

Basemap source: Barr Engineering

- USGS Gauging Station
- Historic Weather Station
- Historic Surface Water Quality Data Locations
- Major Rivers
- St. Louis River Basin
- Project Boundaries

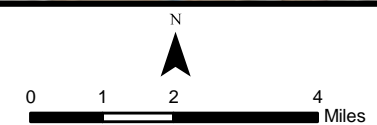
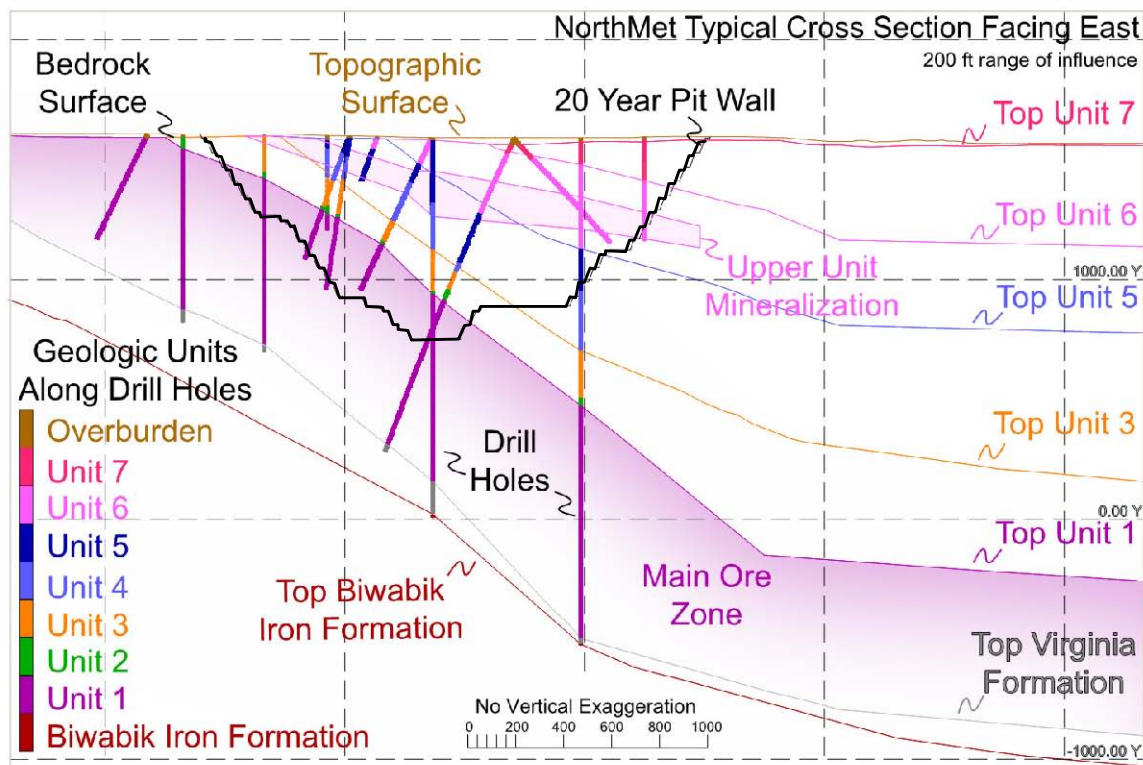
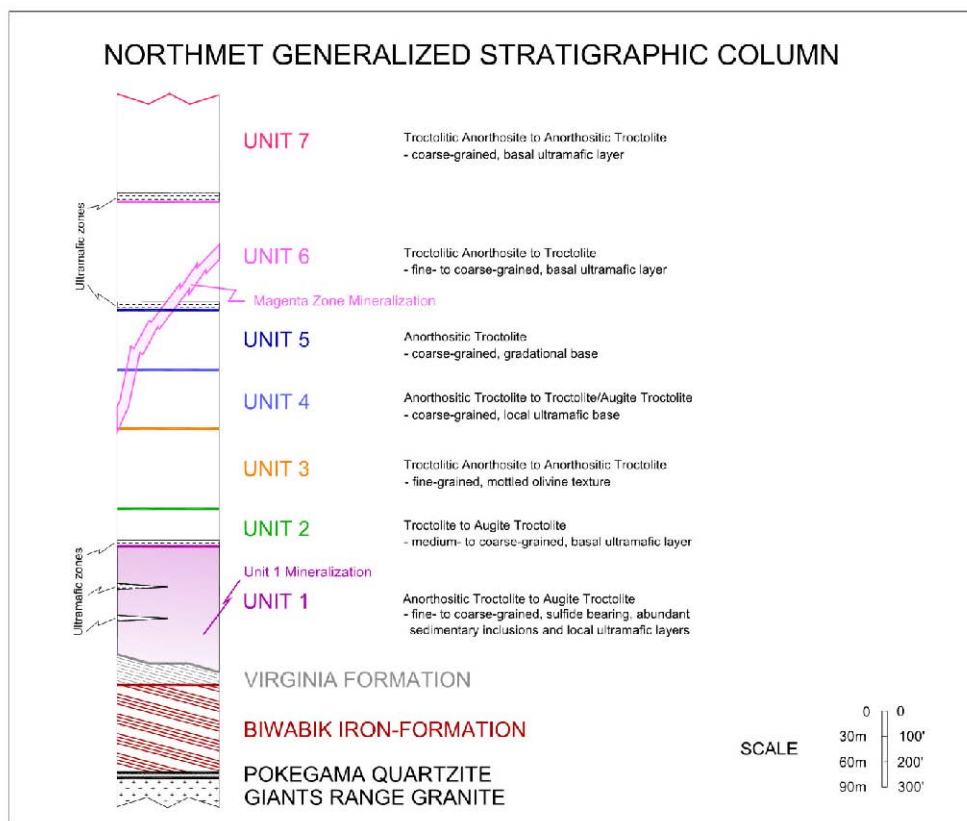


Figure 4.1-1
Watersheds, Streams and Historical Data
Collection Sites
NorthMet Project
PolyMet Mining, Inc.
St. Louis County, Minnesota

October 2009

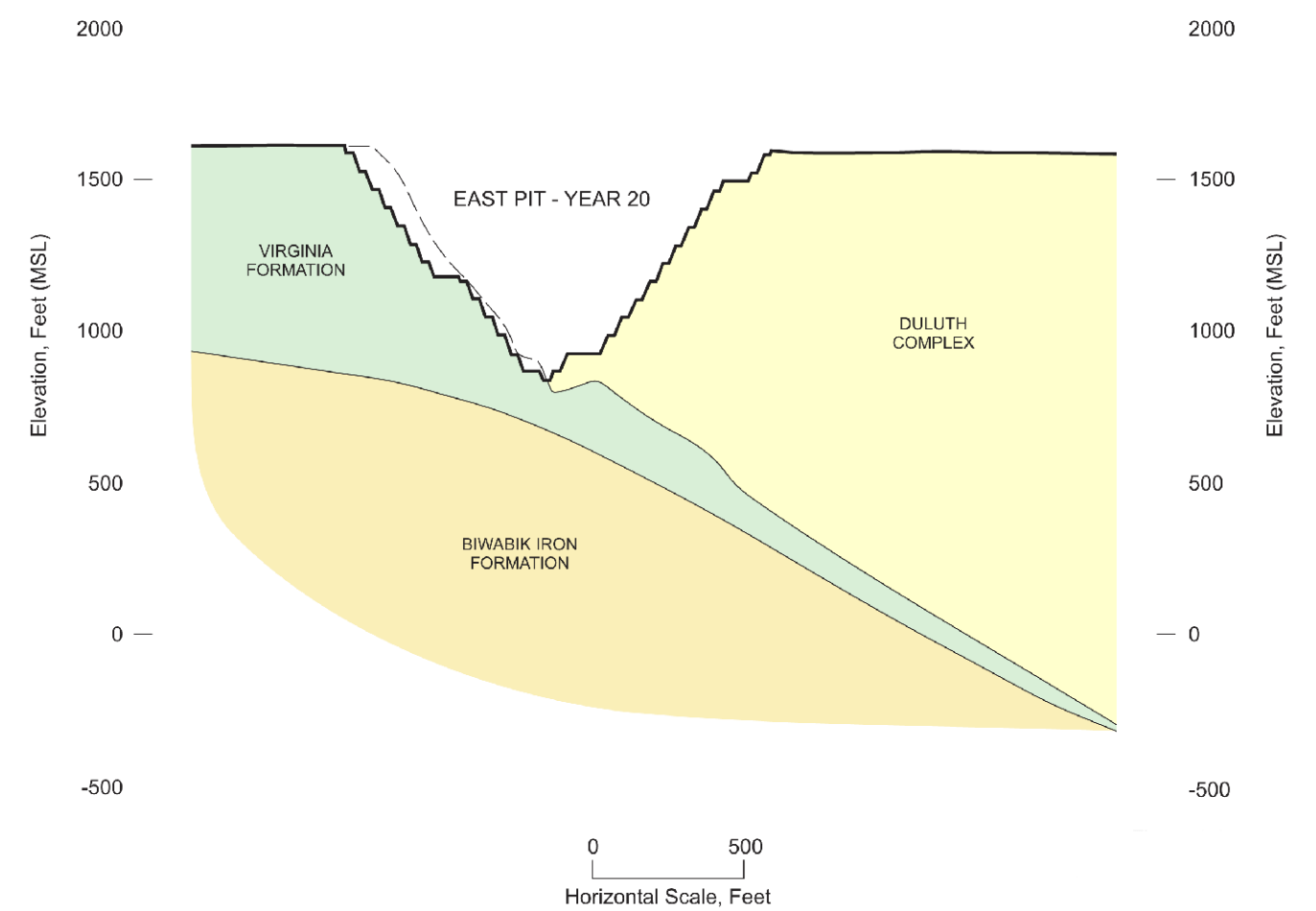
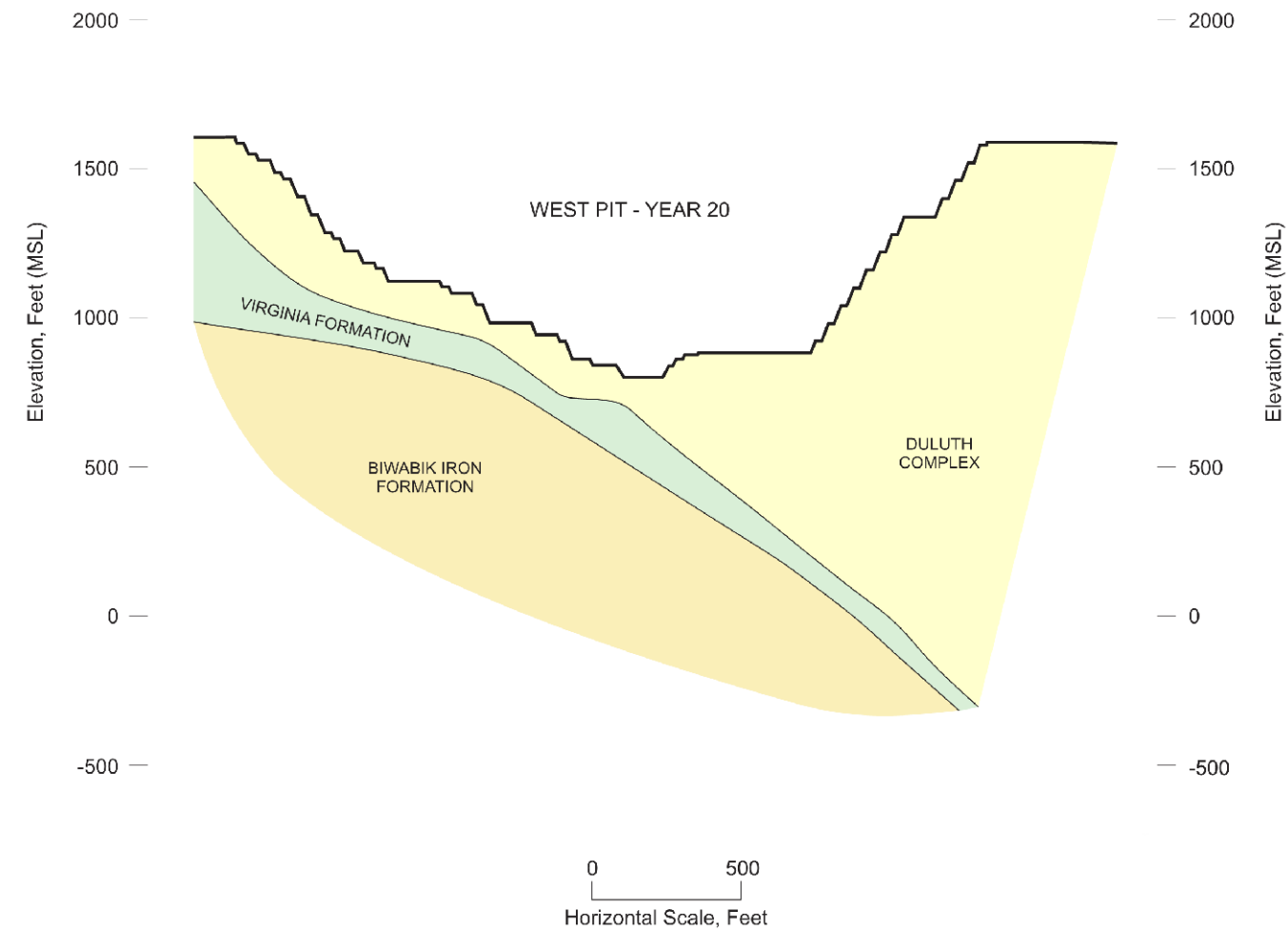


Images Provided by: PolyMet

Figure 4.1-2
Geologic Cross-Section and
Stratigraphic Column at Mine Site
NorthMet Project
PolyMet Mining, Inc.
St. Louis County, Minnesota



October 2009



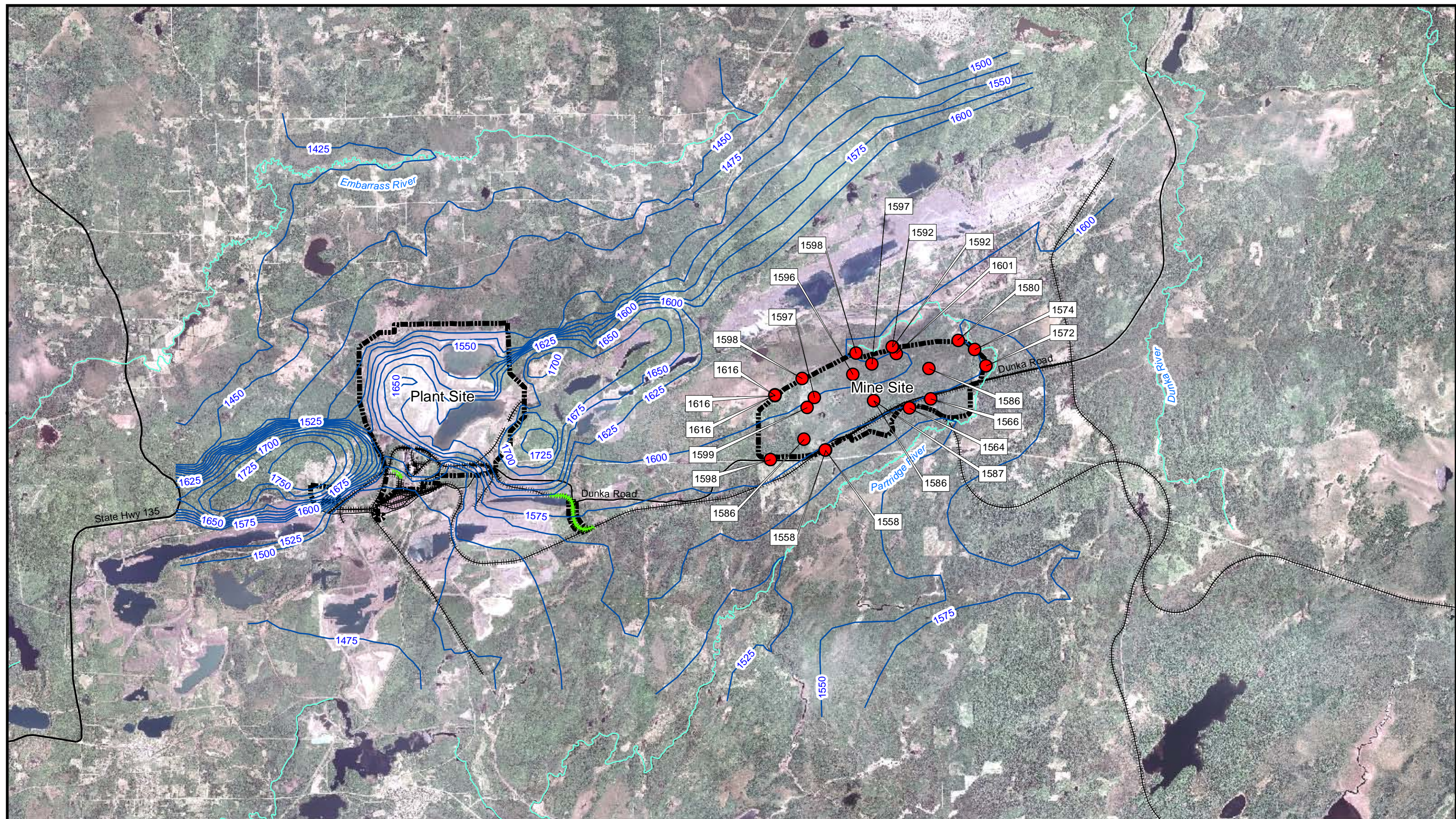
Data Source: Barr Engineering



Figure 4.1-3
Geologic Cross Sections (Looking East)

