Exhibits

To the November 13, 2015 Request of the Fond du Lac Band of Lake Superior Chippewa for Predecision Referral to the Council on Environmental Quality of Disagreements Over Environmental Impacts of NorthMet Mining Project and Land Exchange Action

Exhibit 1

Draft Referral to the Council on Environmental Quality

Draft Referral to the CEQ

Christina W. Goldfuss, Managing Director
White House Council on Environmental Quality
Eisenhower Executive Office Building
1650 Pennsylvania Avenue, NW
Washington, DC 20501
chair@ceq.eop.gov

RE: Referral to the Council on Environmental Quality of Disagreements Over Environmental Impacts of NorthMet Mining Project and Land Exchange Action

Dear Director Goldfuss:

Pursuant to 40 C.F.R. Part 1504, we are referring to the Council on Environmental Quality unresolved disagreements over the environmental impacts of the proposed NorthMet Mining Project and Land Exchange.

The applicant for the proposed project, PolyMet Mine Inc., seeks to develop a copper sulfide ore open pit mine and processing plant on lands in northeastern Minnesota, within the Superior National Forest. It would be the first non-ferrous mine in Minnesota and would include three new open pits, permanent and temporary waste rock stockpiles, and processing facilities to extract copper, nickel, and platinum ore. The processing facilities would be at the former LTV Steel Mining Company Site and would use the existing LTV tailings basin. The waste rock at the site is acid generating. The mine would operate for 20 years, after which active closure and post-closure maintenance would need to continue indefinitely. The project would require an exchange of land with the U.S. Forest Service, a Section 404 permit from the U.S. Army Corps of Engineers, as well as permits from the State of Minnesota.

The Minnesota Department of Natural Resources, the U.S. Army Corps of Engineers and the U.S. Forest Service are Co-lead Agencies on the environmental review of the project. The Environmental Protection Agency, along with three tribes (the Fond du Lac Band of Lake Superior Chippewa, the Grand Portage Band, and the Bois Forte Band) are cooperating agencies in the environmental review.

This project has been proceeding through environmental review since 2005. A Final Environmental Impact Statement for the proposed project was recently released, notice of which was published in the Federal Register on November 13, 2015.

The disagreement that is the subject of this request arises from a fundamental disagreement about the groundwater hydrology and the impact of the proposed mine on surface and groundwater resources in northeastern Minnesota. The disagreement on the hydrologic characterization of the site affects two major watersheds – the Lake Superior Basin and Rainy River Basin, which include important protected natural resources, among which is the Boundary Waters Canoe Area Wilderness. The disagreement on hydrologic characterization of the site directly affects the mine's potential impacts on ground and surface water quality, water treatment

needs both during the mine operations and post-closure, mercury loading, wetlands, natural resource habitat, cultural resources, and cumulative effects.

Among other issues, the major difference of opinion on hydrologic characterization of the site calls into question the conclusion expressed in the Final EIS that the mine "would not directly, indirectly, or cumulatively affect the water" in either the Boundary Waters Canoe Area Wilderness or Voyageurs National Park. *See* Final Environmental Impact Statement at ES-36. However, when the hydrological model was run by the Tribes and their expert (with guidance and training from staff at the U.S. Geological Service), using corrected baseline data, the model showed that post-closure, the waters from the mine site would not only flow south and east as predicted by the applicant but would also, in fact, flow north to the Rainy River Basin (including the Boundary Waters Canoe Area Wilderness).

The Fond du Lac Band, as a cooperating agency, detailed the basis for their disagreement in their letter to us dated November 13, 2015, a copy of which accompanies this referral. The disagreements on the hydrological characterization of the site are summarized principally in Chapter 8 of the Final Environmental Impact Statement (FEIS) which is entitled Major Differences of Opinion, as well as more recent memoranda provided by the Tribes' expert to the Co-lead Agencies dated August 11, 2015 and October 20, 2015, in on-going efforts to resolve those disagreements.

In our view, the differences that exist regarding the hydrological characterization of the site are substantial, require further close examination, and meet the criteria for a referral to the CEQ. 40 C.F.R. §1504.2(a)–(f).

The potential adverse environmental impacts arising from the disagreement on the hydrologic characterization threaten to lead to violations of national environmental standards governing water quality and the protections required by law for the Boundary Waters Canoe Area Wilderness and for Lake Superior – an Outstanding International Resource Water. The risk of error on the hydrology of the site, if realized, could lead to permanent and irreparable damage to water quality and natural resources. 40 C.F.R. § 1504.2(a).

Those potential effects are severe, *id.* §1504.2(b), with adverse effects over a broad geographical scope – extending to both the St Louis River/Lake Superior watershed during the mine's operations, and into the Rainy River Basin and the Boundary Waters Canoe Area Wilderness post-closure. *Id.* §1504.2(c). Because the mine would operate for 20 years and then, by its own terms, require water treatment facilities to satisfy water quality standards for possibly more than 200 years, the duration of the adverse impacts are effectively perpetual. *Id.* §1504.2(d). Because the project is the first sulfide mine proposed for development in Minnesota, the proposed project and the issues regarding hydrologic characterization could establish significant precedent. *Id.* §1504.2(e).

Finally, we believe that the dispute can be resolved by independent examination and application of a properly formulated and calibrated hydrological model. That hydrologic characterization would provide a basis for meaningful evaluation of the potential environmental

impacts of the project so that informed decisions can be made for avoiding impacts and on the permits and land exchange required for it to proceed. 40 C.F.R. §1504.2(f).

For the foregoing reasons, we refer this matter to the CEQ.

Sincerely

Exhibit 2

Resume of Nancy Schuldt
Water Projects Coordinator
Fond du Lac Band of Lake Superior Chippewa

Nancy J. Schuldt

Director, Fond du Lac Office of Water Protection: responsible for planning, administering and implementing a comprehensive tribal water quality protection program, including physical, chemical and biological monitoring of reservation lakes and streams, data management and analysis, grant writing, developing and implementing restoration projects, environmental review and regulatory oversight.

Professional Preparation

B.S., BIOLOGY YEARS ATTENDED: 1975-1979
University of Dayton *Dayton, Ohio*

M.A., AQUATIC ECOLOGY YEARS ATTENDED: 1993-1997
University of Kansas *Lawrence, Kansas*

Appointments:

1997-present: Director, Office of Water Protection, Fond du Lac Reservation Environmental Program

1993-1997: Graduate Research Assistant, Graduate Teaching Assistant, University of Kansas Department of Systematics and Ecology (now Department of Ecology and Evolutionary Biology)

1985-1993: Full time parent, founding member of Overland Park Citizens Advisory Council on Environmental Issues, Overland Park, Kansas

1983-1984: Pharmacy Laboratory Technician, Home Health Care of America, Fairfield, New Jersey

1979-1982: Microbiology Laboratory Technician, Cincinnati Health Department Laboratories, Cincinnati, Ohio

Relevant Activities:

- Implementing a tribal water quality program through the development of a comprehensive monitoring project to address water quality parameters of reservation lakes and streams listed in tribal water quality standards. Developed a database of physical, chemical and biological data collected in ongoing, long-term monitoring program, which is used to determine attainment or impairment of designated and aquatic life uses of reservation waterbodies, and assess nonpoint source impacts to reservation waters
- Demonstrated success in acquiring federal (EPA) grant funding for tribal base water program (18 years); additional project grant funding (EPA's Great Lakes National Program Office) for two sediment quality assessment projects; cooperative partner with MN Dept. of Health, MN Sea Grant; State of Minnesota Clean Water Partnership grants; multi-year tribal capacity grant funding through the EPA Great Lakes Restoration Initiative; National Environmental Information Exchange Network funding for regional tribal wild rice monitoring consortium
- Coordinating a multi-stakeholder (tribal and non-tribal) partnership to consider, select, fund and construct appropriate wastewater collection and treatment alternative for heavily developed reservation lake

- Coordinated comprehensive hydrologic study of Stoney Brook watershed, which includes the Reservation's wild rice lakes; partnered with NRCS, USGS in data acquisition and hydrologic model development to guide watershed management plan
- Presented invited talks to North American Benthological Society's annual symposia (1999, 2006)
- Presented talks at North American Lake Management Society annual symposia (2002, 2003)
- Invited instructor at National Biocriteria Workshop (April 2003)
- Presented invited talk at EPA's National Science Forum (June 2004) about tribal mercury monitoring activities
- Presented case studies and helped facilitate two tribal Water Quality Standards Academies through EPA (2005, 2011)
- Facilitated day-long session on tribal water quality standards program development at first National Tribal Science Forum (2006)
- Gave invited presentation on tribal water quality protection program at regional American Institute of Architects conference (2007)
- Presented at annual EPA Region 5 state/tribal water quality program conference on a collaborative tribal/state bioassessment of the St. Louis River (2007)
- Gave invited overview presentation ("Water Quality 101") to Carlton County Waters Summit, a community outreach event (2008)
- Presented on cumulative impacts of mining to tribal resources in northeastern Minnesota at tribal mining conference "The Land, Sky, Water and Culture" (2008)
- Gave invited presentation to EPA Cumulative Risk Assessment Workshop on Protecting Traditional Tribal Lifeways by Protecting the Resources (2009)
- Gave invited presentation to the Izaak Walton League on tribal participation in mining review (2009)
- Gave invited presentation to the Hubert Humphrey Institute (University of Minnesota) Water Symposium on tribal water protection and policy (2009)
- Co-team leader for the Recreational/Spiritual/Cultural team for the state of Minnesota's Water Sustainability Framework (2010)
- Guest lecturer in Dr. Deb Swackhammer's graduate Water Policy course at the University of Minnesota (2010, 2012, 2013, 2014, 2015); also in Dr. Rebecca Teasley's graduate Water Policy course at the University of Minnesota Duluth (2014, 2015)
- Invited presenter at 2011 Minnesota Lakes and Rivers Conference (tribal response to sulfide mining projects)
- Presented at 2011 International Association of Great Lakes Research (IAGLR) on mining impacts to tribal trust resources in the Lake Superior Basin
- Presented at 2012 National Water Quality Monitoring Conference on a watershed hydrologic study, in partnership with NRCS, USGS
- Presented Lake Superior update to the 2011 State of the Lakes Ecosystem Conference (SOLEC) on behalf of the Lake Superior Binational Program Work Group
- Coordinated multiagency technical team in developing a Restoration Concept Plan for Spirit Lake in the St. Louis River Estuary, in conjunction with a Great Lakes Legacy Act remedial investigation/feasibility study for the former US Steel site (2012)
- Presented invited talk at the St. Louis River Estuary Summit on mining impacts to the headwaters (2013)
- Presented at 2014 National Water Quality Monitoring Conference on "Using Cloud Computing to protect Ecology, Economy, and Tradition through the Wild Rice Wetlands Water Quality Data Sharing Project"
- Presented invited talk at BIA Partners in Action Conference (2014) on sulfate, wild rice and mining in Minnesota

- Invited panelist at Midwest Chapter of the Native American Fish and Wildlife Society Symposium (2014) regarding Mining Impacts and Tribal Response
- Guest lecturer in J. Reyer's Environmental Policy class at the University of Wisconsin Superior (2014)
- Presented invited webinar on Tribal Water Governance to the University of Minnesota Certified Watershed Specialist online course (2015)
- Presented at 2015 St. Louis River Estuary Summit on an Ecosystem Services Valuation for the St. Louis River watershed
- Presented at Tribal Lands and Environment Forum on the development of lake-specific nutrient criteria for reservation fisheries lakes (2015) and the SLR ESV
- Presented at the annual Minnesota Water Resources Conference on the St. Louis River Ecosystem Services Valuation (2015)
- Active participant in local and regional workgroups: Lake Superior Binational Partnership, St. Louis River TMDL Partnership (Chairman, Board of Directors), tribal trustee for Natural Resource Damage Assessment at St. Louis River Interlake/Duluth Tar Superfund site; Biological Technical Advisory Group for the site; member of Strategy Work Group for the Minnesota statewide mercury TMDL implementation plan; member of University of Minnesota Sea Grant Advisory Board; USEPA Region 5 representative on National Tribal Water Council since 2008
- Active in educational outreach to reservation, local and regional community

Collaborators and other Affiliations

Peter Cooper, P.E., USDA Natural Resources Conservation Service (Stoney Brook Hydrology Study)

Perry Jones, US Geologic Service Hydrologist (Stoney Brook Hydrology Study)

Mark LeBaron, GoldSystems (*Region 5 Tribal Consortium for Protecting Manoomin (wild rice),* EPA-OEI-13-01

Dr. Amy Myrbo, University of Minnesota Lacustrine Core Repository (*Manoomin, investigating the past, the present, and the future conditions of wild rice lakes on the Fond du Lac Band of Lake Superior Chippewa Reservation,* NSF OEDG 2009-2014)

Dr. John Pastor, University of Minnesota Duluth (*Wild Rice Population and Nutrient Dynamics,* NSF 2002-2006; *Wild rice population oscillations, allocation patterns, and nutrient cycling*, NSF 2007-2011)

Dr. Diana Dalbotten, University of Minnesota (*REU Site on Sustainable Land and Water Resources: A Community-Based Participatory Research Experience for Undergraduates,* NSF OEDG 2015-2019)

Dr. Ann St. Amand, President, PhycoTech (*Development of Lake-specific Numerical Nutrient Criteria for Water Quality Standards in Fond du Lac Reservation Lakes: Analysis of the Phytoplankton Rapid Assay Results 1998-2012 compared to Southern MN lakes.*) Final report submitted to EPA Region 5 2015.

Exhibit 3

Resume of Dr. John Colman
Environmental Modeler and Section Leader
Great Lakes Indian Fish and Wildlife Commission

GREAT LAKES INDIAN FISH AND WILDLIFE COMMISSION

P. O. Box 9 • Odanah, WI 54861 • 715/682-6619 • FAX 715/682-9294

• MEMBER TRIBES •

MICHIGAN	WISCONSIN		MINNESOTA
Bay Mills Community	Bad River Band	Red Cliff Band	Fond du Lac Band
Keweenaw Bay Community	Lac Courte Oreilles Band	St. Croix Chippewa	Mille Lacs Band
Lac Vieux Desert Band	Lac du Flambeau Band	Sokaogon Chippewa	

Name and Address:

John Coleman
Great Lakes Indian Fish & Wildlife Commission at the Land Information & Computer Graphics Facility, University of Wisconsin - Madison
550 Babcock Drive
Madison, Wisconsin 53706
608 263-2873 (office) 608 262-2500 (fax)
e-mail:jcoleman@glifwc.org

Position:

Honorary Fellow, Land Information and Computer Graphics Facility, U.W. - Madison. 1995 to present.
Environmental Modeler, Great Lakes Indian Fish and Wildlife Commission. 1994 to present.
Environmental Section Leader, Great Lakes Indian Fish and Wildlife Commission. 1997 to present.

Education:

Ph.D. in Wildlife Ecology; minor in Statistics, 1994 U. of Wisconsin., Madison.
M.S. in Fisheries and Wildlife Science, 1985 Virginia Polytechnic Institute and State University (VPI & SU).
B.S. in Wildlife Management, 1980 University of Maine, Orono.

Professional Experience:

Mining and water quality specialist, Great Lakes Indian Fish and Wildlife Commission. Reviewed and commented on mining and mining exploration permit applications in the Chippewa Ceded Territories, of Wisconsin, Michigan, and Minnesota. Development of groundwater models for characterization of groundwater hydrology at multiple mine sites. Instructor in cooperation with USGS staff for groundwater modeling training focused on mine sites. Participated in development of non-ferrous mining regulations for Michigan. Participated as member of a cooperating agency on two federal EISs, providing advice on water quality, water quantity modeling, and fugitive materials control. Developed and implemented baseline water quality sampling programs at two mine sites. Developed and implemented sampling of biota at multiple mine sites to establish baseline concentrations of metals in biota.

Environmental data modeler, Great Lakes Indian Fish and Wildlife Commission. Collected and modeled data on surface and sub-surface natural resources in the Chippewa Ceded Territories of Michigan,

Wisconsin, and Minnesota. Emphasis on relationship between mineral development and surface plant and animal resources. Statistical modeling of spatial, temporal, and physical relationships. Mapping of spatial relationships. 1994 - present.

GIS Manager and Data Modeler, Great Lakes Indian Fish and Wildlife Commission and University of Wisconsin - Madison cooperative project. Modeled spatially referenced data to predict suitable habitat for pine marten and fisher. 1993 - present.

Research assistant, University of Wisconsin - Madison. Conducted a study of small mammalian predators. Focus on predation of songbirds. Collected, analyzed, and modeled data concerning the effects of landscape characteristics on predator behavior using feral domestic cats as a model species. 1988 - 1993.

Laboratory researcher in molecular genetics labs, Laboratoire de microbiologie, Lyon, France and Dept. of Zoology, U. of Leicester, England. Applied molecular techniques to wildlife conservation and biology. 1987 - 1988.

Wetlands manager, Florida Game and Fresh Water Fish Commission. Monitored changes in fish and vegetation species during restoration of a large channelized river. 1986.

Computer analyst, Virginia Polytechnic Institute and State University. Developed digital habitat maps from USGS, GIRAS geographic data base for a study of bald eagle movements and habitat use on the Chesapeake Bay. Helped develop and wrote documentation for radio-telemetry analysis software 1985-1986.

Researcher assistant, VPI & SU and the National Park Service. Planned, supervised, and collected data in a study of the ecology of black and turkey vultures in Pennsylvania. 1983 - 1985.

Publications and Presentations:

Coleman, J., Chiriboga, E. 2009. GIS based methods for estimation of indirect hydrologic impacts to wetland plant communities due to mine dewatering. Society of Wetland Scientists - Wisconsin Wetlands Association 2009 Joint Conference.

Coleman, J., Chiriboga, E. 2007. GLIFWC Crandon Mine Technical Review: State of the Site report. Great lakes Indian Fish and Wildlife Commission.

Coleman, J. S., DeWild, J. F., David P. Krabbenhoft, D. P., 2003.Cooperative Mercury Sampling of Surface Waters Near the Site of the Proposed Crandon Mine. American Water Resources Association. Wisconsin Annual Conference.

Coleman, J. S., Chiriboga, E. 2003. Establishing Baseline Environmental Quality Information at a Proposed Mine Site. U.S. EPA Workshop on

Mining Impacted Native American Lands. Reno, Nevada
Coleman, J. S., Chiriboga, E. 2003. Uncertainty in Prediction of Impacts to Groundwater Flow and Level from a Proposed Base Metal Mine. U.S. EPA Workshop on Mining Impacted Native American Lands. Reno, Nevada
Coleman, J. S., Chiriboga, E. 2003. Environmental Monitoring at the Proposed Crandon Mine Site. SETAC Conference.
Coleman, J. S. 1998. Visualizing the conceptual basis and results of a groundwater flow model using a Geographic Information System. American Water Resources Association, Wisconsin Annual Conference
Coleman, J. S. 1998. The importance of independence: Correctly identifying the independent variable when calculating rating equations. American Water Resources Association, Wisconsin Annual Conference
Coleman, J. S., J. Gilbert, J. Probst, and S. Ventura. 1995. Modeling suitable fisher habitat at a landscape scale in Wisconsin. Abstract, Second International *Martes* Symposium. Edmonton, Alberta.
Coleman, J. S. and S. A. Temple. 1993. A survey of owners of free-ranging domestic cats in rural Wisconsin. Wildl. Soc. Bull. 21:381-390.
Coleman, J. S. and J. D. Fraser. 1990. Southeast distribution and status of black and turkey vultures. Pages 78-88 in B. G. Pendleton, ed. Proc. Southeast raptor management symposium. National Wildlife Federation.
Coleman, J. S. and J. D. Fraser. 1989. Northeast distribution and status of black and turkey vultures. Pages 73-82 in B. G. Pendleton, ed.. Proc. Northeast raptor management symposium. National Wildlife Federation.
Coleman, J. S. and J. D. Fraser. 1989. Habitat use and home ranges of black and turkey vultures. J. Wildl. Manage. 53:782-792.
Coleman, J. S. and J. D. Fraser. 1989. Growth and age estimation of black vultures (Coragyps atratus) and turkey vultures (Cathartes aura). Wilson Bull. 60:197-208.
Coleman, J. S. and J. D. Fraser. 1988. Hematocrit and protein concentration of black vulture and turkey vulture blood. Condor. 90:937-938.
Coleman, J. S. and J. D. Fraser. 1987. Food habits of black and turkey vultures in Pennsylvania and Maryland. J. Wildl. Manage. 51:733-739.
Coleman, J. S. and L. Perrin. 1986. Preliminary analysis of changes in floating and submergent vegetation in the Kissimmee River demonstration project: some effects of water fluctuation and flow. Florida Game and Fish Comm. 8pp.
Coleman, J. S. and J. D. Fraser. 1986. Predation on black and turkey vultures. Wilson Bull. 98:600-601.
Coleman, J. S. and A. B. Jones III. 1986. User's guide to TELEM: Computer analysis system for radio- telemetry data. Dept. Fisheries and Wildlife, VPI & SU, Blacksburg, VA. 46pp.
Sweeney, T. M., J. D. Fraser, and J. S. Coleman. 1985. Further evaluation of

marking methods for black and turkey vultures. J. Field Ornithology. 56:251-257.

Coleman, J. S., J. D. Fraser, and C. A. Pringle. 1985. Salt-eating by black and turkey vultures. Condor 87:291-292.

Coleman, J. S., and J. Willmarth. 1980. Death Canyon, Grand Teton National Park, Wyoming (hack site report). The Peregrine Fund's western report 1980. pp. 57-66.

EPA Approved QAPPs

Quality assurance project plan for: Testing of fish for mercury under the Great Lakes Indian Fish and Wildlife Commission EPA STAR grant: "Reducing risks to the Anishinaabe from methylmercury." EPA Grant RD83104701/0, 2004. Involved development of an intervention program to reduce risks associated with subsistence-based consumption of walleye contaminated with methyl mercury.

Quality assurance project plan for: GLIFWC Testing of Fish for Mercury. EPA grant GL96540801-0 2004. Involved sampling of fish from inland lakes, testing of those fish for mercury and incorporation of the sampling results into GLIFWC's GIS based fish consumption advisory maps.

Quality assurance project plan for: Tribal Monitoring of Stream Flow in Swamp Creek, Forest County Wisconsin. EPA grant X-995574-01, 2003. Involved installation and operation of stream gages in cooperation with one of our member tribes and the USGS.

Quality assurance project plan for: Mercury in Surface Waters Testing Project Near the Crandon Potential Mine Site in Northern Wisconsin. EPA grant X995574-01-02), 2001 and 2002. Involved sampling and analysis of mercury and other metals in surface waters in cooperation with the Wisconsin DNR and the USGS.

Quality assurance project plan for: the Great Lakes Indian Fish and Wildlife Commission wild rice, mussels and fish contaminant monitoring near potential mine sites in northern Wisconsin. EPA grant X 995574-01-02, 2001. Involved field acquisition of plant and animal tissues for contaminant analysis, statistical analysis and spatial mapping of the contaminant results over multiple years.

Quality assurance project plan for: Great Lakes Indian Fish and Wildlife Commission Water Quality Baseline Sampling in Watersheds Potentially Impacted by Mining Activity. EPA grant GL00E00613-0, 2011. Involved field acquisition of water quality data through water samples, field measurement and automated data logging.

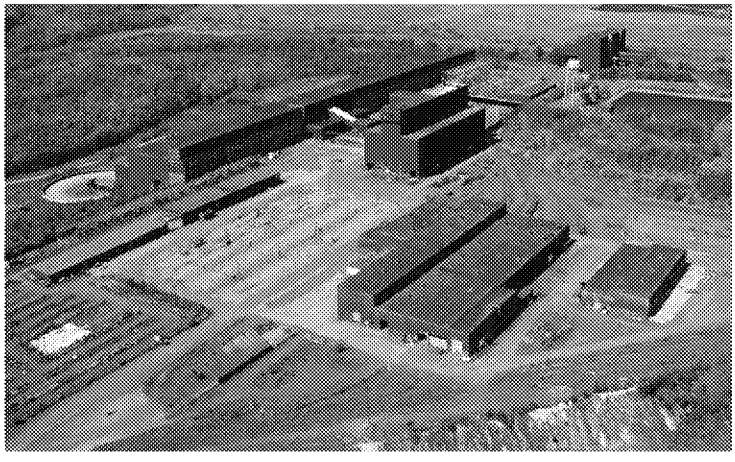
Exhibit 4

Final Environmental Impact Statement
Chapter 8 - Major Differences of Opinion
November 2015

NorthMet Mining Project and Land Exchange

Final Environmental Impact Statement

November 2015



Prepared by

Minnesota Department of Natural Resources
United States Army Corps of Engineers
United States Forest Service

MNDNR

US Army Corps of Engineers
St. Paul District

FOREST SERVICE
USFS
DEPARTMENT OF AGRICULTURE

8.0 MAJOR DIFFERENCES OF OPINION

8.1 SUMMARY

This chapter discloses major differences of opinion Tribal Cooperating Agencies identified with the analysis that was presented in the SDEIS with updated Co-lead Agency responses for the FEIS. This information is provided to ensure that EIS reviewers are aware that major differences of opinion (MDOs) exist between the Co-lead Agencies and the Bands, GLIFWC, and 1854 Treaty Authority regarding the effects of the NorthMet Project Proposed Action and Land Exchange Proposed Action on the environment. The Co-lead Agencies' rationale for the analysis as presented in the FEIS, including references to where relevant concepts are discussed in the document, is also provided.

