Appendix 14 Reclamation, Closure and Postclosure Plan

NorthMet Project
Reclamation, Closure, and Postclosure Maintenance Plan

September 2016

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Acronyms, Abbreviations and Units

Acronym, Abbreviation or Unit	Stands For
ACM	asbestos-containing materials
AWMP	Adaptive Water Management Plan
Cliffs Erie	Cliffs Erie, LLC
FTB	Flotation Tailings Basin
HRF	Hydrometallurgical Residue Facility
kV	kilovolt
LTVSMC	LTV Steel Mining Company
MDH	Minnesota Department of Health
MDNR	Minnesota Department of Natural Resources
MPCA	Minnesota Pollution Control Agency
OSLA	Overburden Storage and Laydown Area
OSP	Ore Surge Pile
PCB	polychlorinated biphenyl
PolyMet	Poly Met Mining, Inc.
Project	NorthMet Project
PTM	Permit to Mine
RTH	Rail Transfer Hopper
TWP	Treated Water Pipeline
WWTF	Mine Site Waste Water Treatment Facility
WWTP	Plant Site Waste Water Treatment Plant

1.0 Introduction

This Reclamation, Closure, and Postclosure Maintenance Plan (Plan) for the NorthMet Project (Project) describes how Poly Met Mining, Inc. (PolyMet) will comply with the Permit to Mine (PTM) Regulations with respect to the requirements for progressive reclamation during the mine operations and the additional requirements that apply after mine operations end. In particular, this Plan addresses the reclamation standards and requirements of Minnesota Rules, parts 6032.1000 - 6032.3200. The various periods after mine operations end are defined in Minnesota Rules, part 6032.0200 as the "reclamation," "closure," and "postclosure maintenance" periods.

Project phases discussed in this Plan are defined as follows:

- Operations – The operations phase is estimated to last 20 years (Mine Year 1 to Mine Year 20). It will begin when PolyMet starts production blasting and end when PolyMet stops mining and mineral processing. PolyMet will undertake progressive reclamation during operations, as appropriate.
- Reclamation – The reclamation phase is estimated to last 4 years (Mine Year 21 to Mine Year 24). It will end when structures are demolished, footprints are revegetated, and perimeters are fenced.
- Closure – The closure phase is estimated to last 30 years (Mine Year 25 to Mine Year 55). It will end when the West Pit is fully flooded and treated water discharge to the environment from the Mine Site begins.
- Postclosure maintenance - The postclosure maintenance phase will continue as long as necessary. PolyMet's closure and postclosure maintenance activities will continue until standards of Minnesota Rules, part 6132.3200 have been met.

See Section 3.2 of the PTM application for additional description of Project phases. Figure 3-4 of the PTM application presents the overall anticipated schedule for the reclamation, closure, and postclosure periods. This figure also contains a summary of activities within each of these three periods. Figure 15-1 and Figure 15-2 of the PTM application show the Mine Site and Plant Site conditions, respectively after final reclamation actions (including closure and postclosure maintenance) are complete.

The Project activities and features covered by this Plan are described in Sections 3, and 7 through 11 of the PTM Application.

This Plan will be periodically updated. After permits are issued, this plan will be updated to reflect the terms of the Permit to Mine, the NPDES/SDS Permits, the Water Appropriations Permits, the Air Permit, and the Dam Safety Permits. A Revision History is included at the end of the Plan.

1.1 Objective

The overall objective of the Reclamation, Closure, and Postclosure Maintenance Plan is, consistent with the requirements of PTM Regulations and good mining practices, for the Mining Area to meet various criteria when it (or any portion of it) is closed and no renewed use or activity will occur. These criteria include the following:

- the closed Mining Area or portion is safe, secure, and free of hazards
- it is in an environmentally stable condition

- it minimizes hydrologic conditions and the release of hazardous substances that adversely affect natural resources; and it is maintenance free

In addition to meeting the foregoing criteria, PolyMet's planned reclamation, closure, and postclosure maintenance work is intended to allow restoration of the Mining Area so as to encourage planning of future land utilization and to facilitate implementation of such future plans as contemplated by the PTM Regulations.

In general, under the Reclamation, Closure, and Postclosure Maintenance Plan, PolyMet will reclaim areas as soon as practical while the Project is in operation. In addition to such progressive reclamation, PolyMet will evaluate conditions within the Mining Area at the end of operations. Thereafter, PolyMet will implement the Reclamation, Closure and Postclosure Maintenance Plan with respect to areas not previously reclaimed, including demolishing buildings and structures, reclaiming and vegetating the sites on which such facilities were located, remediating any environmental hazards in compliance with applicable statutes and regulations, and implementing other necessary reclamation, closure, and postclosure maintenance practices to satisfy the standards and requirements of Minnesota law, including the pertinent reclamation standards set forth in Minnesota Rules, parts 6132.0200 - 6132.3200.

PolyMet's closure and postclosure maintenance activities will continue until standards of Minnesota Rules, part 6132.3200 have been met, including requirements that the closed Mining Area is stable, and free of hazards, and that hydrologic impacts and any releases of substances that adversely impact other natural resources have been minimized. Postclosure maintenance will continue until the reclamation is stable and self-sustaining and no further maintenance is required, at which time Minnesota Department of Natural Resources (MDNR) may issue release of the permittee once the requirements Minnesota Rules, parts 6132.1400 and 6132.4800 have been met.

1.2 Variances

Minnesota Rules, part 6132.4100 provide for variances from the MDNR reclamation rules if requested by the entity doing the reclamation and approved by the MDNR Commissioner. Requested variances anticipated include subsequent use, acceptable research to demonstrate that reclamation can be achieved by alternative methods, and abandonment of underground pipelines in-place.

1.2.1 Subsequent Use

Minnesota Rules, part 6132.3200, subpart 2, item E(4) requires that structures be completely demolished within three years after closure or a longer period if approved by the Commissioner. The structures at the Plant Site, Area 1 Shops, and Area 2 Shops are part of a brownfield site that PolyMet will reuse as part of this Project. PolyMet requests a variance to allow structure demolition to take longer than three years, and is accounting for this in the 4-year timeframe requested for the reclamation phase. .

1.2.2 Acceptable Reclamation Research

The PTM Regulations allow alternative activities to be implemented in certain circumstances, including after operations cease, based upon acceptable research and findings. Minnesota Rules, part 6132.0100, subpart 2 defines "acceptable research" as “research approved by the commissioner that is site-related and

is reasonably designed for the purpose of demonstrating that reclamation can be achieved by alternative methods." PolyMet intends to undertake several test projects during operations to evaluate alternative methods for reclamation. Test projects have previously been proposed for the Flotation Tailings Basin (FTB) Pond Bottom Cover System, the Category 1 Waste Rock Stockpile Cover System, and Non-Mechanical Treatment Systems. Assuming this research is acceptable and successful, PolyMet may seek to incorporate alternative methods of reclamation into its Reclamation, Closure, and Postclosure Maintenance Plan.

2.0 Mine Site Reclamation, Closure, and Postclosure Maintenance

Mine Site Facilities discussed in this section are described in Sections 7, 10, and 11 of the PTM application, and depicted on Figure 7-1 of the PTM application. Phases discussed in this section include progressive reclamation (Section 2.1), reclamation (Section 2.2), closure (Section 2.3), and postclosure maintenance (Section 2.4).

2.1 Progressive Reclamation

Progressive reclamation will take place during the operations phase at the Mine Site and will include:

- relocation of the waste rock from the Categories 2/3 and 4 Waste Rock Stockpiles (Section 2.1.1)
- removal of water management systems associated with the Categories 2/3 and 4 Waste Rock Stockpiles (Section 2.1.1)
- removal of select pit dewatering pumps and pipes in the East and Central Pits (Section 2.1.1)
- incremental installation of the Category 1 Waste Rock Stockpile Cover System (Section 2.1.2)

2.1.1 Categories 2/3 and 4 Waste Rock Stockpiles Relocation and East Pit Flooding

The Categories 2/3 and 4 Waste Rock Stockpiles are temporary waste rock stockpiles. Progressive reclamation of these stockpiles will begin during Mine Year 11 after mining in the East Pit is completed. The waste rock and overburden in the Categories 2/3 and 4 Waste Rock Stockpiles will be relocated to East and Central Pits for final subaqueous storage. At that time, Category 2, 3, and 4 waste rock mined from the West and Central Pits will be hauled directly to the East Pit for disposal or to the temporary stockpiles, depending on the rate of backfilling.

Starting in Mine Year 11, the waste rock and Saturated Overburden materials in the stockpiles will be relocated to the East and Central Pits for ultimate disposal. The Category 4 Waste Rock Stockpile will be completely removed and dismantled in Mine Year 11, with stripping of the Central Pit occurring in that same year. The Category 2/3 Waste Rock Stockpile will be relocated to the East Pit starting in Mine Year 12 and continuing through Mine Year 19. Once the liner system from the Category 4 Waste Rock Stockpile is removed, stripping for the Central Pit can begin. The Central Pit stripping area almost entirely encompasses the footprint of the Category 4 Waste Rock Stockpile. The small area outside the Central Pit will be reclaimed by scarifying the surface or by placing a soil layer and seeding. As ultimate pit limits are reached, the overburden banks will be sloped and vegetated. The East Pit dewatering systems will be removed, with the exception of temporary pumps needed during pit backfilling.

The movement of rock from the stockpiles will be timed to allow complete relocation of the material (waste rock and overburden) in the Category 4 Waste Rock Stockpile first, followed by relocation of the material from the Category 2/3 Waste Rock Stockpile. The Category 4 material is expected to be relocated in Mine Year 11. The Category 2/3 Waste Rock Stockpile is larger, , and is expected to be completely relocated by the end of Mine Year 19. The ore in the Ore Surge Pile (OSP) will be removed by the end of Mine Year 20.

Reclamation of the former temporary stockpile footprints will occur incrementally after the waste rock and overburden are completely relocated from the temporary stockpiles to the East and Central Pits. The entire footprint of the Category 2/3 Waste Rock Stockpile, as well as portions of the Category 4 Waste Rock Stockpile that are outside the extent of the Central Pit, and the OSP will be reclaimed. The stockpile bases, which include the overliner drainage system, liner system, underdrain system (if required), and portions of the foundation, will be disassembled. Water management systems associated with the temporary stockpiles, including piping, pump systems, and liner systems associated with the stockpile foundations and the stockpile sumps and ponds will be removed. Once these systems have been removed, the footprint of the stockpiles, sumps, ponds, and associated disturbed areas will be reclaimed with a growth medium, followed by seeding and planting. The area will be a mixture of upland and wetland areas, depending on the ultimate elevation of the remaining materials. Once reclamation in these areas is complete, the adjacent haul and access roads will also be scarified and seeded to allow access by small vehicles for long-term monitoring.