NorthMet Project
PolyMet Mining, Inc.
St. Louis County, Minnesota

October 2009



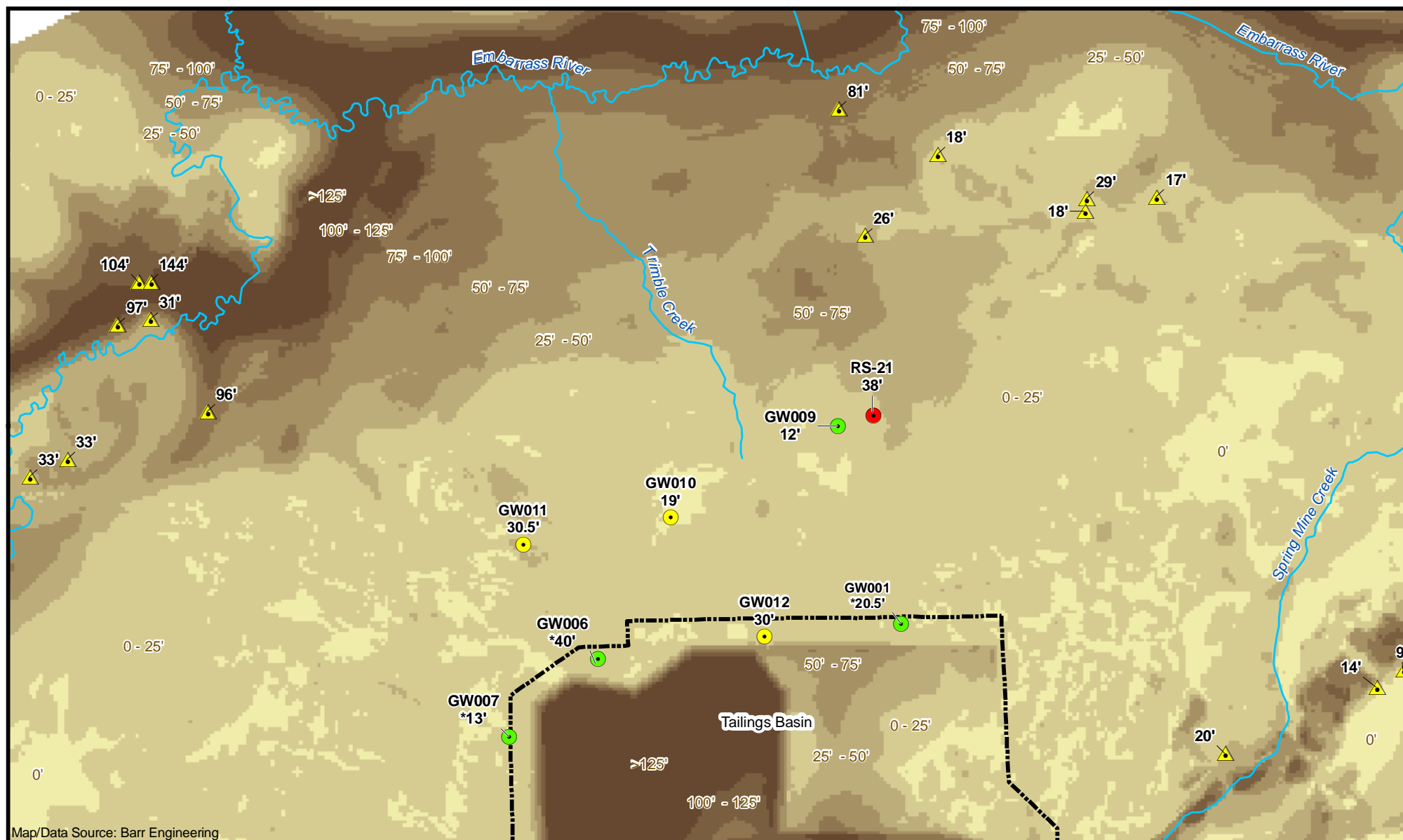
— Rivers/Streams

+++++ Existing Railroads

Groundwater Contour* (Contour Interval=25FT.)
*Water table elevation are in feet MSL

Monitoring Wells





Map/Data Source: Barr Engineering

Residential Wells from
County Well Index
with Depth to Bedrock

Monitoring Wells

Groundwater Well - Existing

Soil Borings

Depth to Bedrock

0 - 25'

25' - 50'

50' - 75'

75' - 100'

100' - 125'

>125'

*Depth represents thickness of native unconsolidated material
encountered in boring drilled near the well location

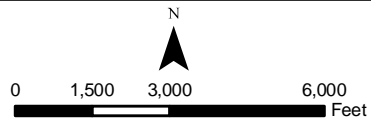
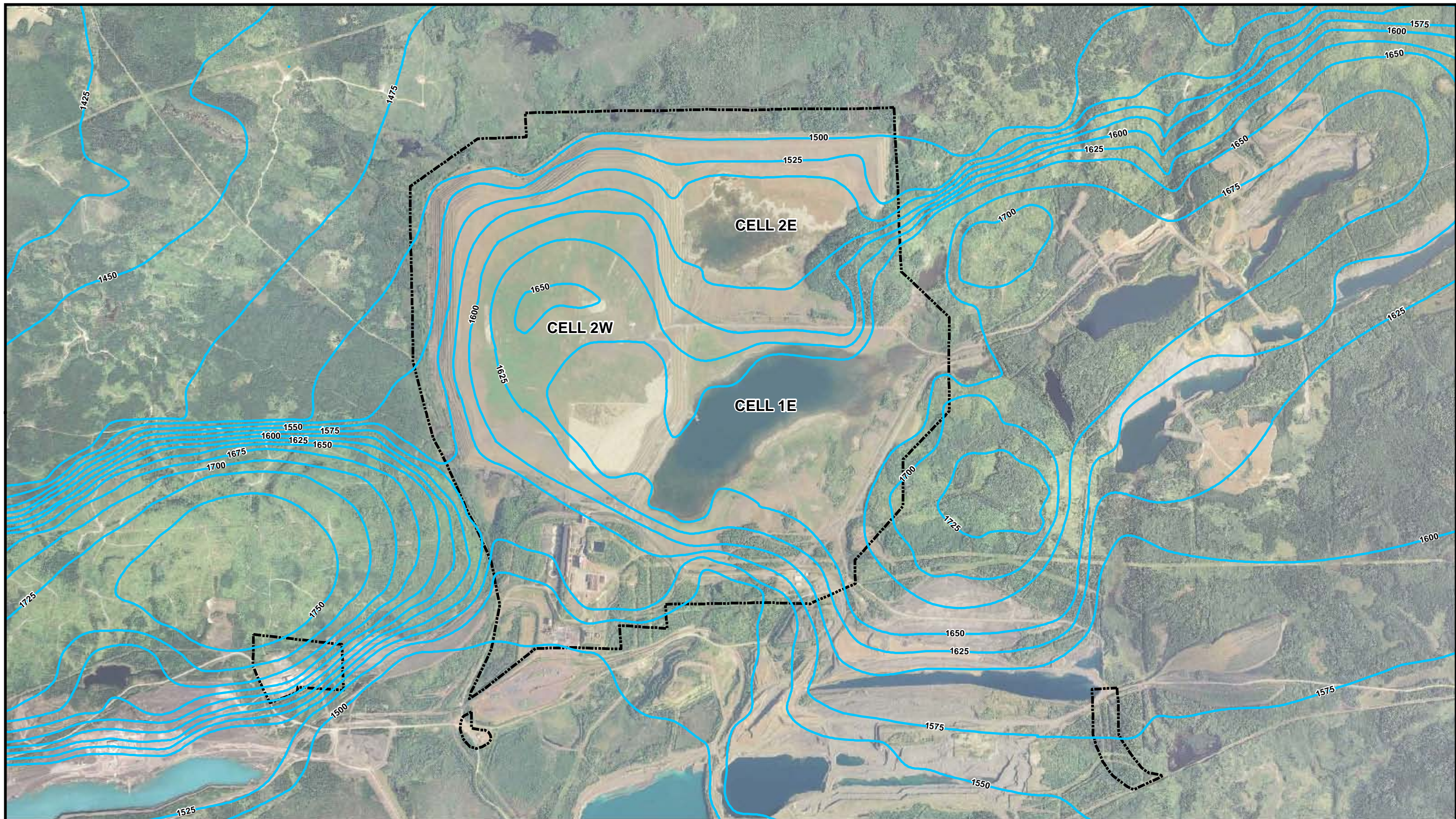


Figure 4.1-5
Depth to Bedrock at Tailings Basin Area


NorthMet Project
PolyMet Mining, Inc.
St. Louis County, Minnesota


October 2009



Basemap source: Barr Engineering

Groundwater contours based on modeling results presented in RS13, elevation data for surface water features, and data presented in Siegel and Ericson, 1980.

 Plant Site

 Groundwater Elevation
(Contour Interval = 25ft)
Elevations are in feet MSL

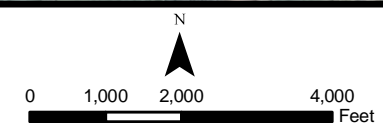
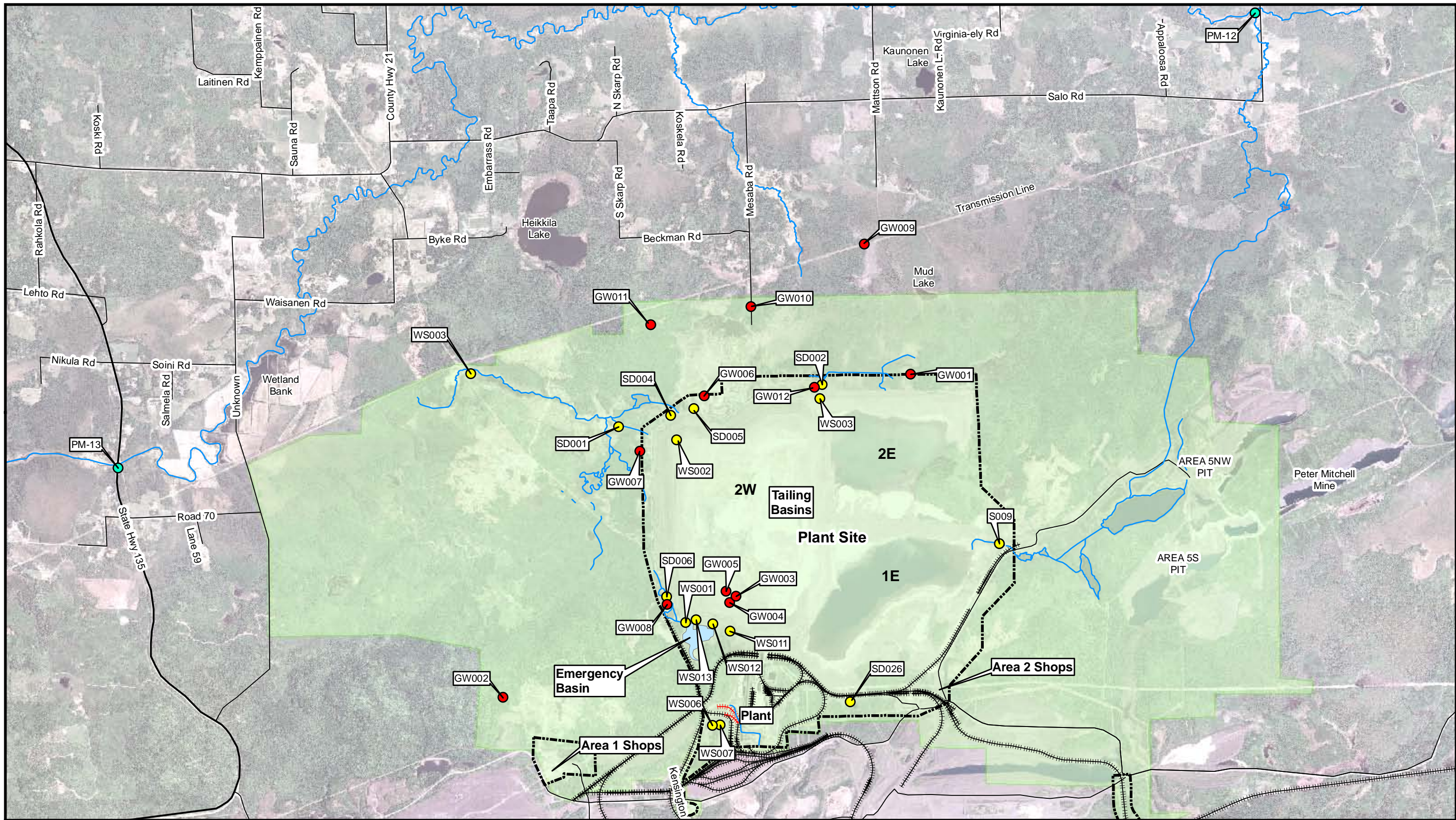


Figure 4.1-6
Generalized Groundwater Elevations at Plant Site

NorthMet Project
PolyMet Mining, Inc.
St. Louis County, Minnesota

October 2009



Basemap source: Barr Engineering

- | | | |
|---|--|--|
| ● NPDES Surface Discharge Monitoring Stations | — County Roads | Plant Site |
| ● Surface Water Monitoring Station (not NPDES) | — State/Federal Roads | Proposed PolyMet Land Control - Plant Site |
| ● Groundwater Monitoring Wells | — Dunka Road | Sample Designations: |
| — Rivers/Streams/Drains | + + + + + Existing Railroad | SD = Surface Discharge Sample |
| | + + + + + Proposed Railroad | S = Seep |
| | | WS = Waste Stream |
| | | GW = Groundwater Sample |