The USEPA is also a Cooperating Agency. Although the USEPA provided comments, the USEPA did not identify MDOs during preparation of the SDEIS.

8.2 INTRODUCTION

In developing the NorthMet Mining Project and Land Exchange EIS, the Co-lead Agencies invited the Bois Forte, Grand Portage, and Fond du Lac Bands to be Cooperating Agencies in preparation of the EIS. Other Tribal entities participating in the EIS process include the 1854 Treaty Authority and GLIFWC. In addition, THPOs and staff from the 1854 Ceded Territory Bands have been, and continue to be, involved in Section 106 consultation with the USACE and USFS regarding potential effects on historic properties in the NorthMet Project area as directed in 36 CFR 800.

The EIS process anticipated comment and input from the Tribal Cooperating Agencies in the development of the FEIS. The Communications and Coordination Plan commits the Co-lead Agencies to actively seek input from the Bands on how potential effects of the NorthMet Project Proposed Action and Land Exchange Proposed Action on natural and cultural resources would affect the Bands' traditional cultural practices, and to identify and disclose where differences exist between the parties.

Consistent with the Communications and Coordination Plan commitment, the Co-lead Agencies engaged the Tribal Cooperating Agencies throughout development of the EIS and took into consideration their comments on the DEIS and SDEIS, and other concerns brought forth through their participation in a series of post-DEIS technical teams, along with other information-sharing and disclosure venues. These include:

- **Impact Assessment Planning (IAP)**. The Co-lead Agencies convened a series of workgroups from September 2010 through July 2011 to identify the evaluations necessary to determine effects on the environment of the Agencies' Draft Alternative for the NorthMet Project Proposed Action. Impact areas assessed in the IAP process included air, wetlands, geotechnical stability, and water resources in four areas (surface water, groundwater, geochemistry, and impact criteria). Each workgroup was charged to update the analyses from the DEIS required for the analysis of the Agencies' Draft Alternative in terms of: 1) impact analysis requirements, 2) modeling assumptions, and 3) work plan requirements. Tribal

Agencies and USEPA involvement varied across teams as a function of relevant expertise and subject matter, including instances where these agencies did not participate because the subject matter fell outside of their areas of expertise. Each workgroup adopted a Final IAP Summary Memo to capture these requirements, but also identified key issues, decision points, and areas of disagreement with the Tribal Cooperating Agencies where applicable. See IAP Final Summary Memos (MDNR et al. 2011).

- **Tribal Issue Review Meetings**. After the DEIS and prior to the release of the SDEIS, meetings were held approximately every other month between the Co-lead Agencies and Tribal Cooperating Agencies to discuss the potential effects of the proposed NorthMet Project Proposed Action and Land Exchange Proposed Action on tribal interests. These sessions included the Co-lead Agencies' feedback on how these same comments and concerns have been taken into consideration in the development of the SDEIS. Participants typically included staff from the Co-lead Agencies, Tribal Cooperating Agencies, and the USEPA. Twelve meetings were held from June 2011 through March 2013, and included numerous opportunities for the Tribal Cooperating Agencies to engage the Co-lead Agencies on issues of concern and disagreement.
- **Monthly Cooperating Agency Meetings**. Meetings were held once a month between the DEIS and SDEIS publications to provide the opportunity for the Co-lead Agencies to brief the Tribal Cooperating Agencies on the status of concerns from the Tribal Issue Review Meetings or otherwise articulated by the Bands. These sessions were facilitated by the USACE using a general agenda, where participants typically included staff from the Co-lead Agencies, Tribal Cooperating Agencies, and USEPA. High-level outcomes typically addressed coordination and information needs or gaps identified by the Cooperating Agencies.

These were the primary venues where Tribal Cooperating Agencies were provided opportunities to express their points of view on the potential effects of the NorthMet Project Proposed Action and Land Exchange Proposed Action on the environment, including points of disagreement with the Co-lead Agencies, prior to the release and review of the SDEIS. Other opportunities took the form of ongoing coordination for information development and availability, and ad hoc technical meetings.

Following the publication of the SDEIS, the Cooperating Agencies were invited to participate at the three public meetings held during the SDEIS public comment period. The Tribal Cooperating Agencies hosted a Tribal Cooperating Agency informational booth at each of the meetings, which were open to the public.

Regular Cooperating Agency meetings were reestablished prior to the SDEIS comment period (December 2013), through development of the FEIS (October 2015). These meetings were facilitated by the USFS to provide a continuing opportunity for the Co-lead Agencies to brief the Tribal Cooperating Agencies and USEPA on the status of the project, and for the Cooperating Agencies to identify specific topics for more detailed discussion at separate technical meetings. Several technical meetings were conducted in order for the Co-lead Agencies to fully understand and consider the specific Cooperating Agency comments received on the SDEIS, as well as for the Co-lead Agencies to update the Cooperating Agencies on how the comments would be addressed for the FEIS.

The Communications and Coordination Plan also included provisions for the Co-lead Agencies to identify and disclose in the SDEIS differences of opinion with the Cooperating Agencies. The Communications and Coordination Plan notes for the MDNR, in its capacity as RGU, that *Minnesota Rules* part 4410.2300, item H, states: "The EIS shall identify and briefly discuss any major differences of opinion concerning significant impacts of the proposed project on the environment." For the USACE and USFS, in their capacity as federal Co-lead Agencies, 40 CFR § 1502.9 and 1503.4 note they are obligated to work with the Cooperating Agencies to obtain their comments and "shall make every effort to disclose and discuss at appropriate points in the draft statement all major points of view on the environmental impacts of the alternatives including the proposed action." The Co-lead Agencies believe these information disclosure requirements were satisfied by providing the Tribal Cooperating Agencies MDOs in chapter 8 of the SDEIS.

8.3 MAJOR DIFFERENCES OF OPINION

The Co-lead Agencies distributed a Preliminary Supplemental Draft Environmental Impact Statement (PSDEIS) and requested review by the Cooperating Agencies (both Tribal and USEPA) and the MPCA. Reviewers assessed the document for accuracy and identified gaps in technical information or general logic that could substantially affect the reader's understanding of the subject material. Comments were generated from all entities involved. The Co-lead Agencies reviewed all comments and incorporated suggested edits or provided additional clarification or analysis in the SDEIS as required. All substantive comments were reviewed and discussed by work groups comprised of technical experts from the Co-lead Agencies and MPCA.

The Co-lead Agencies worked diligently with the Cooperating Agencies over the course of the PSDEIS's development to consider and resolve any concerns prior to its release for Cooperating Agencies' review and comment. While the USEPA provided comments and suggested edits on the PSDEIS, none of these were identified as representing an MDO. For comments from the Tribal Cooperating Agencies on the PSDEIS, there were cases where the Co-lead Agencies disagreed with the comments and determined that the PSDEIS analysis was valid and best disclosed potential environmental effects and permitting requirements as directed by NEPA and MEPA. Those comments were identified as potentially representing MDOs. Three workshops were held to identify the specific issue areas and reach consensus on the language summarizing tribal views. Ultimately, 18 issue areas were identified in the workshops as being "unresolved" and determined to represent MDOs in the SDEIS.

Supporting documentation and independent analyses for the 18 issue areas were also provided by the Tribal Cooperating Agencies (see Section 8.4). Although this information was considered, the Co-lead Agencies ultimately determined that the analyses and supporting documentation presented in the SDEIS were valid and best disclose potential environmental effects as directed by NEPA and MEPA.

All Cooperating Agencies submitted comment letters on the SDEIS. The USEPA gave the SDEIS a rating of EC-2 (Environmental Concerns – Insufficient Information) and provided detailed recommendations to improve the analysis. The Tribal Cooperating Agencies provided comments that included the previously identified MDOs, as well as additional comments on the SDEIS. In order to address the comments received on the SDEIS, the Co-lead Agencies

considered new information, and also engaged with the Cooperating Agencies to fully understand their comments prior to addressing or responding to them in the FEIS.

As a result of addressing the SDEIS comments, the analysis relating to some of the Tribal Cooperating Agencies' MDOs was updated.

Table 8-1 summarizes the information presented by the Tribal Cooperating Agencies by providing:

- the 18 issue areas as identified in the SDEIS;
- the Tribal Position Summaries as identified in the SDEIS;
- the Tribal Cooperating Agency(ies) holding the MDO;
- the Co-lead Agencies' responses on the issues for the SDEIS and updated responses for the FEIS; and
- the location in the FEIS of reference material supporting the Co-lead Agencies' opinion on the issues.

Table 8-1 Major Differences of Opinion

MDO #	Specific Major Difference of Opinion Area	Tribal Position Summary	Co-lead Agencies' Response	
			SDEIS	FEIS
1	Impacts to flow in Embarrass and Partridge Rivers	Grand Portage, Fond du Lac, and GLIFWC believe that projected reductions in average stream flows in the Partridge and Embarrass Rivers, and subsequent impacts to aquatic habitat in these same systems, result in measurable impacts. They believe that the interaction of the project's impacts with natural variability in precipitation would be more adverse than reported in the SDEIS. This is because effects of climatic variability are additive to the project-related change, which would be especially true for drier periods. These agencies believe there is very little understanding of the hydrology of the Upper Partridge River, and the XP-SWMM model used to extrapolate flow data is flawed and does not produce usable results. Appendix C provides additional information from these agencies on this major difference of opinion revealed in the development of the SDEIS.	The Co-lead Agencies believe the understanding of the hydrology of the Partridge and Embarrass rivers is sufficient to assess effects and that the SDEIS adequately predicts potential changes to flow in the Embarrass and Partridge rivers. The NorthMet Project Proposed Action is not predicted to result in any substantial changes to average stream flow when compared to existing conditions. Underlying impact assessment methodologies are presented in SDEIS Section 5.2.2.2.2 and provide readers with specific information and cited reference documents that support the basis for the Co-lead Agencies' position. Surface water flow monitoring is proposed for both rivers and is presented in SDEIS Section 5.2.2.3.5 for permitting agencies to consider. If actual NorthMet Project Proposed Action effects were found to be higher than predictions, then steps could be taken to reduce those effects.	The Co-lead Agencies believe the understanding of the hydrology of the Partridge and Embarrass rivers is sufficient to assess effects and that the FEIS adequately predicts potential changes to flow in the Embarrass and Partridge rivers. The NorthMet Project Proposed Action is not predicted to result in any substantial changes to average stream flow when compared to existing conditions. FEIS Section 5.2.2.2.2 describes the results of the water impact analysis. Surface water flow monitoring is proposed for both rivers. Sections 5.2.2.3.5 and 5.2.2.3.6 describe the monitoring and adaptive management measures that could be applied to minimize impact on flow, including impacts to tributaries extending from the Tailings Basin (as appropriate). Section 5.2.6 describes the impacts on aquatic species.
2	Predicted decrease in mercury loading	Fond du Lac, Grand Portage, and GLIFWC do not believe the proposed project will result in a decrease in mercury loading to the Embarrass and Partridge River aquatic systems. For the Embarrass River, they do not believe that: 1) the tailings basin will function as a mercury sink; and 2) mercury	The Co-lead Agencies believe that the SDEIS thoroughly considers potential sources of mercury, including those identified by the Tribal Cooperating Agencies. The SDEIS discloses in Section	The Co-lead Agencies' position as reflected in the SDEIS response remains unchanged for the FEIS. The mercury mass balance presented in the SDEIS has been revised to reflect updates to the water models and

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MDO #	Specific Major Difference of Opinion Area	Tribal Position Summary	Co-lead Agencies' Response	
			SDEIS	FEIS
		methylation would decrease due to projected reductions in sulfate contributions. For the flows for the Partridge River, Embarrass River, or their tributaries, they disagree that the project would not significantly impact flow and water level fluctuations, thus leading to increased mercury methylation and bioaccumulation, which taken together may be sufficient to impact habitat leading to alterations of species composition, food web structure, and ultimately mercury bioaccumulation. Potential mercury contributions from peat stored at the Overburden Laydown and Storage Area have also not been addressed. Mercury-related concerns are present for created wetlands at the East Pit and mercury concentrations in water discharged from the West Pit. Air-related mercury emissions do not account for sources from energy generation of vehicle use at the site. For the Lake Superior watershed, any additional mercury releases to the environment are exacerbating already existing impairments including fish advisories set for recreational fishing. Increased fish mercury levels will also have direct impacts on both the cultural and recreational resources of the region. Appendix C provides additional information from these agencies on this major difference of opinion revealed in the development of the SDEIS.	5.2.2.3.4 that the Embarrass River is predicted to result in a net increase in mercury-loadings of up to 0.6 grams per year, from 22.3 grams to 22.9 grams. For the Partridge River, the SDEIS indicates mercury-loading is predicted to decrease 1.2 grams per year, from 24.2 grams to 23.0 grams. This represents a projected 0.6 grams per year reduction across both river systems. Mercury-related analyses include water mass-balances, human health air risk assessments, potential bioaccumulation, and wetland/riparian sources of methylmercury generation. Impact assessment methodologies are presented in SDEIS Section 5.2.2.1.2 and provide readers with specific information and cited reference documents that support the basis for the Co-lead Agencies' position. The Co-lead Agencies understand the NorthMet Project Proposed Action includes features to control air emissions such that statewide TMDL reduction goals would not be impeded. The wastewater treatment facilities are also expected to provide mercury removal from the process water waste streams. The Co-lead Agencies respectfully disagree with the Tribal Cooperating Agencies and believe the Tailings Basin would act as a mercury sink, at least similar to other media like soils, and believe it cannot be predicted	air emissions inventory. The new results disclosed in Chapter 5, Section 5.2.2, are consistent with the conclusions made in the SDEIS that predict a net decrease of mercury-loadings of approximately 1.0 grams per year (i.e., a net decrease of 0.8 grams per year in the Partridge River and a net increase of 0.2 grams per year in the Embarrass River), resulting in a net decrease in overall mercury loadings to the St. Louis River. Total potential mercury emissions to air are estimated to be 4.6 lbs/year from the Plant Site and less than 1.0 lb/yr for the Mine Site. Mercury-related effects are addressed in FEIS Sections 5.2.2, 5.2.5, 5.2.6, 5.2.7, 5.2.9, 5.2.10, and 6.2.3. Surface water quality monitoring and adaptive management methods are presented in FEIS Section 5.2.2.3.5 for permitting agencies to consider.

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MDO #	Specific Major Difference of Opinion Area	Tribal Position Summary	Co-lead Agencies' Response	
			SDEIS	FEIS
			whether methylmercury production may or may not change under the NorthMet Project Proposed Action. In addition, surface water quality monitoring and adaptive management methods are presented in SDEIS Section 5.2.2.3.5 for permitting agencies to consider. If actual NorthMet Project Proposed Action effects were found to be higher than predictions, then steps could be taken to reduce those effects.	
3	Wild rice standard regulatory applicability determinations and areas of production	Grand Portage, Fond du Lac, GLIFWC, and The 1854 Treaty Authority disagree with the MPCA's draft staff recommendations about the applicability determination of the wild rice 10 mg/L sulfate surface water standard to the NorthMet Project. These agencies do not agree with a seasonal application of the standard, or the reaches of waters determined as used for the production of wild rice, and compliance points for the sulfate standard, nor do they agree with basing a determination of a wild rice production water on the density of wild rice found growing there. The 1854 Treaty Authority states that it is arbitrary to define how much rice presence is required, especially given the lack of long-term monitoring data on a given water. Embarrass Lake is considered a water used for the production of wild rice under current MPCA draft staff recommendations; water quality is not meeting the wild rice water quality	The Co-lead Agencies acknowledge that both the proper application of the existing standard and the questions of whether and how that standard should be applied are the subjects of continuing general controversy. The Co-lead Agencies believe the MPCA's project-specific guidance on the applicability of the wild rice standard is a relevant and appropriate water quality evaluation criterion to use in the SDEIS. The Co-lead Agencies acknowledge that the MPCA's project-specific guidance may change as their NPDES/SDS permitting process progresses. If their guidance were to change in the future while the EIS is underway, the new guidance would be considered as appropriate for use in the FEIS and permitting. The wild rice standard is based in rule where applicability is determined by the MPCA. Any future regulatory	The Co-lead Agencies' position as reflected in the SDEIS response remains unchanged for the FEIS.

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MDO #	Specific Major Difference of Opinion Area	Tribal Position Summary	Co-lead Agencies' Response	
			SDEIS	FEIS
		standard there and wild rice is also found further upstream in the Embarrass River because it is an existing use defined by the Clean Water Act. Grand Portage states that the wild rice sulfate standard for waters used in the production of wild rice applies in the Embarrass River. The 1854 Treaty Authority notes that research and evaluation of the standard are ongoing, and that application of the standard may change. All believe the State's application of the wild rice standard is not in compliance with the Clean Water Act. This difference of opinion is directed at an element of the State's water quality regulatory program, but is offered in the SDEIS because the effects analysis presented in the SDEIS is based on the regulatory program. Appendix C provides additional information from these agencies on this major difference of opinion revealed in the development of the SDEIS.	determinations and basis for applicability of the wild rice standard is outside of the scope of this SDEIS. The Co-lead Agencies also note there will be opportunities for Grand Portage, Fond du Lac, GLIFWC, and The 1854 Treaty Authority to engage the MPCA in these regulatory determinations outside of this project-specific EIS, and these opportunities would be the more appropriate venue to raise these concerns.	
4	Impaired waters list regulatory designation should be made for Embarrass River watershed	Grand Portage and Fond du Lac believe that sulfate concentrations should be a criteria used for designation of an impaired wild rice water. They note that no wild rice waters in the state have been designated impaired by the MPCA. Grand Portage states that all segments of the Embarrass River that are identified as wild rice waters by MPCA are impaired due to water quality exceedances for sulfate. Grand Portage further notes waters where wild rice historically occurred, all exceed the 10 mg/L sulfate standard and therefore should be on the impaired waters list because it is	The Co-lead Agencies believe it is appropriate to rely on the MPCA's Clean Water Act Section 303(d) final 2012 TMDL List of impaired waters in the SDEIS. The Co-lead Agencies recognize that there are segments of the Embarrass River on the 2012 List, but the listing is for an impairment not specific to sulfate and/or wild rice. The Co-lead Agencies give regulatory deference to the MPCA and USEPA's process for determining the basis for, and finalizing, the impairments	The Co-lead Agencies' position as reflected in the SDEIS response remains unchanged for the FEIS.

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MDO #	Specific Major Difference of Opinion Area	Tribal Position Summary	Co-lead Agencies' Response	
			SDEIS	FEIS
		known that wild rice previously grew in these waters. These agencies contend the Embarrass River is already impaired so any sulfate additions constitute cumulative effects. This difference of opinion is directed at the MPCA's impaired waters regulatory program, but is offered in the SDEIS because the effects analysis impact criteria presented in the SDEIS are based on information developed with respect to this regulatory program. Appendix C provides additional information from these agencies on this major difference of opinion revealed in the development of the SDEIS.	assigned to a given reach of water on the 303(d) list. The development of the 303(d) list is a separate biennial process outside the scope of the EIS. Furthermore, the Co-lead Agencies will continue to rely on MPCA's project-specific guidance on the applicability of the wild rice standard as a relevant and appropriate water quality evaluation criterion to use in the SDEIS.	
5	Underground Mining analysis	GLIFWC believes that the Underground Mine Alternative has been prematurely eliminated from consideration in the NorthMet Project SDEIS and it would provide significant environmental benefits when compared to the proposed project. An underground mine would largely eliminate impacts to wetlands, and would substantially limit water quantity and quality impacts for surface- and groundwater resources. GLIFWC concurs that underground mining is technically feasible and available at the site, leaving only the lack of economic feasibility as the rationale used by the Co-lead Agencies to eliminate the alternative. On this GLIFWC's opinion is that the Co-lead Agencies did not fully assess information on economic feasibility provided by the proposer. Deficiencies noted by GLIFWC are related to the: error term for economic	The Co-lead Agencies believe that adequate consideration was given to the Underground Mining Alternative prior to eliminating it from further consideration for the SDEIS. This option was screened against specific alternatives-consideration criteria in terms of purpose and need, technical and economic feasibility, availability, and environmental and socioeconomic benefit. Both the SDEIS Section 3.2.3.4.1 and the Co-lead Agency position paper (Appendix B) disclose that an underground mine would result in a smaller footprint, thus offering certain environmental benefits such as reduced effects on wetlands, vegetation, and wildlife habitat. However, both the SDEIS and the Co-	The Co-lead Agencies' position as reflected in the SDEIS response remains unchanged for the FEIS.

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MDO #	Specific Major Difference of Opinion Area	Tribal Position Summary	Co-lead Agencies' Response	
			SDEIS	FEIS
		projections; rates on return on investment; costs of the land exchange; environmental goods and services provided by natural systems; economic impact and inconsistency with state mineland reclamation program goals regarding perpetual maintenance and water treatment at the site. Appendix C provides additional information from this agency on this major difference of opinion revealed in the development of the SDEIS.	lead Agency position paper also disclose that the tonnage/volume and grade (amount of metals) of rock would not generate enough revenue to pay for all costs associated with underground mining. Therefore, underground mining would not be economically feasible. The Co-lead Agencies also considered that a smaller mining operation would employ fewer workers for a shorter amount of time, resulting in fewer socioeconomic benefits than the NorthMet Project Proposed Action. Also, preliminary economic screening by PolyMet determined that sale of metal precipitates produced from an underground mine would not meet the NorthMet Project Proposed Action Purpose and Need, which is integral to whether an alternative should be evaluated in the SDEIS. Therefore, it was found to not be a reasonable alternative and was eliminated from further consideration.	
6	West Pit backfill option analysis	GLIFWC believes that the West Pit Backfill option has been prematurely eliminated from consideration in the NorthMet Project SDEIS. They believe the potential environmental benefits to long term water quality have not been fully assessed and mineral encumbrance issues can be avoided. This alternative meets the purpose and need, is available, and is technically and economically feasible. By limiting the consideration of environmental benefits to only a screening-level analysis, the full effect of the alternative on the	The Co-lead Agencies believe that the West Pit Backfill option was given adequate consideration prior to eliminating it from further examination for the SDEIS. SDEIS Section 3.2.3.4.2 details the factors considered by the Co-lead Agencies regarding this potential alternative, including: backfill sequencing; volume of material; water quality and WWTP treatment; visual aesthetics; operational air, noise, and	The Co-lead Agencies' position as reflected in the SDEIS response remains unchanged for the FEIS. FEIS Section 3.2.3.4.2 details the factors considered by the Co-lead Agencies regarding this potential alternative.