For the Category 2/3 Waste Rock Stockpile, wetlands will be restored or cultivated where the hydrology and soil conditions exist to support their development. Approximately 60 acres of wetlands have been identified within the Category 2/3 Waste Rock Stockpile footprint. Wetlands could be developed in areas that were wetlands prior to the start of stockpile development, as well as in additional areas where the stockpile load has depressed the soils enough that wetland hydrology can be established from prior upland areas. The plan for development of wetlands within these areas will likely include grading, the addition of soils, and wetland plant propagation. The ultimate goal in restoration and development of wetlands will be to restore the original flow patterns that existed prior to mining and to establish an area of wetlands equal to or greater than existed prior to mining. For portions of the footprint that cannot be converted to wetlands, the surface will be scarified or soil will be placed over the reclaimed foundation, by seeding.

2.1.2 Category 1 Waste Rock Stockpile Cover System

The Category 1 Waste Rock Stockpile is the only permanent stockpile. Progressive reclamation of the Category 1 Waste Rock Stockpile will consist of an engineered geomembrane cover system, which will minimize exposure of the waste rock to precipitation. The cover system will reduce the flow of water into the stockpile, thus reducing the load of constituents to the West Pit during reclamation, closure, and postclosure maintenance. Installation of the cover system will be implemented progressively starting in Mine Year 14 after material is no longer being placed in the stockpile; the cover system is expected to be fully installed by the end of Mine Year 21. The cover system will be required to function until constituents have been depleted from the stockpile or the release rates of constituents from the stockpile have decreased to the point where West Pit lake concentrations result in achieving water resource objectives without limiting drainage (Section 3.5 of Reference (1)).

Prior to construction of the cover system, the stockpile surface will be re-graded for long-term stability and to develop a surface drainage network. These efforts will promote vegetation growth, minimize erosion of the outer slopes, and minimize the need for active site care and maintenance during postclosure maintenance.

After the geomembrane barrier layer and cover soils have been placed and vegetation is established, the stockpile will no longer generate mine drainage; surface runoff will be managed as stormwater.

Stormwater will be collected by the stormwater ditch surrounding the stockpile and routed through sedimentation ponds prior to off-site discharge or directed to the West Pit.

The mine water ditch along the Category 1 Stockpile Groundwater Containment System will also be progressively reclaimed as the cover system is constructed. The ditch will be filled, as shown on the typical sections on Drawing GCS-011 in Appendix 4 of the PTM Application, and clean surface water runoff will be routed to the stormwater ditch. The containment system vertical pipe risers will be extended to finished cover grade to provide access for pipe cleanout as shown on the typical sections on Drawing GCS-011 in Appendix 4 of the PTM Application.

2.2 Reclamation

Upon completion of mining operations in the West Pit, the final reclamation process will begin to prepare the Mine Site in accordance with Minnesota Rules, part 6132.3200. Final reclamation will be required for the Category 1 Waste Rock Stockpile (including groundwater containment system), OSP, and Overburden Storage and Laydown Area (OSLA).

2.2.1 Structure Removals

Demolition and reclamation of the equipment, machinery, and structures associated the Mine Site Fueling and Maintenance Facility and Rail Transfer Hopper (RTH) (approximately 2 acres in size) will occur during the second year of reclamation. There are approximately 118 acres of parking lots and roads that will be demolished at the Mine Site. After demolition of Mine Site buildings and parking areas, two feet of overburden material suitable for vegetation will be placed over the facility's former footprint. Building areas and parking lots not needed in closure or postclosure maintenance will be reclaimed and vegetated according to Minnesota Rules, part 6132.2700. Seeding and mulching will be based on PolyMet's Reclamation Seeding and Mulching Procedure.

The Rail Transfer Hopper (RTH), which is described in Section 7.4.2.1 of the PTM, will be covered with two feet of material and vegetated. If the rock platform is composed of Category 1 waste rock, it will be covered in the same manner as the Category 1 Waste Rock Stockpile or the rock will be relocated to the East Pit for subaqueous disposal. The Ore Handling Area will be reclaimed by removing sediment from the ditches and the RTH mine water pond; sediment will be placed in the East Pit. Any ore remaining in the RTH, the OSP, or along the railroad tracks between the RTH and the OSP will be placed in the East Pit.

The material used to construct the driving surface of the platform and the rail bed in the vicinity of the RTH will either be placed in the East Pit or covered with at least two feet of soil and vegetated according to Minnesota Rules, part 6132.2700 and part 6132.3200. The railroad track and ties for the rail spur at the RTH will be removed and recycled or disposed. 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.

Other Mine Site infrastructure, including culverts and powerlines, will also be demolished and reclaimed during this time period. Culverts will be removed from abandoned roads and railroads 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.

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. The 7.20 kV distribution power lines at the Mine Site will be removed during reclamation. Power lines that will remain through closure and postclosure maintenance include the 13.8 kV lines from the Minnesota Power Substation to Mine Site facilities and the 4.16 kV distribution lines at the Mine Site.

Because the Waste Water Treatment Facility (WWTF) will operate during closure and postclosure maintenance, demolition will be deferred until the MDNR and Minnesota Pollution Control Agency (MPCA) determine that mechanical treatment is no longer needed. Approximately 30 acres of roads will be required through postclosure maintenance for monitoring and maintenance activities.

2.2.2 Temporary Stockpiles and Haul Roads Reclamation

The footprint of the OSP will be reclaimed. Any excess material remaining in the OSP will be transported to the Process Plant or disposed of in the East Pit. Similar to the temporary stockpiles, the liner, piping, pumps, and sumps will first be removed. The footprint of the OSP will be reclaimed by creating wetlands where possible; however, there were no wetlands within this footprint prior to stockpile development. Due to the elevation of the railroad, the OSP liner is very deep, so reclamation in this area will likely be suitable for wetland development. If wetlands are developed, they will be headwater wetlands connecting to existing wetlands west of the OSP and south of Dunka Road. Portions of the footprint that cannot be converted into wetlands will be reclaimed by regrading, as necessary, scarifying the surface, or placing a soil cover, followed by seeding.

By the time the flooding of the West Pit begins in Mine Year 21, the OSLA will no longer be in operation. The majority of the material stored at the OSLA is expected to be reused for reclamation of the Mine Site. At closure, the OSLA (approximately 41 acres) and any remaining overburden stockpiles will be reclaimed. Reclamation activities include sloping, vegetation, and construction of wetlands. Approximately 11 acres of wetlands will be impacted in the development of the OSLA. Where possible, wetlands will be created in these areas. For portions of the footprint that cannot be converted into a wetland, the surface will be scarified or a soil cover placed, followed by seeding.

Approximately 116 acres of haul roads are not necessary for access during postclosure maintenance, and an estimated 30 acres of roads will be required through postclosure maintenance for monitoring and maintenance activities. Roads not needed in postclosure maintenance will be reclaimed and vegetated according to Minnesota Rules, part 6132.2700. Seeding and mulching will be based on PolyMet's Reclamation Seeding and Mulching Procedure. Any roads, which include mine access roads that may develop into unofficial off-road vehicle trails, will require a variance to allow a 15-foot wide unpaved and unvegetated track down the centerline of the road once reclamation is completed.

Refer to Section 2.1.1 for a description of progressive reclamation of the temporary Category 2/3 and Category 4 Waste Rock Stockpiles.

2.2.3 Mine Pit Reclamation

Progressive reclamation of the mine pits will include backfilling of the East and Central Pits with the material from the temporary Categories 2/3 and 4 Waste Rock Stockpiles, as described in Section 2.1.1. Tasks to begin during operations when appropriate and to be completed in reclamation will include:

- removal of select dewatering systems and in-pit power lines
- sloping and vegetation of the overburden layer of the pit walls
- installation of a pit perimeter barrier, which includes fencing, rock barricades, ditches, stockpiles, and berms
- providing access to the pit lake
- construction of an outlet control structure between the East Pit and the West Pit
- construction of a wetland in the East Pit
- water management, including flooding of the West Pit and treatment of the East Pit water to remove constituent load from backfilled waste rock

All power lines, substations, pumps, hoses, pipes, and appurtenances used for dewatering the mine pits will be removed. The pits will be allowed to flood with water. Some temporary pumps may remain in the mine pits for selected dewatering that will be necessary during reclamation. The pipes from the pits to the CPS and the WWTF will also be removed. The water pipes between the WWTF and the East Pit, as well as the water pipes between the West Pit and the WWTF will remain in place to convey treated water as needed.

The toe of the overburden portion of the pit walls will be set back at least 20 feet from the crest of the rock portion of the pit wall. The overburden portions of the pit walls will be sloped and graded (refer to Drawing EW-008 in Appendix 3 of the PTM Application). The sloped areas and other areas disturbed by pipe removal will be vegetated to conform to Minnesota Rules, part 6132.2700.

A pit perimeter barrier system will be installed. The system will consist of fences, rock barricades, ditches, stockpiles, and berms. Fencing will consist of barbed wire in most locations, but when roads will remain adjacent to the fences, non-climbable mesh fencing will be installed.

Safe access to the water in each mine pit lake will be provided by selected haul roads built during pit development and mine operation. A gated entrance will be placed at each of the pit lake access locations. The access road will be selected such that, as pit lake water level rises, there will always be a clear path to the water surface.

The steady-state water level in the West Pit in closure and postclosure maintenance will be established by pumping of the pit water to the WWTF for treatment and discharging to the Partridge River. The actual steady-state water level in the East Pit will be established by an outlet structure described below.

A channel will be excavated from the southwest corner of the East Pit to the northeast corner of the West Pit during operations or shortly thereafter to control overflows from the East Pit during reclamation and

closure and for water management during postclosure maintenance. The overflow for the East Pit will be set at elevation 1,592 ft-MSL to provide an adequate buffer between this overflow and the natural overflow elevation of 1,594 ft-MSL in the southeast corner of the pit. The annual average overflow from the East Pit to the West Pit will vary depending on the sources used to flood the pits with water. The outlet structure was designed for the expected peak overflow rate of 187 cubic feet per second (cfs), based on removal of 10% of the runoff from a 100-year, 24-hour rainfall event (5.2 inches of precipitation) within one hour. This is a conservative estimate based on total runoff volume and does not consider the potential reductions in peak flow due to the specific characteristics of the East Pit watershed.

The East Pit outlet structure will be formed out of bedrock or a reinforced concrete weir; the invert of the outlet will be set at the East Pit overflow elevation (1,594 ft-msl). A 425-foot-long channel will connect the East Pit overflow to the West Pit. The channel will have a 6-foot-wide bottom with side slopes of 3H:1V. The final locations of the intake and discharge of the connection channel will be determined prior to the end of operations. As part of site restoration, a wetland may be constructed on the backfilled East Pit.

2.2.4 Water Management Infrastructure Reclamation

Reclamation tasks related to the water management infrastructure include:

- filling and rerouting of ditches
- removal of select perimeter and pit rim dikes
- restoration of mine water and stormwater sedimentation ponds
- select pump and pipe removal, including the CPS, once pumping has ceased from the Plant Site to the West Pit

During reclamation, stormwater runoff within the Mine Site will be routed to the mine pits using a combination of existing and new ditches. Ditches will be maintained to direct stormwater into the West Pit for flooding. Use of ditches that already exist in Mine Year 20 will be maximized, but a few new ditches may need to be constructed to direct stormwater runoff into the East or West Pits during reclamation. Reclamation of ditches will include either installing ditch blocks or filling, covering with topsoil, and vegetating the restored surface.