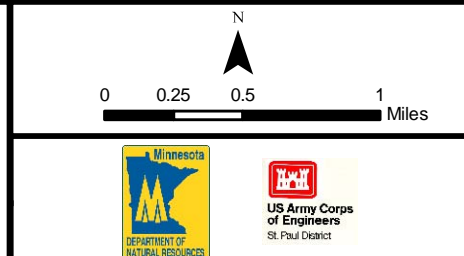
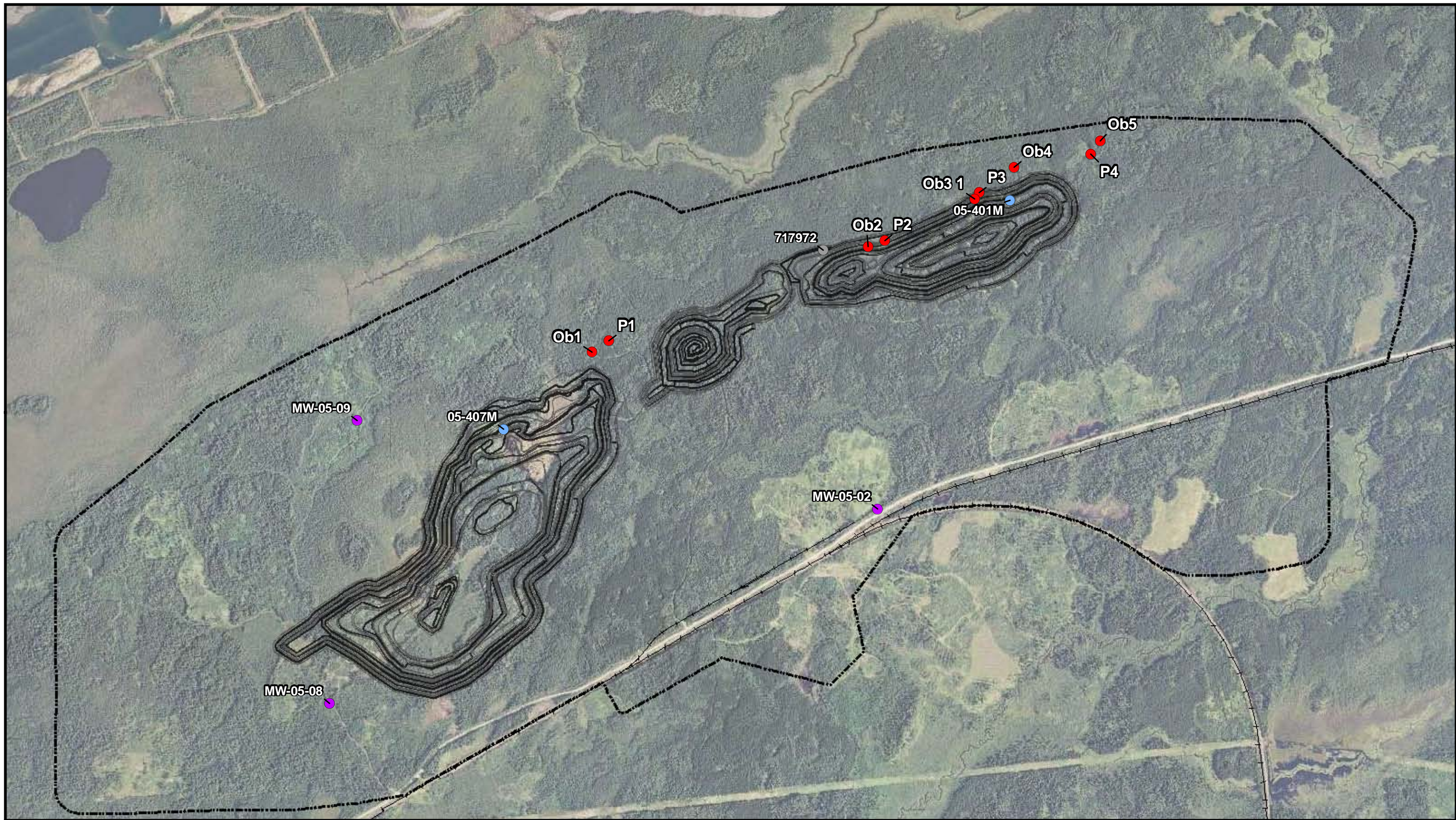


Figure 4.1-7
Monitoring Locations Near Existing
Tailings Basins
NorthMet Project
PolyMet Mining, Inc.
St. Louis County, Minnesota
October 2009



Map Image Source: Barr Engineering

- Bedrock Monitoring Well
- Exploratory Borehole
- Surficial Aquifer Monitoring Well
- Water Well
- Mine Site

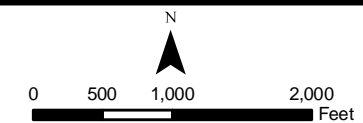
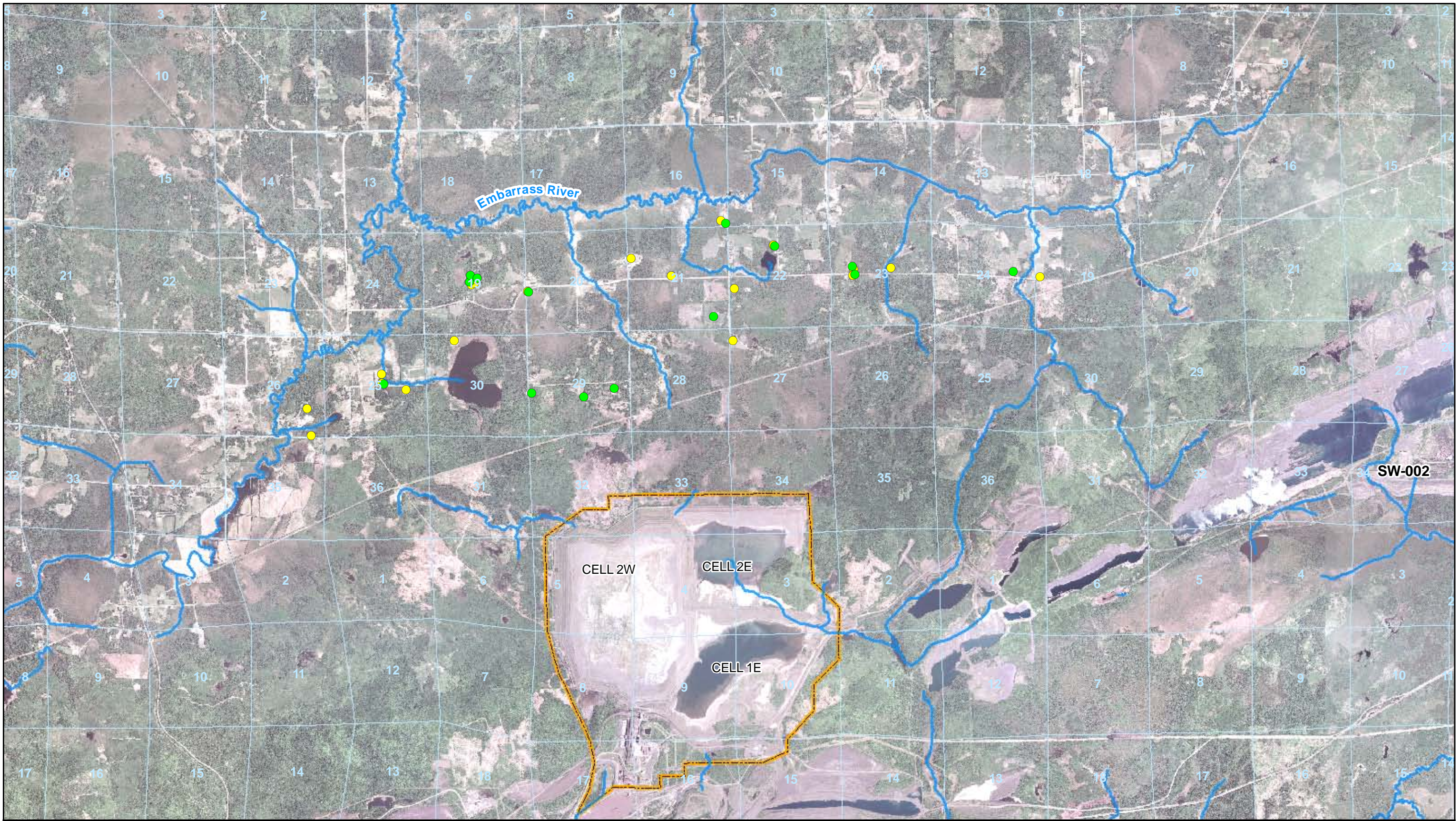


Figure 4.1-8
Groundwater Sampling Locations at the Mine Site

NorthMet Project
PolyMet Mining, Inc.
St. Louis County, Minnesota

October 2009



Map Source: Barr Engineering

- NorthMet Tailings Basin
- Residential Wells - Sampled
- River/stream
- Other Residential Wells - Not Sampled
- PLS sections

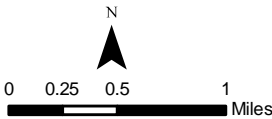
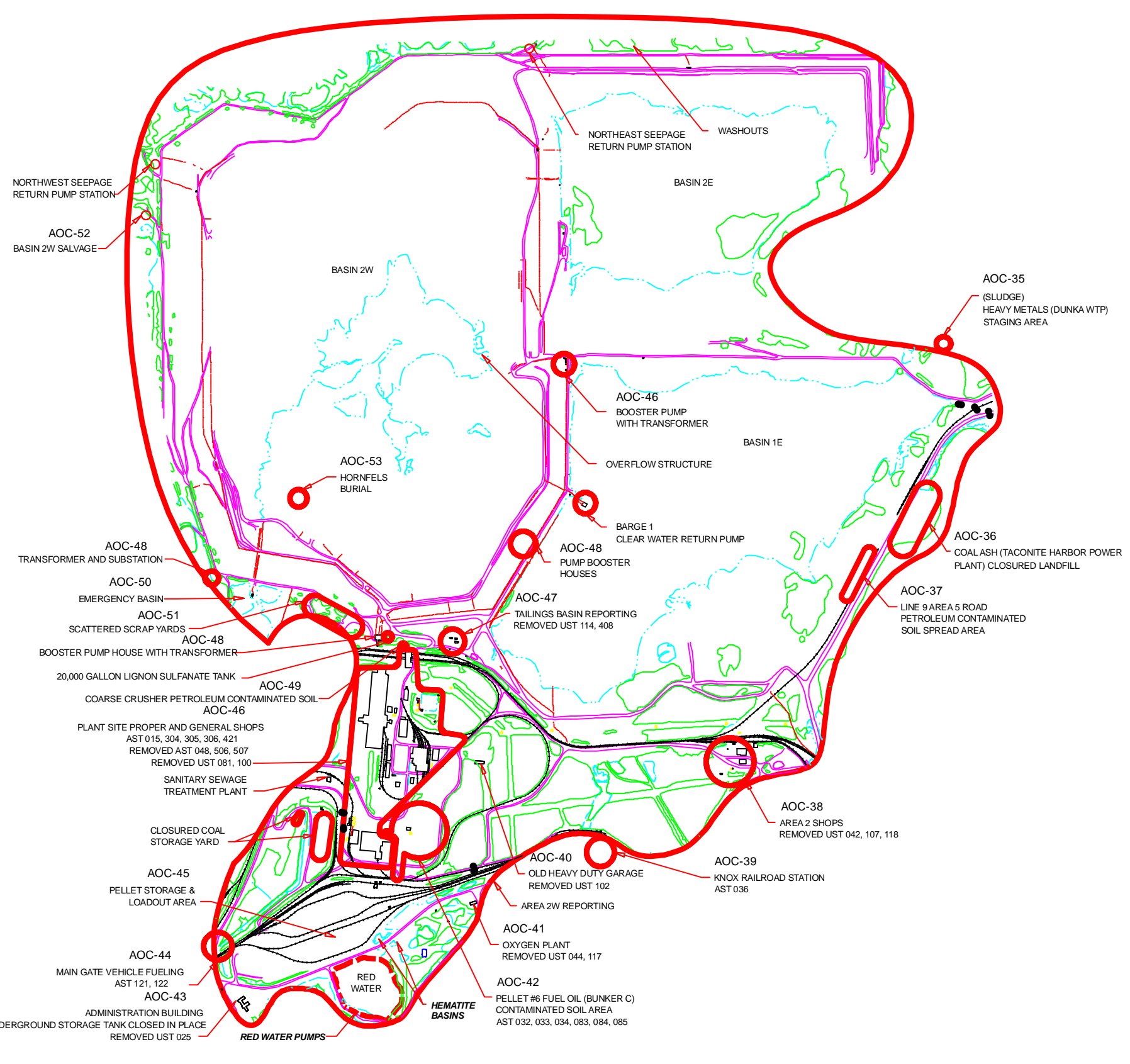


Figure 4.1-9
Residential Well Locations Between the
Tailings Basin and the Embarrass River
NorthMet Project
PolyMet Mining, Inc.
St. Louis County, Minnesota
October 2009



NOTE

HORIZONTAL AND VERTICAL CONTROL FURNISHED BY BENCHMARK ENGINEERING. MAP ACCURACY IS RELATED DIRECTLY TO THE CONTROL FURNISHED. THIS MAP HAS BEEN DESIGNED TO MEET NATIONAL MAP ACCURACY STANDARDS AT ITS ORIGINAL BASIC SCALE OF 1"=200' AND CONTOUR INTERVAL OF 5 FT. MARKHURD'S LIABILITY FOR ANY INACCURACIES FOUND IN THIS MAP SHALL BE LIMITED TO THE CORRECTION OF ANY SUCH INACCURACIES FOUND DUE TO THE PHOTOGRAMMETRIC PROCESS, AND SHALL NOT EXCEED THE CONTRACT VALUE OF THE MAP. IT IS THE RESPONSIBILITY OF THE MAP USER TO ASCERTAIN WHETHER OR NOT THE ABOVE SCALE, CONTOUR INTERVAL AND ACCURACY ARE SATISFACTORY FOR WHATEVER PURPOSE THE MAP IS TO BE USED.

CONTOUR INTERVAL = 5 FEET

TOPOGRAPHY BY PHOTOGRAMMETRIC METHODS FROM AERIAL PHOTOGRAPHS TAKEN ON MAY 18, 2001.

HORIZONTAL DATUM IS MINNESOTA STATE PLANE 27, NORTH ZONE 2201.

VERTICAL DATUM IS NGVD 29, U.S. SURVEY FOOT. GRID SHOWN AT A 1000 FOOT INTERVAL.