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MDO #	Specific Major Difference of Opinion Area	Tribal Position Summary	Co-lead Agencies' Response	
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		environment is not known, especially for water quality and potential need for perpetual treatment (contrary to state mineland reclamation program goals). The issue of mineral encumbrance is raised as proposer concern, but is avoided by employing standard underground mining techniques from other locations. GLIFWC's opinion is that economic considerations of a future mine expansion are the only concrete reasons for not conducting a full analysis, and every available option that might improve long term impacts should be explored regardless of mineral lease commitments. Appendix C provides additional information from this agency on this major difference of opinion revealed in the development of the SDEIS.	dust impacts; footprint impacts for wetlands; mineral encumbrance lease provisions; and costs. These factors were weighed against specific alternatives-consideration criteria in terms of purpose and need, technical and economic feasibility, availability, and environmental and socioeconomic benefit. The screening analysis revealed the opportunity to reclaim wetlands and vegetation at the Category 1 Stockpile footprint would be the only measurable environmental benefit offered by backfilling the Category 1 Stockpile into the West Pit. However, because the stockpile would have to be constructed anyway even under a backfilled option, these impacts would still occur with mitigation required under wetlands-related permitting or site reclamation requirements under the Permit to Mine. On balance, it is the Co-lead Agencies' opinion that the West Pit Backfill option would not provide substantial environmental benefit to the project as proposed. As such, the option to backfill the West Pit was eliminated from further consideration in the SDEIS.	
7	Partridge River baseline base flow and XP-SWMM model	Grand Portage, Fond du Lac, and GLIFWC believe that basic site surface water flow hydrology at the Mine Site is inadequately characterized. The XP-SWMM model predictions may have underestimated	The Co-lead Agencies believe that the SDEIS adequately predicts Partridge River baseline baseflow and that the XP-SWMM model calibration was	The Co-lead Agencies have concluded after additional analysis and discussion that the USGS gage data and derived XP-SWMM values used in the EIS remain the most reasonable estimate of

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MDO #	Specific Major Difference of Opinion Area	Tribal Position Summary	Co-lead Agencies' Response	
			SDEIS	FEIS
	calibration	baseflow conditions in the Partridge River by a factor of five (5). If true, this mis-characterization might affect water quality compliance projections in that although more baseflow might mean more dilution of contaminants, it could also mean transport of greater quantities of pollutants or drawdown for the Partridge River. They also contend that XP-SWMM's projections, which are based on data from 17 miles away collected from 1978 to 1987, do not align with the rating curve from new MDNR winter monitoring data, or the results of GLIFWC's own projections taken from two years of new data from the Dunka Road gage. Because XP-SWMM's low estimates of baseflow are used in the calibration of the MODFLOW model, it will influence many aspects of the baseline site characterization and impact prediction. These include pit inflow, dewatering impacts to the Partridge River and wetlands, water treatment needs, groundwater flow rates, contaminant transport times and concentrations, and contaminant dilution in the Partridge River watershed. Appendix C provides additional information from these agencies on this major difference of opinion revealed in the development of the SDEIS.	appropriate. Baseflow estimation methodologies, including limitations, and data sources are presented in SDEIS section 4.2.2.2.2 and provide readers with specific information and cited reference documents that support the basis for the Co-lead Agencies' position. Section 5.2.2.2.2 identifies the methods to assess existing conditions in the Partridge River, while Table 5.2.2-4 provides the results of the XP-SWMM modeling for various reaches of the river. Regarding the use of the 1978 to 1987 flow data, the Co-lead Agencies believe it is reasonable to rely on this information because there have not been any relevant changes in the watershed since that time. In addition, the SDEIS acknowledges the issue by noting in Section 4.2.2.2.2 the implications of using a lower modeled baseflow are that any changes of flow volume due to withdrawals, discharges, or augmentation would result in greater effects during the impact modeling than if higher baseflow values were used, such as showing higher concentrations of solutes in the rivers and creeks. Surface water flow monitoring is proposed for the Partridge River and is presented in SDEIS Section 5.2.2.3.5 for permitting agencies to consider. If actual NorthMet Project Proposed Action effects were found to be higher	groundwater baseflow conditions in the Partridge River for the purposes of MODFLOW and GoldSim modeling. Groundwater baseflows for the Partridge River developed in the SDEIS are best-estimate values and were retained for the FEIS. In addition, a groundwater baseflow sensitivity analysis was performed to consider the effect of variable groundwater baseflow inputs on water quality. Results show that modeled groundwater and surface water concentrations are sensitive to changes in groundwater baseflow. However, the NorthMet Project Proposed Action's ability to meet groundwater quality and surface water quality evaluation criteria is not sensitive to changes in groundwater baseflow. As per the SDEIS, FEIS Section 5.2.2.2.2 describes the methodology and results of water impact analysis. Surface water flow monitoring is proposed for the Partridge River, in Section 5.2.2.3.6. Section 5.2.2.3.5 describes the adaptive management measures that could be applied to minimize impacts to water resources. Section 5.2.6 describes the impacts on aquatic species.

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MDO #	Specific Major Difference of Opinion Area	Tribal Position Summary	Co-lead Agencies' Response	
			SDEIS	FEIS
			than predictions, then steps could be taken to reduce those effects.	
8	Analog method to assess indirect impacts from mine dewatering	Grand Portage, Fond du Lac, GLIFWC, and The 1854 Treaty Authority believe that the Co-lead Agencies' proposed analog method of assessing potential indirect impacts from mine site pit dewatering is not rigorous, and as such should not be the sole means of indirect impact assessment for the SDEIS. Resource assessment areas of concern include wetlands, groundwater, and surface waters. All these agencies consider the impact zones and distances to be somewhat arbitrary, and also challenge the automatic exclusion of ombrotrophic wetlands from potential drawdown effects. Accounting for these factors GLIFWC conducted an independent assessment using the same methods as the Co-lead Agencies, along with additional analog data from other mining-impacted sites, which found an estimated total of 5719.75 acres of wetlands would be potentially susceptible to severe indirect impacts from mine pit drawdown. These agencies are of the opinion that the USACE should require up front mitigation for all severely impacted wetlands, but at a minimum up front mitigation should be required for wetlands occurring in zone 1. They also contend that additional up front mitigation should be considered for wetlands that are classified in the moderate to severe category, with robust monitoring being required for wetlands in the moderate category. These agencies also note that the upper Partridge River is located in Zone 2;	The Co-lead Agencies believe that the SDEIS adequately uses the analog method to assess potential indirect effects from mine dewatering. The complex mixes of bedrock, glacial till, and wetland soils at the Mine Site impede the ability to reasonably model and accurately assess the potential effect of pit dewatering on wetlands. In light of this modeling limitation, wetlands were divided into zones based on distance from the open pit. The closer a wetland was to the pit during dewatering, the greater the water table drawdown would be and the greater potential there would be for hydrologic effects on overlying wetlands. These impact assessment methodologies are presented in SDEIS Sections 5.2.2.3.2 and 5.2.3.1.2. The Co-lead Agencies respectfully believe reliance on potential impact zones is appropriate but recognize uncertainty remains. In the event that the required wetland monitoring identifies additional indirect effects, permit conditions would likely include a plan for adaptive management practices to be implemented, such as hydrologic controls or additional off-site compensatory mitigation, which may be identified through annual reporting.	The Co-lead Agencies believe that the analog method used in the SDEIS to assess potential indirect effects from mine dewatering is adequate. Further, the FEIS has been revised to address concerns raised by the Bands regarding the assertion that ombrotrophic bogs would not be impacted by mine dewatering. Section 5.2.3.2.2 of the FEIS applies a more conservative assumption of the potential indirect effects for all bog communities within the 0-1,000-ft analog zone. Specifically, ombrotrophic bogs were reclassified from the "no effect" category to the "low likelihood" category, the same status as that assigned to minerotrophic bogs. The complex mixes of bedrock, glacial till, and wetland soils at the Mine Site impede the ability to reasonably model (e.g., using MODFLOW) and accurately assess the potential effect of pit dewatering on wetlands. In light of this modeling limitation, wetlands were divided into zones based on distance from the open pit. The closer a wetland was to the pit during dewatering, the greater the water table drawdown would be and the greater potential there would be for hydrologic effects on overlying wetlands. These impact assessment methodologies are presented in

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		GLIFWC's independent analysis estimated drawdowns of 3 to 5 ft under the river, which would severely reduce baseflow in the channel, indirectly impact riparian wetlands downstream, and affect other surface water features. Appendix C provides additional information from these agencies on this major difference of opinion revealed in the development of the SDEIS.		Sections 5.2.2.3.2 and 5.2.3.1.2 of the FEIS. The Co-lead Agencies are not relying solely on the potential impact zones determined in the analog method for the FEIS but would monitor wetlands for potential indirect effects if the NorthMet Project Proposed Action were approved. In the event that the required wetland monitoring identifies additional indirect effects, permit conditions would likely include a plan for adaptive management practices to be implemented. Additional compensatory mitigation would be required if indirect wetland impacts were identified during monitoring and annual reporting.
9	Mine Site groundwater impact travel times	Grand Portage and GLIFWC believe that assumed groundwater pollutant travel times at the mine site are underestimated. They contend that relevant literature and data suggest otherwise, and this has not been captured in the modeling of bedrock aquifer transport of pollutants from the mine pit to surface water features. Grand Portage further disagrees with the Co-lead Agencies' assumption that the Duluth Complex would remain highly competent with extremely low hydraulic conductivities post-blasting. If true, resulting groundwater travel times through bedrock would be shorter than predicted in the SDEIS. They recommend conducting a greater characterization of the entire Partridge River watershed and mine site.	The Co-lead Agencies believe that the SDEIS adequately predicts groundwater impact travel times at the Mine Site as a function of bedrock hydraulic conductivity. The hydrogeology of the mine site bedrock units has been evaluated as detailed in SDEIS Section 4.2.2.2.1, including the potential that fractures, including faults and fracture zones, may exist that could permit transmission of groundwater through the bedrock over distances of thousands of feet. SDEIS Section 5.2.2.2.1 considers how fractures may affect hydraulic conductivities at the Mine Site, and although the presence of fractures	The Mine Site GoldSim model was changed following the SDEIS in response to comments and additional analysis occurred relating to hydraulic conductivities. The modeled bedrock and surficial aquifers contribute groundwater baseflow to the Partridge River. The Duluth bedrock hydraulic conductivity was increased and a bedrock flowpath thickness was established at 15 m at the Mine Site to better represent the likelihood of an upper zone of more fractured bedrock than deeper in the formation. The increased bedrock hydraulic conductivity is still less than the value for the surficial deposits. For

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MDO #	Specific Major Difference of Opinion Area	Tribal Position Summary	Co-lead Agencies' Response	
			SDEIS	FEIS
		Appendix C provides additional information from these agencies on this major difference of opinion revealed in the development of the SDEIS.	cannot be completely ruled out, site-specific data such as boring logs indicate the bedrock appears competent. Deep fractures are rarely encountered near the surface, and hydrogeologic investigations have indicated that the bulk of hydraulic conductivity of bedrock at this Mine Site is very low. Blasting-related effects within the pit wall have also been considered. They are expected to be limited in terms of lateral extent and do not have much effect on solute transport in bedrock. In addition, bedrock groundwater monitoring to evaluate bedrock water quality trends is proposed at the Mine Site as presented in SDEIS Section 5.2.2.3.5 for permitting agencies to consider. If actual NorthMet Project Proposed Action effects were found to be higher than predictions, then steps could be taken to reduce those effects.	the bedrock flowpaths that originate at the mine pits, the travel time for water to reach the property boundary is much longer than the modeled 200-year period. Surficial groundwater travel times are related to river groundwater baseflow estimates. Partridge River groundwater baseflow estimates used in the SDEIS are reasonable. A groundwater sensitivity analysis was completed which predicted higher peak concentrations that occur sooner for some constituents. However these peaks remain below evaluation criteria for most parameters. Groundwater monitoring and adaptive measures to manage pit groundwater flows, including for any water conducting features or faults if encountered, are described in FEIS Sections 5.2.2.3.5 and 5.2.2.3.6.
10	No Action Alternative analysis	Fond du Lac, Grand Portage and GLIFWC believe CEQ guidance require that water quality modeling of a No Action alternative should include activities that will occur under the existing Cliffs Consent Decree. The consent decree requires mitigation for water quality exceedances from Area Pit 5, the LTVSMC tailings basin, and the Dunka Pit, all of which under the No Action alternative would cause compliance with all water quality standards with no additional reductions in flows. Further, they contend the current modeling of the	The Co-lead Agencies believe that the SDEIS adequately analyzes effects on water resources under the No Action Alternative as required by NEPA/MEPA. Future remedial actions that would be required at the LTVSMC Tailings Basin under the consent decree and other permits are not established so it is not possible to model those conditions. The No Action Alternative is described in SDEIS Section 5.2.2.4 and acknowledges it is not static, but at this	The Co-lead Agencies' position as reflected in the SDEIS response remains unchanged for the FEIS. To further refine the impact assess and consistent with this position, the Co-lead Agencies have elected to remove the Northshore Pit discharges to the Partridge River from both the continuation of existing conditions and project model scenarios at year 2070. This was done because the timing and the effects of the Northshore Pit discharge cessation are reasonably

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MDO #	Specific Major Difference of Opinion Area	Tribal Position Summary	Co-lead Agencies' Response	
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		"continuation of existing conditions," which omits the dilution effect of precipitation on the water quality of the basin, is not appropriate. Claims that the basin's water quality has stabilized and that current conditions will not change over time is based on pond water sampling for only 4 years (2001-2004). If precipitation since 2004 has not influenced water quality by further diluting water chemistry in the pond, then more recent data on basin pool water chemistry is needed to support the assumption. These agencies are of the opinion while the CEQ makes it clear that a blind "continuation of existing conditions" model is inappropriate as a No Action alternative, a "continuation of existing conditions" model that ignores simple environmental processes such as precipitation is even less appropriate. Appendix C provides additional information from these agencies on this major difference of opinion revealed in the development of the SDEIS.	time the exact nature, timing, and effectiveness of measures under the consent decree are unknown, and thus are not quantifiable for the SDEIS. The Co-lead Agencies have considered the water quality implications of the No Action Alternative and believe it is reasonable to expect that water quality within the Embarrass River could improve over time, absent other unforeseen activities that could affect water quality. The Co-lead Agencies are not relying on the continuation of existing conditions modeling scenario in consideration of the No Action Alternative. This model run represents conditions in the absence of the NorthMet Project Proposed Action and allows for a direct comparison of the predicted water quality model results with the same run with the proposed project. The Continuation of Existing Conditions Scenario facilitates the assessment of the extent to which the NorthMet Project Proposed Action would result in changes in water quality as captured in the model. The Co-lead Agencies believe this comparison is valuable in considering the efficacy of measures available to mitigate potential NorthMet Project Proposed Action-related adverse water quality effects for both the mine and plant sites. These mitigative measures are already	known.

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MDO #	Specific Major Difference of Opinion Area	Tribal Position Summary	Co-lead Agencies' Response	
			SDEIS	FEIS
			contained in the design of the NorthMet Project Proposed Action, or are available as adaptive or contingent NorthMet Project Proposed Action features as detailed in SDEIS Section 5.2.2.2.5.	
11	Cumulative Effects to groundwater and surface water quality and quantity	Grand Portage, Fond du Lac, GLIFWC, and The 1854 Treaty Authority disagree with the Final SDD and SDEIS conclusion that no cumulative effects to groundwater resources are expected. They note bedrock and surficial groundwater pollution is already documented at the old LTVSMC site (i.e., plant site; area pits 5, 6, and 9S) and the Dunka Pit. Cumulative effects at these locations should be assessed with the proposed project along with potential groundwater pollution from the Peter Mitchell Pit, Laskin Energy, Arcelor-Mittal, United Taconite, and US Steel Minntac. They suggest a future action that should be considered in a cumulative effects analysis is any potential future backfill of Virginia Formation waste rock for in-pit disposal at the Cliffs Peter Mitchell Pit. And they contend that potential dewatering-related interaction effects between the proposed NorthMet Project and the Peter Mitchell Pit should be evaluated for cumulative effects. Appendix C provides additional information on this major difference of opinion revealed in the development of the SDEIS.	The Co-lead Agencies believe that the SDEIS appropriately considered the potential for cumulative groundwater effects and accurately predicts cumulative effects to surface water quality and quantity. Cumulative effects impact assessment methodologies for both groundwater and surface water resources are presented in SDEIS Section 6.2.3.3 and provide readers with specific information and cited reference documents that support the basis for our position. The Co-lead Agencies believe the potential for cumulative effects on groundwater resources from the NorthMet Project Proposed Action is not supported. The SDEIS reports the NorthMet Project Proposed Action would affect groundwater levels, but this effect would be limited geographically and temporally, the latter being that groundwater levels would begin to be restored once pit dewatering ceases, and is subject to interactions causing cumulative effects. The Co-lead Agencies do believe, however, that assessment of cumulative effects on surface water quality does	The Co-lead Agencies believe that the FEIS appropriately considers cumulative effects for both groundwater and surface water resources. Water-related cumulative effects assessment methodologies and results are presented in FEIS Section 6.2.2. In addition to the NorthMet Project Proposed Action, water-related cumulative actions considered in the FEIS include: ArcelorMittal Deposits (Laurentian and East Reserve deposits), City of Aurora POTW, City of Babbitt POTW, City of Biwabik POTW, City of Hoyt Lakes POTW, Former LTVSMC Pits and Tailings Basin, Mesabi Nugget (formerly Mesabi Nugget Phase I), Mesabi Mining Project (formerly Mesabi Nugget Phase II), Minnesota Power Laskin Energy Center, Northshore Mine, and Northshore Mine Closure. Cumulative impacts result when the effects of an action are added to or interact with other effects in a particular place and within a particular time. The modeled groundwater flowpaths of the NorthMet Project

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MDO #	Specific Major Difference of Opinion Area	Tribal Position Summary	Co-lead Agencies' Response	
			SDEIS	FEIS
			require consideration of potential groundwater solute contributions. SDEIS Section 6.3.3.3 provides a complete examination of this concern, including existing and potential future actions. The actions considered are: Arcelor-Mittal; Northshore Mine; Area 5 NW Pit; four POTWs; Cliffs Erie LTVSMC site; Mesabi Nugget; Mesabi Mining; Mesaba Energy – East Range Site; and Minnesota Power Laskin Energy Center.	Proposed Action do not interact with other groundwater flowpaths. There may be other plumes from other projects in the vicinity of the NorthMet Project Proposed Action, but the effects of these plumes would only interact with NorthMet Project Proposed action impacts within surface waters. This has been evaluated. The only exception is the seepage effects from existing LTVSMC Tailings Basin that the NorthMet Project Proposed Action would supplant. This combined effect has been considered in the groundwater quality models presented in Section 5.2.2. The Northshore Mine Progression Ultimate Pit Limit project which includes the in-pit stockpiling of Virginia Formation waste rock in the Peter Mitchell Pit would have no impact on the Partridge River, as all operations discharges would be primarily to Langley Creek. The FEIS considers potential interaction effects between the NorthMet Project Proposed Action and the Northshore Mine through operations and closure of both facilities; see Section 6.2.2.3.1. The FEIS indicates that expanded bedrock groundwater monitoring would be required between the sites; see Section 5.2.2.3.6. Contingency mitigation measures to prevent any interaction effects are also identified; see Section

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MDO #	Specific Major Difference of Opinion Area	Tribal Position Summary	Co-lead Agencies' Response	
			SDEIS	FEIS
				5.2.2.3.5.
12	CEAA for Partridge and Embarrass Rivers	Fond du Lac, Grand Portage, GLIFWC, and The 1854 Treaty Authority believe that limiting the cumulative effects analysis area (CEAA) for water resources to the Partridge and Embarrass River watersheds is too small. Rather, they contend the analysis should be expanded to include the St. Louis River. Impacts associated with United Taconite's proposal for 1,200 acres of wetland destruction to build a new tailings basin should be considered. More broadly, they contend the project would add to the load of pollutants that are already causing an excursion from the water quality standards in the St. Louis River and would reduce tributary flows to the river. If true, then project-related impacts that may occur due to the project could be underestimated (due to modeling concerns), and would not stop before reaching the St. Louis River. This would mean that any added impact from the project to the St. Louis River would in turn impact Lake Superior, so this should be the scale to analyze cumulative effects. Appendix C provides additional information from these agencies on this major difference of opinion revealed in the development of the SDEIS.	The Co-lead Agencies believe that the SDEIS uses an appropriate cumulative effects assessment area, or CEAA. The Co-lead Agencies have appropriately defined the spatial extent for the water resources CEAA to be at the scale of contributing watersheds. This is reasonable geographic area because the Plant Site is within the Embarrass River watershed and the Mine Site is within the Partridge River watershed as detailed in SDEIS Section 6.2.3.3.1 The Co-lead Agencies have also considered the appropriateness of defining the CEAA for surface water quality to include the St. Louis River. Because the NorthMet Project Proposed Action would result in only minor changes in surface water hydrology and quality of the Embarrass and Partridge rivers, cumulative effects to the St. Louis River cannot be definitively assigned so it is not included in the CEAA.	The Co-lead Agencies' position as reflected in the SDEIS response remains unchanged for the FEIS. Section 6.2.2.1.1 describes the water resources CEAA.

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MDO #	Specific Major Difference of Opinion Area	Tribal Position Summary	Co-lead Agencies' Response	
			SDEIS	FEIS
13	Effects on groundwater and surface water hydrology	Fond du Lac, Grand Portage, and GLIFWC disagree with the conclusion that the Proposed Project is not predicted to result in any significant effects on groundwater or surface water hydrology. XP-SWMM relies on antiquated data from far downstream, which means the model's projection of hydrologic effects cannot be supported. They believe GoldSim cannot reliably predict whether the 28 solutes modeled at both the plant and mine sites would meet the Minnesota water quality standards. Appendix C provides additional information from these agencies on this major difference of opinion revealed in the development of the SDEIS.	Similar and related to MDOs #1 and #7 above, the Co-lead Agencies believe that the SDEIS adequately predicts effects on groundwater and surface water hydrology. Overall water impact assessment methodologies are presented in SDEIS Section 5.2.2.2 and provide readers with specific information and cited reference documents that support the basis for the Co-leads Agencies' position. The Co-lead Agencies approved GoldSim to be programmed with a suite of complex algorithms to estimate the release of 28 solutes or contaminants from the mine facilities and their transport to groundwater and surface water evaluation locations. A probabilistic method was also approved to estimate the probability of a given water quality outcome occurring as a means to account for uncertainties. This is unlike deterministic modeling where all inputs are known or estimated, and when modeled, always produce a single result without accounting for uncertainty. Lack of accounting for uncertainty was identified as a concern regarding the original DEIS's analyses. The Co-lead Agencies believe focusing on the P90 threshold in assessing the NorthMet Project Proposed Action's potential to meet applicable water quality standards is logical because it generally equates to a reasonable worst-case scenario and has been adopted for	The Co-lead Agencies' position as reflected in the SDEIS response remains unchanged for the FEIS. The water models were updated to address comments received on the SDEIS and to consider new information. As described in FEIS Section 5.2.2, the conclusions of the updated model results support those in the SDEIS. In addition, a groundwater baseflow sensitivity analysis was performed to consider the effect of variable baseflow inputs on water quality. Results show that modeled groundwater and surface water concentrations are sensitive to changes in groundwater baseflow. However, the NorthMet Project Proposed Action's ability to meet groundwater quality and surface water quality evaluation criteria is not sensitive to changes in groundwater baseflow

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MDO #	Specific Major Difference of Opinion Area	Tribal Position Summary	Co-lead Agencies' Response	
			SDEIS	FEIS
			other mining NEPA documents where probabilistic modeling was used. Regardless, the Co-lead Agencies' reliance on the P90 criterion does not supersede how water quality-based effluent limits (WQBELs) would be developed for NPDES/SDS permitting. Appropriate WQBELs would be derived based on water quality standards and implemented in the permit. In addition, water monitoring and adaptive management methods are presented in SDEIS section 5.2.2.3.5 for permitting agencies to consider. If actual NorthMet Project Proposed Action effects were found to be higher than predictions, then steps could be taken to reduce those effects.	
14	GoldSim not able to replicate Tailings Basin water/Partridge River Water Quality under the No Action Alternative	GLIFWC believes that the GoldSim model does not accurately predict existing water quality conditions, such as the existing exceedance of the aluminum standard in the Embarrass River, or existing conditions in the Partridge River. This agency contends that if a model is unable to accurately predict current conditions, then it is even less likely to accurately predict future project conditions. GLIFWC notes that for many parameters at several water bodies, the No-Action P50 model of annual average value is substantially different than the observed average under existing conditions. The GoldSim model(s) need to be better calibrated to existing conditions.	The Co-lead Agencies believe that the GoldSim model adequately replicates NorthMet Project Proposed Action water quality for Tailings Basin water and the Partridge River under the Continuation of Existing Conditions modeling scenario for the SDEIS. The same hydrology and water quality existing conditions datasets that were used for modeling the Proposed Action were used for the Continuation of Existing Conditions modeling scenario. Also, this scenario never introduces any NorthMet mine features or activities and conducts the same simulations for the same durations.	While the Co-lead Agencies' position remains consistent with that reflected in the SDEIS, the Mine Site and Plant Site water models were updated to address SDEIS comments, including using new, available data collected since the SDEIS. This required new calibrations to better reflect existing conditions. In addition for the Mine Site modeling, a new variable was added to account for runoff contributions to Colby Lake. The FEIS water sections for the NorthMet Project, Sections 4.2.2, 5.2.2, and 6.2.2, have been updated

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MDO #	Specific Major Difference of Opinion Area	Tribal Position Summary	Co-lead Agencies' Response	
			SDEIS	FEIS
		Without new calibrations, the GoldSim model's projections are not adequate to ensure protection of water resources. Appendix C provides additional information from this agency on this major difference of opinion revealed in the development of the SDEIS.	Models calibrated for the SDEIS to address differences between observed and simulated values include Mine Site MODFLOW and XP-SWMM models, Mine Site Natural Runoff, Plant Site MODFLOW, Plant Site Natural Runoff, and existing LTVSMC Tailings Basin loading. The existing tailings basin calibration included aluminum, as well as a number of other solutes. The Co-lead Agencies evaluated the various model calibrations underlying GoldSim and believe the differences between the observed and simulated values for each of the calibration targets are minimized within accepted modeling norms. The GoldSim model set up and calibration information is presented in SDEIS section 5.2.2.2.3. Model predictions are also reliable and are presented in the "GoldSim Model Operations and Output" and "Application of Evaluation Criteria to Probabilistic Modeling Results" subsections in SDEIS Section 5.2.2.2.3.	accordingly. The conclusions of the updated model results are consistent with those in the SDEIS.