The perimeter dike located north of the Central and East Pits will be maintained in order to minimize mixing of Partridge River flows with the East Pit water. Perimeter dikes located on the north side of the Category 1 Waste Rock Stockpile and along the west boundary of the Mine Site will be maintained to provide access to groundwater monitoring locations. Some pit rim dikes will remain if they are needed to prevent inflow to the mine pits and potential erosion of the pits walls, but most pit rim dikes will be removed. Material removed from the pit rim dikes will be used for restoration of disturbed surfaces prior to reclamation. To minimize disturbance of subsurface soils, the subsurface seepage control component of the dikes will remain in place. Typical construction erosion control measures will be taken as part of the dike removal work, such as installing silt fence on the down slope side of disturbed areas and control of surface water runoff. The reclaimed surface will be scarified, topsoil placed, and the area will be revegetated, as described in PolyMet's Reclamation Seeding and Mulching Procedure.

The stormwater sedimentation ponds, the mine water ponds, and the remaining stockpile sumps and overflow ponds will be reclaimed by developing wetlands or by filling, covering with topsoil, and revegetating the area. Outlet control structures from Ponds A and B will remain in-place to prevent Partridge River floodwater from entering the Mine Site. Outlet control structures from Ponds C (East) and D will remain in-place to direct water under Dunka Road and the railroad to the Partridge River along natural drainage paths. The overflow weir in Pond C (West) will be modified to create a more natural transition to the remaining stormwater ditch. The mine drainage sumps and ponds may require cleanout and removal of the geomembrane liner. Material removed from the ponds will be disposed of in the mine pits or an approved landfill.

The CPS Building will be removed once it is no longer necessary, and the CPS Pond will be reclaimed as a wetland or filled, covered with topsoil, and revegetated.

Above-ground pipelines and other facilities (e.g., pump booster station, associated controls) will be disassembled or demolished and the material recycled or disposed. Underground pipelines will be abandoned in place. Manholes and aboveground 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 scarified and revegetated to achieve final reclamation. All mine water pipes and pumps will be removed and recycled or abandoned in place except those used for the flooding of the West Pit or recycling of the East or West Pit water.

The pipeline system that connects the OSP sump to the WWTF and the pipeline system that connects the mine water ponds to the WWTF will be removed or abandoned in place during reclamation. The pipeline system connecting the WWTF to the East Pit will be required to remain until postclosure maintenance begins. The West Pit dewatering pipelines and the pipeline system connecting the Category 1 Stockpile Groundwater Containment System sumps to WWTF pipelines will be required to remain through postclosure maintenance.

2.2.5 Water Management During Reclamation

Water management will be a continuous process through reclamation and closure so these two phases are described together in Section 2.3.1.

2.3 Closure

During closure, PolyMet will continue to manage water and maintain the remaining facilities and reclaimed areas.

2.3.1 Water Management During Reclamation and Closure

Water management will be a continuous process through reclamation and closure, so these two phases are described together in this section. Full details on Plant Site water management in reclamation and closure are presented in Section 2 of Reference (1). During reclamation and closure, water management tasks will include the following:

- the WWTF will treat drainage from the Category 1 Groundwater Containment System, water from the East Pit, and Waste Water Treatment Plant (WWTP) reject concentrate (Section 2.3.1.1; 2.3.1.4)
- water from the East Pit will be pumped to and treated by the WWTF to remove the flushing load of constituents added as waste rock was backfilled to the pit and the pit walls were inundated (Section 2.3.1.2)
- pit dewatering will stop and the West Pit will flood, supplemented by water pumped from the Plant Site (Section 2.3.1.3)

2.3.1.1 WWTF

During reclamation and closure, the WWTF will primarily treat water from the Category 1 Stockpile Groundwater Containment System and water flooded from the East Pit. In addition, WWTP reject concentrate will continue to be delivered to the WWTF. The quantity and quality of the WWTF influent are expected to vary less, both annually and seasonally, during reclamation and closure as compared to Operations because flows will be originating from stable components of the Project (Section 2.2.2.1 of Reference (1)). The WWTF unit processes can be configured to treat the anticipated flow rates and water quality during reclamation (Section 2.2.5.1 of Reference (1)).

All sources of influent will have relatively high concentrations of sulfate and other constituents, with the WWTP reject concentrate likely having the highest concentrations. As such, the configuration of the WWTF during the operations phase will be maintained during reclamation and closure to accept water of different quality into two different treatment processes (Section 2.2.2.2 of Reference (1)). The WWTP reject concentrate will be routed to the chemical precipitation train. The seepage from the Category 1 Stockpile Groundwater Containment System and water from the East Pit will be routed into a single equalization basin for treatment in the membrane separation system (Section 2.2.2.2 of Reference (1)).

No significant modifications to the chemical precipitation train are planned for reclamation and closure; however, operating conditions may be modified to optimize overall performance of the treatment units. This can likely be accomplished without significant effort due to the operational adaptability that will be built into the WWTF. Sludge produced by the chemical precipitation system will be dewatered via filter press, and the dewatered sludge will be hauled to an approved off-site landfill during reclamation (Section 2.2.5.1.1 of Reference (1)). Primary membrane concentrate will be routed to the VSEP unit. VSEP concentrate will be routed to the chemical precipitation train for removal of metals and sulfate, and VSEP permeate will be routed to the East Pit. The primary membrane permeate will be pumped as WWTF effluent, as described below (Section 2.2.5.1.2 of Reference (1)).

WWTF effluent will be pumped to the West Pit to augment pit flooding and to the East Pit to maintain water levels and assist with removal of additional constituent load from the backfilled waste rock (Section 2.2.5.1 of Reference (1)). At the beginning of reclamation (through approximately Mine Year 21), effluent pumped to the East Pit will be treated to increase alkalinity. The purpose of treatment will be to manage the mass of dissolved constituents in the East and West Pits. Specifically, the primary purpose of treatment during the reclamation and closure phases will be to remove the flushing load of constituents added as waste rock was backfilled to the pits and the pit walls were inundated (Section 2.2.1.2 of Reference (1)).

Treatment of the East Pit flushing load (as described in Section 2.3.1.2) is expected to be complete before the West Pit is flooded (as described in Section 2.3.1.3). If this occurs, in the period after treatment of the East Pit flushing load is complete (about Mine Year 35) and before the West Pit would overflow (about Mine Year 52), the only influent to the WWTF would be the water from the Category 1 Stockpile Groundwater Containment System, a very low volume of flow. During this time, water from the containment system could be discharged directly to the West Pit, with agency approval, or treatment of the water from the containment system could transition to non-mechanical treatment with gravity discharge to the West Pit, after the non-mechanical system has been proven to provide appropriate treatment. If one of these options is approved and implemented, WWTF operations could be scaled back or suspended during the latter years of reclamation (Section 2.1.1 of Reference (1)). In this configuration, treatment of the WWTP reject concentrate would be shifted to the WWTP (Section 2.2.5.1.3 of Reference (1)).

2.3.1.2 East Pit Flushing

As described in Section 2.1.1, the saturated overburden and waste rock in the Categories 2/3 and 4 Waste Rock Stockpiles will be relocated to the East Pit. This will result in a flushing of oxidation products into the East Pit water. As the East and West Pits flood with water, oxidation products that have accumulated on the pit wall rock will be flushed into the pits as the water level rises. The flushed oxidation products will be removed from the West and East Pits by pumping the pit water to the WWTF for treatment and returning the treated water to the pits.

2.3.1.3 West Pit Flooding

During Closure, pit dewatering will stop and the associated pit dewatering systems will be removed. The West Pit will begin to flood naturally with water from groundwater inflows, precipitation, and stormwater runoff from the tributary watershed. The flooding process will be augmented with the addition of treated and untreated seepage water from the FTB. Treated WWTF effluent will also be discharged to the West Pit during reclamation (Section 2.1.1 of Reference (1)).

2.3.1.4 Category 1 Stockpile Groundwater Containment System

The Category 1 Stockpile Groundwater Containment System will continue to operate during reclamation and closure. Water collected by the containment system will be collected and routed to the WWTF for treatment prior to being pumped to the East or West Pit.

2.3.2 Maintenance of Reclaimed Areas

Establishment of dense vegetative cover and root mass is among the most effective methods to minimize erosion, so the quality and density of the vegetation will be periodically reviewed after final reclamation construction is complete. Reclaimed areas will be inspected at least twice per year (in the spring and fall), as necessary, or as required by Minnesota Rules, part 6132.5200. Any areas that have been damaged by erosion, animal activity, or that have lost vegetation will be identified. A plan to reseed or repair the damage will be developed and implemented.

Reclaimed mine overburden slope erosion will be corrected and re-vegetated as needed. In areas where excess erosion is a repetitive problem, channels and/or outfall structures will be designed for those specific locations.

2.4 Postclosure Maintenance

Once the Closure activities described in Section 2.3 are complete, a postclosure maintenance period will begin. Monitoring and reporting will likely occur at a reduced frequency from the closure period. Monitoring, reporting, and water treatment will continue until release from these activities is granted via the PTM. If any of the monitoring data shows that additional work is needed, a plan will be created and implemented to further improve water quality.

2.4.1 Water Management During Postclosure Maintenance

Full details on Mine Site water management in postclosure maintenance are presented in Section 2 of Reference (1). During postclosure maintenance, Mine Site water management tasks will include the following:

- continued operation of the WWTF, with treated water discharge to a tributary of the Partridge River (Section 2.4.1.1)
- maintenance of the water level in the West Pit below the natural overflow elevation (Section 2.4.1.2)
- continued pumping of the Category 1 Stockpile Groundwater Containment System drainage to the WWTF (Section 2.4.1.3)

The ultimate objective is to transition from the mechanical treatment provided by the WWTF to non-mechanical treatment systems. Options for non-mechanical water treatment at the Mine Site during postclosure maintenance are described in Section 6 of Reference (1). 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. The WWTP will be maintained operable until MDNR releases the company from active water treatment requirements under the PTM and the MPCA releases the company under the NPDES/SDS permit.

Two non-mechanical treatment systems at the Mine Site, which are independent of each other, could be used for long-term treatment of water from the Category 1 Stockpile Groundwater Containment System and the West Pit overflow. It is expected that the Category 1 Waste Rock Stockpile Non-Mechanical Treatment System will be deployed earlier than the West Pit Overflow Non-Mechanical Treatment System. The non-mechanical treatment system for the water from the Category 1 Stockpile Groundwater Containment System could potentially be deployed while the West Pit is still flooding. It is assumed that the WWTF will continue to operate during postclosure maintenance. Water from the Category 1 Stockpile Groundwater Containment System will continue to be treated by the WWTF until non-mechanical treatment with gravity discharge to the West Pit has been proven to provide appropriate treatment. This may occur during closure or postclosure maintenance (Section 2.2.1.3 of Reference (1)).