- LEGEND**
- RAILROAD TRACKS
 - ROAD
 - ROAD UNDER-CONSTRUCTION
 - DRAIN OR SHORELINE
 - SWAMP
 - PIPELINE
 - FOUNDATION OR SLAB
 - WOODS OUTLINE
 - CULVERT
 - END OF CULVERT

Basemap source: Barr Engineering

N

Not to Scale



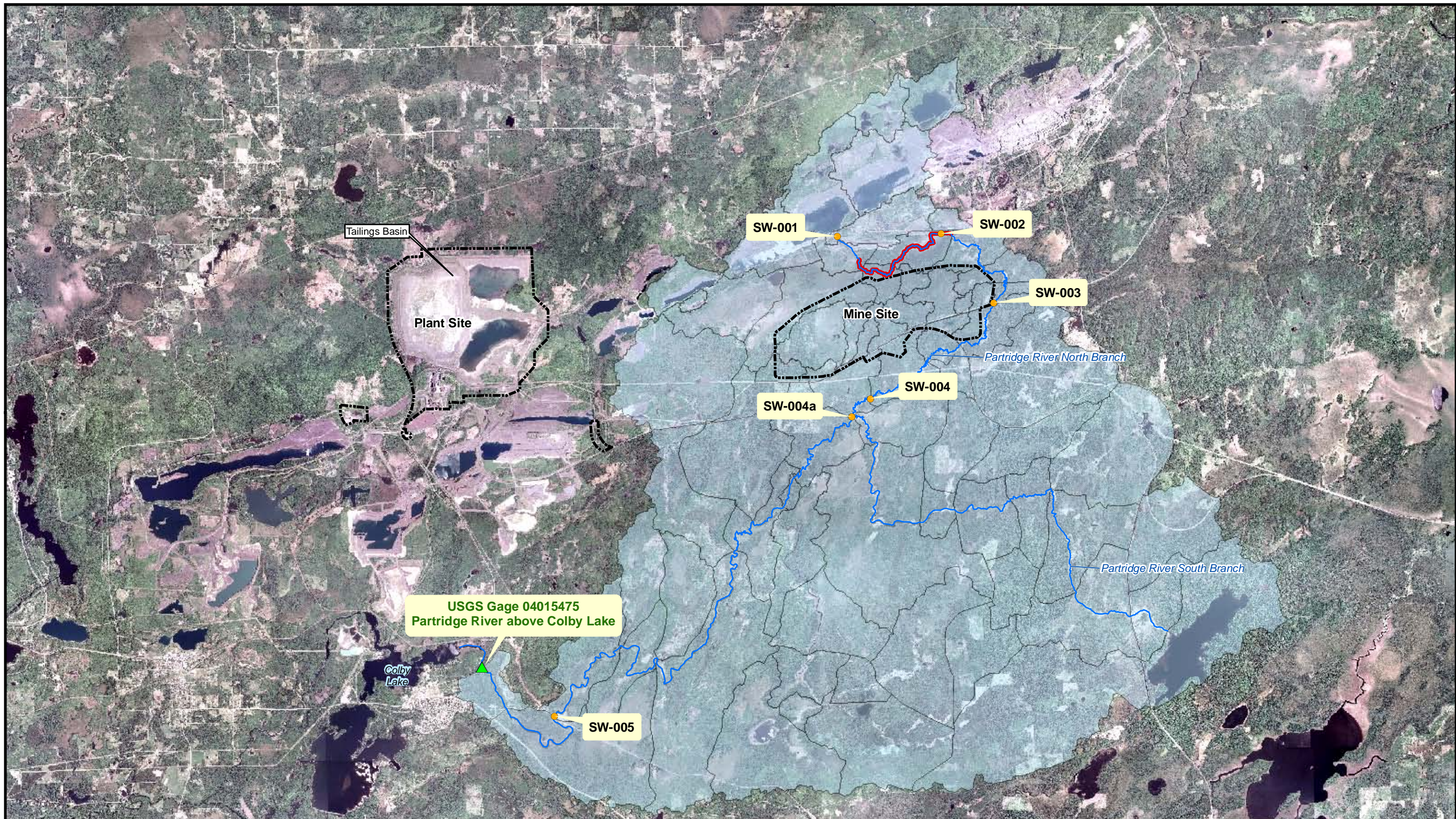


Figure 4.1-10
Plant Site Areas of Concern

NorthMet Project
PolyMet Mining, Inc.
St. Louis County, Minnesota

October 2009



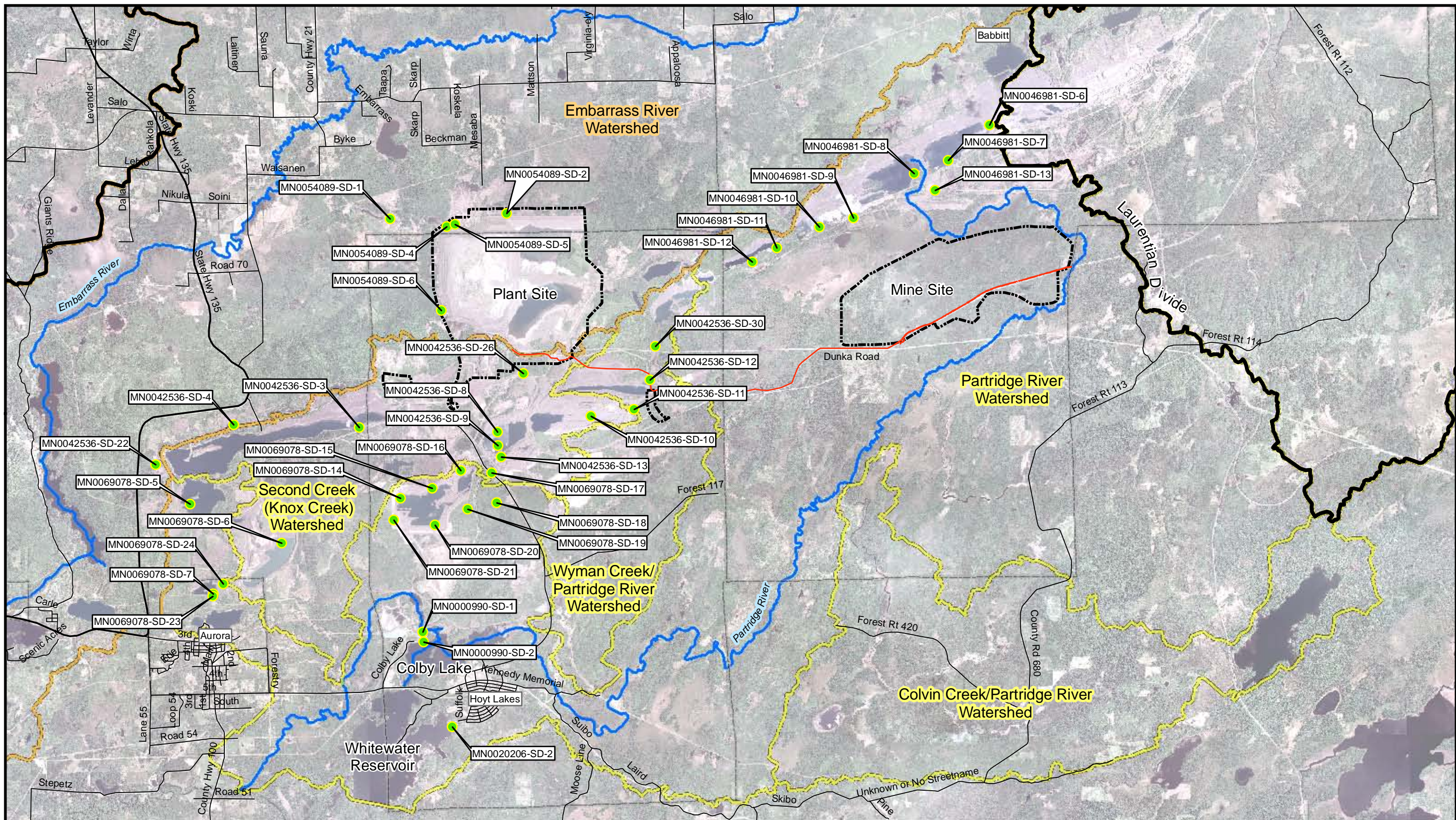
Basemap source: Barr Engineering

- Surface Water Monitoring Stations
- ▲ USGS Gage Stations
- Rivers/Streams
- Area of Streambank Erosion/Channel Widening
- Watersheds - Existing Conditions



Figure 4.1-11
**Locations of Surface Water Modeling/
 Monitoring Stations in the Partridge River**
 NorthMet Project
 PolyMet Mining, Inc.
 St. Louis County, Minnesota

October 2009



Basemap source: Barr Engineering

- MPCA Water Quality Stations or NPDES Discharge Points
- Rivers/Streams
- Dunka Road
- County Roads
- Site Boundaries
- Partridge River Watershed
- Embarrass River Watershed

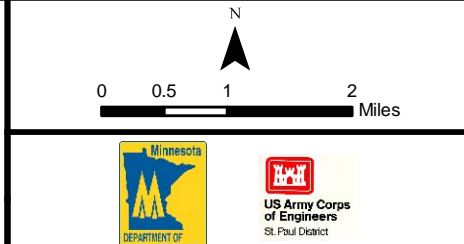
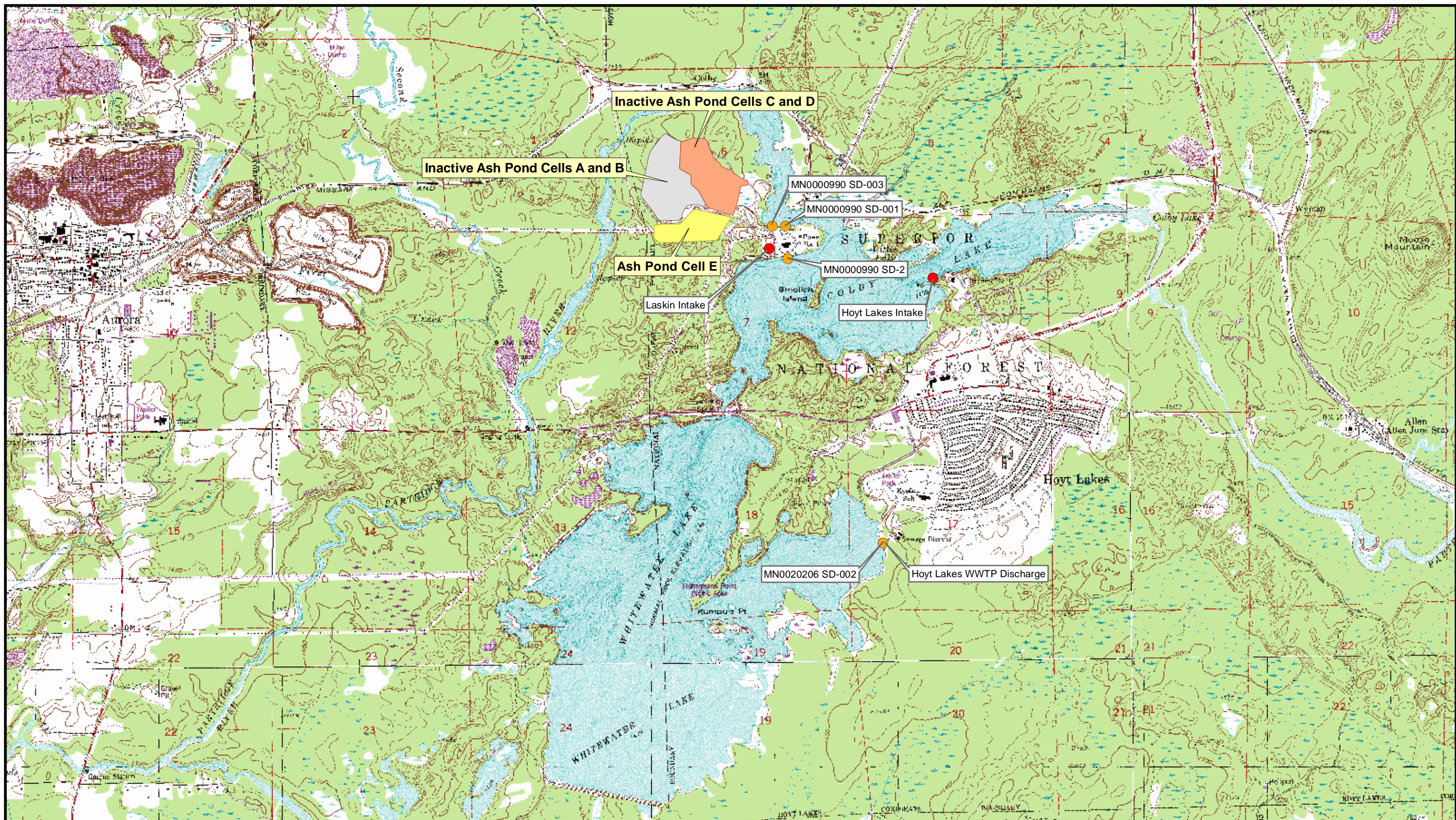


Figure 4.1-12
Past and Current NPDES Discharges into the
Partridge and Embarrass Rivers
NorthMet Project
PolyMet Mining, Inc.
St. Louis County, Minnesota
October 2009



Map Source: Barr Engineering

- Water Withdrawals from Colby Lake
- MPCA Water Quality Stations 2006/
Discharges to Surface Waters
NPDES Discharges

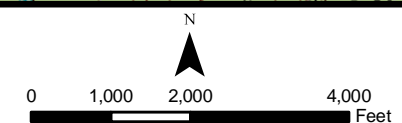
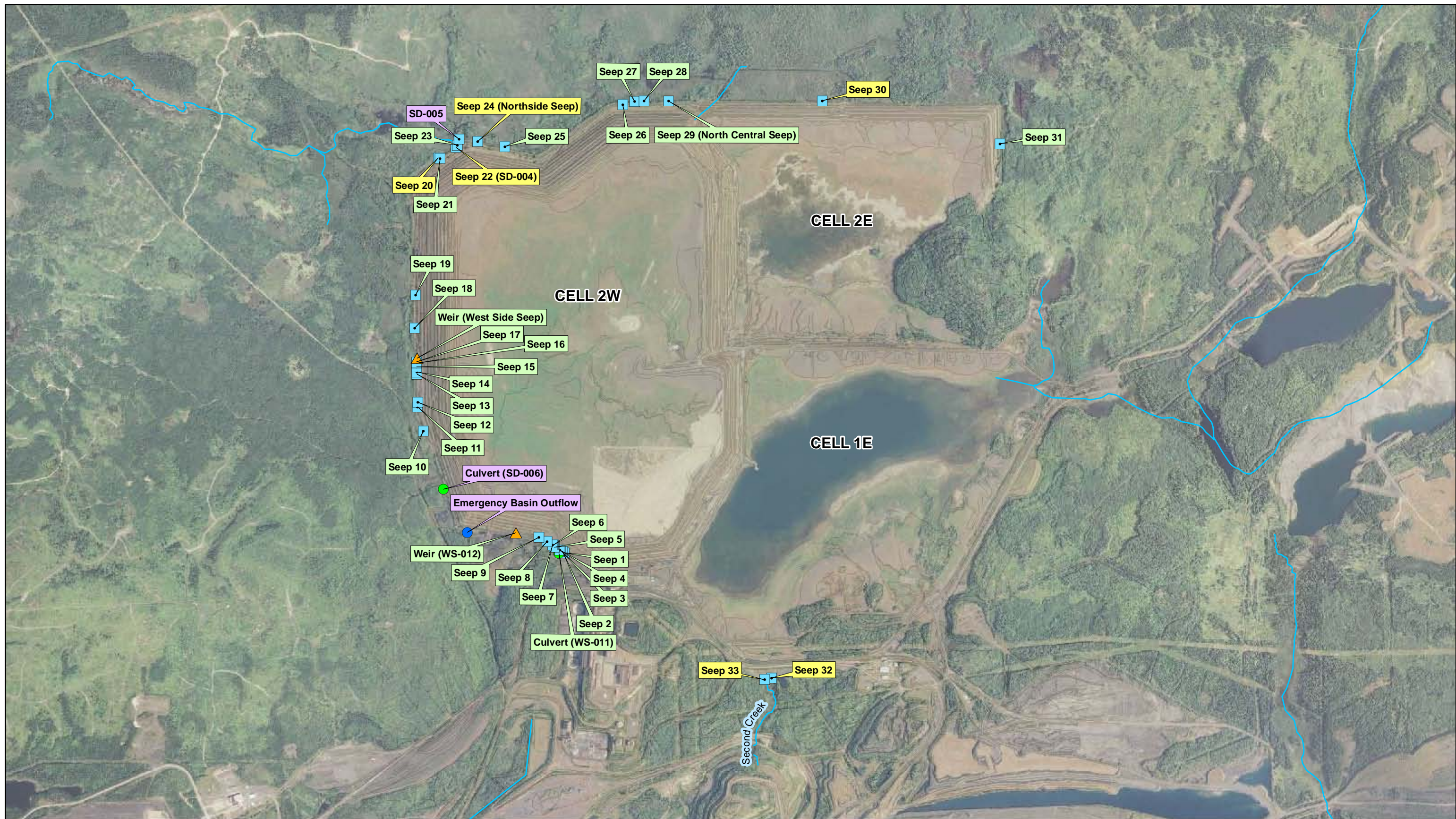


Figure 4.1-13
Map of Colby Lake and Whitewater
Reservoir Area
 NorthMet Project
 PolyMet Mining, Inc.
 St. Louis County, Minnesota

October 2009



Map/Data Source: Barr Engineering

Historical Seeps

- | | |
|--|--|
| ● Culvert | Seep Surface Discharge |
| ● Emergency Basin Outflow | Seep Flow Not Measurable or No Flow |
| ■ Seeps | Seep Active Seep |
| ▲ Weirs | |
| — Streams | |