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MDO #	Specific Major Difference of Opinion Area	Tribal Position Summary	Co-lead Agencies' Response	
			SDEIS	FEIS
15	Mineral fibers	Fond du Lac, Grand Portage, and The 1854 Treaty Authority believe the risks associated with exposure to mineral fibers are greater than portrayed in the SDEIS. Fond du Lac disagrees that 9% amphibole fibers identified by PolyMet testing can be considered a "small" percentage of the fibers identified, while Grand Portage notes chrysotile fibers that would be expected to be found in the NorthMet deposit are not considered. Grand Portage and Fond du Lac indicate that information cited from studies in this section is outdated and that the section should be updated to rely on the most recent reports (i.e.; U of M study released in April 2013). The Bands contend that one year of monitoring as currently proposed is not adequate to account for the variability and unpredictable mineralogy in the rock to be mined, and that monitoring for mineral fibers should be conducted for the duration of the mining operation. Fond du Lac identifies that risks associated with ingestion should be considered in addition to inhalation; risks from ingestion are not discussed in the air quality section or the human health risk section of the document. Appendix C provides additional information from these agencies on this major difference of opinion revealed in the development of the SDEIS.	The Co-lead Agencies believe that the SDEIS adequately describes the risks associated with mineral fibers, including chrysotile (or serpentine) minerals, and potential ingestion risks. Findings from the University of Minnesota study updates to the Minnesota Legislature in April 2013 are considered in the mineral fibers portion of the document. The SDEIS also includes monitoring and mitigation measures described in Section 5.2.7.5.	The Co-lead Agencies' position as reflected in the SDEIS response remains unchanged for the FEIS.

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MDO #	Specific Major Difference of Opinion Area	Tribal Position Summary	Co-lead Agencies' Response	
			SDEIS	FEIS
16	Rail car spillage and dust	GLIFWC disagrees that the amount of ore that could escape from rail cars would be small because the rail cars proposed for use are not sealed. GLIFWC states that, given the design and current condition of rail cars proposed for transport, an ecologically significant amount of spillage could occur into streams, wetlands, and their watersheds. GLIFWC believes that fugitive dust escaping through gaps in the rail cars is also a concern. GLIFWC does not believe that the method described to segregate fines in the center of the rail car, away from the gaps, is realistic. Further, GLIFWC does not believe that monitoring of the creeks along the rail line will be effective in preventing or minimizing impacts because once detected in monitoring, the impact will have already occurred. GLIFWC states that cleanup of ore dust in an aquatic environment is a long and difficult process. Appendix C provides additional information from this agency on this major difference of opinion revealed in the development of the SDEIS.	The Co-lead Agencies believe that the SDEIS adequately predicts the rail car spillage and potential environmental effects. No substantial reactive airborne fugitive dust emissions from rail transport are expected. However, the Co-lead Agencies note that estimates of potential spillage are presented in SDEIS Section 5.2.2.3.2, and potential effects are presented in Sections 5.2.2.3.2, 5.2.3.2.2, and 5.2.7.1.3. These sections provide readers with specific information and cited reference documents that support the basis for the Co-lead Agencies' position. Water quality monitoring for the streams located along the Transportation and Utility Corridor is recommended. If streams along the railroad corridor between the Mine Site and Plant Site were to show degradation in water quality as a result of material spilled from railcars, then contingency mitigation would be available through developing catchment areas adjacent to the tracks at stream crossings to minimize the amount of material that reaches the streams. This information is available for permitting agencies to consider as necessary.	While the Co-lead Agencies' position as reflected in the SDEIS response remains unchanged for the FEIS, the proposer has made a commitment to refurbish the proposed rail cars to minimize gaps and therefore spillage between the Mine Site and the Plant Site. Further detail on the rail cars is provided in FEIS Section 3.2.2.2.4.

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MDO #	Specific Major Difference of Opinion Area	Tribal Position Summary	Co-lead Agencies' Response	
			SDEIS	FEIS
17	Use of water evaluation criteria vs. water quality standards	Fond du Lac and Grand Portage do not agree with statements in the document that indicate there is "no impact" when that assertion is based on not exceeding an evaluation criteria. They believe the SDEIS should acknowledge where there is a change, regardless if a criteria or standard is exceeded. With regard to the water quality effects analysis, Grand Portage and GLIFWC note that evaluation criteria are not equivalent to water quality standards. Grand Portage further notes that some evaluation criteria are high enough to cause human health impacts and evaluation criteria are not equal to or a substitute for water quality standards compliance. GLIFWC notes that in some areas, for example the cumulative effects section for the Partridge River, the text states all water evaluation criteria would be met, though water quality standards would be exceeded for several constituents. Appendix C provides additional information from these agencies on this major difference of opinion revealed in the development of the SDEIS.	The Co-lead Agencies believe that the SDEIS appropriately considers effects on water, including the evaluation criteria specific to the NorthMet Project Proposed Action. It is also appropriate for the reporting of effects to reflect specific evaluation criteria based on the applicable water quality standard. CEQ guidance identifies that whether an action threatens to violate a federal, state, or local law or requirements imposed for the protection of the environment is an appropriate intensity factor for evaluating significance. The SDEIS also discloses where any given evaluation criterion differs from the water quality standards, which is necessary for some constituents because a specific standard has not been formulated. Regarding assessing effects on the Partridge River, relevant cumulative effect water evaluation criteria are described in SDEIS Section 6.2.3.3.4.	The Co-lead Agencies' position as reflected in the SDEIS response remains unchanged for the FEIS. Section 6.2.2.4.1 contains details on cumulative effects for the Partridge River.
18	Loss of "High Biodiversity Significance Values" sites	Fond du Lac, GLIFWC, and Grand Portage believe that native plant communities identified by the Minnesota Biological Survey will be impacted by the proposed mine site and related transportation and utility corridor without appropriate mitigation for their landscape-scale and ecosystem values. There are two MBS sites of high biodiversity significance (18.8 acres) located within the transportation and utility corridor, including the 100 mile	The Co-lead Agencies believe that the SDEIS appropriately discloses potential effects (loss) to high biodiversity significant sites as listed in the Minnesota Biological Survey characterization data. There is no policy or requirement to mitigate effects on MBS Sites of High Biodiversity Significance for those attributes. SDEIS Section 4.2.4 discloses these MBS sites. Sections 3.2.2 and 5.2.4 also describe	Based on consideration of comments received on the SDEIS, the Co-lead Agencies have clarified information regarding sites of biodiversity significance in the FEIS and believe that the FEIS appropriately discloses potential effects (loss) to high biodiversity significant sites as listed in the Minnesota Biological Survey characterization data. In addition, FEIS Sections 4.2.4 and 4.3.4 discuss

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MDO #	Specific Major Difference of Opinion Area	Tribal Position Summary	Co-lead Agencies' Response	
			SDEIS	FEIS
		swamp and the upper Partridge River. They state that forty-one percent of the mine site consists of imperiled/vulnerable communities, but there is no proposed mitigation. Fond du Lac and Grand Portage's opinion is that there will be a net loss to the federal estate of these MBS communities that would not be compensated with equivalent MBS land exchange parcels gained through the USFS land exchange. Appendix C provides additional information from these agencies on this major difference of opinion revealed in the development of the SDEIS.	mine reclamation that would be completed as part of the NorthMet Project Proposed Action, some of which may allow such MBS sites to re-establish.	and provide maps of the MBS Sites (Figures 4.2.4-1, 4.2.4-2, 4.2.4-5, 4.3.4-1, and 4.3.4-2) to provide clarity on locations and extent. WCA rules (including those parts applicable to mining projects under *Minnesota Rules* 8420.0930) include a special consideration for wetlands that are rare natural communities (*Minnesota Rules* 8420.0515, subp 3). There is no state or federal policy or requirement to mitigate effects on MBS Sites of High Biodiversity Significance that are not wetlands. However, FEIS Sections 3.2.2 and 5.2.4 describe mine reclamation activities that would be completed as part of the NorthMet Project Proposed Action, some of which may allow such MBS sites to re-establish. The Permit to Mine would address special consideration of wetlands that include rare natural communities. Additional information on rare natural communities would be included in the wetland permit application as part of the Permit to Mine process for further refinement of site-specific conditions.

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8.4 TRIBAL AGENCY APPENDIX – SUPPORTING INFORMATION FOR TRIBAL COMMENTS

Although not required by NEPA and MEPA, the Co-lead Agencies committed to providing an appendix in the SDEIS that contained the Tribal Cooperating Agencies' comments and supporting documentation representing MDOs. The Co-lead Agencies have engaged the Tribal Cooperating Agencies extensively on these issues in preparation of the SDEIS and FEIS, and examined the information provided in the appendix in support of Tribal Cooperating Agency comments submitted on the SDEIS. Response to the Tribal Cooperating Agency comments on the SDEIS is provided in Appendix A.

See Appendix C for comments and supporting documentation from the Bois Forte, Grand Portage, Fond du Lac, GLIFWC, and the 1854 Treaty Authority. These take the form of eight position papers and a Co-lead Agencies' PSDEIS comment disposition spreadsheet for the Tribal Cooperating Agencies. The Tribal Cooperating Agency submittals in Appendix C are provided verbatim and in identical form as they were for the SDEIS. They were considered in the development of the FEIS.

Issue areas provided in Appendix C include:

- Hydrology Section;
- Mercury Section;
- Wild Rice Section;
- Underground Mine and West Pit Backfill Alternatives Section;
- Wetlands Section;
- Cumulative Effects Analysis Section;
- Proposed Transport of Ore Section;
- Perpetual Maintenance and Water Treatment at the NorthMet Project Section; and
- Tribal Responses to Co-lead Agencies' Disposition of Tribal PSDEIS Comments.

Exhibit 5

Correspondence from GLIFWC to Co-lead Agency Project Managers
Comments on PolyMet mine site contaminant northward flowpath and groundwater model calibration
August 11, 2015

GREAT LAKES INDIAN FISH AND WILDLIFE COMMISSION

P. O. Box 9 • Odanah, WI 54861 • 715/682-6619 • FAX 715/682-9294

• MEMBER TRIBES •

MICHIGAN	WISCONSIN		MINNESOTA
Bay Mills Community	Bad River Band	Red Cliff Band	Fond du Lac Band
Keweenaw Bay Community	Lac Courte Oreilles Band	St. Croix Chippewa	Mille Lacs Band
Lac Vieux Desert Band	Lac du Flambeau Band	Sokaogon Chippewa	

Via Electronic Mail / Original by Mail August 11, 2015

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Re: Comments on PolyMet mine site contaminant northward flowpath and groundwater model calibration.

NorthMet EIS Co-lead Agency Project Managers:

Following up on the web-meeting of July 22, emails of February 26, April 10 , April 20, letter of June 18 and emails of July 21 and July 29, we will clarify our concerns related to a northward flowpath and model calibration These comments are based on: 1) our letter of June 18th; 2) the materials provided in the Co-lead Agency draft memos on a northern flowpath and model calibration; 3) the webinar/meeting conducted July 22, 2015; 4) materials in the PFEIS of June 2015; and 5) further analysis. Since before 2008, GLIFWC staff have consistently raised concerns about the quality and validity of the groundwater characterization at the mine site. Most recently it has come to our attention that the mine site MODFLOW model was incorrectly bounded and calibrated and unlikely to provide the hydrologic characterization of the site that is needed in order to perform adequate project impact evaluations. It has also come to our attention that detailed (MODFLOW) and simplistic (MathCad) models predict that a northward contaminant flowpath is probable under likely closure conditions.

GLIFWC is acting in coordination with our member tribes, including the Fond du Lac Band, to review and contribute to the PolyMet EIS process. As you may know, GLIFWC is an organization exercising delegated authority from 11 federally recognized Ojibwe (or Chippewa) tribes in Wisconsin,

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Michigan and Minnesota.[1] Those tribes have reserved hunting, fishing and gathering rights in territories ceded in various treaties with the United States. GLIFWC's mission is to assist its member tribes in the conservation and management of natural resources and to protect habitats and ecosystems that support those resources. The proposed PolyMet mine is located within the territory ceded by the Treaty of 1854.

Mine-site MODFLOW model calibrated to conditions that did not exist in the 1980s, do not exist now and will not exist in the future:

The existing Northshore Peter-Mitchell (P-M) taconite mine pits on the north side of the PolyMet project area play a significant role in the groundwater hydrology of the project site. In the applicant's groundwater model of 2014 (and earlier versions), documented in the "Water Modeling Data Package Vol 1-Mine Site v13 DEC2014.pdf" (WMDPv13), those pits supply approximately 90% of the groundwater baseflow to the upper Partridge River (see GLIFWC email of 4/20/2015). It is not surprising that those taconite pits play a significant role in the local groundwater hydrology since they are positioned high in the local terrain, at times contain large volumes of water, and sit in relatively high conductivity bedrock (Biwabik Iron Formation or BIF and Virginia Formation). Because they play a dominant role in the local hydrology, it is critical that they be correctly incorporated into the project hydrologic modeling.

Unfortunately, the existing project MODFLOW model for the PolyMet mine site was calibrated using P-M taconite pit water levels that were 13 or more meters too high. The project model incorporates the P-M pits as constant-head-cell boundary conditions (Large Figure 7 of Attachment B of the WMDPv13, attached as Figure 1). The project model sets the P-M pit lakes as constant-head-cells approximately 5 meters above the level of the upper Partridge River, yet pit lakes during the period when flow data was collected (1979-88) were actually well below the elevation of the upper Partridge. Because of this error, the calibration model has the local direction of groundwater flow from the pits 180 degrees reversed from the actual conditions during the calibration period. The model predicts that during the calibration period water was flowing from the hydrologic high at the P-M pits to the hydrologic low at the upper Partridge River, when in fact, because the pits were partly to completely empty, water would have been flowing from the upper Partridge River to the P-M pits.

Attached is a figure that shows the predicted water tables and groundwater flow between the upper Partridge and the P-M pits when the P-M pits are set at different levels (attached as Figure 2). In red are the project model results used in recent and past project reports. In those models the P-M pits are assumed to be at their 1996 elevation of 493 meters. The 483 meter model (in purple) is the same as the project model except that the water levels in the P-M pits, that are adjacent to the upper Partridge, are set to 483 meters. An average pit water elevation of less than 480 meters appears to be the correct elevation for the calibration period of 1979-1988 (attached as Table 1). Calibration and use of the MODFLOW model with the P-M pits erroneously set to the unusually high conditions in 1996 (493 meters) is a problem for the following reasons:

- The baseflow used in formulating (calibrating) the PolyMet project MODFLOW mine site

1 GLIFWC member tribes are: in Wisconsin -- the Bad River Band of the Lake Superior Tribe of Chippewa Indians, Lac du Flambeau Band of Lake Superior Chippewa Indians, Lac Courte Oreilles Band of Lake Superior Chippewa Indians, St. Croix Chippewa Indians of Wisconsin, Sokaogon Chippewa Community of the Mole Lake Band, and Red Cliff Band of Lake Superior Chippewa Indians; in Minnesota -- Fond du Lac Chippewa Tribe, and Mille Lacs Band of Chippewa Indians; and in Michigan -- Bay Mills Indian Community, Keweenaw Bay Indian Community, and Lac Vieux Desert Band of Lake Superior Chippewa Indians.

model was calculated from flow conditions in the 10 years of 1979 through early 1988. During calibration, the MODFLOW model was adjusted until the baseflow it predicted matched the 0.51 cfs baseflow target at station SW003, where the Dunka Road crosses the Partridge River.

- The water level in the P-M pits used as boundary conditions when calibrating the project model was assumed to be 493 meters elevation, the water elevation in 1996. This level is much higher than any water levels that occurred during the period when flow was measured.

- The average water level in the P-M pits, when the baseflow at SW003 was estimated to be 0.51 cfs (i.e. in the 10 years of 1979 to early 1988), was actually more than 13 meters lower, at less than 480 meters.

As the diagram shows, with the pit water levels that occurred in November of 1986 (i.e. ~483 meters), the upper Partridge would have been losing water to the pits and would have had no baseflow. The water table would have sloped down northward from the Partridge River toward the P-M taconite pits. This is because the riverbed of the upper Partridge River is at 486-489 meters elevation, whereas the water levels in the adjacent P-M pits were at approximately 483 meters elevation in 1986. Average water levels in the P-M pits during the 10 years for which baseflow was calculated (1979-1988) were *even lower* than the 483 meter elevation found in 1986.

Water levels in the P-M Area003-East pit increased from an elevation of less than 478 meters in 1979 to 488 meters in the fall of 1987. During most of that period the Area003-East pit was empty, i.e. less than 478 meters elevation. In contrast the 1996 water level used for the Area003-East pit was 492.6 meters elevation. The P-M pit water levels were not vaguely "variable" as stated in the draft memo on calibration, but rather consistently well below the levels used in the Barr MODFLOW modeling. The 1996 water level used for the P-M pits as a boundary condition in the modeling was abnormally high. Such high levels did not occur in the 1980s, do not occur now and will not occur at closure.

The significance of this is that the MODFLOW model was calibrated (adjusted to fit reality) to average baseflow calculated for 1979-88, yet the P-M pit water levels used as boundary conditions in calibration were the unusually high levels that occurred in 1996, not those that occurred in 1979-88 or those that occur now. A fundamental requirement of model calibration is that the calibration targets (i.e. baseflows) and the model boundary conditions (i.e. the water levels in the taconite pits) must be from the same time period. The hydrologic system in 1996 was significantly different from the system in 1979-88 because the water levels in the taconite pits were so different. The result of this mis-match of boundary conditions and calibration targets is that the model is incorrectly calibrated and can not be expected to produce accurate predictions. The model gives the impression of generating reasonable results but is based on conditions that never existed at the same point in time. The 1996 boundary conditions in the form of P-M pit water levels did not occur in the 1980s, do not occur now and are not expected to occur in the future. Given the importance of the P-M pit water elevations as boundary conditions, this is a critical flaw.

Contrary to statements in the WMDP (v13) section on Model Technical Review Checklist, the MODFLOW model was not evaluated to sensitivity of some of the most significant boundary conditions, the Constant-head boundary conditions representing the P-M pits. If such evaluation had been done, it would have been obvious that the model was very sensitive to the levels specified at those pits. Our analysis suggest that approximately 90% of upper Partridge River baseflow comes from the P-M pits when the P-M are at their 1996 level and the shape of the watertable and bedrock potentiometric surface is highly dependent on the P-M pits boundary condition in the model.

Sensitivity analysis as a substitute for correct model bounding and calibration:

It has been proposed that sensitivity analysis can substitute for understanding site hydrology. While sensitivity analysis on a properly bounded and calibrated model provides insights on the range of possible predictions, sensitivity analysis conducted on a grossly mis-configured model can not be depended upon. The closure period model, on which the sensitivity analysis was conducted, was configured with boundary condition in the form of P-M pit water levels at their 1996 levels, over 300 feet higher than the water levels actually expected at the time of PolyMet closure. Those P-M pits are close to the center of the model used for sensitivity analysis and, therefore, erroneous boundary conditions of this magnitude invalidate the results of the sensitivity analysis.

Northward Flow of Contaminants from PolyMet Pits and Category 1 Stockpile at Closure:

Northward flow in the bedrock aquifer:

The project mine site MODFLOW model distributed to cooperating agencies on January 5, 2015 was used by the applicant to predict that contaminants would flow from the mine site at closure to the south and south-east (for example: Large Figures 28 & 29 of the WMDPv13, attached as Figures 3 and **4**). In those project model runs of closure conditions, the water levels in the P-M taconite pits were assumed to remain at the level found in 1996. At closure the P-M pits will not be at 1996 levels but over 300 feet lower. In fact those 1996 levels were atypical; they did not occur in the 1980s, do not occur now and will not occur at closure. A plot of water levels in the Area003-East P-M pit, the pit closest to the PolyMet east pit, shows how atypical the mid-1990s water levels were (attached as Figure 5). In the project predictive models of closure conditions, the adjacent taconite pits to the PolyMet project site were set to have a 1996 water elevation of 1616 feet or 493 meters. However, the P-M taconite pit water levels expected at P-M pit closure are 1300 feet or 396 meters. After reflooding of the P-M pits, the water levels in those pits will be maintained by an outfall in the north-east at 1500 feet or 457 meters (see figure from the Northshore Watershed Mitigation Plan of 2011, attached as Figure 6).

Given the large effect that the project groundwater MODFLOW model and ERM's MathCad cross-section model indicate the water in the taconite pits has on the local bedrock hydrology, one would expect that a large change in the elevation of the water in the taconite pits would have a significant impact on local hydrology and predictions of closure conditions. The close proximity of the P-M pits to the Partridge River and PolyMet mine features (attached Figure 7) suggests that the taconite mine pits would impact the hydrology of these features. In fact, runs of the project model indicate that the groundwater flow direction between the PolyMet project and the taconite pits would be reversed if the taconite pits had the correct P-M pit closure water elevation of 396 meters or even the very long-term level of 457 meters (attached as Figure 8). This initial modeling, conducted by GLIFWC, limited the amount of water that could be lost by the Partridge River to the aquifer because the Partridge can not be an infinite source of water. However, supplemental modeling such as that provided during the July 22nd meeting, (see email of July 21 "Materials for July 22nd modeling discussion, part 2", attached as Attachment A) had no such limitation, yet still showed a strong bedrock gradient toward the P-M taconite pits at closure. That supplemental modeling, without limiting leakage from the bottom of the Partridge River, showed a steep bedrock groundwater gradient from the PolyMet east pit to the P-M pits at closure water levels of 1300 ft (396 meters) and 1500 ft (457 meters) (attached as Figure 9). Additional MODFLOW modeling with recharge to the top of the model set at over 8 in/yr also showed northward flow from the PolyMet project at closure. Under this high recharge modeling scenario, a

small mound does develop in the bedrock aquifer but not one large enough to prevent northward flow. Development of a groundwater mound is limited, not because of low recharge, but because of the low vertical conductivity of the surficial deposits and the strong pull of the low water levels in the P-M pits.

Northward flow of groundwater is in agreement with ERM's Mathcad model which shows bedrock water levels sloping steeply to the north given the water levels expected at closure of the P-M pits. According to ERM's MathCad analysis, only if a groundwater mound forms in the bedrock would flow to the north not occur (attached as Attachment B). Formation of such a substantial mound by movement of water downward from the 100 Mile Swamp is simply not possible given the hydrogeology defined by project documents (e.g. WMDPv13 Table 3-4, attached as Table 2).

The draft co-lead memo on a northward flowpath correctly states that:

> "for the case where downward leakage is negligible ..., the mound does not develop, there is no drainage divide, and the bedrock system would have continuous northward flow from the proposed NorthMet East Pit to the Northshore pits."

and

> "a key factor in the conceptual model is the amount of downward leakage from the surficial deposits into bedrock."

The memo goes on to state that at least 8 inches/year of leakage into the bedrock would be necessary to prevent northward flow. What has not been demonstrated is that the 8 inches per year of leakage into the bedrock is theoretically possible, given the low vertical conductivity of the overlying wetlands.

The result, from both the project MODFLOW model runs with the correct closure water elevations and ERM's MathCad model runs, indicate that water in bedrock will flow to the north from the PolyMet site at closure, unless a bedrock groundwater mound forms. <u>No feasible natural mechanism for such a mound has been articulated.</u> A bedrock groundwater mound at the level necessary to prevent northward flow, i.e. a mound of elevation of approximately 1600 feet, appears to be hydrologically impossible without long-term active management. Northward flow would be primarily from the PolyMet east pit and, despite attempted containment in the surficial aquifer, from the Category 1 stockpile. These flowpaths have been overlooked in project evaluations of contaminant transport. The current project contaminant transport modeling, which assumes contaminant flow paths only to the south and south-east, is incomplete because it is based on the incorrect assumption of 1996 era water levels in the taconite pits, even during closure, a water level that is more than 300 feet too high.

Northward flow in the surficial aquifer:

In addition to potential for northward flow of contaminants in the bedrock that is documented in our previous correspondences, including our email of July 21 ("Materials for July 22nd modeling discussion, part 2", attached as Attachment A) and ERM's MathCad modeling, there is evidence that flow may be to the north in the surficial aquifer. In the examples from other taconite pits represented by Figures 2 and 3 of the Barr June 4th memo (attached as Figures 10 and 11), accounting for the compressed x-axis scale, the cross-sections appear to show that the cone of depression caused by taconite pits extends 1.4 to 1.5 miles from the pits in the surficial aquifer. The PolyMet east pit is only 1.2 miles and the Category 1 stockpile is only 0.8 miles from the edge of the final Peter-Mitchel pit (attached as Figure 7). Preliminary MODFLOW modeling of the surficial aquifer shows northward flow of contaminants from the PolyMet east pit in the surficial aquifer. This is the case if model recharge is limited to the 0.75 in/yr used in the PolyMets closure model (PFEIS page 5-27) but also if the model is run with more than 8 in/yr of recharge to the surficial aquifer. The drawdown by the over 300 foot deep

taconite pits is so great that the surficial aquifer becomes partly dewatered and all baseflow in the upper Partridge ceases.