2.4.1.1 WWTF

During postclosure maintenance, the WWTF will continue to treat water from the Category 1 Stockpile Groundwater Containment System. The WWTF will also treat water from the West Pit as necessary to

prevent the West Pit from overflowing. Because the West Pit will receive direct precipitation, it is expected that the flow will vary seasonally. The majority of this variability will be dampened by the volume of the West Pit and management of the West Pit water level.

Operation of the WWTF will occur year-round with the discharge directed to an unnamed tributary to the Partridge River until the non-mechanical treatment system is in use. Before the WWTF begins discharging to the small watercourse that flows into the Partridge River, the WWTF will be upgraded to reverse osmosis (RO) or equivalent technology. Primary membrane separation unit reject concentrate will continue to be treated with the existing secondary membrane separation and chemical precipitation equipment to the extent practical, or will be evaporated, if necessary. The residual solids will be disposed off-site (Section 2.1.1 of Reference (1)).

During postclosure maintenance, it is anticipated that the quality of the water collected by the Category 1 Stockpile Groundwater Containment System will be consistent with the values seen during closure. The quality of the West Pit Overflow will likely have significantly lower concentrations than the water from the Category 1 Stockpile Groundwater Containment System (Section 2.2.2.2 of Reference (1)).

As described in Section 2.2.5.2 of Reference (1)), the WWTF treatment train will be reconfigured to consist of the following components:

- pretreatment via media filtration
- RO or equivalent technology that will meet water quality targets for removal of metals and sulfate
- secondary membrane separation for volume reduction of the primary membrane separation system concentrate
- Chemical precipitation of the secondary membrane concentrate
- If necessary, thermal treatment of a portion of the secondary membrane concentrate via evaporation/crystallization

2.4.1.2 West Pit Discharge to a Tributary of the Partridge River

During postclosure maintenance, the water level in the West Pit will be maintained below the natural overflow elevation by pumping excess water to the WWTF for treatment, then discharge to a small watercourse that flows to the Partridge River. The ultimate objective is to transition from the mechanical treatment provided by the WWTF to a non-mechanical treatment system. Potential non-mechanical treatment systems include construction of an outlet structure from the West Pit, as described in Section 6.3 of Reference (1).

2.4.1.3 Category 1 Stockpile Groundwater Containment System

Water collected by the Category 1 Stockpile Groundwater Containment System will be treated at the WWTF and then pumped to the West Pit or discharged to a tributary of the Partridge River. The drainage will continue to be treated at the WWTF until the West Pit lake concentrations meet the required water resource objectives or treatment is transitioned to a non-mechanical system. Potential non-mechanical treatment systems for the Category 1 Groundwater Containment System are described in Section 6.2 of Reference (1).

2.4.2 Maintenance of Reclaimed Areas

Reclaimed areas will be inspected as necessary, or as required by Minnesota Rules, part 6132.5200. Monitoring and reporting will likely occur at a reduced frequency from the closure period. Any areas that have been damaged by erosion, animal activity, or that have lost vegetation will be identified. A plan to reseed or repair the damage will be developed and implemented.

Reclaimed mine overburden slope erosion will be corrected and re-vegetated as needed. In areas where excess erosion is a repetitive problem, channels and/or outfall structures will be designed for those specific locations. Of the areas at the Mine Site, the Category 1 Waste Rock Stockpile cover system may require further maintenance in the postclosure maintenance period.

Inspection and repair will continue until the MDNR determines that the reclamation is stable and self-sustaining and issues a partial or full release from the PTM responsibilities, as outlined in Minnesota Rules, part 6132.1400 and 6132.4800.

3.0 Plant Site Reclamation, Closure, and Postclosure Maintenance

Plant Site Facilities discussed in this section are described in Sections 8, 10 and 11 of the PTM application, and depicted on Figure 8-1 of the PTM. Phases discussed in this section include progressive reclamation (Section 3.1), reclamation (Section 3.2), closure (Section 3.3), and postclosure maintenance (Section 3.4).

3.1 Progressive Reclamation

Progressive reclamation will take place during the operations phase at the FTB and the HRF.

3.1.1 FTB Exterior Dam-slope Reclamation

As FTB dams are constructed, exterior slopes will be stabilized and vegetated in order to minimize wind and water erosion. During construction of FTB dams, the exterior face of the dams will be amended with a bentonite layer to limit oxygen infiltration into the Flotation Tailings as indicated on Drawing FTB-024. The bentonite amendment will entail addition of granulated bentonite (approximately 3% by dry weight) to an 18-inch thick layer of the dam construction material, overlain by an additional 30-inch layer of dam construction material. The exterior dam faces will be permanently vegetated by a qualified reclamation contractor according to Minnesota Rules, part 6132.2700 and requirements of the Reclamation Seeding Plan (Attachment 1). Inactive interior beach areas will be temporarily vegetated as necessary for fugitive dust control.

3.1.2 HRF Exterior Dam-slope Reclamation

As HRF dams are constructed, exterior slopes will be stabilized and vegetated in order to minimize wind and water erosion . Progressive reclamation will be conducted by a qualified reclamation contractor according to Minnesota Rules, part 6132.2700 and requirements of the Reclamation Seeding Plan (1).

3.2 Reclamation

3.2.1 Structure Removals

PolyMet will decommission the majority of the Plant Site during the reclamation phase. PolyMet will remove the tailings pipeline and associated pumping systems and will also demolish and reclaim the Beneficiation Plant, Hydrometallurgical Plant, and associated facilities. The exception is the WWTP, which will be used through closure and postclosure maintenance as described in Section 3.3.1 and Section 3.4.1. Appropriate controls for airborne asbestos will be in-place during demolition. Utility tunnels will be sealed and closed in-place. Locations of Plant Site Buildings are shown on Figure 8-1 of the PTM.

3.2.2 FTB Reclamation

During FTB reclamation, PolyMet will establish vegetation, amend the FTB beaches and pond bottom with bentonite, construct the closure overflow, and remove infrastructure.

3.2.2.1 Vegetation

Interior portions of the FTB will be graded to provide a gently sloping surface that effectively will route stormwater runoff to the FTB Pond and accommodate potential differential settlement of the underlying Flotation Tailings.

Upland areas will be mulched and planted with permanent vegetation to minimize air and water erosion. Vegetation types will be selected to limit root penetration to within the top 24-inches of the Flotation Tailings in order 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.

3.2.2.2 Bentonite Amendment

Bentonite will be added to exposed beach areas and to the bottom of the FTB Pond. During reclamation, exposed beach areas will be amended 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 (see Drawing FTB-024 in Appendix 6 of the PTM). The bentonite will be injected via agricultural equipment such as that commonly used for below-grade manure injection. This will entail pneumatic injection of bentonite through hollow tines of a rake pulled through the tailings, at the desired depth and at the desired rate of bentonite injection. If access proves difficult and/or to facilitate further mixing of the bentonite and tailings, the upper layer of tailings could be peeled back to facilitate bentonite application and thorough mixing, then replaced. The cover layer of tailings will vegetated in accordance with requirements of the Reclamation Seeding Plan.

Around Mine Year 30, the pond bottom will be amended with bentonite to 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. Adding bentonite to the bottom of the FTB Pond will also reduce the amount of water collected by the FTB seepage capture systems. The FTB final reclamation system will be designed and constructed in accordance with applicable requirements of Minnesota Rules, part 6132.2500, subpart 2. The proposed method of adding bentonite to the pond bottom is by broadcasting. Bentonite injection, or placement of a geosynthetic clay liner, are alternate methods. Details on the design and installation of the FTB Pond Bottom Cover System are provided in Section 5.2 of Reference (1).

3.2.2.3 Closure Overflow

During reclamation, the FTB Closure Overflow (Drawing FTB-024 in Appendix 6 of the PTM) will be constructed. However, during reclamation and closure, FTB overflow will be prevented by pumping any excess FTB pond water to the WWTP.

3.2.2.4 FTB Infrastructure Removal

During reclamation of the FTB the following will be removed:

- Tailings Transport Pipeline, Booster Pumphouses and Tailings Disposal Diffuser Raft
- Water Transfer Pipeline and Transfer Pump Raft
- Return Water Barge
- Return Water Pipeline
- 13.8Kv and 4.16Kv power lines
- power substations

In general, removal will be prior to bentonite amendment of the FTB beach and pond areas. However, if components are needed to implement the bentonite amendment, those components will be removed after the bentonite amendment is complete.

Structures needed to pump pond water to the WWTP to prevent overflow will remain in place as long as needed.

3.2.3 HRF Reclamation

During HRF reclamation PolyMet will dewater the HRF, install a cover system, and remove infrastructure.

3.2.3.1 Dewatering

PolyMet will pump HRF pond water and HRF drainage to the WWTP for treatment and discharge. At the end of operations, the void spaces in the Residue will be full of water. PolyMet will activate the HRF Drainage Collection System to collect drainage from the Residue, and operate the system until drainage ceases. The rate of drainage will decrease over time as the pore water within the Residue is collected and removed.

3.2.3.2 Cover System

A multi-layer cover system will be placed over the Residue. Cover placement will be staged. Early in the Residue dewatering process, access to the Residue surface may be somewhat difficult, due to the fine-grained characteristics of the Residue. A temporary cover will be placed to limit infiltration of precipitation while dewatering progresses and the Residue consolidates and settles. The barrier layer of the temporary cover, in addition to covering the deposited residue, will be extended over the dams to exclude rainwater infiltration back into the residue while also accommodating settlement of the temporary cover system. The settlement of the temporary cover will be monitored, and when the rate and magnitude of settlement has diminished, the final cover will be placed.

The cover system is designed to have a relatively flat slope. The residue will be a water-deposited material that will naturally deposit at a relatively flat slope - currently estimated at a 1% slope. The residue, consisting of saturated silt-size particles, would be difficult to regrade to steeper slopes as part of closure. Placement of the temporary cover will accommodate differential settlement, and positive drainage will be re-established when the final cover is placed over the temporary cover. Cover system

design and sequencing are shown on Drawing HRF-020 and Drawing HRF-021 in Appendix 7 of the PTM.

In ascending order, the cover system will consist of:

- a layer of LTV Steel Mining Company (LTVSMC) tailings or common borrow immediately above the Residue with geotextile or geogrid reinforcing placed between the Residue and tailings/borrow if needed to create a working surface (Drawing HRF-020)
- a barrier layer consisting of a geosynthetic clay liner (GCL) overlain by a 40-mil low density polyethylene or similar MPCA-approved geomembrane barrier layer
- additional LTVSMC coarse tailings and/or common borrow and cover soils placed on top of the barrier layer to create a covered surface capable of sustaining a vegetated cover
- vegetation, established as described in Attachment 1.