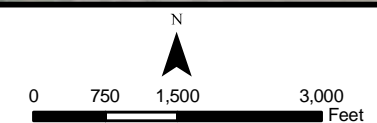
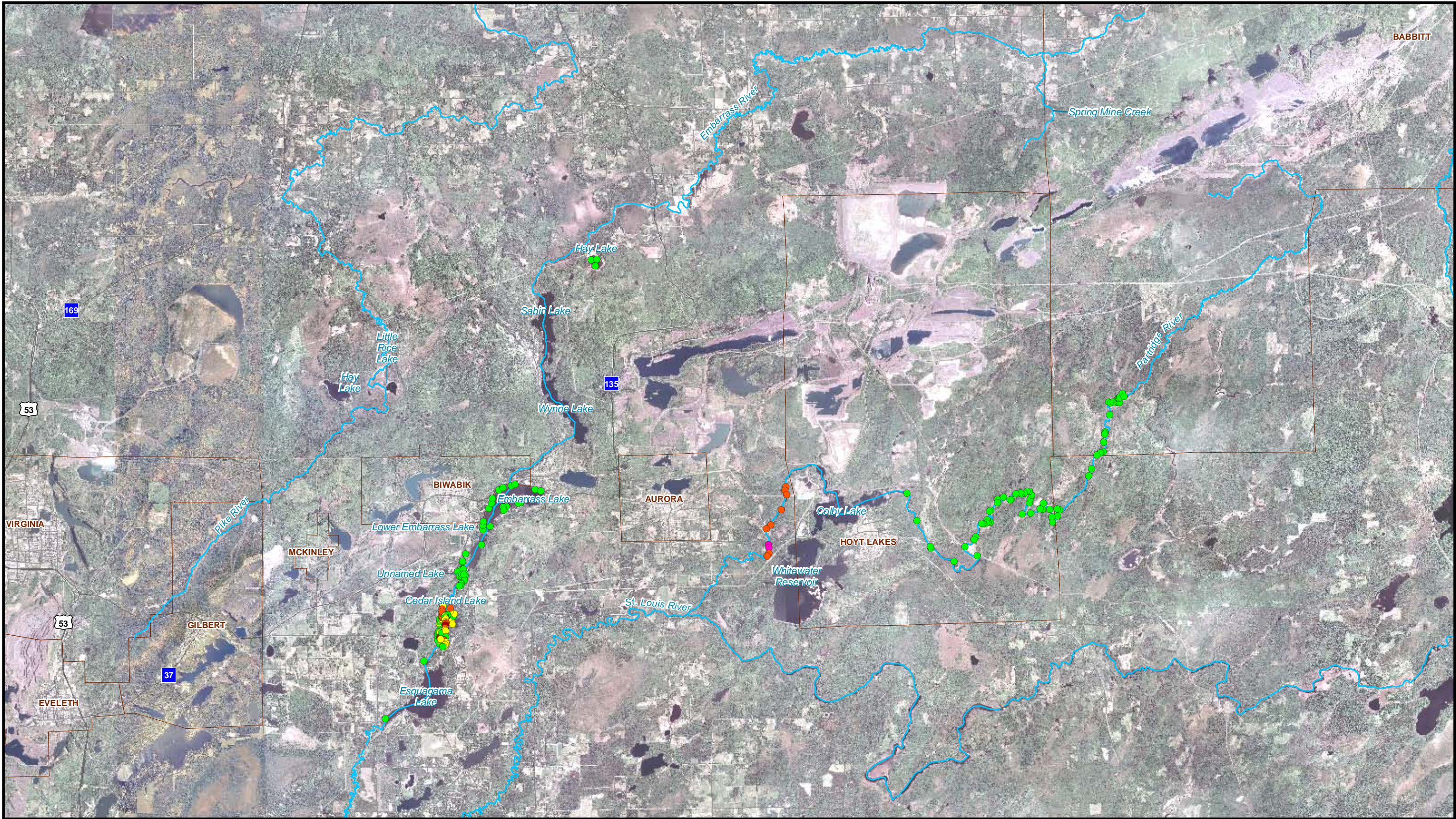


Figure 4.1-14 Seep Locations

NorthMet Project
PolyMet Mining, Inc.
St. Louis County, Minnesota

October 2009



Map/Data Source: Barr Engineering

Rivers and Streams

City Boundaries

●

1 < 10% Wild Rice Coverage

●

2

●

3

●

4

●

5 > 75% Wild Rice Coverage

N

00.751.53

Miles

Minnesota

DEPARTMENT OF NATURAL RESOURCES

US Army Corps of Engineers

St. Paul District

Figure 4.1-15

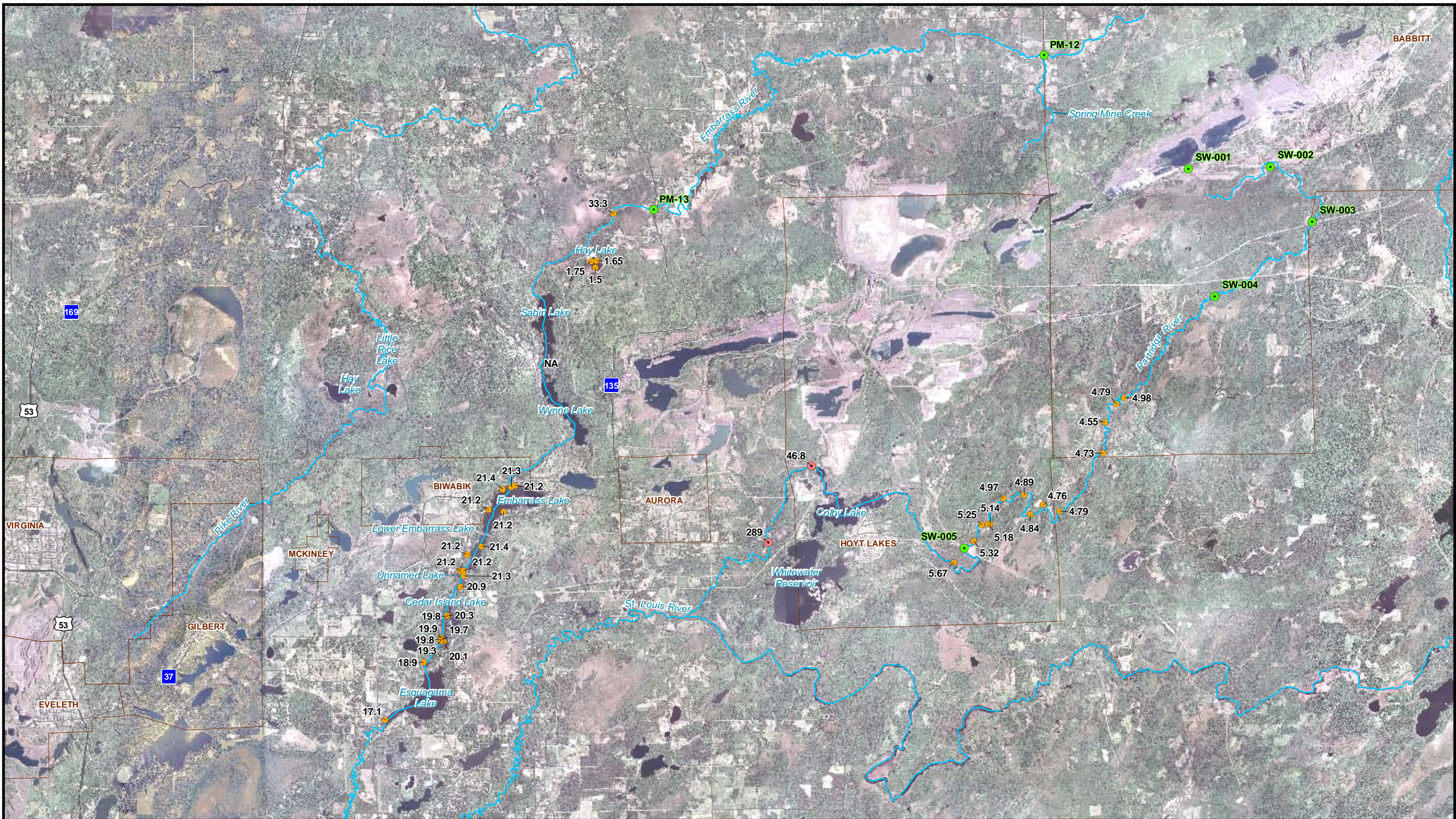
Wild Rice Field Survey Results

NorthMet Project

PolyMet Mining, Inc.

St. Louis County, Minnesota

October 2009



Map/Data Source: Barr Engineering

- Surface Water Monitoring Stations
- 2009 Sulfate Sampling Locations with Sulfate Listed in mg/L
- Mesabi Nugget Surface Water Monitoring Data - Aug. 19, 2009
- Rivers and Streams
- City Boundaries

N

0 0.75 1.5 3 Miles

Figure 4.1-16
Wild Rice and Sulfate Sampling Locations

NorthMet Project
 PolyMet Mining, Inc.
 St. Louis County, Minnesota

October 2009

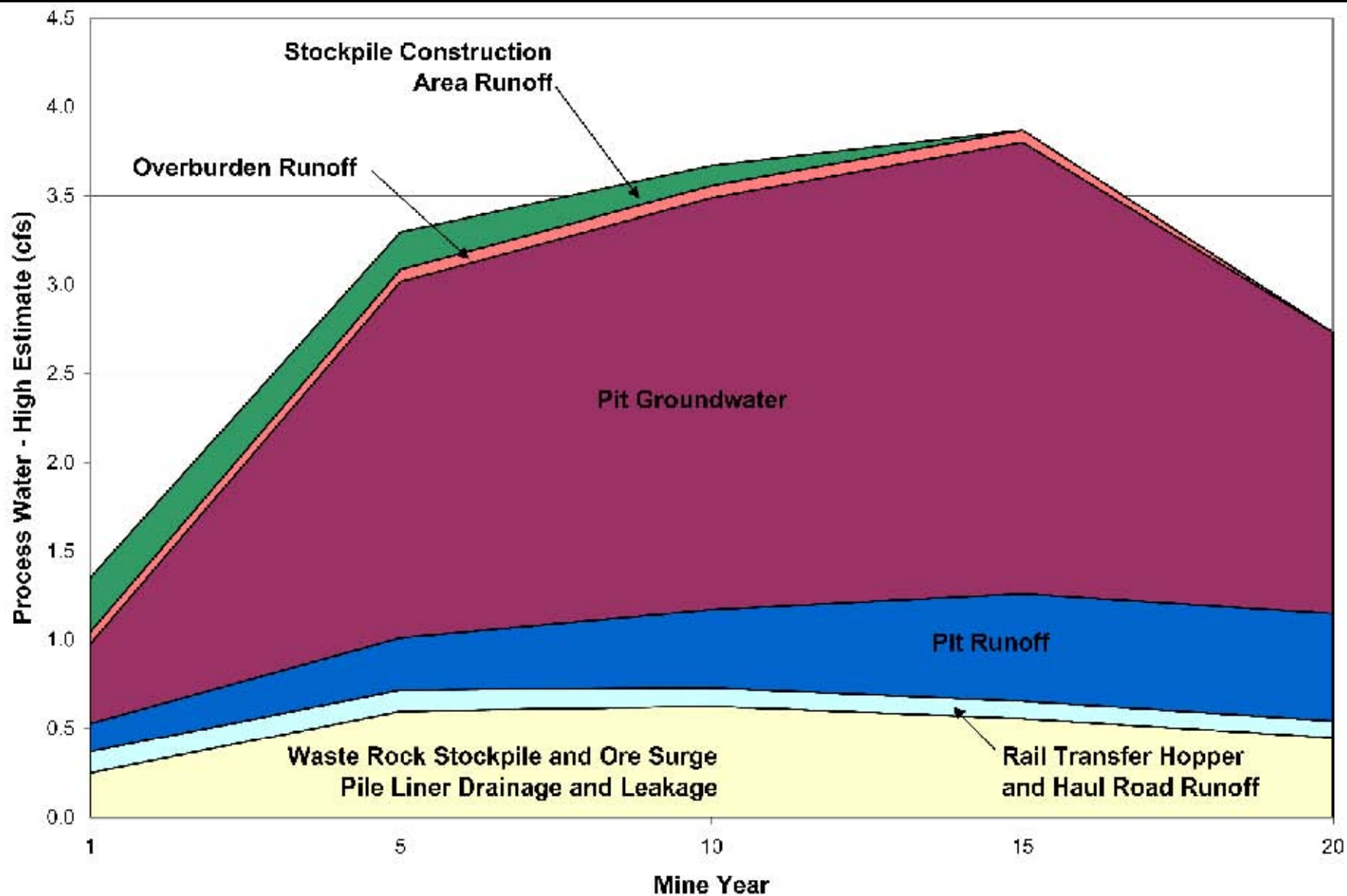
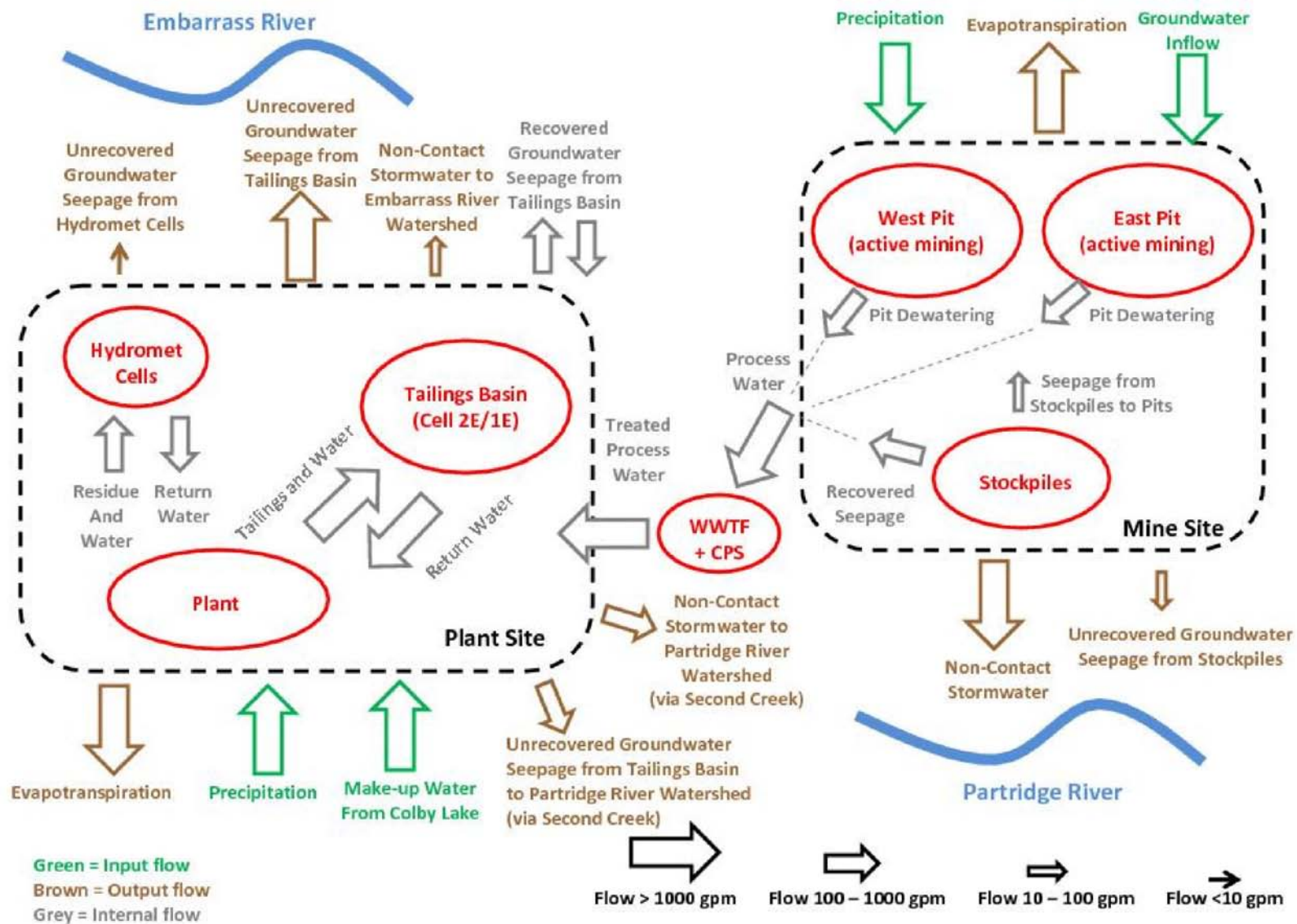