Importance of understanding groundwater hydrology for prediction of surface water impacts:

Adequate characterization of the groundwater system at a proposed mine site is essential to understanding most of the potential impacts from the project. The amount of water entering the groundwater system, be it precipitation or discharge from the bed of lakes, rivers or mine pits, determines the direction of flow and dilution of contaminants, and dictates points of compliance for both ground and surface waters. The horizontal and vertical conductivity of the soil and bedrock materials determines how the groundwater system responds to stresses and the rate at which the groundwater flows horizontally and vertically. The character of interaction between surface water features and the groundwater system, whether it is loss of water from rivers or wetlands to the groundwater system, or discharge from the groundwater system to the surface water features, determines predicted impacts to surface water features by stresses such as mine dewatering. Estimating water budgets and quantities of water that must be treated requires an adequate understanding of the groundwater system. None of the above effects of a mine project can be predicted accurately if there is not an adequate characterization of the groundwater system. Without an integrated model of the groundwater system, one would be left with only professional judgment to determine the value of the many interrelated parameters that are used for impact prediction. Professional judgment is useful in checking the reasonableness of the predictions from a groundwater model but, by itself, can not adequately integrate the complex site specific information, all pieces of which must fit together like a complex puzzle.

The essential role of groundwater system characterization, characterization that integrates information from the available sources into a coherent model, is demonstrated by the myriad of uses that the project groundwater model has been put to by the applicant during impact evaluation. We have compiled, from the text in the WMDPv13 and the PFEIS, references to the use of the groundwater modeling to predict impacts from the proposed project . Those uses range from contaminant flow direction and gradients (PFEIS page 5-26) to delineation of the Area of Potential Effect for cultural impacts (PFEIS page 4-309 and Figure 4.2.9-5). Project documents include very clear statements about the importance of MODFLOW in formulating impacts, for example the Water Modeling Data Package v13 Section 5.1.2.6 states:

> "Groundwater contours for the unconsolidated deposits and bedrock are the primary source of information used to delineate the flow path areas. The groundwater contours are from the Mine Site MODFLOW model"

The GoldSim contaminant transport modeling in particular uses many outputs from the MODFLOW groundwater modeling (attached as Table 3). These extend far beyond the original purpose of the groundwater model; which was to predict pit inflow, thus making it very clear that a valid model that characterizes site groundwater hydrology is foundational for impact prediction.

The project MODFLOW model was used to characterize the general nature of the groundwater system such as mine site head distribution (e.g. watertable, Large Figure 14 of the WMDPv13, attached as Figure 12), groundwater levels at closure (e.g. Large Figure 30 of Attachment B of WMDPv13, attached as Figure 13) and contaminant flow paths (Large Figures 28 & 29 of the WMDPv13, attached as Figures 3 & 4). In addition, the MODFLOW model was used to supply the numeric input parameters to the GoldSim model that is used for prediction of contaminant flow and contaminant concentrations (WMDPv13, Table 1-1). That table, attached as Table 4, identifies approximately 12 critical GoldSim input parameters that are outputs from the mine site MODFLOW groundwater model. Of those twelve,

approximately 6 parameters are related to mine pit inflow; the rest of the 12 parameters relate to the groundwater system across the entire mine site. Those parameters include contaminant flowpath conductivity (K_flowpath), flowpath gradients (I_ops), bedrock porosity (Bedrock_Porosity), recharge (Recharge_min and Recharge_max) and flowpath gradients at closure (I_close). While some of these parameters, such as flowpath conductivity, are secondarily derived from MODFLOW outputs, MODFLOW is an input to calculation of the GoldSim parameter, as documented in WMDP(v13) Section 5.2.3.3.

It is clear that without the conceptual (flow directions etc.) and numeric (gradient, conductivity etc.) outputs from the MODFLOW model, the GoldSim model could not be run. Because of the dependence of the GoldSim modeling of contaminant transport on MODFLOW model outputs, it is essential that the MODFLOW outputs be valid. Because the MODFLOW model was incorrectly calibrated to baseflow from 1979-88 and bounded with taconite pit water levels from 1996 it is very unlikely that the MODFLOW outputs are correct. Not only was the calibration model incorrectly bounded but the predictive runs use the same abnormally high P-M pit water levels. In particular the predictive runs for long-term closure (MODFLOW run "SS_west_fill_Sept2014_1585ec1595" resulting in Large Figures 29 and 30, WMDPv13 and PFEIS Figure 5.2.2-7) use the 1996 taconite pit water levels that are over 300 feet higher than the expected closure water levels.

Need for a consistent conceptual model of site hydrology:

There are two conflicting conceptual models presented in the draft northward flowpath memo: 1) that surface water features are not well connected to the bedrock, e.g. the Argo & Iron Lakes examples, and a multitude of previous EIS documents arguing for separated surficial and bedrock aquifers and against wetland impacts (see email of July 29, 2015, attached as Attachment C); and 2) that surface water features are well connected to the bedrock aquifer and that the 100 Mile Swamp (a wetland) can supply at least 8 inches/year of leakage. These two arguments would seem to be mutually exclusive. Both arguments can not be used simultaneously to support the concept of a groundwater mound between the PolyMet and Peter-Mitchel projects. A third argument has been hinted at during meetings; that the bedrock between PolyMet and the P-M pits is of such low conductivity that the cone of depression from the mine pits does not extend any significant distance from the pits. This argument is not supported by the site-specific conductivity data collected on the Virginia Formation or the documented conductivity of the Biwabik Iron Formation (see PFEIS tables 4.2.2-5 and 5.2.2-7).

A coherent conceptual model needs to be articulated, either one in which surface water features are poorly connected to the bedrock aquifer and are therefore, unaffected by pit dewatering, or one in which surface water features are well connected to the bedrock aquifer and can provide leakage to support a groundwater mound between the PolyMet and Peter-Mitchel pits. If the first model is accepted then wetlands and the upper Partridge River may be little affected by pit dewatering but dewatering of the Peter-Mitchel pits causes a bedrock northward flowpath to develop at closure. If the second conceptual model is accepted then a bedrock groundwater mound develops, but wetlands and the upper Partridge River are severely impacted by PolyMet and Peter-Mitchel pit dewatering.

"Adaptive management" as a substitute for understanding the site and predicting impacts:

Given the uncertainty that the co-leads feel there is in characterization of contaminant flowpath direction, the draft co-lead memo of June 22 proposes several mitigations that attempt to prevent northward flow of contaminants. The feasibility of any of those measures has not been evaluated. Even with the minimal information presented in the memo, several obstacles to successful mitigation of a

northward flowpath are evident: 1) The thickness of the low conductivity surficial deposits between the PolyMet site and the P-M pits, approximately 50 feet thick according to Minnesota Geological Survey 2005 publication M158, makes the practicality of an infiltration trench questionable; 2) Lowering of water levels in the the PolyMet pits would expose reactive Virginia Formation rock to air and water, creating acid generation and dewatering surrounding wetlands; 3) Groundwater injection or extraction wells may be a feasible, but costly, mechanism to block northward flow but, as noted in the memo, would require perpetual operation, care and replacement.

In addition to the proposed adaptive management appearing to be impractical, substituting 'adaptive management" for understanding of the hydrologic system is contrary to the NEPA concept of site characterization and impact prediction. NEPA is a forward looking process with the goal of anticipating and describing impacts so that measures can be taken to avoid or minimize those impacts. A northward flowpath for contaminants is indicated by both MODFLOW and MathCad. The character of the hydrology between the PolyMet and P-M projects needs to be described correctly so that impacts of that northward flowpath can be evaluated and the feasibility of mitigation measures can be determined.

In summary:

- The project mine site groundwater flow model (MODFLOW) was calibrated with multiple conditions that did not exist simultaneously, i.e. boundary conditions in the form of taconite pit water levels from 1996 and river baseflows from 1979-88. This means that the mine site model is not correctly configured and, therefore, unlikely to generate accurate predictions.

- The project model was configured and used by the applicant as a basis for contaminant transport predictions at closure. As configured, it predicts that contaminants would flow from the PolyMet site south to the Partridge River at project closure. However, if the model is configured with correct closure boundary conditions in the form of taconite pit water levels at their closure level of 396 meters (1300 feet) or the very long-term level of 457 meters (1500 feet), contaminants are predicted to flow to the north toward the P-M pits. This contaminant flow direction (to the P-M pits) is opposite the direction assumed for the current project contaminant transport modeling. The project contaminant modeling is incomplete because it does not evaluate northward flow of contaminants from either the PolyMet pits or the Category 1 stockpile.

- The conceptual model used for the basis of many of the conclusions in project reports and in the PFEIS text is that the taconite pits have little influence on the surrounding aquifer, regardless of whether they are full of water or pumped dry and that the surface water features are not hydraulically connected to the bedrock aquifer. However, the mine site MODFLOW model, which incorporates historical and site-specific conductivity data on the bedrock formations and is used by the applicant to predict closure conditions, indicates that the taconite pits have a profound impact on the surrounding aquifer. This is because the cone of depression caused by taconite pit dewatering extends well into the surrounding bedrock. Impact on the aquifer makes sense because of the relatively high horizontal conductivity of the bedrock in which the taconite pits sit.

-The current concept, articulated in the draft co-lead memo on a northward flowpath and the supporting MathCad modeling, appears to recognize the documented horizontal conductivities of the bedrock formations, yet seems to propose both the isolation of surface water features and the transmission of large quantities of water from surface water features to the bedrock. Both

isolation and transmission are not simultaneously possible. A consistent conceptual model must be presented.

-Pit dewatering may induce significant quantities of water from the surficial aquifer into the bedrock. Although this would likely cause substantial wetland & stream impacts, natural formation of a groundwater mound in the bedrock, adequate to prevent northward flow, is impossible given the conductivities documented in the project materials.

The mine site groundwater model needs to be reconfigured to contain realistic water levels in the P-M taconite pits, both for a "current conditions" model and a "closure conditions" model, not the 1996 water levels that were unusually high. The predictive modeling for the post closure period must use the correct closure water elevations for the P-M pits which are 300 feet lower than the unusually high 1996 levels. Groundwater modeling with MODFLOW, with correct P-M pit closure water levels of 396 meters, and MathCad modeling, both indicate that at closure contaminants are likely to flow north in addition to the southward direction currently assumed by project reports. Evaluation of contaminate flow to the north must be conducted and impacts predicted. Sensitivity analysis and adaptive management can not be substitutes for consistent and rational characterization of site hydrology.

Sincerely,

John Coleman

John Coleman, GLIFWC Environmental Section Leader

cc: Randall Doneen, Environmental Review Unit Supervisor, MN-DNR
Brenda Halter, Forest Supervisor, Superior National Forest
Tamera Cameron, Chief, Regulatory Branch, St Paul District of the Army Corps of Engineers
Kenneth Westlake, NEPA Coordinator, USEPA Region 5
Nancy Schuldt, Water Projects Coordinator, Fond du Lac Environmental Program
Neil Kmiecik, GLIFWC Biological Services Director
Ann McCammon Soltis, Director, GLIFWC Division of Intergovernmental Affairs

550 Babcock Dr., Rm. B102
Madison, WI 53706
608-263-2873 Fax 608-262-2500

Attachment A

Subject:	Materials for July 22nd modeling discussion, part 2
From:	"john.coleman" <jcoleman@glifwc.org>
Date:	7/21/2015 3:41 PM
Attachments:	Fig.30_Attach.B_of_Water_Modeling_Data_Package_Vol_1-Mine_Site_v13_DEC2014.pdf (417 KB), Fig.30_with_Peter-Mitchel_pits_at_closure_level_of_1500ft.pdf (553 KB)
To:	"Johnson, Bill H (DNR)" <bill.johnson@state.mn.us>, Sedlacek.Michael@epa.gov, mwatkins@grandportage.com, NancySchuldt@FDLREZ.COM, blatady@boisforte-nsn.gov, est [...]

Closure period modeling files:
The Barr modeling file for the closure period is named "Steady_State_west_pit_filling_Sept2014_1585ft_ec1595ft.gwv" and "SS_west_fill_Sept2014_1585ec1595.nam ." It is the model run used to generate:
Large Figures 28 and 29 of the Water Modeling Data Package Vol_1-Mine_Site_v13_DEC2014, .pdf pages 510 & 511 (contaminant flowpaths)
and
Large Figures 29 and 30 of Attachment B of Water Modeling Data Package Vol_1-Mine_Site_v13_DEC2014, .pdf pages 713 & 714 (bedrock and surficial water levels)

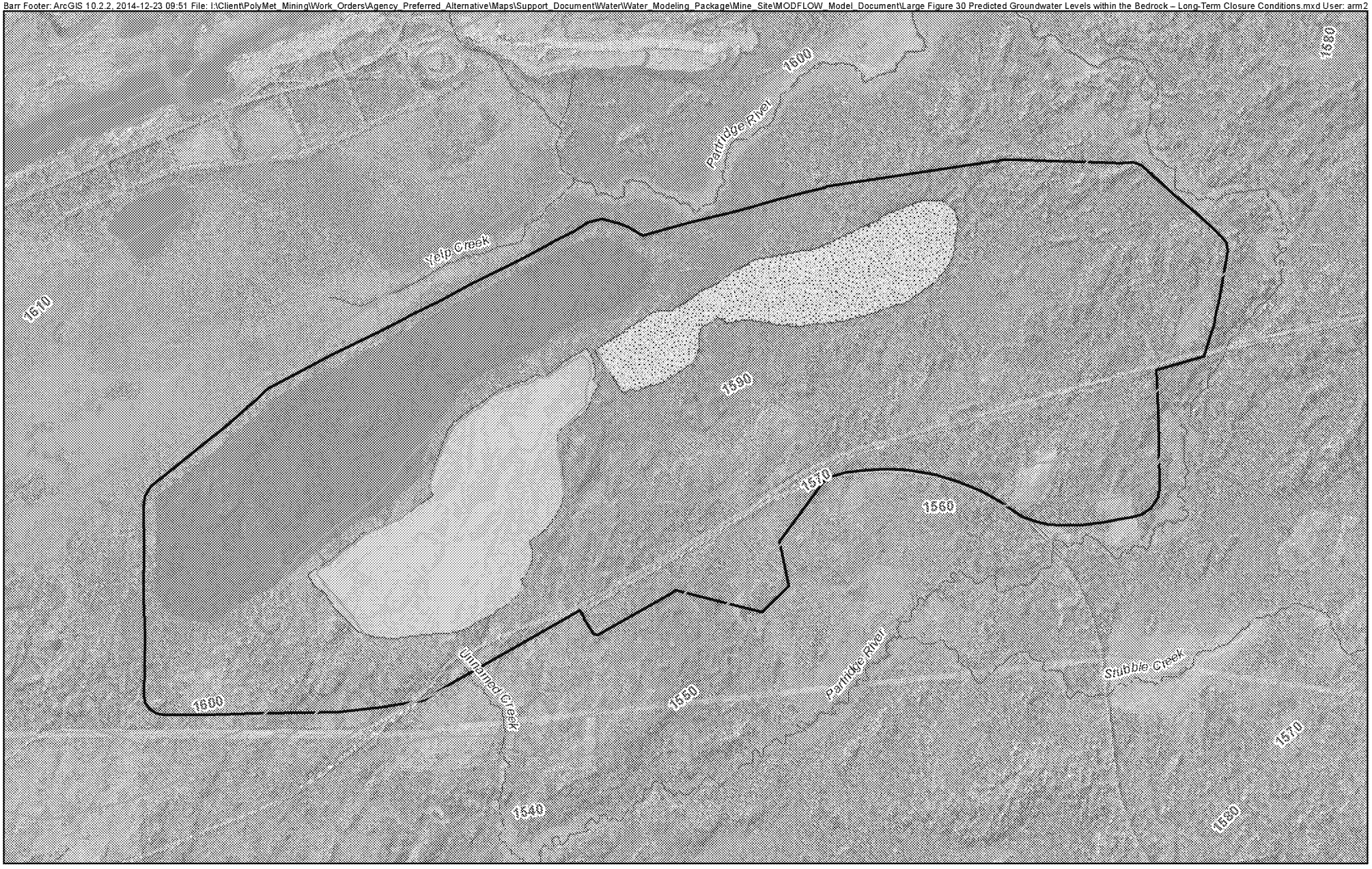
The model files were distributed to cooperating agencies by Bill Johnson in February of this year.
Is is described by Barr in an accompanying txt file as:
"Steady-state simulations of closure under baseline conditions:"
"West pit at 1585 feet MSL, East and Central pit at 1595 feet MSL:
Steady_State_west_pit_filling_Sept2014_1585ft_ec1595ft.gwv"

Polymet use of closure period modeling files:
Polymet predicted groundwater levels in the bedrock under long-term closure conditions using the MODFLOW model run referenced above. For example, the attached Large Figure 30 of Attachment B of the Water Modeling Data Package Vol_1-Mine_Site_v13_DEC2014 shows the bedrock water level contours predicted by that model run.
Those predicted contours were used in the Water Modeling Data Package to define flow paths (Large Figure 29 of the Water Modeling Data Package Vol_1-Mine_Site_v13_DEC2014). As stated on page 75 of the Water Modeling Data Package v13 (.pdf page 82):

> "Groundwater contours for the unconsolidated deposits and bedrock are the primary source of information used to delineate the flow path areas. The groundwater contours are from the Mine Site MODFLOW model"

Closure period model with correct closure levels:
Using the same model "Steady_State_west_pit_filling_Sept2014_1585ft_ec1595ft.gwv" except that water levels in the Peter-Mitchel taconite pits were set at their correct long term level of 1500 feet, we find that the model predicts different groundwater contours in the bedrock (figure attached). Neither "downward leakage" nor any other parameters in the model were modified. The contours predicted by the model when the P-M pits are at their long-term closure level of 1500 ft, indicate that there are bedrock flow paths to the north from the Polymet pits. At the time of Polymet closure, the P-M pits are expected to be at an elevation of approximately 1300 ft, amplifying the effect on the aquifer.

Barr Footer: ArcGIS 10.2.2, 2014-12-23 09:51 File: I:\Client\PolyMet_Mining\Work_Orders\Agency_Preferred_Alternative\Maps\Support_Document\Water\Water_Modeling_Package\Mine_Site\MODFLOW_Model_Document\Large Figure 30 Predicted Groundwater Levels within the Bedrock – Long-Term Closure Conditions.mxd User: arm2



Simulated Piezometric Surface (feet)
Contour Interval = 10 feet

Project Areas

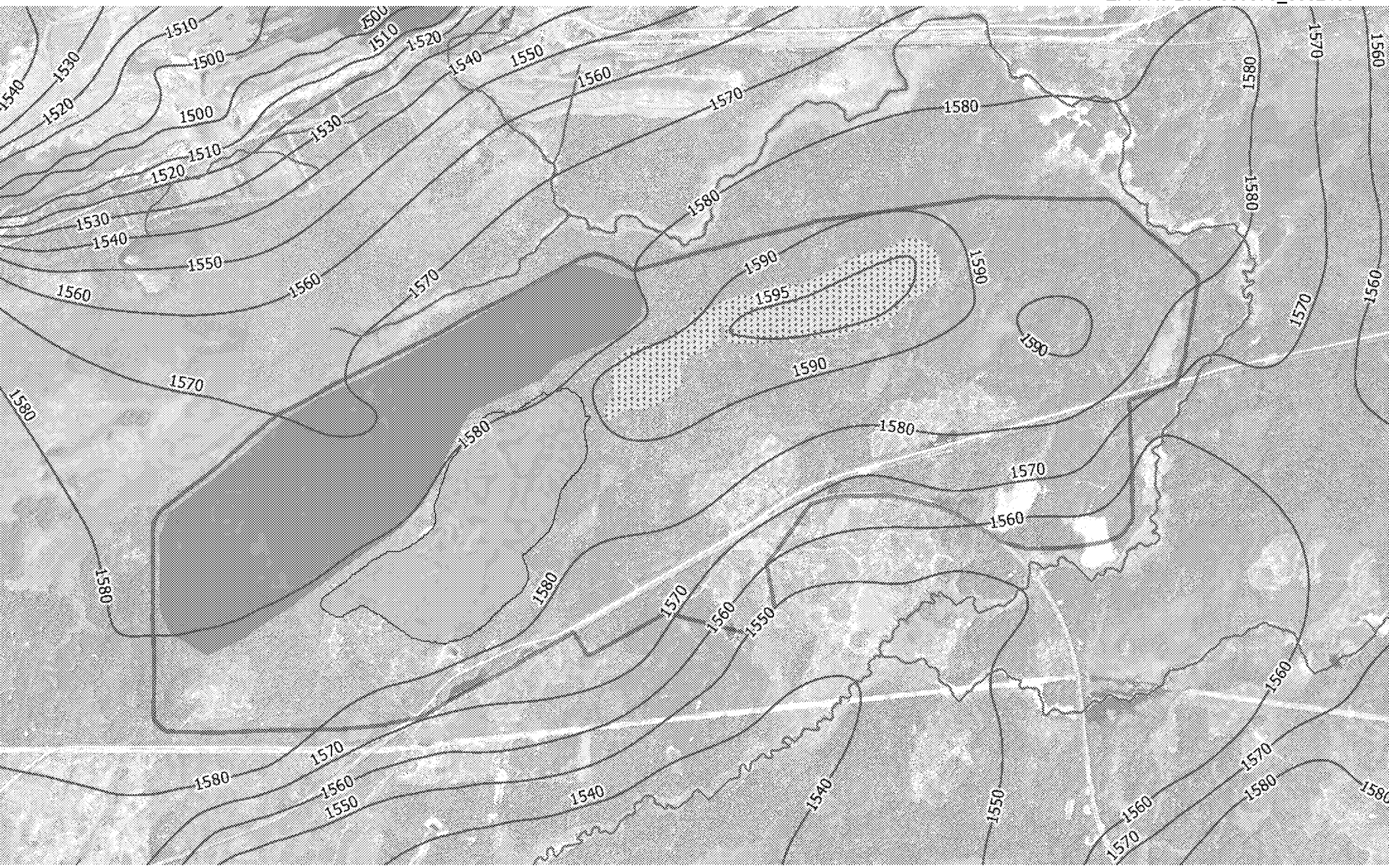
Covered Stockpile

West Pit

East Pit Wetland

0 1,250 2,500 5,000
Feet

Large Figure 30
PREDICTED GROUNDWATER LEVELS
WITHIN THE BEDROCK –
LONG-TERM CLOSURE CONDITIONS
NorthMet Project
Poly Met Mining, Inc.