In order to achieve a reclamation system that is largely maintenance-free (stipulated as a goal in the MNDNR nonferrous rules), an open-meadow closure approach will be used, with estimated contours as depicted in Drawings HRF-021 and HRF-022 in Appendix 7 of the PTM. This approach will yield a gently sloping closure surface that readily sheds surface water runoff, accommodates future differential settlement of the underlying Residue, and minimizes ponding of water on the closed HRF surface. To control surface water runoff, the cover will slope gently toward the site perimeter to promote natural drainage. Final cover slopes on the cell interior will be relatively shallow (on the order of 1.0%) to minimize surface water runoff flow velocity and erosion. Runoff that becomes channelized along the cell perimeter will be routed through plug-resistant inlet structures and piping systems (Drawing HRF-023). These piping systems, which are commonly used at closed solid waste management facilities, will be used to safely transmit runoff down-slope, particularly after the transition of the relatively flat top slope to the steeper slope of the dam of the facility (at slopes on the order of 15%).

3.2.3.3 Infrastructure Removal

During HRF reclamation and cover construction the following will be removed:

- Residue Transport and Deposition System
- Return Water System (after completion of facility dewatering)
- Power lines (once facility dewatering and water treatment are complete)
- Power substations (once facility dewatering and water treatment are complete).

3.2.4 Water Management Infrastructure Reclamation

Stormwater ponds would be reclaimed by developing wetlands or by filling and revegetating the areas. Reclamation of water management infrastructure associated with the FTB and the HRF is described in Sections 3.2.2.4 and 3.2.3.3.

3.2.5 Building Areas, Roads, and Parking Lots

After demolition of Plant Site buildings and parking areas, two feet of overburden material suitable for vegetation will be placed upon the facility's former footprint. Plant area roads that are deemed not necessary for access by the MDNR Commissioner will be 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; reclamation of these features is the responsibility of the owner of record for the roads.

Building areas, roads, and parking lots will be reclaimed and vegetated according to Minnesota Rules, part 6132.2700 by a qualified reclamation contractor. Seeding and mulching will be based on PolyMet's Reclamation Seeding Procedure (Attachment 1). Any roads that may develop into unofficial off-road vehicle trails (Minnesota Rules, part 6132.3200) will require a variance to allow a 15-foot wide unpaved and unvegetated track down the centerline of the road once reclamation is completed.

Where roads 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.

3.2.6 Water Management During Reclamation

Water management will be a continuous process through reclamation and closure so these two phases are described together in Section 3.3.1.

3.3 Closure

During closure, PolyMet will continue to manage water and maintain the remaining facilities and reclaimed areas.

3.3.1 Water Management During Reclamation and Closure

Water management will be a continuous process through reclamation and closure, so these two phases are described together in this section. Full details on Plant Site water management in reclamation and closure are presented in Section 4 of Reference (1). During reclamation and closure, water management tasks will include the following:

- the WWTP will treat tailings basin seepage collected by the FTB seepage capture systems, excess FTB pond water (if needed to prevent overflow), and HRF pond water and drainage (Section 3.3.1.1)
- the FTB Pond will not be allowed to overflow (Section 3.3.1.3)
- the FTB seepage capture systems will continue to operate (Section 3.3.1.2)
- the HRF Leakage and Drainage Collection Systems will continue to operate (Section 3.3.1.4)
- Stream augmentation will continue (Section 3.3.1.5)

3.3.1.1 WWTP

At the start of reclamation, the volume of water treated by the WWTP will increase relative to operations. Influent sources during reclamation and closure will be tailings basin seepage collected by the FTB seepage capture systems, excess FTB pond water (if needed to prevent overflow), and HRF pond water and drainage.

During reclamation and closure, WWTP effluent will continue to be discharged to Second Creek, Unnamed Creek, and Trimble Creek for stream augmentation (Section 3.3.1.5). Some WWTP effluent will be blended with untreated collected tailings basin seepage and pumped to the Mine Site to accelerate flooding of the West Pit. A small portion of WWTP effluent may also be used to maintain the designed water volume within the FTB Pond. WWTP reject concentrate will continue to be sent to the WWTF, as it was during operations.

3.3.1.2 FTB Pond

FTB pond water will be pumped to the WWTP as necessary to prevent any overflow from the pond. (Section 4.1 of Reference (1))

3.3.1.3 FTB Seepage Capture Systems

The FTB seepage capture systems (described in Section 11.4.6.3 of the PTM) will continue to operate through reclamation and closure. Collected seepage will be sent to the WWTP for treatment and discharge, or blended with WWTP effluent and pumped to the Mine Site for use in flooding the West Pit.

3.3.1.4 HRF Leakage and Drainage Collection Systems

The HRF drainage and leakage collection systems (described in Section 11.4.7.4 of the PTM) will continue to operate through reclamation and closure. Collected drainage will be sent to the WWTP for treatment and discharge.

3.3.1.5 Stream Augmentation

During reclamation and closure, WWTP effluent will continue to be discharged to Second Creek, Unnamed Creek, and Trimble Creek, in quantities sufficient to meet the stream augmentation requirements determined during the permitting process.

3.3.2 Maintenance of FTB and HRF Dams and Facilities

Long-term performance of the bentonite amended dams, beaches and pond bottom can be detrimentally impacted by differential settlement and erosion of the overlying soils. Annual inspections will include identification of any detrimental effects from differential settlement and erosion. Areas where differential settlement is occurring may require retreatment with bentonite to remediate affected areas. The bentonite is likely to be an effective barrier to root penetration. However, depth of root penetration will be evaluated once vegetation becomes well established to confirm that most roots are shallower than the depth of the bentonite amendment and/or are spreading laterally rather than vertically once the bentonite amended zone is encountered. Areas where erosion is occurring and exposing the bentonite amended layer will be remediated with additional erosion control measures and/or regrading as needed to prevent further erosion. If erosion does occur into or through the bentonite amended zone, the appropriate segments of the eroded area will be backfilled with a soil-bentonite mix, covered and revegetated.

The planned FTB Pond Bottom Cover System will require very little maintenance to remain effective. Along the pond perimeter where wave action and freeze-thaw cycles occur, the bentonite layer will require protection from wave erosion and some confinement to resist freeze-thaw impacts. This protective layer 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 riprap) is effective and to repair and upgrade riprap in any areas showing signs of erosion and/or freeze-thaw impacts.

3.3.3 Maintenance of Reclaimed Areas

Establishment of dense vegetative cover and root mass is among the most effective methods to minimize erosion, so the quality and density of the vegetation will be periodically reviewed after final reclamation construction is complete. Reclaimed areas will be inspected at least twice per year (in the spring and fall), as necessary, or as required by Minnesota Rules, part 6132.5200. Any areas that have been damaged by erosion, animal activity, or that have lost vegetation will be identified. A plan to reseed or repair the damage will be developed and implemented.

3.4 Postclosure Maintenance

Once the closure activities described in Section 3.3 are complete, the postclosure maintenance period will begin. Monitoring and reporting will likely occur at a reduced frequency from the closure period. Monitoring, reporting, and water treatment will continue until release from these activities is granted via the PTM. If any of the monitoring data shows that additional work is needed, a plan will be created and implemented to further improve water quality.

3.4.1 Water Management During Postclosure Maintenance

Water management at the Plant Site will continue much the same as during closure. The primary difference will be that after the West Pit is completely flooded, WWTP effluent will no longer be pumped to the Mine Site. Full details on water management in postclosure maintenance are presented in Section 4 of Reference (1).

The ultimate objective is to transition from the mechanical treatment provided by the WWTP to non-mechanical treatment systems. Options for non-mechanical water treatment at the Plant Site during postclosure maintenance are described in Section 6 of Reference (1). 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. The WWTP will be maintained operable until MDNR releases the company from active water treatment requirements under the PTM and the MPCA releases the company under the NPDES/SDS permit.

3.4.1.1 WWTP

During postclosure maintenance, the WWTP will continue to treat water collected by the FTB seepage capture systems, any HRF drainage, and excess water from the FTB Pond as needed to prevent overflow. The WWTP will continue to operate in the same configuration used during operations and reclamation and will be upgraded to include solids management for the reject concentrate that will no longer be sent to the WWTF. Solids management may include chemical precipitation and/or an evaporator, similar to the WWTF during postclosure maintenance. WWTP secondary membrane separation unit reject concentrate will be precipitated and/or evaporated, with the residual solids disposed off-site. WWTP effluent will continue to be discharged to Second Creek, Unnamed Creek, and Trimble Creek for stream augmentation (Section 3.3.1.5).

3.4.1.2 FTB Pond

During postclosure maintenance, any excess water from the FTB Pond will be pumped to the WWTP to prevent overflows. The ultimate goal is to allow overflow of the FTB Pond after demonstrating that water in the FTB Pond is stormwater and that it complies with applicable standards. Once this is demonstrated, pond water could be allowed to overflow. The transition from preventing pond overflow to allowing it will occur only after the pond water has been demonstrated to be stormwater meeting applicable standards, and after this demonstration has been approved by the appropriate regulatory agencies. Additional detail on FTB Pond water management during postclosure maintenance is presented in Section 6.5 of Reference (1).

3.4.1.3 FTB Seepage Capture Systems

The FTB seepage capture systems will operate during postclosure maintenance until the seeps stop or until water resource objectives are achieved without mechanical treatment.

3.4.1.4 HRF Drainage and Leakage Collection Systems

The HRF Drainage and Leakage Collection Systems will continue to operate during postclosure maintenance although at greatly reduced rates. Collected drainage will be treated at the WWTP (or subsequently, non-mechanical treatment systems) then discharged. Drainage water quality will be monitored. Potentially, drainage water quality could reach a point where it could be released directly without treatment while maintaining compliance with applicable water quality standards. It is expected that drainage will stop at some point. When drainage stops, Drainage and Leakage Collection System pumps and pipes and supporting electric power systems will be removed.

3.4.1.5 Stream Augmentation

During postclosure maintenance, WWTP effluent will continue to be discharged to Second Creek, Unnamed Creek, and Trimble Creek, in quantities sufficient to meet the stream augmentation requirements determined during the permitting process.

3.4.2 Maintenance of FTB and HRF Dams and Facilities

During postclosure maintenance, FTB maintenance tasks will include:

- annual inspection of vegetation on the exterior dam faces and interior beaches, with erosion repaired and vegetation reseeded in accordance with requirements of the Reclamation Seeding Plan as needed until released from these activities by the MDNR
- snow removal from the dam crest to allow access during winter months
- reconstruction of eroded dam crest, slope or toe
- fugitive dust control
- repair and/or replacement of damaged instrumentation and monitoring devices

During postclosure maintenance, HRF maintenance will include routine surface care maintenance, such as mowing to prevent tree growth if needed and maintenance of stormwater drainage channel flow capacity.

Any problems identified during a routine inspection will be corrected. This includes, but is not limited to, repair of the Leakage Collection System, security systems, cover materials, berms, culverts, riprap, vegetation, dams, or other infrastructure. For example, in the event that excessive erosion occurs soil would be placed and compacted, and measures taken to prevent recurrence of the problem. If riprap were displaced, it would be replaced and measures taken to prevent a recurrence of the problem. If there are any areas where cover vegetation were poorly established or otherwise stressed, reseeding or other measures would be instituted and an adequate turf established.