Image Source: Barr Engineering



Figure 4.1-17
Process Water Produced at Mine Site
(Proposed Action)
 NorthMet Project
 PolyMet Mining, Inc.
 St. Louis County, Minnesota

October 2009



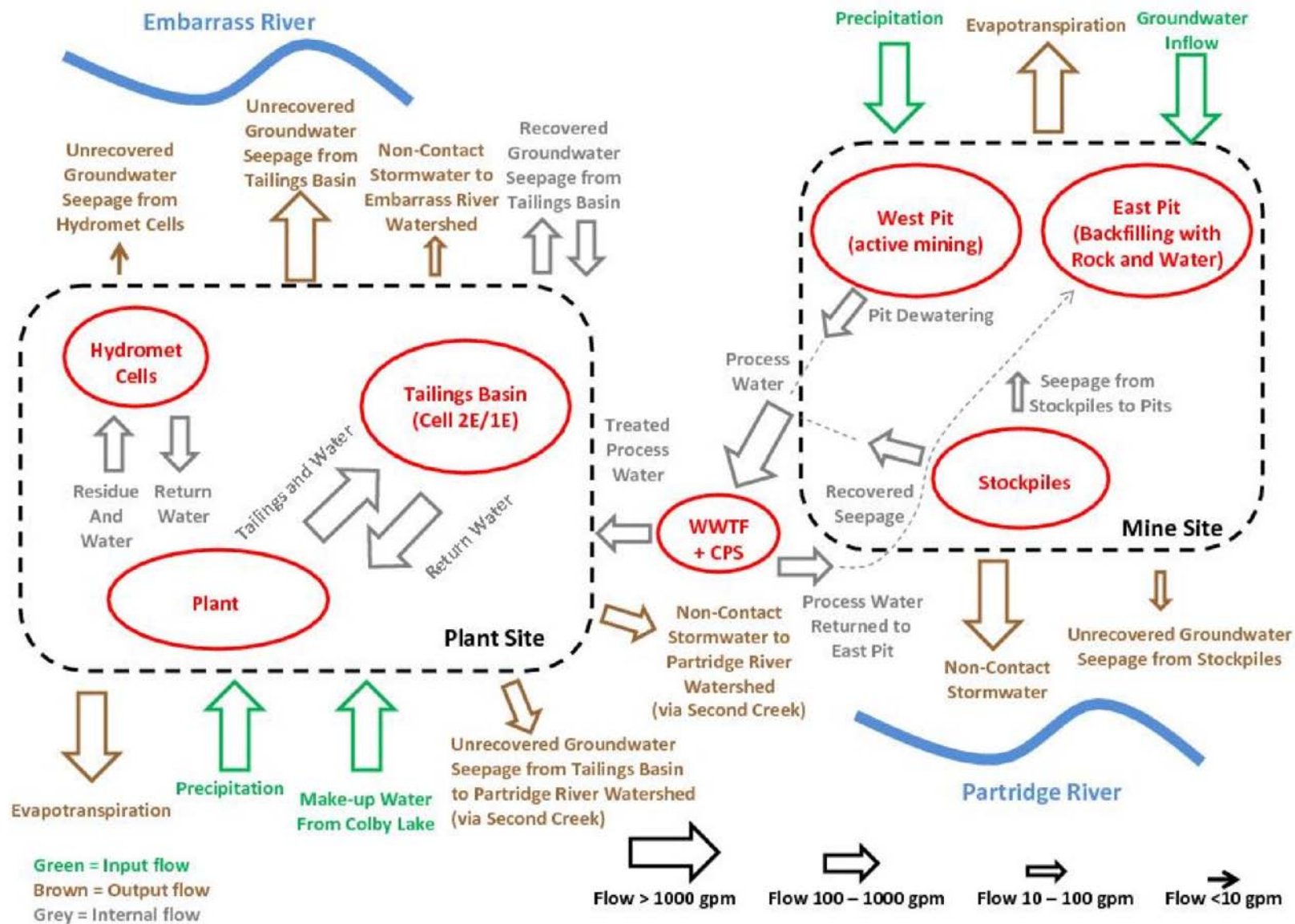
Information Source: Barr Engineering

No Scale Applicable



Figure 4.1-18
Estimated Project Water Balance
Years 1-11 (Proposed Action)
 NorthMet Project
 PolyMet Mining, Inc.
 St. Louis County, Minnesota

October 2009



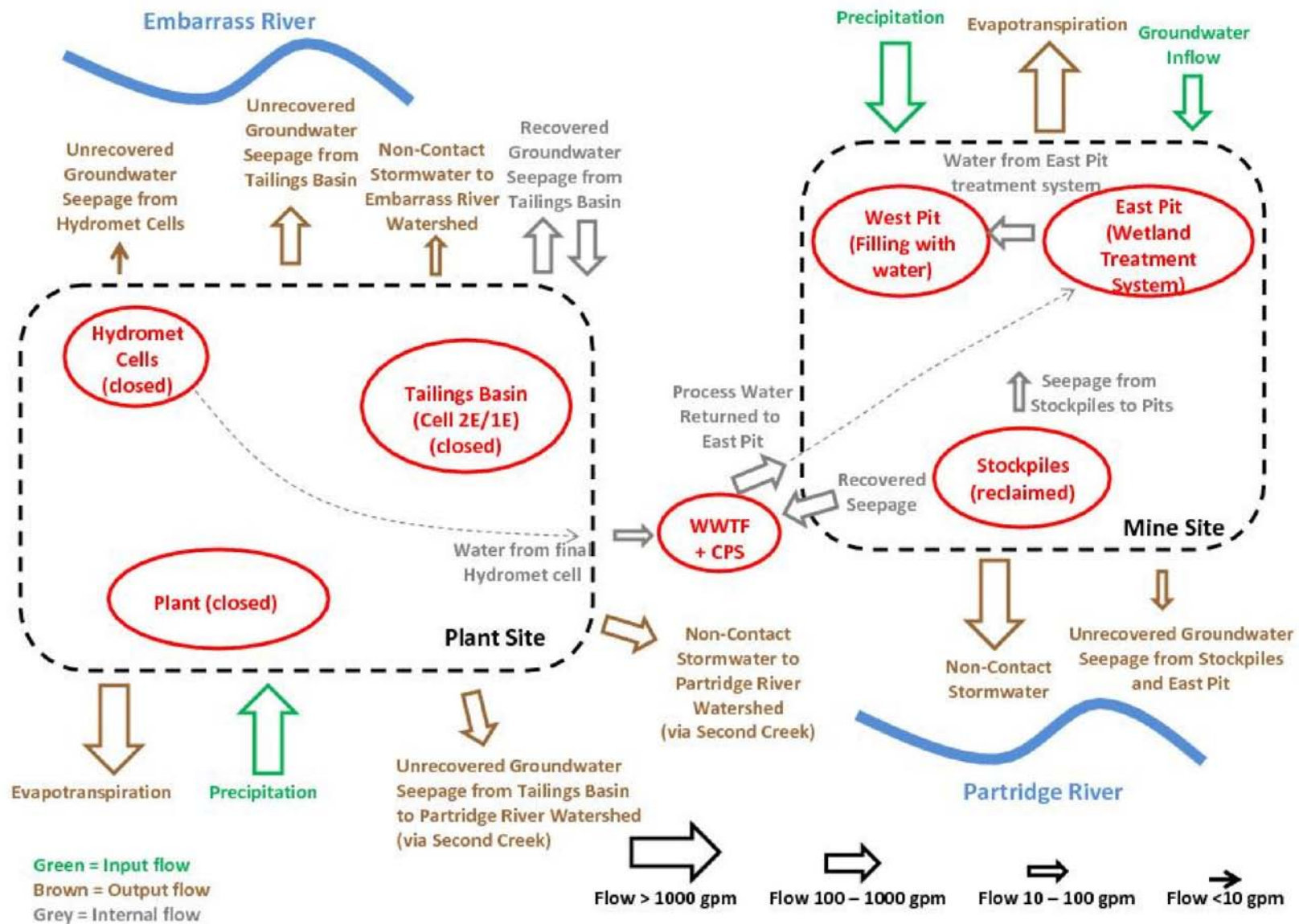
Information Source: Barr Engineering

No Scale Applicable



Figure 4.1-19
Estimated Project Water Balance
Years 12-20 (Proposed Action)
NorthMet Project
PolyMet Mining, Inc.
St. Louis County, Minnesota

October 2009



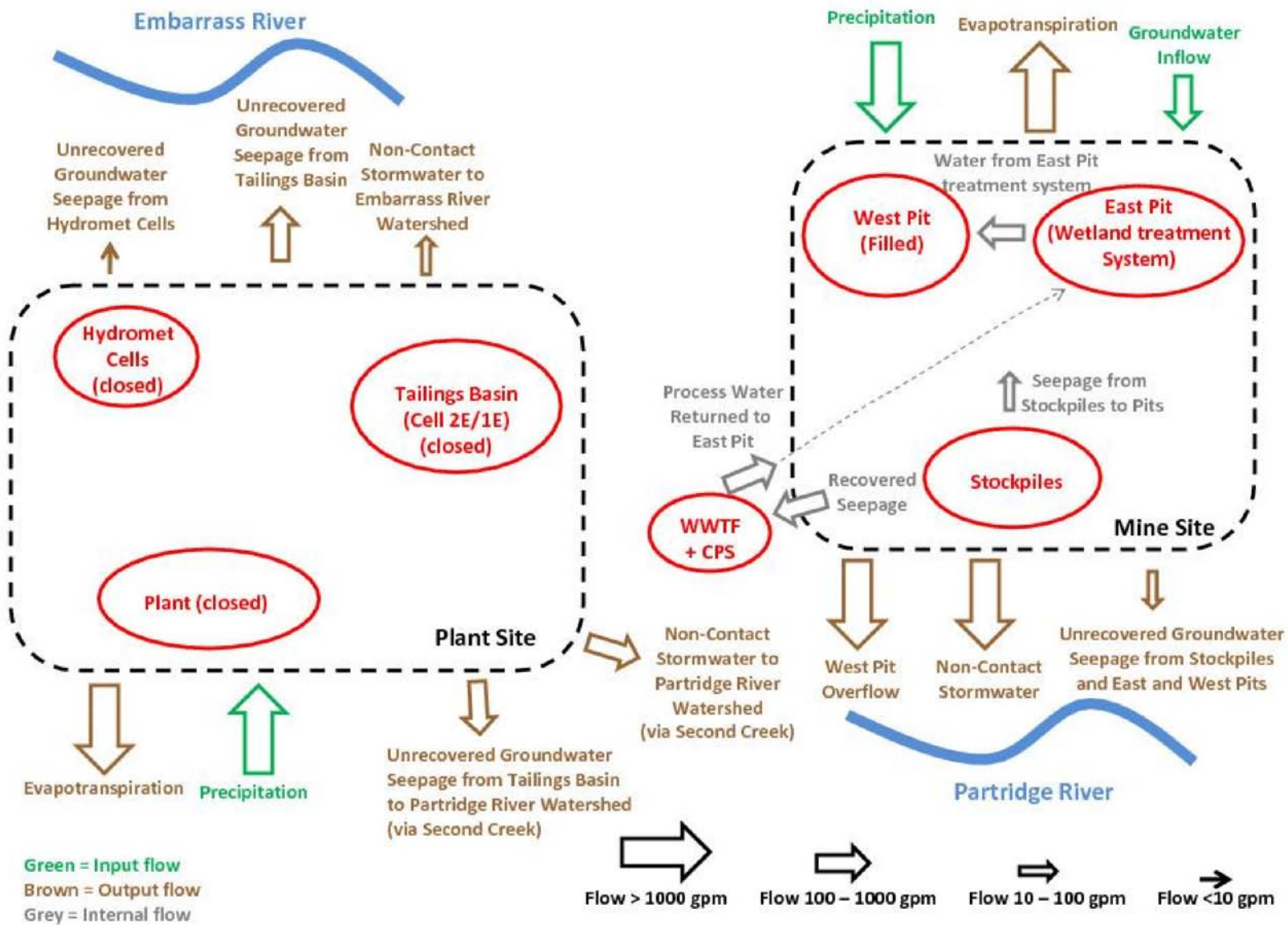
Information Source: Barr Engineering

No Scale Applicable



Figure 4.1-20
Estimated Project Water Balance
Years 21- Approx. 65 (Proposed Action)
NorthMet Project
PolyMet Mining, Inc.
St. Louis County, Minnesota

October 2009



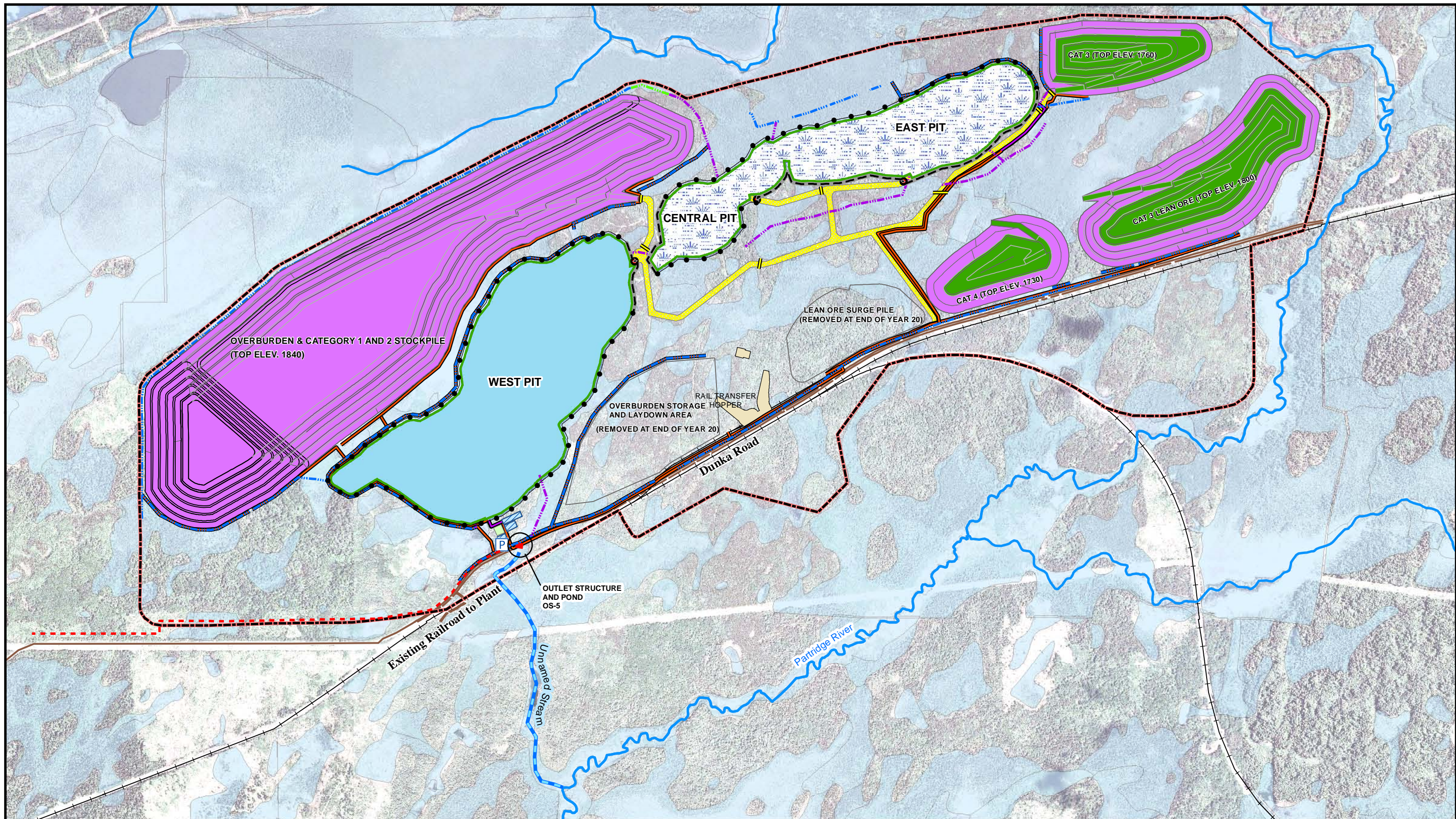
Information Source: Barr Engineering

No Scale Applicable



Figure 4.1-21
Estimated Project Water Balance
After Approx. Year 65 (Proposed Action)
 NorthMet Project
 PolyMet Mining, Inc.
 St. Louis County, Minnesota