Simulated Piezometric Surface (feet)
Contour Interval 10 feet

Project Areas

Covered Stockpile

West Pit

East Pit

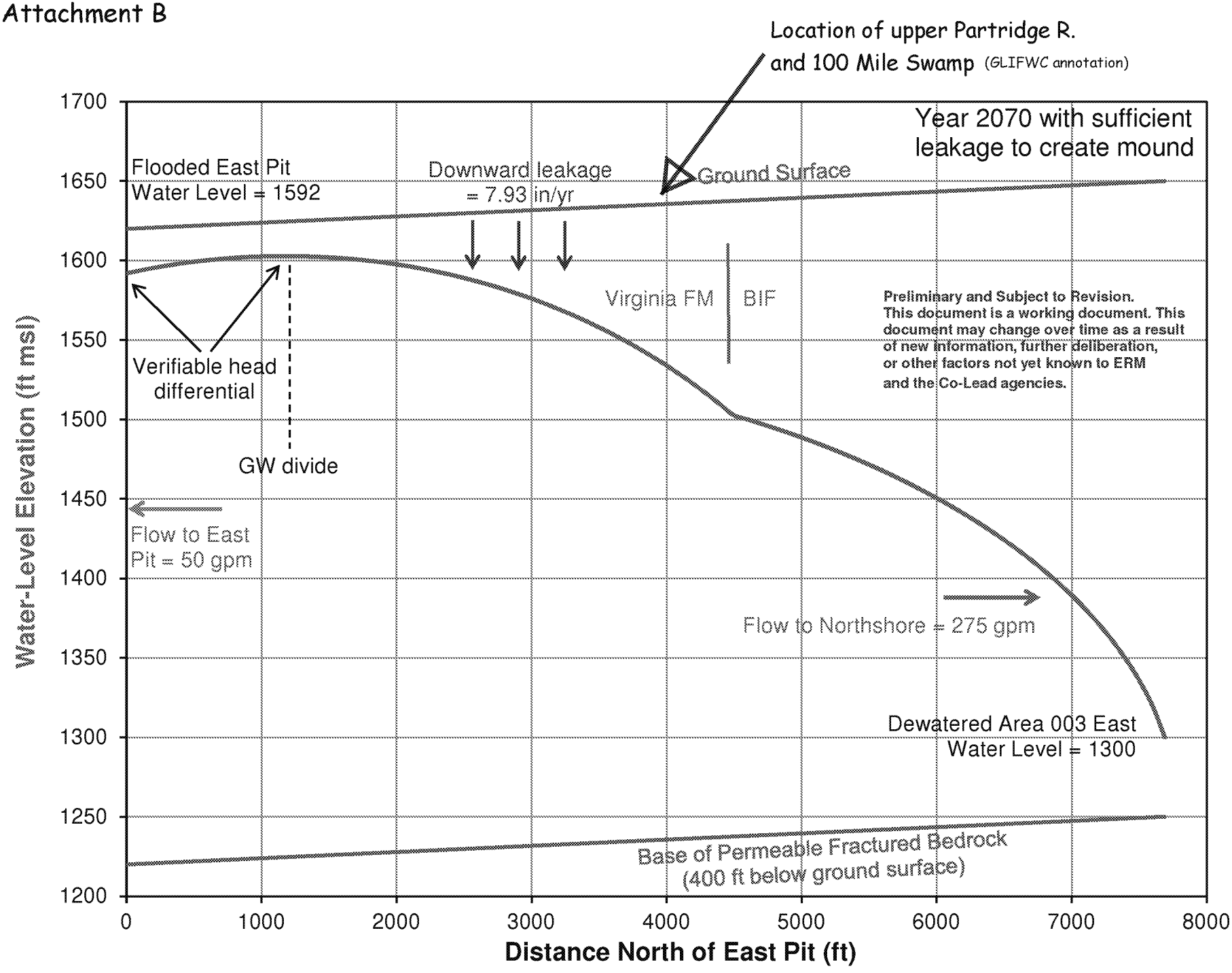
N

2500 0 2500 5000 ft

PREDICTED GROUNDWATER LEVELS
WITHIN THE BEDROCK -
LONG-TERM CLOSURE CONDITIONS
FOR NORTHMET
AND NORTHSHORE PROJECTS

GLIFWC, 2015-06-28

Attachment B



Polymet - Leakage conditions for mound at year 2070

Units below are ft-day

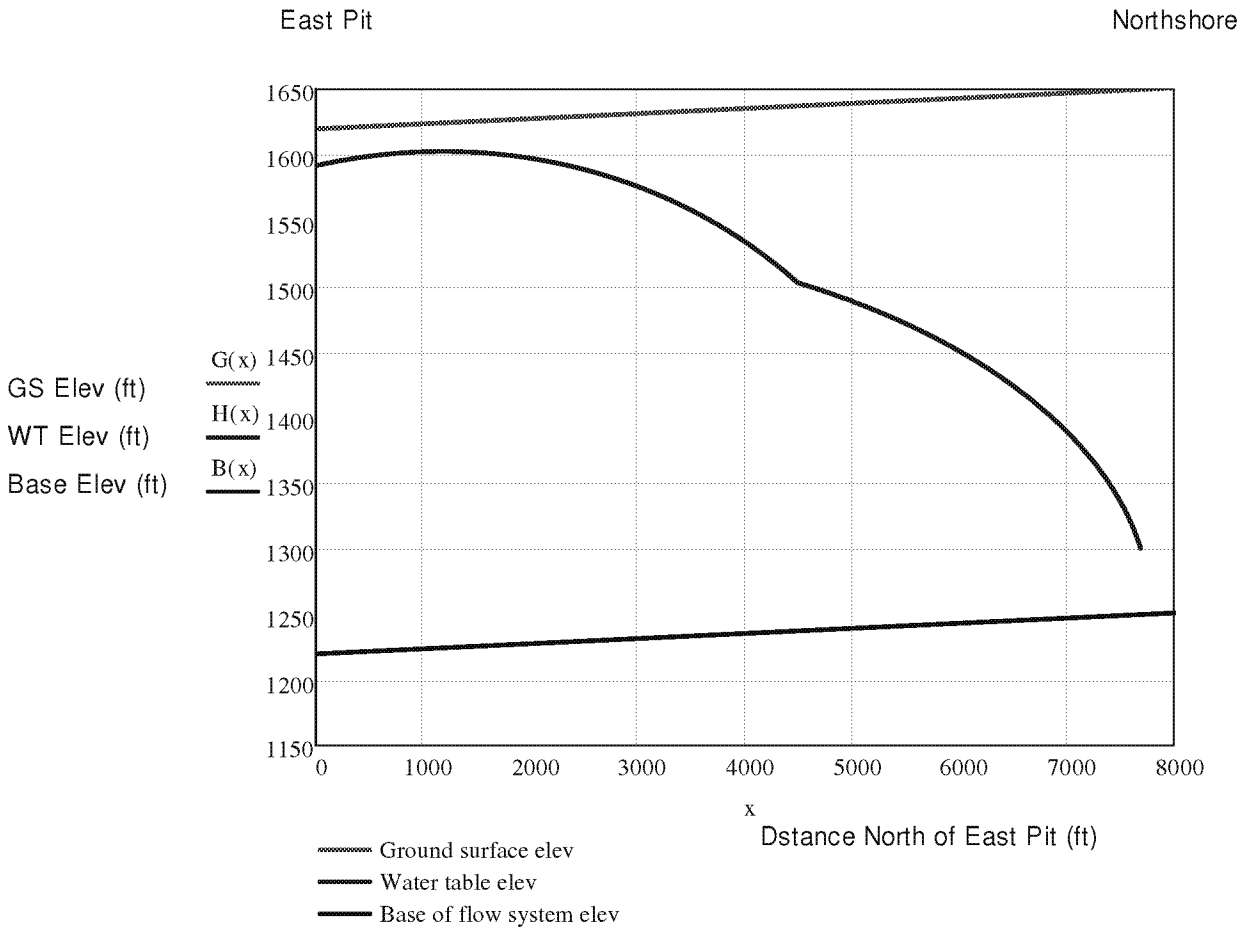
$KK_1 := 0.31 \cdot \frac{ft}{day}$	Hydraulic Conductivity Upper Virginia Fm.	$K_1 := KK_1 \cdot ft^{-1} \cdot day$	$K_1 = 0.310$
$KK_2 := 0.9 \cdot \frac{ft}{day}$	Hydraulic Conductivity Biwabik Fm.	$K_2 := KK_2 \cdot ft^{-1} \cdot day$	$K_2 = 0.900$
$WW := 7.93 \cdot \frac{in}{yr}$	Downward leakage flux into bedrock	$W := WW \cdot ft^{-1} \cdot day$	$W = 1.81 \times 10^{-3}$
$LL := 7690 \cdot ft$	Length of flow system (East Pit to PMP)	$L := LL \cdot ft^{-1}$	$L = 7690.0$
$DD := 4490 \cdot ft$	Distance to Virginia/Biwabik contact	$D := DD \cdot ft^{-1}$	$D = 4490.0$
$ww := 4500 \cdot ft$	Flow tube width	$w := ww \cdot ft^{-1}$	$w = 4500.0$
$GG_o := 1620 \cdot ft$	Ground elevation at x=0	$G_o := GG_o \cdot ft^{-1}$	$G_o = 1620.0$
$HH_o := 1592 \cdot ft$	Head at x=0	$H_o := HH_o \cdot ft^{-1}$	$H_o = 1592.0$
$BB_o := 1220 \cdot ft$	Base elevation at x=0	$B_o := BB_o \cdot ft^{-1}$	$B_o = 1220.0$
$S_G := 0.0039$	Ground slope		$S_G = 0.00390$
$S_B := S_G$	Aquifer base slope		$S_B = 0.00390$
$QQ_o := -50gpm$	Inflow at x=0	$Q_o := QQ_o \cdot ft^{-3} \cdot day$	$Q_o = -9.625 \times 10^{3}$
$G(x) := G_o + S_G \cdot x$	Ground elevation	$G(0) = 1620.0$	$G(L) = 1650.0$
$B(x) := B_o + S_B \cdot x$	Base elevation	$B(0) = 1220.0$	$B(L) = 1250.0$
$K(x) := \begin{cases} K_1 & \text{if } x \le D \\ K_2 & \text{otherwise} \end{cases}$	Hydraulic conductivity distribution along flowpath		

Given $\quad H'(x) = -\dfrac{\frac{Q_o}{w} + W \cdot x}{K(x) \cdot (H(x) - B(x))} \quad H(0) = H_o \quad H := \text{Odesolve}(x, L)$ $\quad$ Governing ODE and BC

"Point-and-shoot" solution method

Iterate on QQ_o and/or WW until the head at x = LL is 1300 ft; that is, H(L) = 1300 $\quad H(L) = 1300.1$

This solution is for 1-D horizontal flow and accounts for:
Variable saturated thickness
Uniform downward leakage
Sloping aquifer base


East Pit
Northshore
1650
1600
1550
1500
1450
1400
1350
1300
1250
1200
1150
G(x)
H(x)
B(x)
GS Elev (ft)
WT Elev (ft)
Base Elev (ft)
0
1000
2000
3000
4000
5000
6000
7000
8000
x
Dstance North of East Pit (ft)
Ground surface elev
Water table elev
Base of flow system elev

Attachment C

Subject:	material related to bedrock-wetland connections at Polymet mine site
From:	"john.coleman" <jcoleman@glifwc.org>
Date:	7/29/2015 8:12 AM
To:	bill.johnson@state.mn.us, Sedlacek.Michael@epa.gov, mwatkins@grandportage.com, NancySchuldt@FDLREZ.COM, blatady@boisforte-nsn.gov, esteban@glifwc.org, TKaspar@1 [...]

Following up on the webinar last week, here is some material related to the hydrologic connection between surficial wetlands and the bedrock aquifer.

Throughout the development of the EIS, the applicant and their consultants have made the argument that the surficial deposits, and in particular wetlands such as the 100 Mile Swamp, are not hydrologically well connected to the bedrock aquifer. 8 inches/year of leakage to establish a groundwater mound in the bedrock would require that the 100 Mile Swamp be well connected to the underlying bedrock aquifer. Statements by the applicant claiming a weak to non-existent connection between surficial deposits and the bedrock include:

1) "there may be an unsaturated zone between the surficial deposits and bedrock present in some portions of the site, which would suggest **a minimal degree of hydraulic connection between the surficial aquifer and bedrock**." (WMDP v13, Section 4.3.3.2 Bedrock)
and

2) "As discussed in Section 4.3.3.2, available data indicates that, **although the surficial aquifer and bedrock are likely hydraulically connected to some degree, the connection is believed to be weak or non-existent in many areas of the Mine Site**." (WMDP v13, Section 5.2.3.1 Groundwater Flow Path Modeling)
and

3) "Because **the dense underlying till acts as an aquitard that restricts downward water flow**, most of the organic and mineral soils in the depressional areas of the site have perched water tables." (page 3, Barr June 2, 2008, Indirect Wetland Impacts at the Mine Site).
and

4) "Figure 4 identifies the moisture content throughout the soil profiles from the soil surface to the bedrock surface (Barr, Overburden Soil Boring Logs - Draft, January 2008). The moisture content was field described as dry, moist or wet. The moisture content changes throughout each soil profile, **indicating the surficial aquifer is not always continuous from the soil surface to the bedrock surface**." (page 4, Barr June 2, 2008, Indirect Wetland Impacts at the Mine Site).
and

5) "Because of the **lack of interaction between the surficial and bedrock aquifers**, the hydrology of the wetlands at the site is primarily supported by direct precipitation with some variable surficial groundwater component from the uplands." (page 4, Barr June 2, 2008, Indirect Wetland Impacts at the Mine Site).
and

6) "A number of factors contribute to the stable hydrology of the wetlands on the site including: 1) **the lack of continuity between the bedrock and surficial aquifers**; 2) the variability of the hydraulic conductivities within the soil layers causing perched water tables;" (page 12, Barr June 2, 2008, Indirect Wetland Impacts at the Mine Site).
and

7) "**Wetlands generally have a perched surficial water table and no interaction with the bedrock aquifer**." (page 12, Barr June 2, 2008, Indirect Wetland Impacts at the Mine Site).

8) "Because of the **general lack of interaction between the surficial and bedrock aquifers**, the hydrology of many wetlands at the Mine Site is primarily supported by direct precipitation with some variable surficial groundwater components from the uplands." (PFEIS Page 4-167, lines 191-193)

9) "indicating that **the connection between the bedrock, unconsolidated deposits, and wetlands may be be relatively weak**." (PFEIS, page 4-168, line 246)

The above quotes are a few examples of the many statements in the EIS materials that contend that the surficial aquifer, and in particular wetlands, are isolated from the bedrock.

The sections of the Water Modeling Data Package (WMDP) are available as part of the PFEIS package.
The Barr June 2, 2008, Indirect Wetland Impacts at the Mine Site is available at:
https://app.box.com/s/fj9lfpppml5a1av2himffyi3c0opjia9
and is cited in the PFEIS as Barr 2008h

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John Coleman, Madison Office of the Great Lakes Indian Fish & Wildlife Commission
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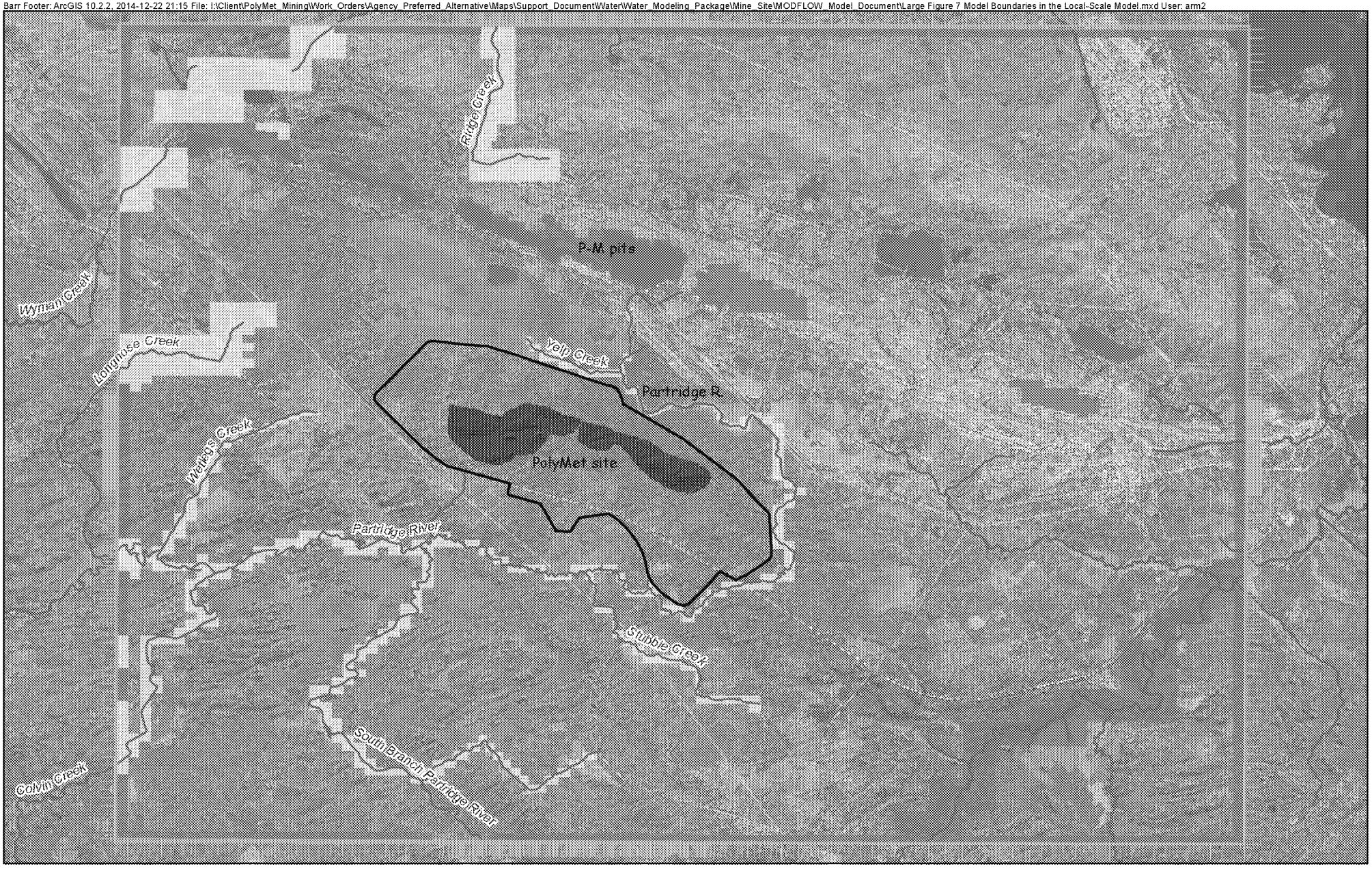
Madison, WI 53706
608-263-2873 or 265-5639
jcoleman@glifwc.org

Figure 1

Barr Footer: ArcGIS 10.2.2, 2014-12-22 21:15 File: I:\Client\PolyMet_Mining\Work_Orders\Agency_Preferred_Alternative\Maps\Support_Document\Water\Water_Modeling_Package\Mine_Site\MODFLOW_Model_Document\Large Figure 7 Model Boundaries in the Local-Scale Model.mxd User: arm2



Local-Scale Model Area
Model Grid
Constant Head Cell
River Cell
Mine Site
Pits - Mine Year 11

0 0.65 1.3 2.6
Miles

Large Figure 7
MODEL BOUNDARIES IN
THE LOCAL-SCALE MODEL
NorthMet Project
Poly Met Mining, Inc.

Figure 2

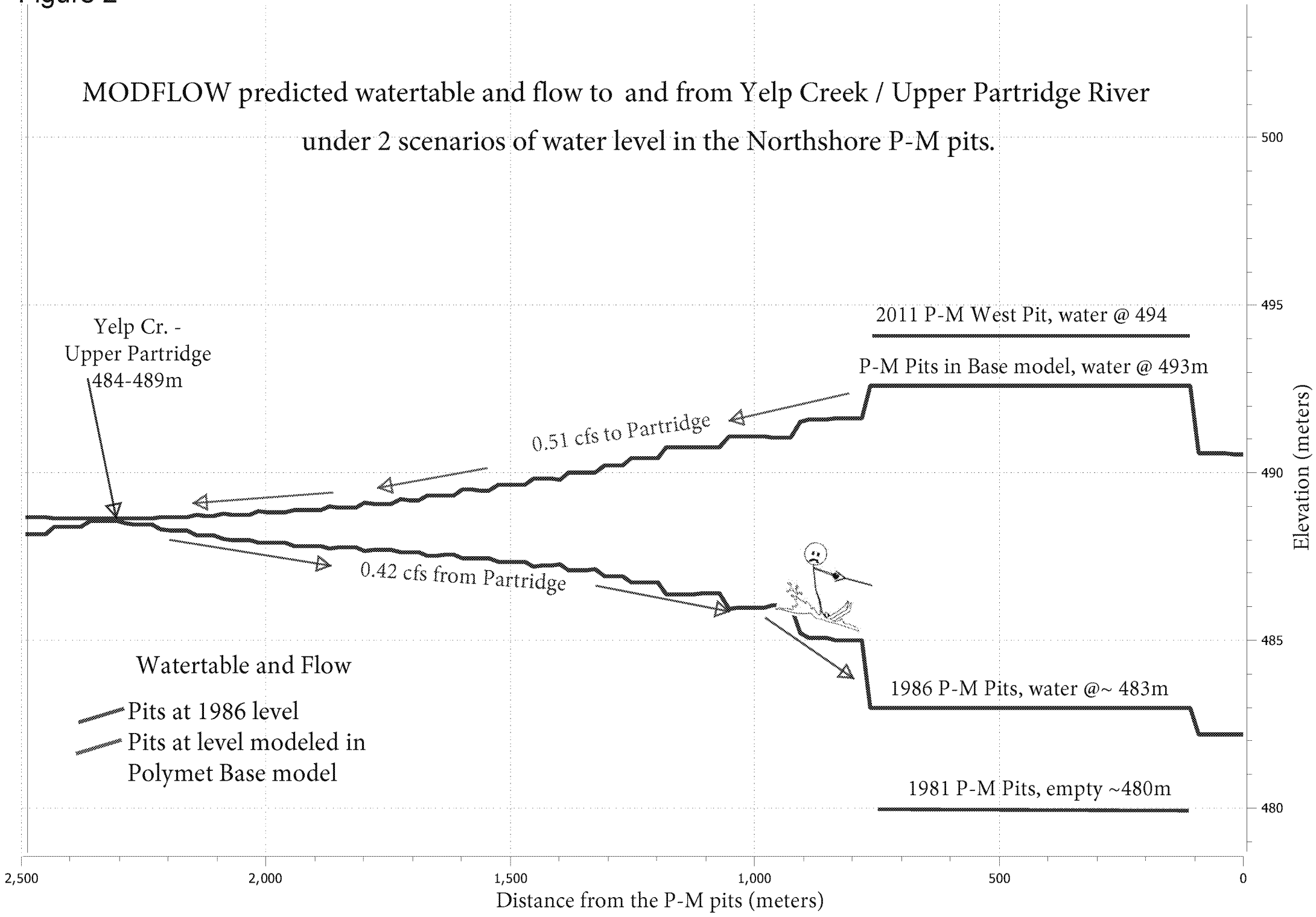
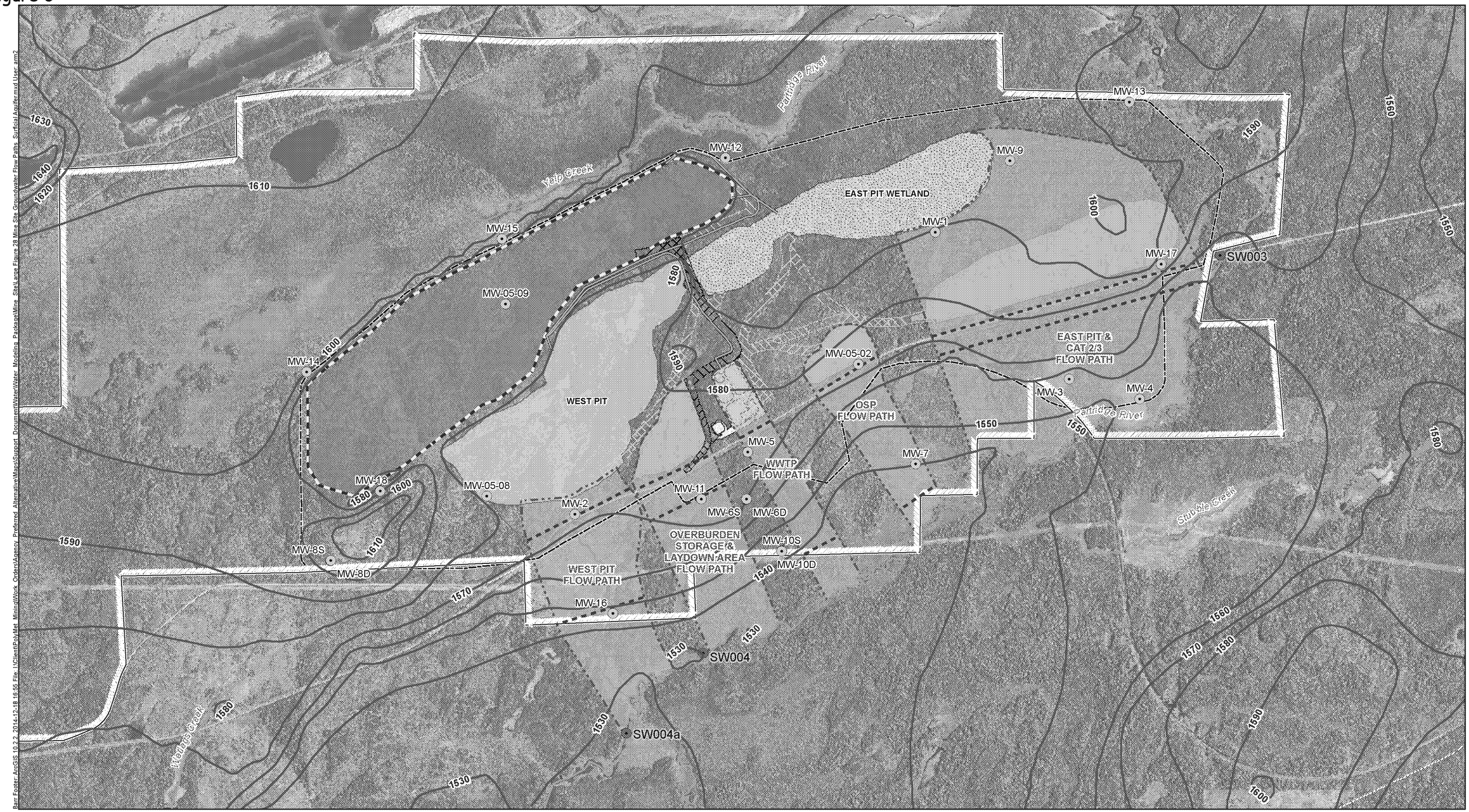

MODFLOW predicted watertable and flow to and from Yelp Creek / Upper Partridge River
under 2 scenarios of water level in the Northshore P-M pits.
Yelp Cr. -
Upper Partridge
484-489m
2011 P-M West Pit, water @ 494
P-M Pits in Base model, water @ 493m
0.51 cfs to Partridge
0.42 cfs from Partridge
1986 P-M Pits, water @~ 483m
1981 P-M Pits, empty ~480m
Watertable and Flow
Pits at 1986 level
Pits at level modeled in
Polymet Base model
500
495
490
485
480
Elevation (meters)
2,500
2,000
1,500
1,000
500
0
Distance from the P-M pits (meters)

Figure 2 - Profile of the water table between the upper Partridge and the P-M pits under 2 scenarios of water level in the pits.
The red stair-step line in the figure is the water table between the upper Partridge R. and the Peter-Mitchel taconite pits when the pits are at 493 meters elevation. Water is flowing from the pits to the upper Partridge R.
The purple stair-step line is the water table between the upper Partridge R. and the Peter-Mitchel taconite pits when the pits are at 483 meters elevation (the elevation that they had in 1986). In the 483 meter model run, water is flowing from the upper Partridge R., to the P-M pits.