Consistent with requirements of Minnesota Rules, part 6115.0390 Termination of Operations and Perpetual Maintenance, the FTB and HRF dams and appurtenances will be perpetually maintained.

3.4.3 Maintenance of Reclaimed Area

Reclaimed areas will be inspected as necessary, or as required by Minnesota Rules, part 6132.5200. Monitoring and reporting will likely occur at a reduced frequency from the closure period. Any areas that have been damaged by erosion, animal activity, or that have lost vegetation will be identified. A plan to reseed or repair the damage will be developed and implemented.

Inspection and repair will continue until the MDNR determines that the reclamation is stable and self-sustaining and issues a partial or full release from the PTM responsibilities, as outlined in Minnesota Rules, part 6132.1400 and 6132.4800.

4.0 Transportation and Utility Corridors Reclamation, Closure, and Postclosure Maintenance

The components of the Transportation and Utility Corridors, including the Treated Water Pipeline (TWP), power distribution system, and railroad, are described in Section 9 of the PTM. Following operations, PolyMet will conduct a survey along the Transportation and Utility Corridors 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 TWP, extending from the Mine Site WWTF to the FTB, will remain operational until pumping has ceased from the WWTP to the West Pit. Then the TWP will be removed, recycled or disposed, or abandoned in place. The area disturbed by these activities will be revegetated.

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. Specifically, the 13.8 kilovolt (kV) distribution system from the FTB to the Coarse Crusher, the 13.8 kV lines from the Main Substation to Area 1 Shop and Area 2 Shop, and the 7.20 kV distribution lines at the Mine Site will be removed during reclamation.

As postclosure maintenance begins, 13.8 kV Line from the Main Substation to Colby Lake Pumphouse will be removed. Power lines that will remain through postclosure maintenance include the 13.8 kV lines from the Minnesota Power Substation at the Mine Site to Mine Site facilities, the 4.16 kV distribution lines at the FTB, and the 4.16 kV distribution lines at the Mine Site.

The railroad track and ties controlled by PolyMet, including the new rail spurs, will be removed and recycled or disposed. The railbed will be reclaimed or evaluated for an approved subsequent use. Reclamation of railroads not controlled by PolyMet is the responsibility of the owner of record. 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.

5.0 Colby Lake Pipeline Corridor Reclamation, Closure, and Postclosure Maintenance

The water supply pipeline from Colby Lake Pumphouse to the Plant Reservoir, will be removed or abandoned in place during reclamation. The Colby Lake Pumphouse will be demolished, and the area reclaimed as described in Section 3.2.5.

6.0 Auxiliary Facilities Reclamation, Closure, and Postclosure Maintenance

6.1 Sanitary Systems and Wells

The septic systems will be pumped out and the tanks filled with soil or crushed rock and backfilled. Monitoring wells, once no longer needed, will be sealed by a licensed well driller in accordance with Minnesota Department of Health (MDH) rules. At the end of operations, the following sanitary systems will be reclaimed:

- Area 1 Shops Septic System
- Area 2 Shops Septic System
- Administration Building Well and Septic System
- Plant Site Sewage Treatment System, including the new sewage treatment system stabilization pond facility and the existing sewage treatment collection system
- Mine Site Sewage Holding Tanks or Septic Systems, depending on installation

6.2 Tanks

The inventory of tanks that will require demolition is included in Table 6-1.

Large aboveground 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 (ACM). 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 plan 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 aboveground storage tanks will be cleaned and removed without disassembly.

Table 6-1 Inventory of Tanks Requiring Demolition – PLACEHOLDER (to be provided after final design)

7.0 Waste Disposal

7.1 Demolition Waste Disposal

Concrete from demolition, with the exception of oil-stained concrete, will be crushed and used for structural fill, placed in building basements where possible and permittable including coarse crusher basement, fine crusher basement, and concentrator basement, or placed in landfills as required. The Plant Reservoir may be used through reclamation and closure for Colby Lake pumping to support stream augmentation; however, if it is available, it will also be used for concrete demolition disposal.

7.2 Special Material Disposal

Special materials on-site at the time of closure may include ACM, 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. All of these materials will be safely collected, removed, and properly recycled or disposed.

Surveys for ACMs have been completed. ACMs (i.e., pipe and electrical insulation) in utility tunnels will be sealed prior to the tunnels being sealed. ACMs (siding, hot water heating system insulation, lube system insulation, floor tile, etc.) from structure demolition will be removed, properly packaged, and disposed in the on-site demolition landfill. Location of any ACMs in demolition landfills will be noted on the property deed. New Project facilities will not include any new ACMs.

During initial closure of the Cliffs Erie facility, all polychlorinated biphenyl (PCB) transformers (including sixteen large transformers) and capacitors were removed and properly disposed. New Project facilities will not include any new PCB transformers.

During closure of the Cliffs Erie facility, all nuclear sources were inventoried and properly disposed. Project facilities will include new nuclear sources in the Beneficiation Plant and in the Hydrometallurgical Plant. These new sources (number of new sources to be determined in during final design) will be disposed in accordance with U.S. Nuclear Regulatory Commission (NRC) regulations in closure, as regulated by the MDH pursuant to their 2006 agreement with the NRC.

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

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

Oil- or chemical-stained concrete will be tested to characterize the material for potential beneficial reuse such as use for structural fill. If the material does not meet the solid waste criteria for beneficial reuse, the oil-stained concrete will be removed and properly disposed.

7.3 Product Disposal

It is expected that all product (copper concentrate, nickel concentrate, mixed hydroxide product, and platinum-group elements precipitate) will be shipped to customers. If any cannot be shipped, it will be placed in the HRF or disposed in an appropriate off-site landfill.

The reagent suppliers, which will be under contract to PolyMet, will remove any reagents remaining at 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 during reclamation.

8.0 Plans to Transition from Mechanical to Non-Mechanical Water Treatment

An important objective of the Project is to provide water treatment for as long as necessary to meet applicable regulatory standards at groundwater and surface water compliance points. The Project includes long-term mechanical treatment (reverse osmosis or equivalently performing technology) at both the Mine Site and Plant Site with a goal of transitioning to a non-mechanical treatment technology requiring less maintenance over the long term. This goal is consistent with the closure and postclosure maintenance requirements of the PTM Regulations, including the regulatory goals of minimizing and eventually eliminating the need for maintenance.

This section provides PolyMet's conceptual plan for transitioning from mechanical water treatment to non-mechanical treatment technologies. Section 6 of Reference (1) provides additional detail. PolyMet plans to transition from mechanical to non-mechanical water treatment as soon as PolyMet can demonstrate that non-mechanical water treatment technologies will effectively treat water to meet the applicable water quality standards. PolyMet anticipates conducting evaluations, including data collection and pilot-studies, during the mine operations and after operations cease to demonstrate the ability to transition to non-mechanical water treatment while maintaining compliance with applicable water quality standards. PolyMet anticipates that its evaluation of non-mechanical treatment systems will include several components of the Project, including the Category 1 Stockpile Groundwater Containment System, West Pit overflow, Tailings Basin, and FTB Pond.

Non-mechanical water treatment technologies are proven methods of water treatment, but they need to be tailored to site-specific conditions, principally those relating to water quality. Non-mechanical water treatment technologies can be thoroughly evaluated in four steps: (1) collecting site-specific information (e.g., hydrology and influent water quality), (2) laboratory testing, (3) pilot-scale testing, and (4) designing a system for full scale implementation.

PolyMet to date has collected and analyzed a substantial quantity of water quality and related data with respect the Project and the historic and existing condition of the Mining Area. It also has conducted extensive modeling with respect to the anticipated performance of the Project's pollution control systems, including the Tailings Basin and the associated seepage capture systems, the WWTP and WWTF, and various liners and covers to prevent groundwater infiltration and surface water runoff of parameters of concern. PolyMet will undertake a number of additional data collection and analyses during operations, such as those summarized below.

At the Tailings Basin, additional site-specific hydrologic information can be collected when the Groundwater Containment System is constructed and throughout operations. Additional data will also be collected on the quality of the nonferrous seepage from the FTB. Thus, the four steps for evaluating non-mechanical water treatment at the Tailings Basin will be implemented during Project operations, potentially allowing the non-mechanical water treatment system at the Tailings Basin to be put in place shortly after operations are complete and the FTB pond bottom cover is installed. If the transition to non-mechanical treatment is undertaken prior to the completion of West Pit flooding, Colby Lake water

possibly could be used to aid in the flooding of the West Pit (with or without treatment at the WWTP). Alternatively, West Pit flooding could be extended, depending on water quality results and other considerations.

At the Mine Site, the four steps for evaluating non-mechanical treatment technologies could be finalized in less than the time estimated for completion of the West Pit flooding (e.g., approximately 35 years after the end of operations). Additional time is included in PolyMet's current plan, however, because the water quality in the pit may take some time to reach equilibrium after the West Pit has flooded. Therefore, PolyMet anticipates implementing the four evaluation steps during the reclamation period (approximately Mine Year 25 – Mine Year 28). As a result, non-mechanical water treatment technology could be implemented at the Mine Site a few years after the West Pit has been flooded at the end of the closure period, currently projected for Mine Year 55.

The water models used to support permitting for the Project were not designed to estimate when treatment for compliance with water quality standards can be ended, nor are they intended to estimate when treatment can transition from mechanical to non-mechanical systems. Rather, PolyMet will assess actual treatment requirements on a recurring basis through operations and the post-operations periods based on the actual results of monitoring discharges, performance of engineering controls, and water resources. This process will rely on monitoring results (supported by additional analysis through modeling) to continuously protect groundwater and surface water in compliance with water quality standards.

9.0 Monitoring During Reclamation, Closure, and Postclosure Maintenance

Monitoring will continue during reclamation, closure, and postclosure maintenance in accordance with permit conditions of the PTM, the NPDES/SDS permits, the Water Appropriations Permits, the Dam Safety Permits, and the Air Permit. Details of the reclamation, closure, and postclosure maintenance monitoring plans will be added in a future update of this Plan after permits are issued.

9.1 Tailings Basin [placeholder]

9.1.1 Pond Water

9.1.2 Seepage

9.1.3 Dam Safety

9.2 Hydrometallurgical Residue Facility [placeholder]

9.2.1 Pond Water

9.2.2 Leachate

9.2.3 Dam Safety

9.3 Surface Water Discharges [placeholder]

9.4 Groundwater [placeholder]

9.5 Surface Water [placeholder]

9.6 Wetlands [placeholder]

9.7 Pit Lakes [placeholder]

10.0 Reporting During Reclamation, Closure, and Postclosure Maintenance

Reporting will continue during reclamation, closure and postclosure maintenance in accordance with permit conditions of the PTM, the NPDES/SDS permits, the Water Appropriations Permits, the Dam Safety Permits. Details of reclamation, closure, and postclosure maintenance reporting will be added in a future update of this Plan after permits are issued.