October 2009



Map Source: Barr Engineering

Culverts to Remain	Modified Ditch	Cover and Revegetation of Building Areas	Wetland Delineations
13.8KV Mine Powerline to Remain	New Ditch	Haul Roads to Remain	Equilization Ponds
Fencing Gates	Ditch to Remain Open	Year 20 Reclamation Area	Wastewater Treatment Facility
Barbed Wire Fencing	New Pipe	Previously Reclaimed Areas	Central Pumping Station
Non-Climbable Fencing	Pipes to Remain	East and Central Pits -Treatment Wetland	
West Pit Drainage Channel	Mine Site	West Pit - Lake	

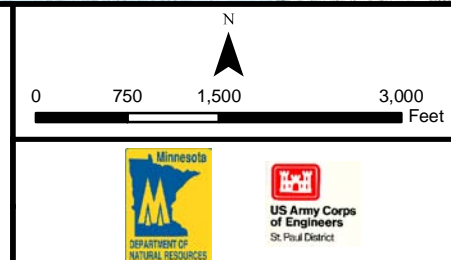
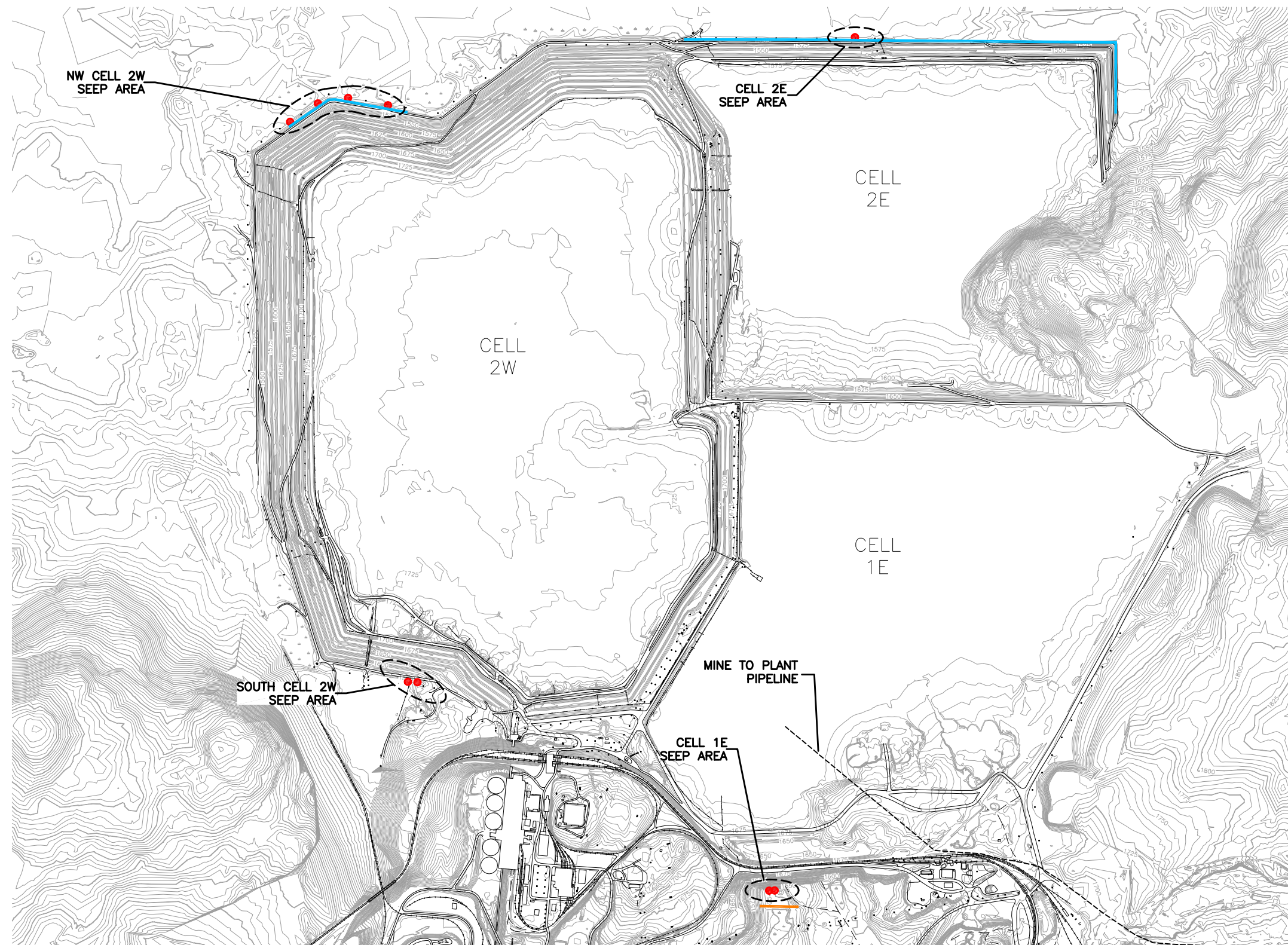


Figure 4.1-22
West Pit Overflow to Partridge River
(Proposed Action)
 NorthMet Project
 PolyMet Mining, Inc.
 St. Louis County, Minnesota
 October 2009



- SEEP LOCATIONS
- EXISTING 25' MAJOR CONTOUR
- EXISTING 5' MINOR CONTOUR
- SEEPAGE COLLECTION SYSTEM
- SEEPAGE BARRIER

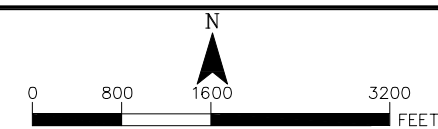
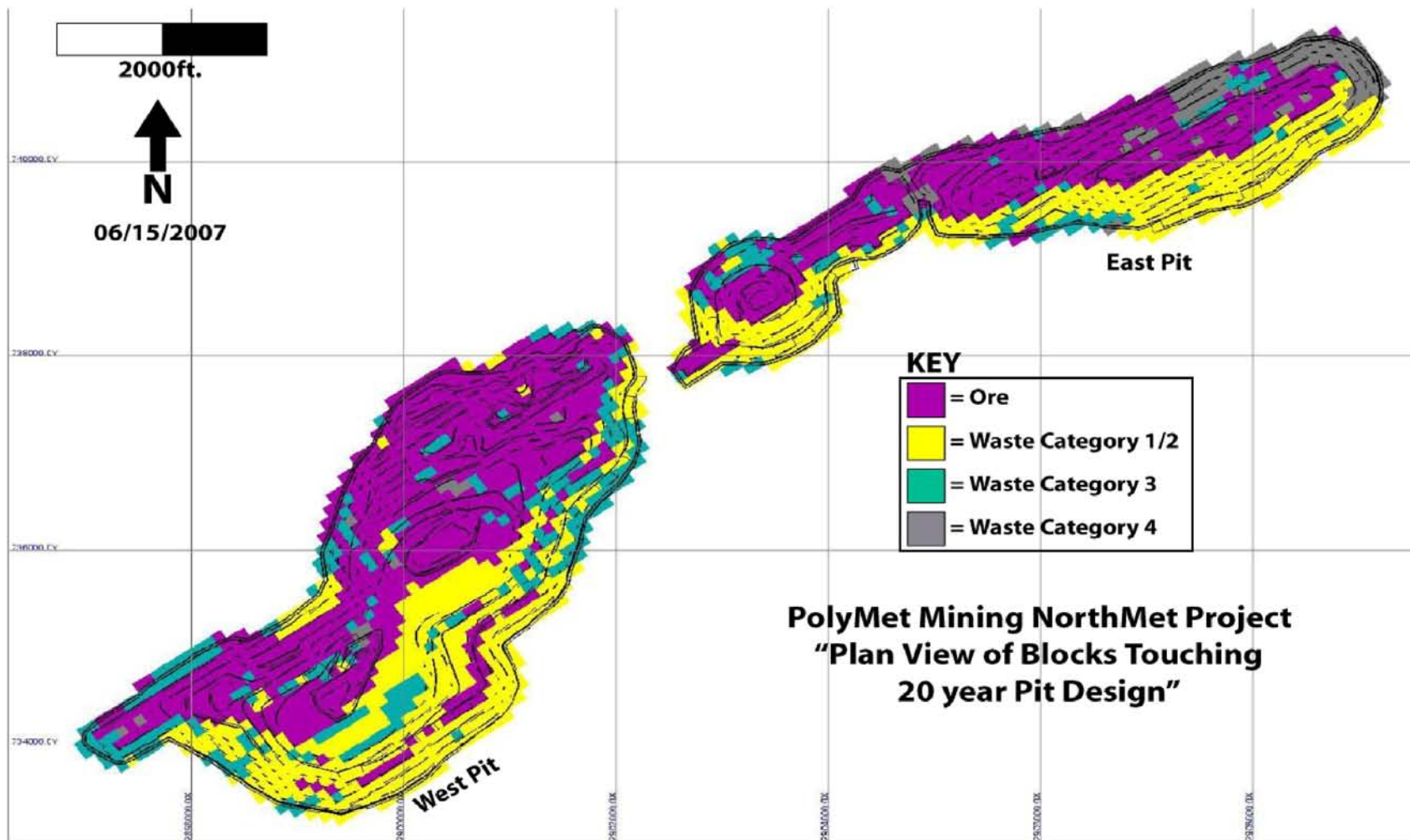


Figure 4.1-23
Tailings Basin Seepage Collection
System (Proposed Action)
 NorthMet Project
 PolyMet Mining, Inc.
 St. Louis County, Minnesota
 October 2009

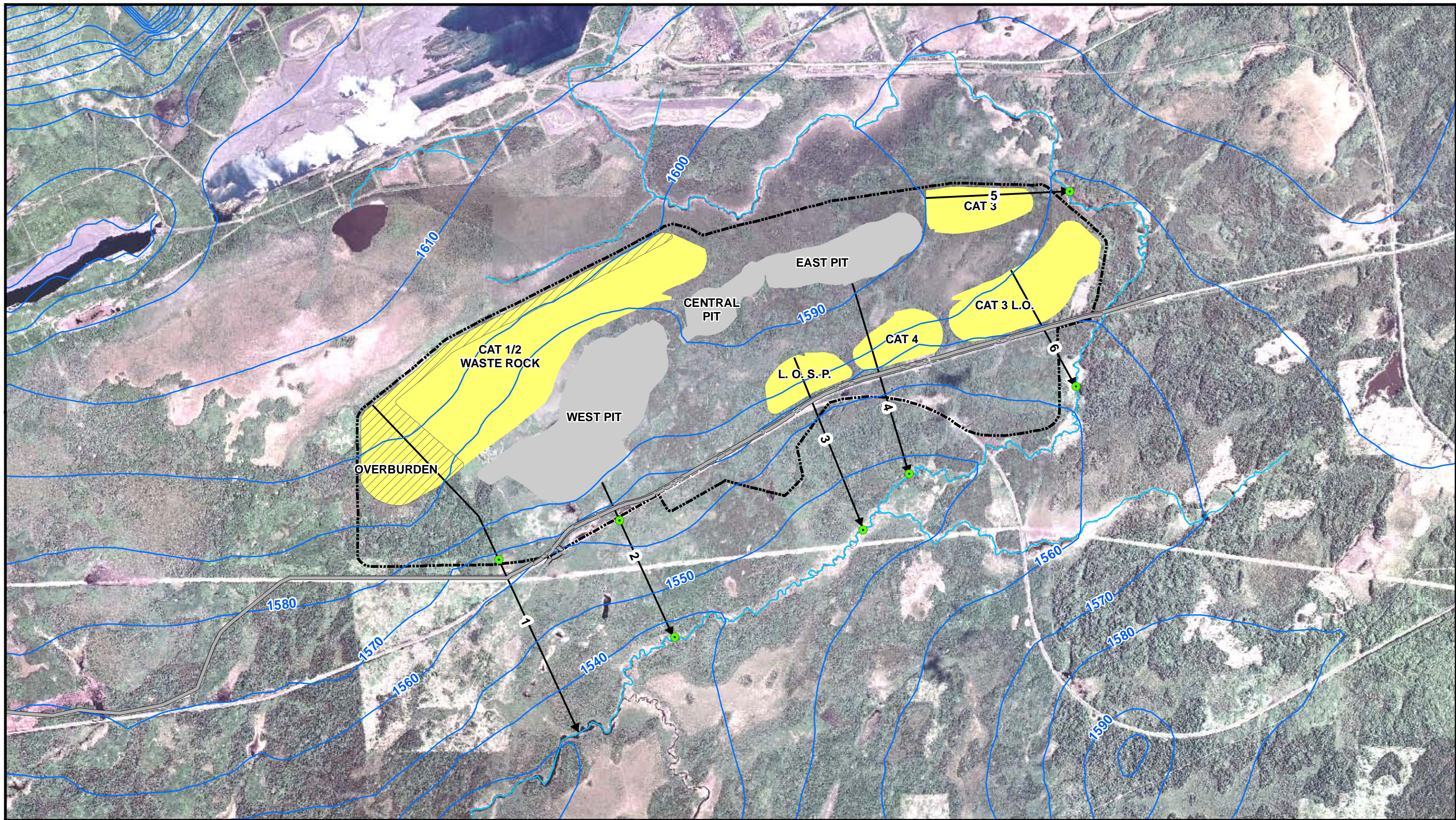


Source: SRK Consulting



Figure 4.1-24
Composition of the Final Pit Walls Predicted
by Block Modeling (Provided by PolyMet)
NorthMet Project
PolyMet Mining, Inc.
St. Louis County, Minnesota

October 2009



Map/Data Source: Barr Engineering

- Groundwater Evaluation Points
- ➔ Groundwater Flow Path
- Head Contour (ft) at Closure
Contour Interval = 10 ft
- Partridge River
- Mine Site
- Stockpile Footprints - Year 20
- Mine Pit Footprints - Year 20
- Overburden (Top Elev. 1840)
- Dunka Road