Figure 3



Mine Features
- West Pit
- East Pit Wetland
- Reclaimed Stockpile
- Removed and Reclaimed Stockpile
- Haul Roads
- Reclaimed Haul Roads

- Surface Water Monitoring Location
- Groundwater Monitoring Location
- Groundwater Containment System
- Process Water Pipe
- Groundwater Elevation Contours (Ft) at Closure[1]

[1] Inferred water table contours were developed using contours from the Mine Site MODFLOW model.

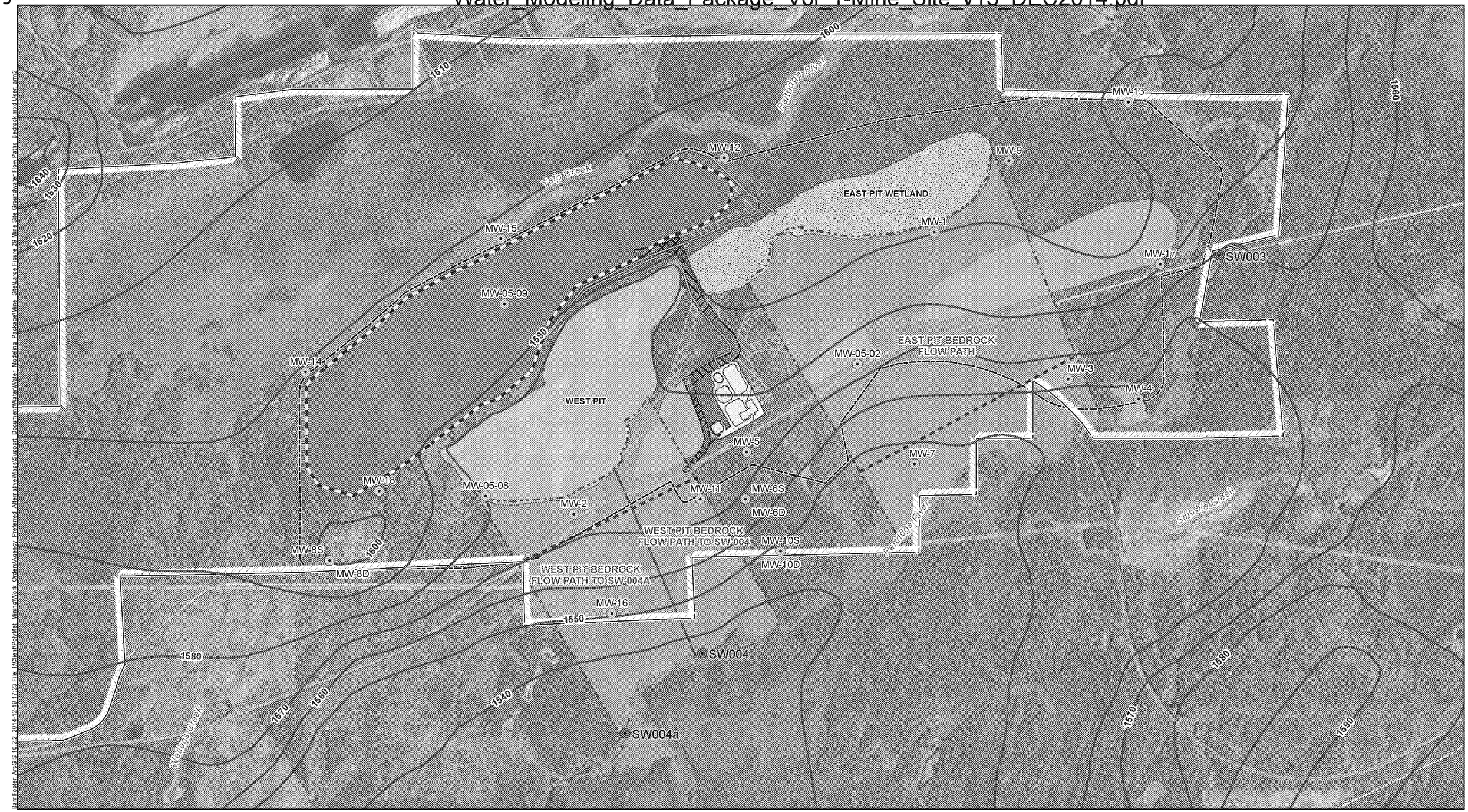
- Groundwater Evaluation Distances
- Groundwater Flow Path
- Mine Site
- Extent of Future PolyMet Lands

0 1,000 2,000 4,000
Feet

Large Figure 28
MINE SITE GROUNDWATER
FLOW PATHS - SURFICIAL AQUIFER
NorthMet Project
Poly Met Mining Inc.
Hoyt Lakes, MN

Figure 4

Water_Modeling_Data_Package_Vol_1-Mine_Site_v13_DEC2014.pdf



Mine Features
- West Pit
- East Pit Wetland
- Reclaimed Stockpile
- Removed and Reclaimed Stockpile
- Haul Roads
- Reclaimed Haul Roads

- Surface Water Monitoring Location
- Groundwater Monitoring Location
- Groundwater Containment System
- Process Water Pipe
- Groundwater Elevation Contours (Ft) at Closure[1]

[1] Inferred water table contours were developed using contours from the Mine Site MODFLOW model.

- Groundwater Evaluation Distances
- Groundwater Flow Path
- Mine Site
- Extent of Future PolyMet Lands

0 1,000 2,000 4,000
Feet

Large Figure 29
MINE SITE GROUNDWATER FLOW PATHS - BEDROCK
NorthMet Project
Poly Met Mining Inc.
Hoyt Lakes, MN

Figure 5

Water Levels in Peter-Mitchel Area003-east pit

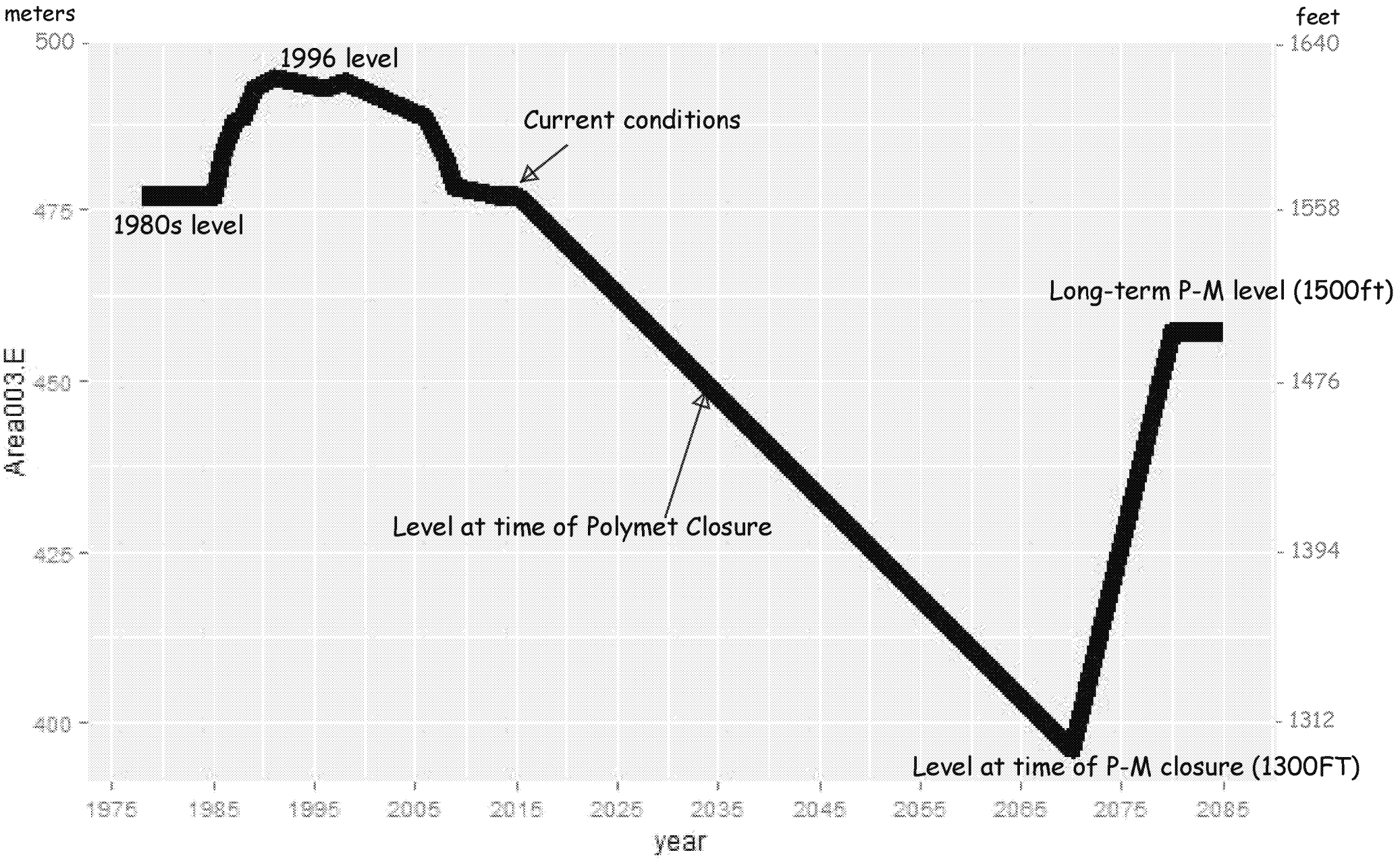
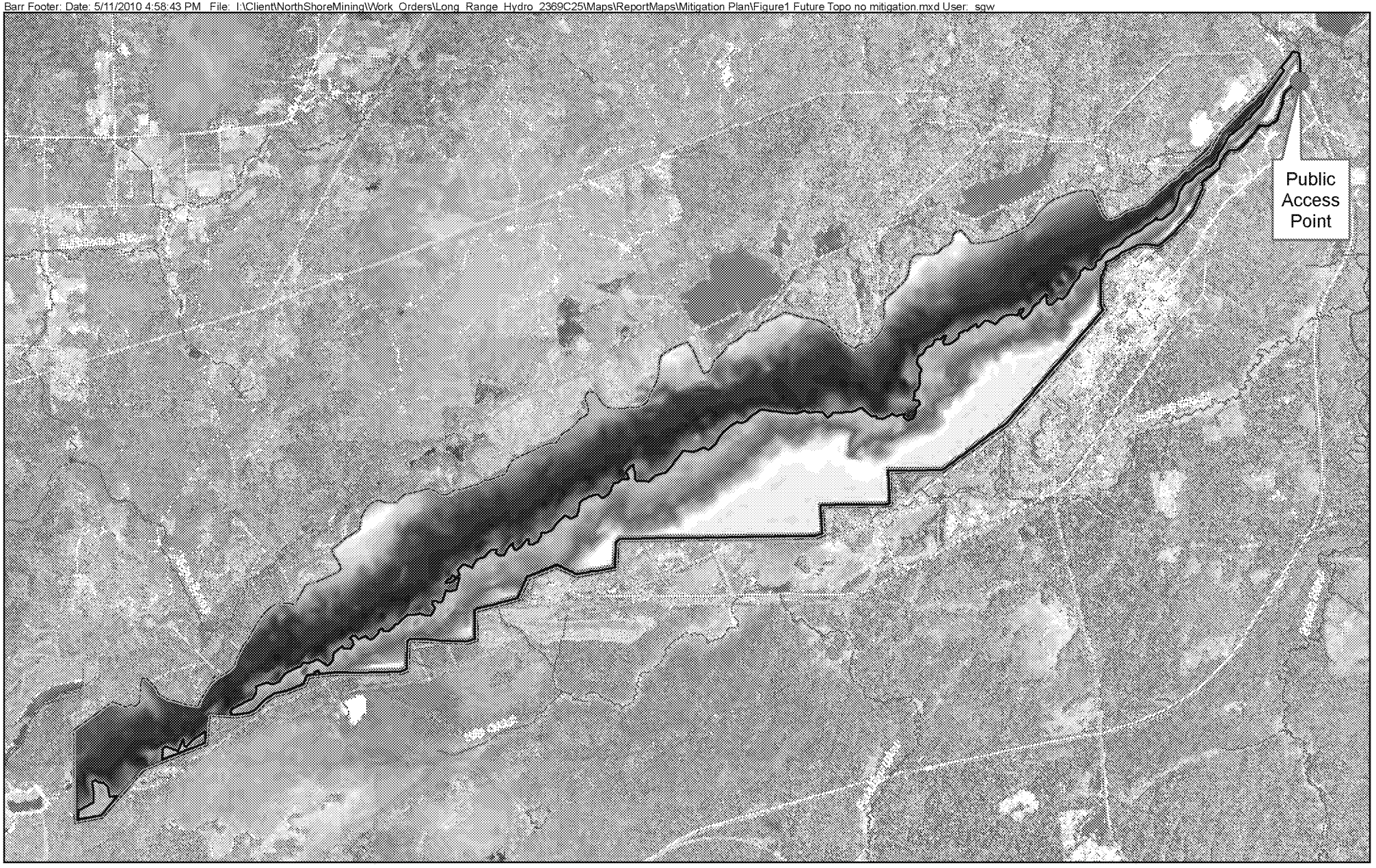


Figure 6

Barr Footer: Date: 5/11/2010 4:58:43 PM File: I:\Client\NorthShoreMining\Work_Orders\Long_Range_Hydro_2369C25\Maps\ReportMaps\Mitigation Plan\Figure1 Future Topo no mitigation.mxd User: sgw



1500 ft contour

Mine Site Boundary

Streams

Future Topography (no mitigation)

Elevation (feet)

High : 1785.95

Low : 1195.2

N

Kilometers

1 0 1 2 3

Miles

1 0 1 2

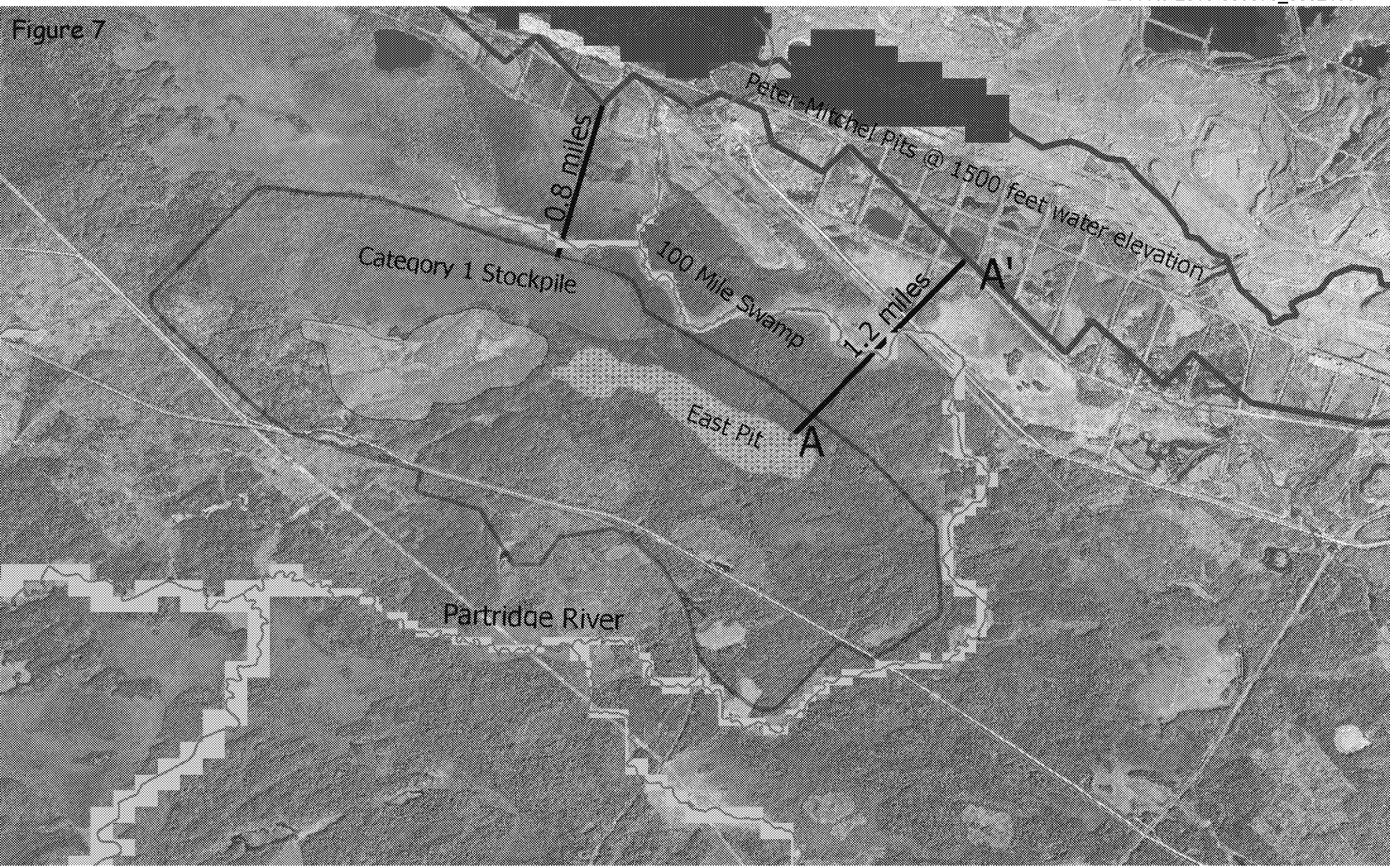
Figure 1

BARR

Ultimate Topography of the PMP
(without Mitigation)
Peter Mitchell Pit Mitigation Plan
North Shore Mining
Babbitt, Minnesota

Figure from the Northshore Watershed Mitigation Plan of 2011. - A map of the Peter-Mitchel pit final lake water elevation from the Feb. 11, 2011 report titled "Watershed Mitigation Plan" (MDNR 2011s.pdf) which contains the May 2010 BARR Engineering document titled: "Peter Mitchell Pit Concept Mitigation Plan". That plan identifies the final status of the P-M pits as being connected into a long east-west pit that will be allowed to fill to a water elevation of 1500 ft (457 meters). The recreational lake formed by this filling is scheduled to passively discharge to a tributary of the Dunka River in the north-east. While the ultimate water level in the reflooded P-M pits is expected to be 1500 feet, in the interim, the taconite pit bottoms continue to be deepened to an elevation of approximately 1300 ft (396 meters). In 2011 the bottoms of the P-M pits ranged down to an elevation of 1394 feet (425 meters).

Figure 7



Outline of Peter-Mitchel1500 ft pit lake.

Project Areas

Cat. 1 Stockpile

West Pit

East Pit

2500 0 2500 5000 ft

Polymet pits and Category 1 stockpile at closure.
Northshore Peter-Mitchel pit lake at 1500 foot level

GLIFWC, 2015-08-06

Figure 8 Flow of particles when P-M pits are at closure levels (457 meters).

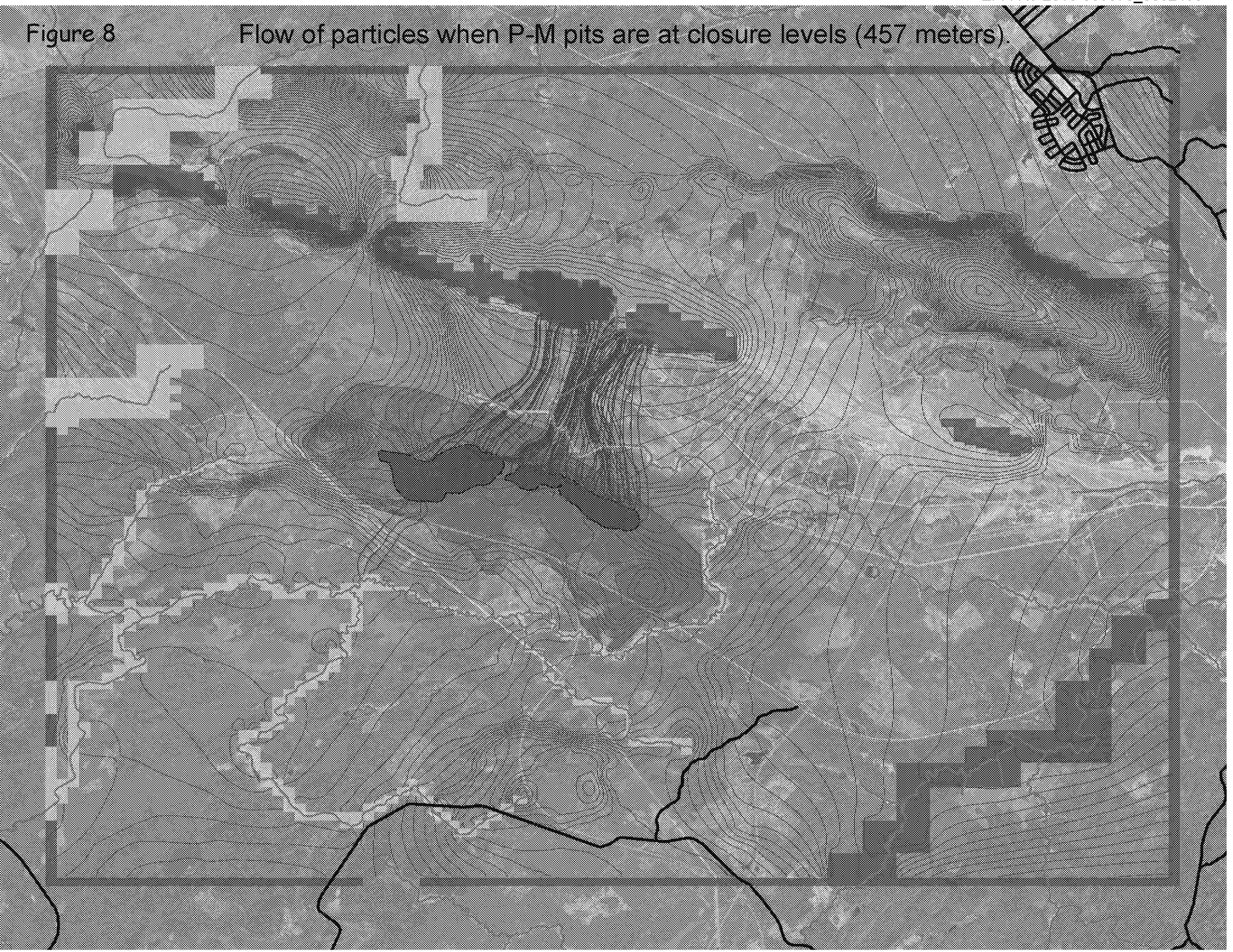
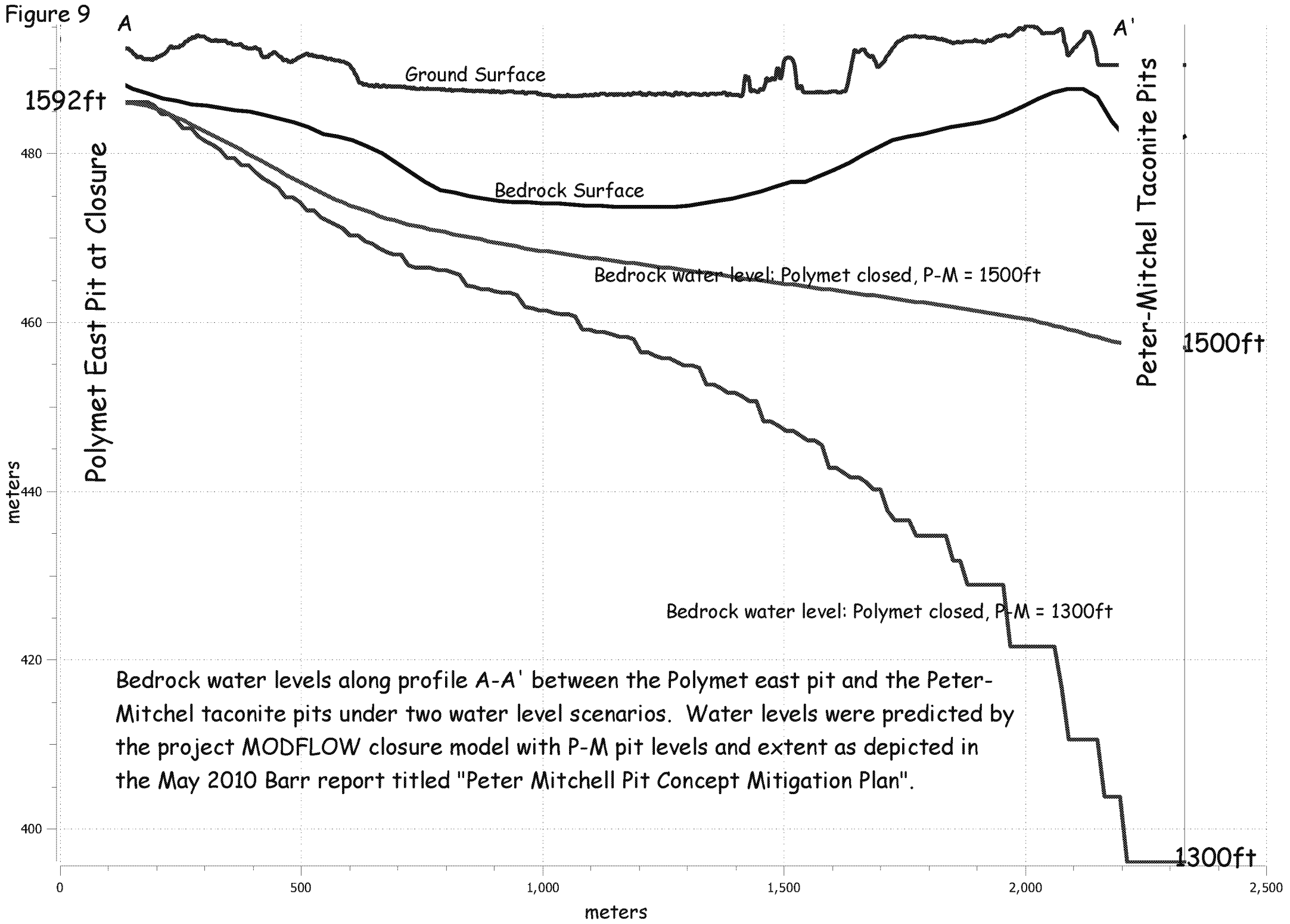