10.1 Permit to Mine Reporting [placeholder]

10.2 NPDES/SDS Reporting [placeholder]

10.3 Water Appropriations Reporting [placeholder]

10.4 Dam Safety Reporting [placeholder]

11.0 References

1. **Poly Met Mining Inc.** NorthMet Project Adaptive Water Management Plan (v10). July 2016.

Revision History

Date	Version	Description
09/30/2016	1	Initial release – submitted with Permit to Mine Application

Attachments

Attachment 1

Reclamation Seeding Plan

Hoyt Lakes, Minnesota **STANDARD PROCEDURE**		
RECLAMATION SEEDING AND MULCHING		
General Manager's Approval _____ Manager's Approval _____ Initiator _____	Date Effective 12/14/12	SP Number ER15
History: 2/14/12 – ER15 - initial version 9/10/13 – Edited to support Plant Site Fugitive Emission Control Plan submittal		

PART I. DESCRIPTION

This work shall consist of the operations of establishing herbaceous ground cover on designated reclamation areas within the NorthMet Project including Flotation Tailings Basin (FTB), Hydrometallurgical Residue Facility (HRF), Pit Wall Overburden Slopes, Category 1 Waste Rock Stockpile, reclaimed roads, reclaimed building sites, and other disturbed areas. It shall include seeding, mulching, fertilizing, and any other work specified in conjunction therewith.

The primary objectives of establishing herbaceous ground cover are to:

- Rapidly (3-5 years) establish a self-sustaining plant community
- Control air emissions
- Control soil erosion
- Provide for wildlife habitat, and
- Minimize to the extent practicable the need for maintenance

In accomplishing these objectives, preference will be given to the establishment of plant communities consisting of native plant species and the introduction of invasive species will be avoided to the extent that such a practice does not interfere with the timely and effective accomplishment of the primary objectives for vegetation establishment.

1.01 CONSTRUCTION REQUIREMENTS

A. General

If any of the work provided for herein is performed under unfavorable conditions or contrary to the restrictions and requirements set forth, the Contractor shall assume full responsibility for the results by repairing any damages and replacing unacceptable work as the *Operations Contact* directs.

The Contractor will provide seed, fertilizer, mulch and any other materials necessary to complete the job unless notified in writing that PolyMet will provide materials.

Contracted equipment and/or substitutions from that listed herein or in the Vegetative Specifications must be approved by the *Operations Contact* before the substitution can be made.

B. Placing and Working-In Fertilizer

Fertilizers shall be applied at the rates indicated in the Vegetative Specifications, using mechanical spreading devices to the fullest extent practicable, and providing uniform distribution of the material over the designated areas.

Unless otherwise specified, immediately prior to sowing the seed, the fertilizer shall be worked into a depth of approximately eight inches on the level and four inches on all slopes, using rotovators, klodbusters, discs, harrows, etc., or as specified on the Vegetative Specifications. On slopes, the cultivating equipment shall be operated in a general direction at right angles to the direction of surface drainage wherever practical.

C. Sowing Seed

The season of planting (dates approximate) for the various seed mixtures shall be as follows:

Season of Planting

Winter: March

Spring: Fertilization will commence as soon as the ground is workable, and planting will commence as soon after May 1st as is practicable and will be completed by approximately June 10th.

Summer: Approximately August 15 - September 15

Fall: October

On areas to be mulched after seeding, no more seed shall be sown on any day than can be mulched on the same day. In any event, the lag time between seeding and mulching shall not exceed 24 hours where the mulch is placed after seeding. Should the mulch application be delayed more than 24 hours, the *Operations Contact* may order the area reseeded at the Contractor's expense.

Seed shall be sown by means of mechanical, Truax native seed drill or hydrospreading of the seeds at the specified rate of application. The use of hand operated mechanical spreaders will be permitted only on areas which are inaccessible to, or too small for the other equipment approved herein, all as determined by the *Operations Contact*. During windy weather, no seeding shall be done with cyclone type broadcasting devices.

All legume seed used must be pre-inoculated. If a hydroseeder will be used to distribute seed, double the appropriate bacteria culture will be added to the hydroseeder tank

immediately before planting commences. The inoculant will be supplied by the Contractor and must be kept cool by the Contractor until the time of its use.

If a seed drill of the agricultural type is used, the drill shall be operated in a general direction at right angles to the direction of surface drainage, wherever practical, and the seed shall not be sown to a depth greater than 1/2 inch. Small seed species such as red top, etc., shall be sown through the grass seed attachment or by other approved means.

Broadcast seeders shall be used in wet areas where drill seeders tend to clog-up and will be followed by a cultipacker or equivalent.

If a hydroseeder is used, it shall have continuous agitation action that keeps the seed mixed in uniform distribution in the water slurry until pumped from the tank. The pump pressure shall be such that a continuous, nonfluctuating stream is maintained.

All seeded areas shall have the seedbed firmed or the seed worked in or covered after seeding and prior to mulching. Soil firming or seed covering shall be accomplished within twenty-four hours after seeding.

D. Mulch Classification

Mulch material shall conform to the requirements for one of the following types, as specified in the Contract:

Type 1 - Mulch shall consist of grain straw, hay, cutting of agricultural grasses and legumes. The material shall be relatively free of seed bearing stalks of noxious grasses or weeds, as defined by the rules and regulations of the Minnesota Department of Agriculture.

Type 2 - Type 2 mulch shall consist of a mixture of Type 1 (straw, hay, etc.) and asphalt emulsion mulch materials.

Type 3 - Type 3 mulch shall consist of Type 1 (straw, hay, etc.) spread on the ground and anchored using an Imco disc or comparable equipment.

Type 4 - Type 4 mulch shall consist of approved chemical application.

Type 5 - Type 5 mulch shall consist of wood fiber, newsprint, chopped straw, cotton fiber or any combination of the four listed materials.

Type 6 - Type 6 mulch shall consist of an initial application of Type 1 mulch held in place with Type 5 mulch.

E. Applying Mulch

Type 1 - Wherever possible, Type 1 mulch shall be placed with blower equipment. The rate of application shall be 2 tons/acre. Where so specified and provided for in the Vegetative Specifications, the mulch shall be anchored the same day it is placed, unless otherwise authorized by the *Operations Contact*.

Type 2 - Type 2 mulch materials shall be applied by blowing, with asphalt emulsion being sprayed into the Type 1 material as it leaves the blower. Disc anchoring will not be required. The rates of application shall be 2 tons of Type 1 and 250 gallons of asphalt per acre.

Type 3 - Type 3 mulch materials shall be applied by blowing or spreading. Application rates shall be 2 tons of Type 1 mulch per acre (or other approved rate). The mulch shall be anchored with an Imco disc or other approved equipment the same day it is placed.

Type 4 - Type 4 mulch shall be applied with hydraulic spray equipment at the rate of 650 gallons per acre (four parts water to one part TREX), or 1,300 gallons per acre (9 parts water to one part Coherex) or another rate and chemicals as designated by the *Operations Contact*. The slurry mixture shall be uniformly sprayed on the prepared seed bed. The *Operations Contact* will verify, by inspection of tank loading and spray application, that materials applied correspond with the per acre requirements within reasonable limitations.

Type 5 - Type 5 mulch shall be applied with hydraulic spray equipment at the rate of 1,500 to 2,000 lbs./acre (or other approved rate). The slurry mixture shall be uniformly sprayed on the prepared seed bed.

Type 6 - Type 6 mulch materials shall be applied by:

1) Blowing on 2 tons/acre of Type 1 mulch material.
2) Application over the Type 1 mulch of 1000 lbs./acre Type 5 mulch.

F. Litter Reduction

Litter reduction will be a spring treatment used on interior areas displaying an excessive amount of organic material from previous year's growth. A brush hog, weed chopper or other equipment approved by the *Operations Contact* shall be used to chop and scatter the existing vegetative material. This treatment will normally be used alone.

G. Plowing

Plowing will be a fall treatment used on interior areas choked with root-bound vegetation or containing excessive amounts of litter. Unless otherwise specified, this treatment shall be done immediately prior to placing and working in fertilizer. Approximate depth of cut shall be eight (8) inches.

1.02 METHOD OF MEASUREMENT

A. Seeding (Areas)

Seeding will be measured by the area seeded, regardless of the seed mixture or quantity of seed used, and regardless of whether the seed was furnished by the Contractor or PolyMet. Areas reseeded by order of the *Operations Contact*, after the original seeding of the area was accepted, will be measured and added to the area originally seeded.

B. Mulch (Mulch - Tons)

(Non-Petro Binder - Pounds or Gallons)
(Dust Retarding Chemicals - Gallons)

Mulch material of Type 1 will be measured by the weight furnished and applied acceptably.

C. Disc Anchoring (Acres)

Disc anchoring of Type 1 mulch will be measured by the area in acres of mulch disced acceptably.

D. Plowing (Acres)

Plowing will be measured by the area in acres treated acceptably.

PART 2 VEGETATIVE SPECIFICATIONS

2.01 TREATMENT A - FERTILIZING AND PLANTING FLAT AREAS

This treatment, described below, will be done on

- the flat, fine tailings found at the FTB and HRF interior areas
- on some coarse tailing FTB and HRF dams with slopes flatter than 3:1
- top and benches of Category 1 Waste Rock Stockpile
- reclaimed roads and building sites
- other disturbed areas

A. Fertilization

1. Application will be made using a mechanical spreader, hydro-seeder, or other equivalent device approved by the *Operations Contact*.

2. Soil testing will be completed to evaluate fertilizer needs. In absence of soil testing, fertilizer will be applied on glacial till overburden at a uniform rate of 400 pounds of 20-20-0 per acre (or equivalent) and on tailings at a uniform rate of 600 pounds of 11-55-0 per acre and 100 pounds of 0-46-0 per acre (or equivalent), or other rate designated by the *Operations Contact*.

3. After application, the fertilizer will be worked and thoroughly mixed with the tailing or glacial till overburden using a disc (or equivalent) to an approximate depth of six (6) inches.

B. Sowing of Seed

1. Seed Mixtures for temporary dust control on FTB beaches.

Mixture Number	Species		Rate (lbs/acre)
A1[1]	Oats (*Avena sativa*)		100
		Total	**100**
A2[2]	Winter Wheat (*Triticum aestivum*)		100
		Total	**100**
A3[3]	Annual Rye (*Loliuum italicum*)		20
	Sweet Clover (*Trifolium repens*)		5
	Redtop (*Agrostis stolonifera*)		5
	Alsike Clover (*Trifolium hybridum*)		5
		Total	**35**
A4	Any substitute mixture or individual species designated by the *Operations Contact*. Substitutes may become necessary due to seed availability or suitability.		

[1] State Seed Mix* 21-111. Temporary cover for spring and summer plantings.
[2] State Seed Mix* 21-112. Temporary cover for fall plantings.
[3] Seed mix used by LTVSMC for temporary dust control.

2. Seed Mixtures for permanent reclamation cover on FTB upland beaches, Category 1 Waste Rock Stockpile top, bench and reclaimed roads, building sites and other disturbed areas.