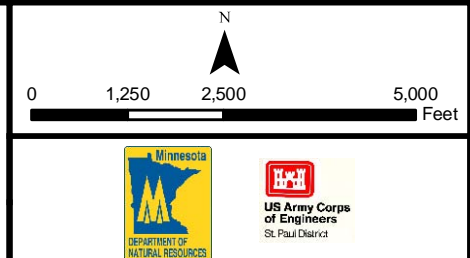
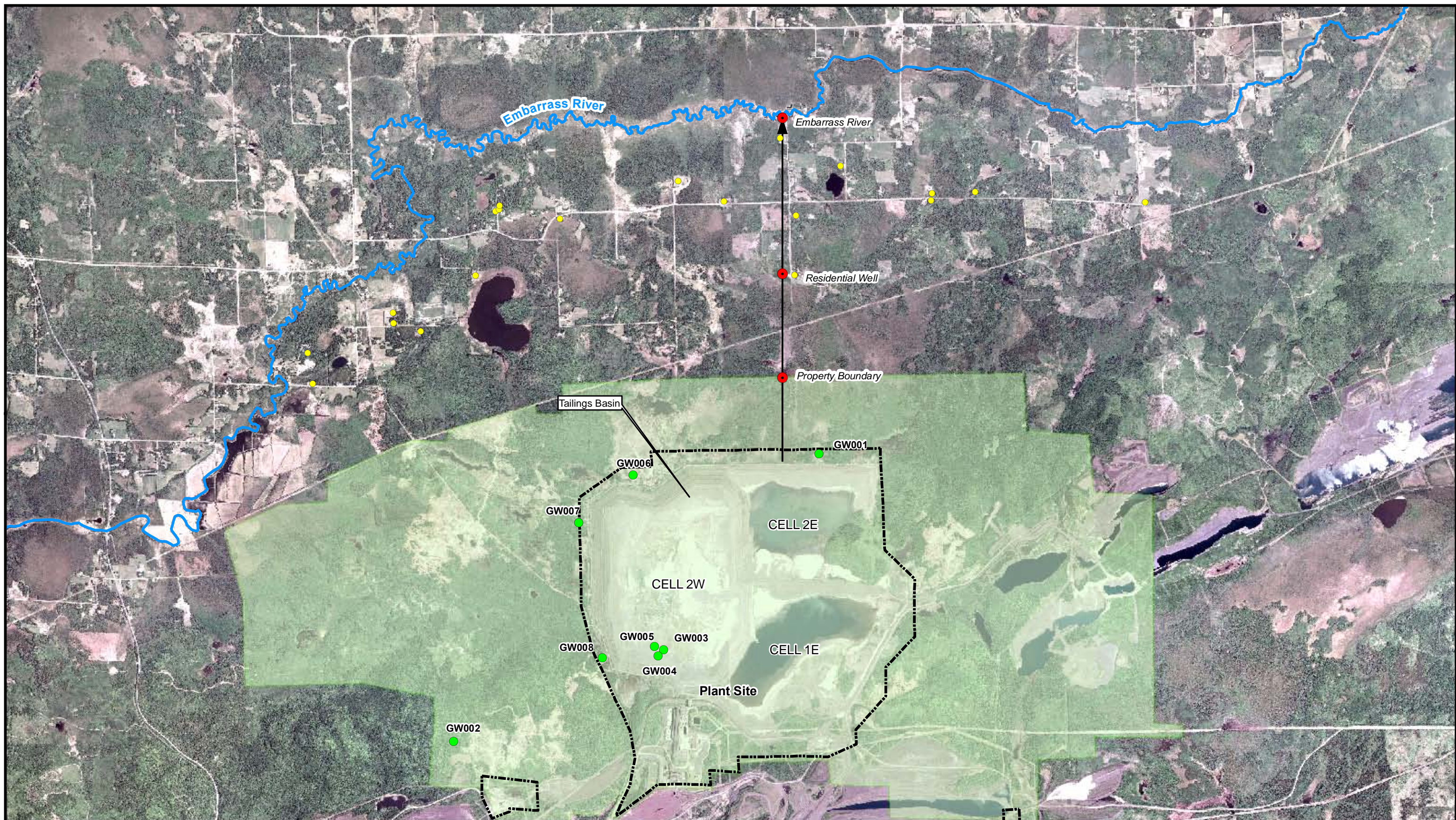


Figure 4.1-25
Flow Paths for Groundwater Evaluation
(Proposed Action) - Mine Site
 NorthMet Project
 PolyMet Mining, Inc.
 St. Louis County, Minnesota

October 2009



Map/Data Source: Barr Engineering

- Existing Monitoring Well
- Domestic Well
- Evaluation Location
- Evaluation Flow Path
- Embarrass River
- Plant Site
- Proposed PolyMet Land Control - Plant Site

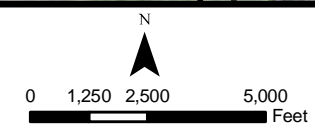


Figure 4.1-26
Flow Path for Groundwater Evaluation
(Proposed Action) – Plant Site
 NorthMet Project
 PolyMet Mining, Inc.
 St. Louis County, Minnesota

October 2009



Data Provided by: Barr Engineering

- Average Water Level, 50 Year Low Flow, 0 gpm Demand (1439.2')
- Minimum Water Level, 50 Year Low Flow, 0 gpm Demand (1437.4')
- Minimum Water Level, 50 Year Low Flow, 3500 gpm Demand (1434.3')
- Minimum Water Level, 50 Year Low Flow, 5000 gpm Demand (1430.3')

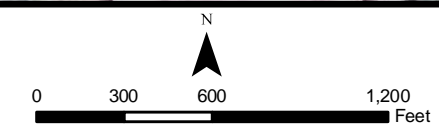
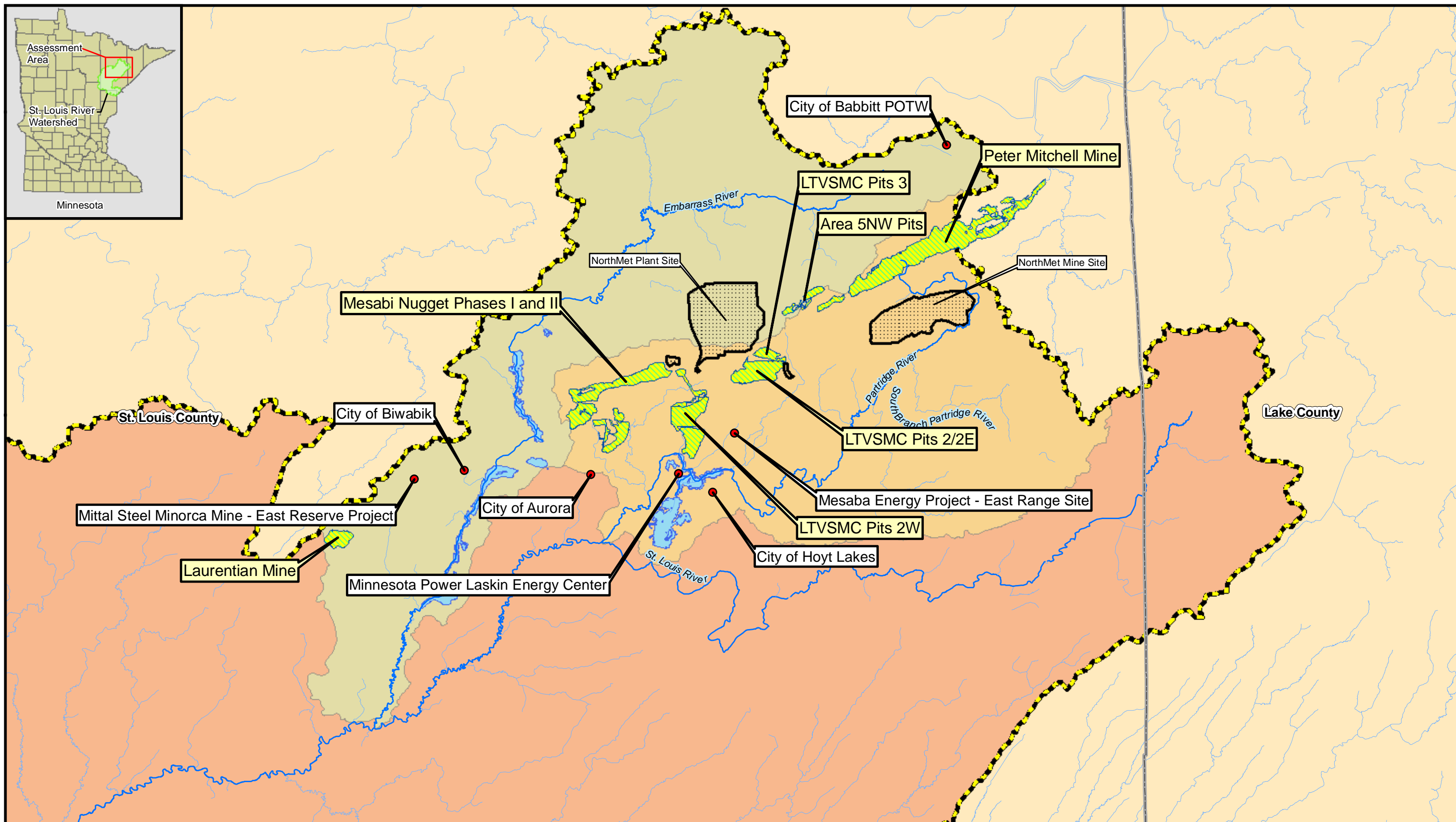


Figure 4.1-27
Water Level Drawdown for 50 Year Low
Flow Conditions in Whitewater Reservoir
(Proposed Action)
NorthMet Project
PolyMet Mining, Inc.
St. Louis County, Minnesota
October 2009



Map/Data Source: Barr Engineering/ERM

- Other Activities
- Rivers/Streams
- ▭ County Boundary
- ▨ NorthMet Mine and Plant Sites
- Lakes
- ▨ Cumulative Impact Project Mine Features
- ▨ Embarrass River Watershed
- ▨ Partridge River Watershed
- ▨ St. Louis River Watershed

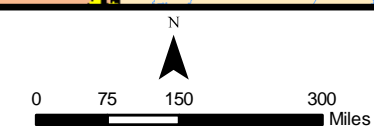
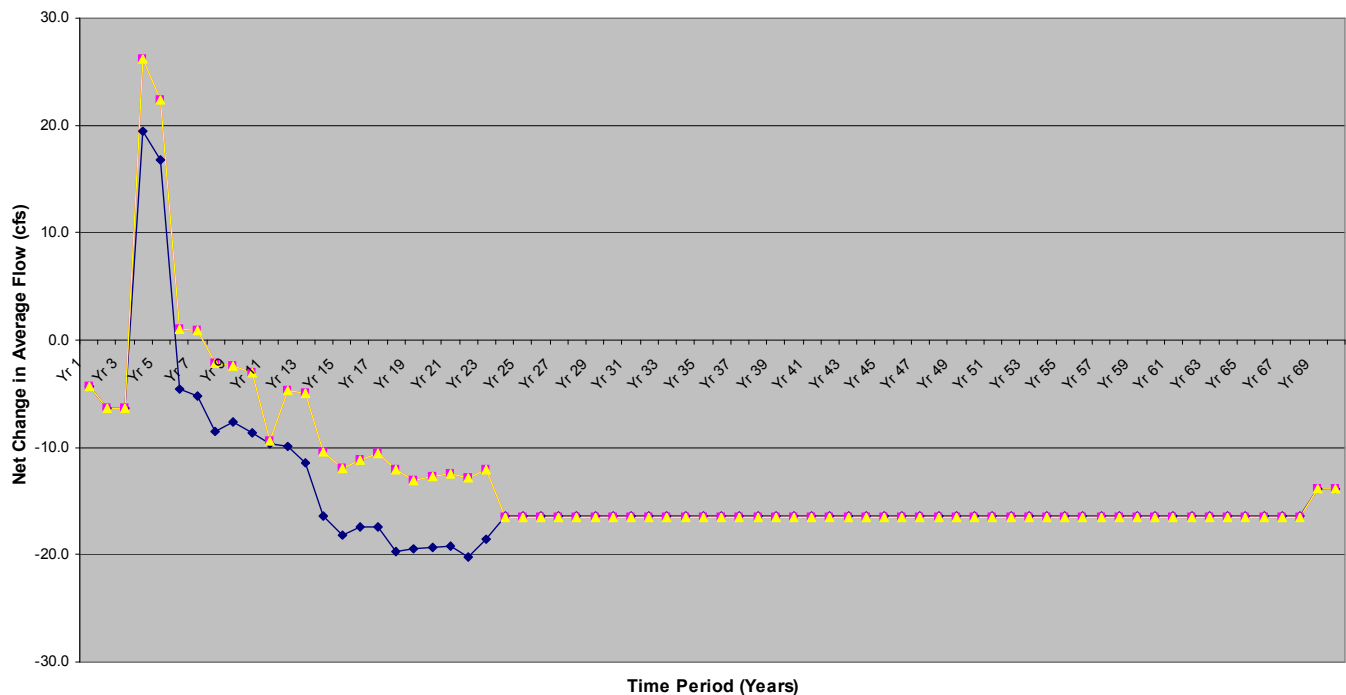
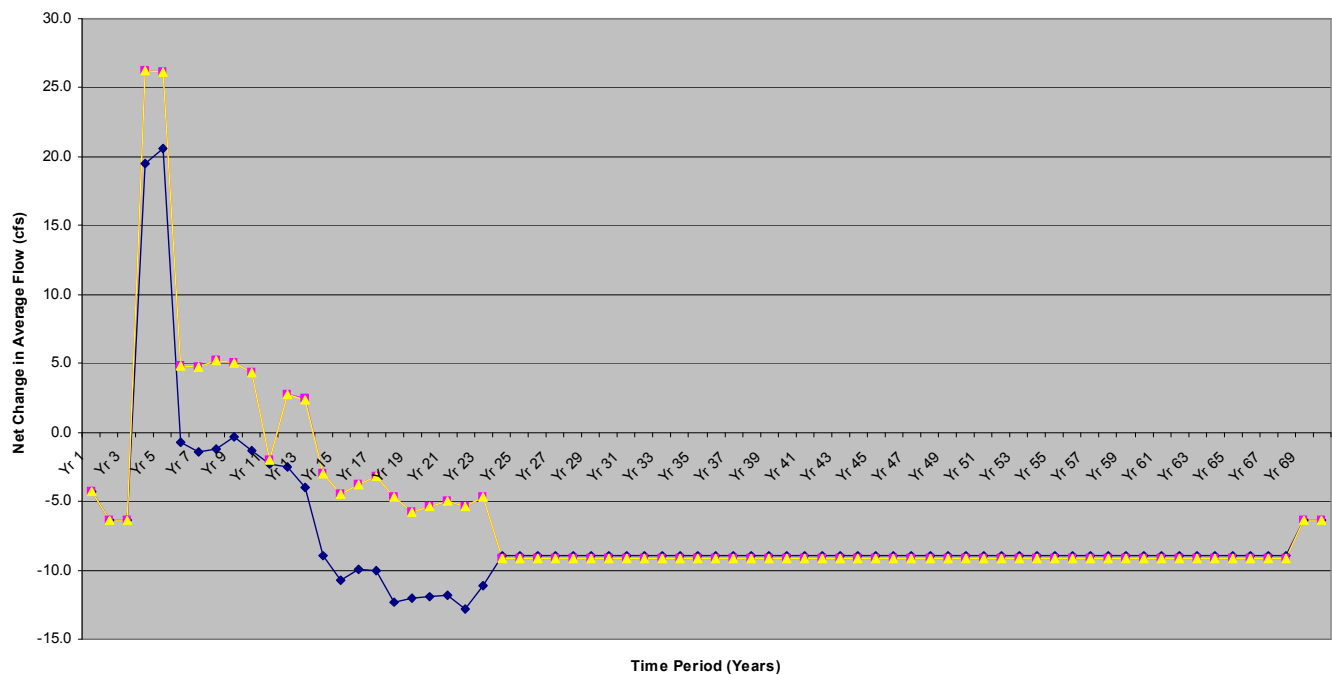


Figure 4.1-28
Activities included in the Cumulative
Effects Assessment
NorthMet Project
PolyMet Mining, Inc.
St. Louis County, Minnesota

October 2009



With Mesaba Energy Project



Without Mesaba Energy Project

Images Provided by: Barr

Proposed Action No Recycle Option Maximum Recycle Option



Figure 4.1-29
70 Year Cumulative Effects on Partridge River Hydrology
 NorthMet Project
 PolyMet Mining, Inc.
 St. Louis County, Minnesota
 October 2009