher concentration.

Hydrochloric acid (up to 100 tons/year) – HCL 20 Baume, delivered as 48,000 bulk loads. $.16/lb.

Sodium bisulfite (approximately 1 ton/year) – $1.50/lb. in 50 lb. bags

Phil Eason
Account Manager
Hawkins, Inc.
Direct 612-617-8534
Mobile 612-750-2221

From: Alison L. Ling [mailto:ALing@barr.com]
Sent: Friday, April 01, 2016 2:05 PM
To: Phil Eason
Cc: Jeff Ubl
Subject: RE: Chemical unit costs for PolyMet

Phil,

See below. Thanks.

Alison L. Ling, PhD

Environmental Specialist
Minneapolis, MN office: 952.842.3568
ALing@barr.com
www.barr.com

From: Phil Eason [mailto:Phil.Eason@HawkinsInc.com]
Sent: Friday, April 01, 2016 12:03 PM
To: Alison L. Ling <ALing@barr.com>
Cc: Jeff Ubl <JUbl@barr.com>
Subject: RE: Chemical unit costs for PolyMet

Alison, do you have specifications on what you need for these products?

Ferric sulfate (up to 50,000 tons/year) – we offer dry bags or a 12% iron solution? Dry

Sodium permanganate (approximately 1 ton/year) – this is sold as either a 20% or 40% solution? 40%

Hydrochloric acid (up to 100 tons/year) – I will quote our HCL 20' solution – which is very common. Ok

Sodium bisulfite (approximately 1 ton/year) – we offer sodium bisulfite in bags or in a 40% solution? Dry

Phil Eason
Account Manager
Hawkins, Inc.
Direct 612-617-8534
Mobile 612-750-2221

From: Alison L. Ling [mailto:ALing@barr.com]
Sent: Wednesday, March 30, 2016 4:01 PM
To: Phil Eason
Cc: Jeff Ubl
Subject: Chemical unit costs for PolyMet

Phil,

We are helping PolyMet with chemical use cost estimates for water treatment at the NorthMet project. Can you provide unit cost estimates for the following chemicals? Can you also provide an estimate of how much it would cost per unit to deliver to the mine in Hoyt Lakes?

- Ferric sulfate (up to 50,000 tons/year)
- Sodium permanganate (approximately 1 ton/year)
- Hydrochloric acid (up to 100 tons/year)
- Sodium bisulfite (approximately 1 ton/year)

Thanks, and don't hesitate to call with questions.

Alison L. Ling, PhD

Environmental Specialist
Minneapolis, MN office: 952.842.3568
ALing@barr.com
www.barr.com

This email has been scanned by the Symantec Email Security.cloud service.
For more information please visit http://www.symanteccloud.com

Attachment L:

Sludge Hauling and Disposal Estimate, 4/5/2016, Waste Management, Trevor Long

April 5, 2016

Jeff Ubl
Barr Engineering Co.
4300 MarketPointe Dr
Suite 200
Minneapolis, MN 55435
952-832-2647
jubl@barr.com

Project: Hoyt Lakes Water Treatment Plant Filter Press Sludge

Dear Jeff:

Waste Management of Minnesota is pleased to provide you with pricing for disposal per your request. Based upon the information provided, the following summarizes our quotation.

DISPOSAL FACILITY:

Voyageur Landfill
6830 Hwy 53
Canyon, MN 55717

WASTE STREAMS

Waste Description	WTP Filter Cake
Disposal Method	Direct Burial
Estimated Volume	15,000 – 100,000 tons annually
Disposal Price	$13.00 per ton (4 ton minimum per load)
Transportation Charge	$20.00 per ton
Environmental Charge	$20.00 per load
Fuel Charge	4.01% week of 4/4/16

ANALYTICAL TESTING REQUIREMENTS:

Go to www.wmsolutions.com to complete profile, attach analytical reports when submitting profile.

SPECIAL CONDITIONS:

Waste must meet acceptability criteria at the site and comply with local, state and federal regulations, as well as the sites permit requirements. *Pricing is contingent upon site and/or sample evaluation and approval*. Customers must have a current Waste Management Industrial Service Agreement.

Pricing is open for consideration for a period of 30 days. Upon acceptance, pricing remains in effect up to and including 60 days from the date of the quote. Pricing based solely on the information available at this time. Additional information may be required prior to approval.

Payment terms are net 30-days from receipt of invoice. Late fees apply on payments received after thirty days at an accrual interest rate of 1.5% per month. Customers that do not have approved credit with Waste Management must submit an up to date credit application.

Waste Management of Minnesota wishes to thank you for allowing us to quote on your disposal needs.

Please do not hesitate to contact me at the phone number below with any questions you may have or if you require any further assistance.

Sincerely,

Trevor Long
Industrial Account Manager
Manufacturing & Industrial
tlong@wm.com
952-807-8913

Waste Management
Technical Service Center
W132 N10487 Grant Drive, Germantown, WI 53022
tscmidwest@wm.com
TSC 800-963-4776
FAX 866-800-2591