Mixture Number	Species	Rate (lbs/acre)
B1[1]	Fringed Brome (*Bromus ciliates*)	2.00
	Bluejoint (*Calamagrostis canadensis*)	0.13
	Poverty Grass (*Danthonia spicata*)	0.50
	Nodding Wild Rye (*Elymus canadensis*)	1.25
	Slender Wheatgrass (*Elymus trachycaulus*)	2.00
	Fowl Bluegrass (*Poa palustris*)	0.87
	False Melic (*Schizachne purpurascens*)	0.25
	Total Grasses	**7.00**
	Common Yarrow (*Achillea millefolium*)	0.03
	Pearly Everlasting (*Anaphalis margaritacea*)	0.02
	Flat-topped Aster (*Doellingeria umbellate*)	0.04
	Tall Cinquefoil (*Drymocallis arguta*)	0.06
	Large-leaved Aster (*Eurybia macrophylla*)	0.02
	Stiff Goldenrod (*Oligoneuron rigidum*)	0.14
	Smooth Wild Rose (*Rosa blanda*)	0.16
	Black-eyed Susan (*Rudbeckia hirta*)	0.26
	Gray Goldenrod (*Solidago nemoralis*)	0.06
	Upland White Aster (*Solidago ptarmicoides*)	0.04
	Lindley's Aster (*Symphyotrichum ciliolatum*)	0.03
	Smooth Aster (*Symphyotrichum leave*)	0.14
	American Vetch (*Vicia americana*)	0.50
	Total Forbs	**1.68**
	Oats or Winter Wheat (season dependent)	25.00
	Total Cover Crop	**25.00**
	Totals:	**33.50**

Mixture Number	Species	Rate (lbs/acre)
B2[2]	Meadow Brome (*Bromus biebersteinii*)	8.0
	Canada Wild Rye (*Elymus canadensis*)	8.0
	Switchgrass (*Panicum virgatum*)	8.0
	Canada Bluegrass (*Poa compressa*)	5.0
	Intermediate Wheatgrass (*Thinopyrum intermedium*)	8.0
	Red Fescue (*Festuca rubra*)	5.0
	Timothy (*Phleum pretense*)	3.0
	Alfalfa (*Medicago sativa*)	12.0
	White clover (*Trifolium repens*)	3.0
	Grass and Legume Total	60.0
	Oats or Winter Wheat (season dependent)	25.0
	Totals:	85.0
B3[3]	Canada Bluegrass (*Poa compressa*)	10
	Redtop (*Agrostis stolonifera*)	5
	Cicer Milvetch (*Astragalus cicer*)	10
	Birdsfoot Trefoil (*Lotus corniculatus*)	20
	Perennial Ryegrass (*Lolium perene*)	10
	Alsike Clover (*Trifolium hybridum*)	10
	Total	65
B4	Any substitute mixture or individual species designated by the *Operations Contact*. Substitutes may become necessary due to seed availability or suitability.	

[1] State Seed Mix* 36-311. Woodland Edge for reclamation in NE MN.
[2] Adapted from "Guidelines for Reclamation Plantings on Taconite Tailings Basins and Stockpiles". MDNR Lands and Minerals. January 2012.
[3] Used by LTVSMC for permanent taconite tailings reclamation.

3. Wetland Seed Mixtures for permanent reclamation cover on wet tailing soils near FTB pond; and wet soils atop the East Pit backfill and/or depressions associated with former temporary stockpile footprints.

Mixture Number	Species	Rate (lbs/acre)
C1[1]	Fringed Brome (*Bromus ciliates*)	2.00
	Bluejoint (*Calamagrostis canadensis*)	0.10
	Virginia Wildrye (*Elymus virginicus*)	1.50
	Tall Manna Grass (*Glyceria grandis*)	0.25
	Fowl Bluegrass (*Poa palustris*)	0.65
	Total Grasses	**4.50**

Mixture Number	Species	Rate (lbs/acre)
	Tussock Sedge (*Carex stricta*)	0.04
	Pointed Broom Sedge (*Carex Scoparia*)	0.05
	Dark Green Bulrush (*Scirpus atrovirens*)	0.20
	Woolgrass (*Scirpus cyperinus*)	0.06
	Total Sedge and Rushes	**0.35**
	Canada Anemone (*Anemone canadensis*)	0.10
	Marsh Milkweed (*Asclepias incarnate*)	0.24
	Flat-topped Aster (*Doellingeria umbellate*)	0.10
	Common Boneset (*Eupatorium perfoliatum*)	0.09
	Grass-leaved Goldenrod (*Euthamia graminifolia*)	0.04
	Spotted Joe Pye Weed (*Eutrochium maculatum*)	0.14
	Blue Monkey Flower (*Mimulus ringens*)	0.03
	Giant Goldenrod (*Solidago gigantean*)	0.03
	Eastern Panicled Aster (*Symphotrichum lanceolatum*)	0.03
	Total Forbs	**0.80**
	Oats or Winter Wheat (season dependent)	6.85
	Total Cover Crop	6.85
	Totals	**12.50**
C2	Any substitute mixture or individual species designated by the *Operations Contact.* Substitutes may become necessary due to seed availability or suitability.	

[1] State Seed Mix* 34-371. Wet meadow NE MN.

4. The individual species or mixtures will be sown in one application in areas clearly designated by the *Operations Contact*.

5. Method of Application If the seed is not premixed, it will be mixed by the contractor in the proper proportions and sown using a hydroseeder, Truax native seed drill, broadcast seeder or equivalent.

6. Soil firming using a cultipacker or equivalent will be required for all Treatment "A" acres and will follow seeding as soon as possible. In all cases, packing will be complete within 24 hours of seeding.

C. Mulching – Type 3

2.02 TREATMENT B - FERTILIZING AND PLANTING SLOPES

This treatment, described below, will be done mainly on the FTB and HRF dam slopes and benches, Pit Wall Overburden Slopes and Category 1 Waste Rock Stockpile slopes but some may be done on natural ground.

A. Fertilization

1. Application will be made using a mechanical spreader, hydroseeder, or another equivalent device approved by the *Operations Contact*.

2. Soil testing will be completed to evaluate fertilizer needs. In absence of soil testing, fertilizer will be applied on glacial till overburden at a uniform rate of 400 pounds of 20-20-0 per acre (or equivalent) and on tailings at a uniform rate of 600 pounds of 11-55-0 per acre and 100 pounds of 0-46-0 per acre (or equivalent), or other rate designated by the *Operations Contact*.

3. After application, the fertilizer will be worked and thoroughly mixed into the tailing or topsoil with a klodbuster or equivalent to an approximate depth of 4 inches (6 passes over a given area).

B. Sowing of Seed

1. Seed Mixtures for permanent cover on FTB and HRF dam slopes and benches. Pit Wall Overburden Slopes and Category 1 Waste Rock Stockpile slopes:

Mixture Number	Species	Rate (lbs/acre)
D1[1]	Fringed Brome (*Bromus ciliates*)	2.00
	Bluejoint (*Calamagrostis canadensis*)	0.13
	Poverty Grass (*Danthonia spicata*)	0.50
	Nodding Wild Rye (*Elymus canadensis*)	1.25
	Slender Wheatgrass (*Elymus trachycaulus*)	2.00
	Fowl Bluegrass (*Poa palustris*)	0.87
	False Melic (*Schizachne purpurascens*)	0.25
	Total Grasses	**7.00**
	Common Yarrow (*Achillea millefolium*)	0.03
	Pearly Everlasting (*Anaphalis margaritacea*)	0.02
	Flat-topped Aster (*Doellingeria umbellate*)	0.04
	Tall Cinquefoil (*Drymocallis arguta*)	0.06
	Large-leaved Aster (*Eurybia macrophylla*)	0.02
	Stiff Goldenrod (*Oligoneuron rigidum*)	0.14
	Smooth Wild Rose (*Rosa blanda*)	0.16
	Black-eyed Susan (*Rudbeckia hirta*)	0.26
	Gray Goldenrod (*Solidago nemoralis*)	0.06
	Upland White Aster (*Solidago ptarmicoides*)	0.04
	Lindley's Aster (*Symphyotrichum ciliolatum*)	0.03
	Smooth Aster (*Symphyotrichum leave*)	0.14
	American Vetch (*Vicia americana*)	0.50
	Total Forbs	**1.68**

Mixture Number	Species	Rate (lbs/acre)
	Oats or Winter Wheat (season dependent)	25.00
	Total Cover Crop	**25.00**
	Totals:	**33.50**
D2[2]	Meadow Brome (*Bromus biebersteinii*)	8.0
	Canada Wild Rye (*Elymus canadensis*)	8.0
	Switchgrass (*Panicum virgatum*)	8.0
	Canada Bluegrass (*Poa compressa*)	5.0
	Intermediate Wheatgrass (*Thinopyrum intermedium*)	8.0
	Red Fescue (*Festuca rubra*)	5.0
	Timothy (*Phleum pretense*)	3.0
	Alfalfa (*Medicago sativa*)	12.0
	White clover (*Trifolium repens*)	3.0
	Grass and Legume Total	60.0
	Oats or Winter Wheat (season dependent)	25.0
	Totals:	85.0
D3[3]	Smooth Brome (*Bromus inermis*)	10
	Red Fescue (*Festuca rubra*)	10
	Perennial Ryegrass (*Lolium perene*)	10
	Cicer Milvetch (*Astragalus cicer*)	10
	Birdsfoot Trefoil (*Lotus corniculatus*)	20
	White Clover (*Trifolium repens*)	10
D4	Any substitute mixture or individual species designated by the *Operations Contact.* Substitutes may become necessary due to seed availability or suitability.	

[1] State Seed Mix* 36-311. Woodland edge for reclamation in NE MN.
[2] Adapted from "Guidelines for Reclamation Plantings on Taconite Tailings Basins and Stockpiles". MDNR Lands and Minerals. January 2012.
[3] Used by LTVSMC for permanent taconite tailings reclamation

State Seed Mixes
Standard seed mixtures used by Mn/DOT, BWSR, and some divisions of the DNR have been revised and consolidated into one list of State Seed Mixes. Standards for the mixes have also been combined, with both BWSR and Mn/DOT requiring that mixes be sold as pure live seed (PLS), Source Identified (Yellow Tag) when available, and specific labeling requirements. Please see:
http://www.bwsr.state.mn.us/native_vegetation/state_seed_mixes.pdf.

2. Method of Application - if seed is not premixed, it will be mixed by the Contractor in the proper proportions and sown using a hydroseeder or similar equipment approved by the *Operations Contact*.

3. The seed will be covered by dragging a light chain over the surface, one (1) pass of the klodbuster or covering by a similar method approved by the *Operations Contact*.

4. All legume seed will be pre-inoculated and supplemented in hydroseeder tank.

2.03 TREATMENT C - MULCHING ONLY

These are fertilized and seeded areas which require additional mulching or areas mulched for dust control.

A. Mulching

1. Mulch will be distributed at a rate provided in Part I of the general specifications and uniformly spread to provide the most adequate vegetative protection on all treatment acres as directed by the *Operations Contact.*