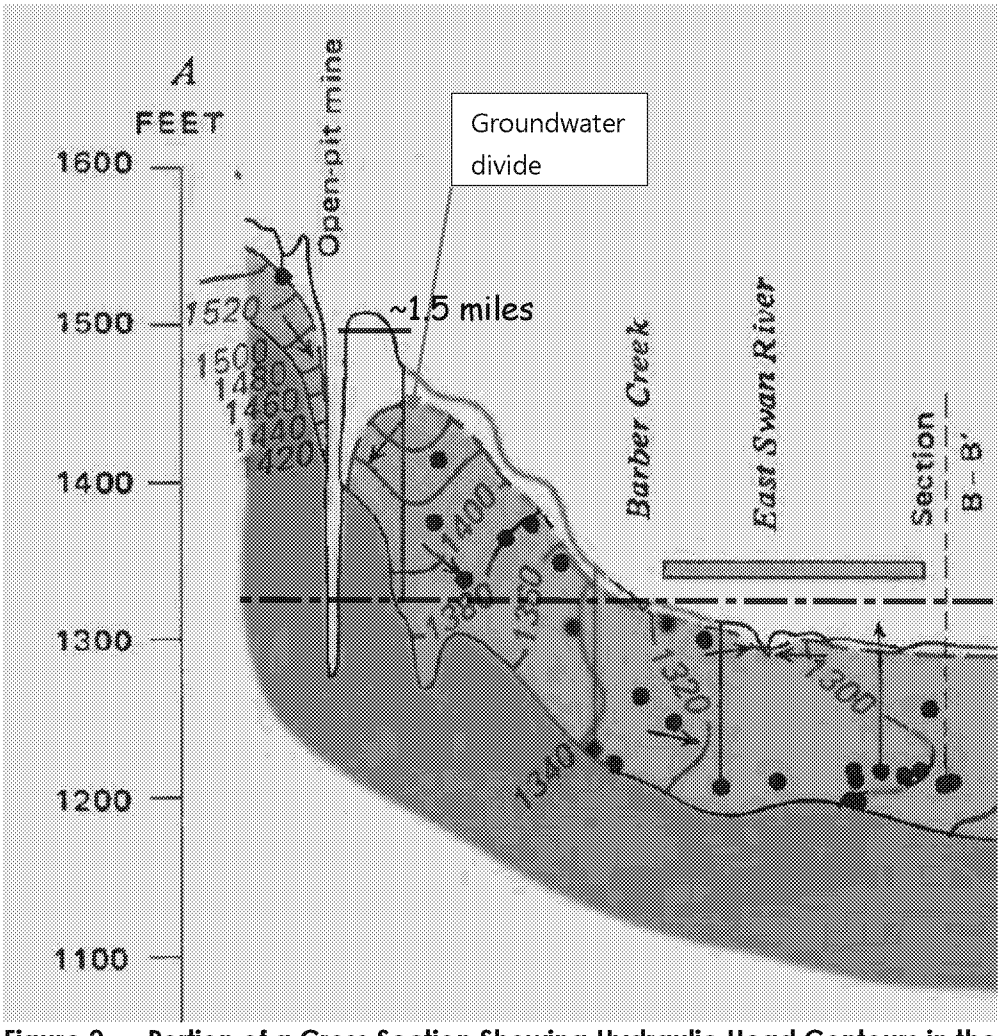
Figure 8 - A map of particles (water) moving from the Polymet pit areas to the P-M pits. This scoping level modeling used the Polymet base MODFLOW model with P-M pits set to their long-term level of 457 meters (1500 ft). Because the upper Partridge River would be unable to supply unlimited water to the aquifer, discharge from the upper Partridge River to the groundwater system is prevented in this model run.
Particles were added to the surficial aquifer and allowed to travel in the direction that the aquifer carried them. These particle tracks originate in the area of the proposed Polymet pits and end at the P-M taconite pits. A few particles leave the Polymet west pit area and travel to the Partridge River because the S-W corner of the Polymet west pit is on the south side of the watertable divide.

Figure 9



Bedrock water levels along profile A-A' between the Polymet east pit and the Peter-Mitchel taconite pits under two water level scenarios. Water levels were predicted by the project MODFLOW closure model with P-M pit levels and extent as depicted in the May 2010 Barr report titled "Peter Mitchell Pit Concept Mitigation Plan".

Figure 10. From Barr 2015-07-04 memo titled: Response to Cooperating Agency Comments Related to Peter Mitchell Pit – Version 3



Note: Polymet E. pit is 1.2 miles from P-M

Figure 2 Portion of a Cross Section Showing Hydraulic Head Contours in the Drift Aquifer Adjacent to an Open-pit Mine (from Cross-section A-A' of Reference (2)). *The portion shown has a length of approximately 17 miles*

Figure 11. From Barr 2015-07-04 memo titled: Response to Cooperating Agency Comments Related to Peter Mitchell Pit – Version 3

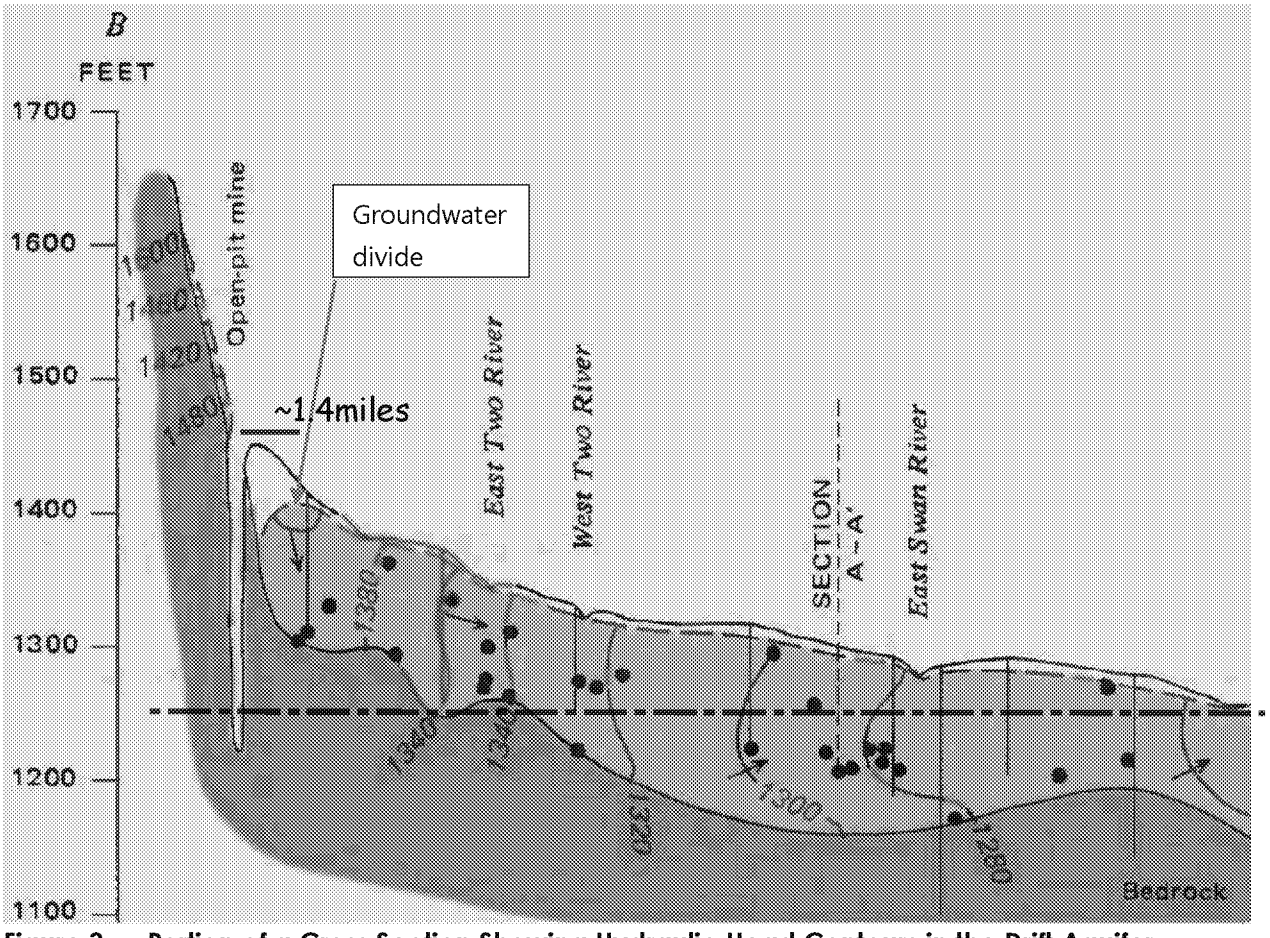


Figure 3 Portion of a Cross Section Showing Hydraulic Head Contours in the Drift Aquifer Adjacent to an Open-pit Mine (from Cross-Section B-B' of Reference (2)]). *The portion shown has a length of approximately 22 miles*

Figure 12

Monitoring Well

Groundwater Elevation Contours (Ft)[1]

Streams/Rivers

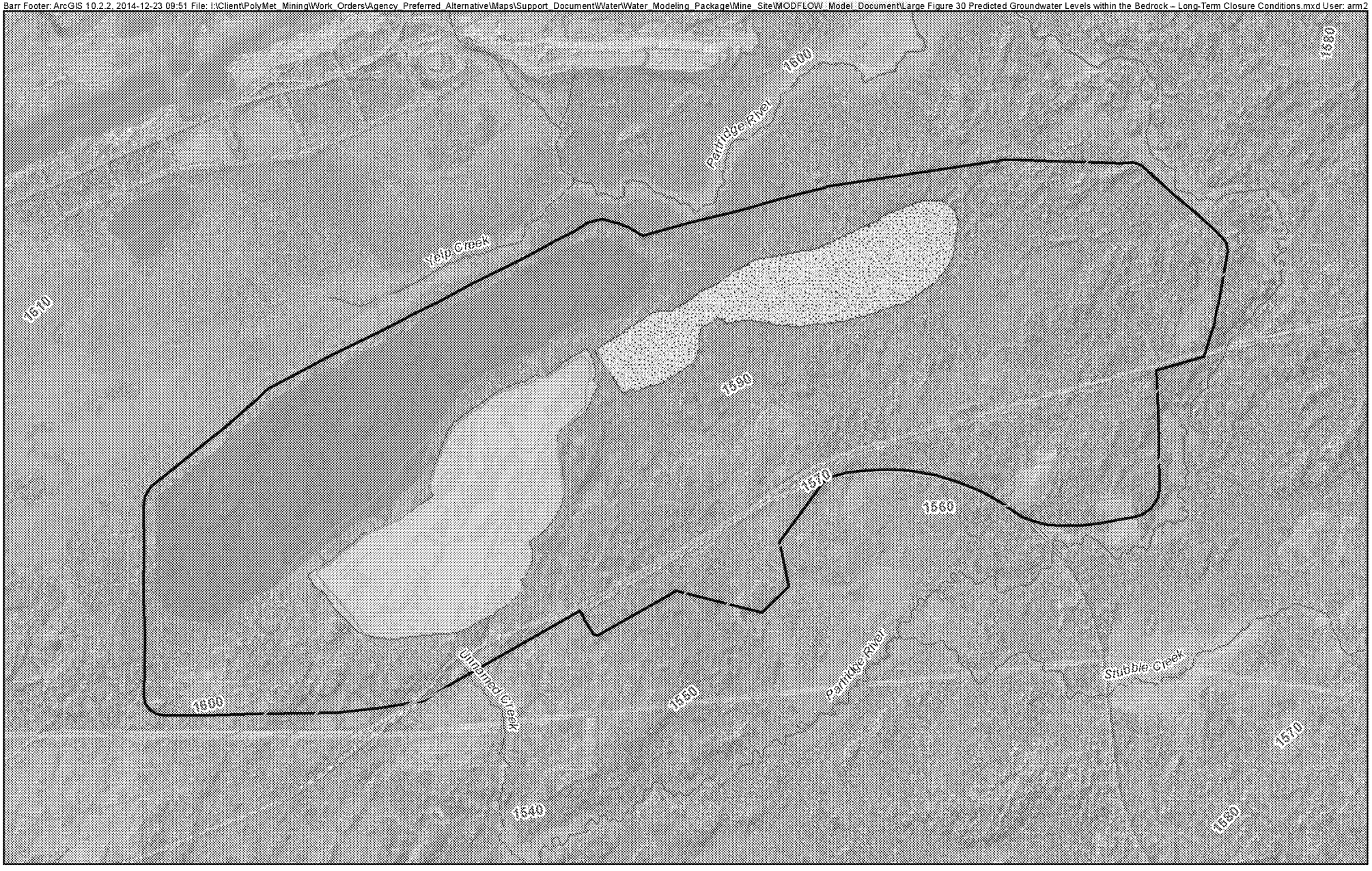
Mine Site

[1]Inferred water table contours were developed using a combination of measured groundwater elevations in site monitoring wells and contours from the Mine Site MODFLOW model.

Large Figure 14
INFERRED GROUNDWATER CONTOURS
SURFICIAL AQUIFER, CURRENT CONDITIONS
NorthMet Project
Poly Met Mining Inc.
Hoyt Lakes, MN

Figure 13

Barr Footer: ArcGIS 10.2.2, 2014-12-23 09:51 File: I:\Client\PolyMet_Mining\Work_Orders\Agency_Preferred_Alternative\Maps\Support_Document\Water\Water_Modeling_Package\Mine_Site\MODFLOW_Model_Document\Large Figure 30 Predicted Groundwater Levels within the Bedrock – Long-Term Closure Conditions.mxd User: arm2



Simulated Piezometric Surface (feet)
Contour Interval = 10 feet

Project Areas

Covered Stockpile

West Pit

East Pit Wetland

0 1,250 2,500 5,000
Feet

Large Figure 30
PREDICTED GROUNDWATER LEVELS
WITHIN THE BEDROCK –
LONG-TERM CLOSURE CONDITIONS
NorthMet Project
Poly Met Mining, Inc.

Table 1. Peter-Mitchel pit water levels.

The pit number correspond to the pits in the attached map.

	<-west			pit				east->
	8	7	6*Area3-West	5*Area3-East	4 Area2	3	2	1
year		SD011-12	SD008-10	SD006-7	SD005	SD004		SD002
1978/09		empty	~empty	**empty**	empty	empty	empty	
1979/09		empty	empty	**empty**	empty	empty	empty	
1980/10		empty	empty	**~empty**	empty	empty	empty	
1985/10		~empty	~empty	**<477.9**	~empty	~empty	~empty	~empty
1986/11				**483.4**				
1987/09				**487.7**				
1988/04				488.3				
1989/10				492.6	492.6			
1991/09		499.0	494.0	494.4	492.6			
2011/05	498.74	499.50	494.4	477.6	460.0	425.1	452.3	432.7
Barr MODFLOW runs (1996)	488.3	500.1	492.6	492.6	missing	475.5	475.5	
Partridge @ SW001			489.7					
confluence of Yelp and Partridge			487.0					
Partridge & RR grade (SW002)			486.8					

*headwaters of Partridge River/Yelp Cr.

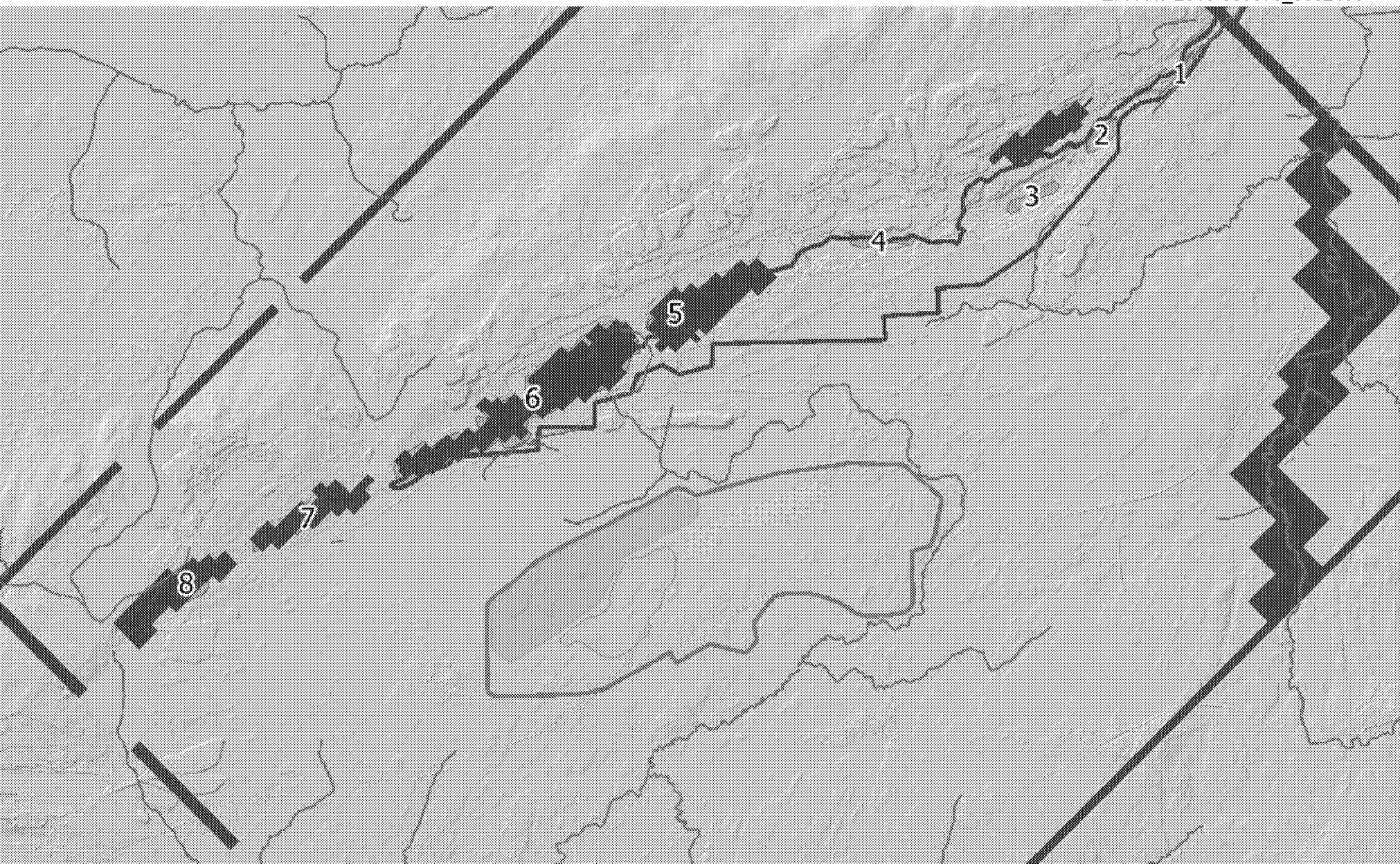

1
2
3
4
5
6
7
8

Table 2. Table 3-4 in WMDPv13

horizontal hydraulic conductivity was 4.5 x 10^{-4} feet/day, estimated from the five borehole tests conducted south of the proposed pits, away from the Virginia Formation contact.

3.2.5.5 Calibration Results

Optimized hydraulic conductivity values are summarized in Table 3-4. Because the horizontal hydraulic conductivity of the unconsolidated deposits varies by cell, the range of values and mean value in each zone resulting from the calibration are shown. Large Figure 18 shows the calibrated hydraulic conductivity distribution in Layer 1 for the area of interest, including the average hydraulic conductivity for each of the GoldSim groundwater flow path areas. Table 3-5 provides a comparison between the estimated and calibrated hydraulic conductivity values at locations where prior information was included in the calibration. Calibrated hydraulic conductivity values generally compare well with the estimated values.

Table 3-4 Optimized Hydraulic Conductivity Values

Model Parameter	Value (feet/day)
Horizontal hydraulic conductivity – Upland deposits	Range: 0.056 - 167 Mean: 19.2
Horizontal hydraulic conductivity – Wetland deposits	Range: 0.003 - 224 Mean: 23.7
Vertical hydraulic conductivity – Upland and wetland deposits (1)	0.0028 (1)
Hydraulic conductivity – Giants Range granite	$K_{xx} = K_{yy} = 0.029$ $K_{zz} = 0.0029$
Hydraulic conductivity – Biwabik Iron Formation	$K_{xx} = K_{yy} = 0.87$ $K_{zz} = 0.087$
Hydraulic conductivity – Virginia Formation, Upper Portion	$K_{xx} = K_{yy} = 0.31$ $K_{zz} = 0.031$
Hydraulic conductivity – Duluth Complex	$K_{xx} = K_{yy} = 4.4 \times 10^{-4}$ $K_{zz} = 4.4 \times 10^{-5}$
Hydraulic conductivity – Virginia Formation, Lower Portion	$K_{xx} = K_{yy} = 0.079$ $K_{zz} = 0.0079$
Vertical hydraulic conductivity term of Partridge River Reach 1	41.0
Vertical hydraulic conductivity term of Partridge River Reach 2	32.8
Vertical hydraulic conductivity term of Partridge River Reach 3	25.6
Vertical hydraulic conductivity term of Partridge River Reach 4	18.5
Vertical hydraulic conductivity term of Partridge River Reach 5	13.2
Vertical hydraulic conductivity term of Partridge River Reach 6	10.4
Vertical hydraulic conductivity term of Partridge River Reach 7	8.8
Vertical hydraulic conductivity term of Partridge River Reach 8	10.0

(1) Parameter not allowed to vary during calibration

Table 3. MODFLOW modeling results used for Goldsim modeling of contaminant transport as reported in the water modeling report "Water_Modeling_Data_Package_Vol_1-Mine_Site_v13_DEC2014.pdf".

Establish general groundwater head distribution (e.g. watertable):	Section 5.2.3.7 of Water Modeling Data Package Volume 1 - Mine Site (.pdf page 124 of Water_Modeling_Data_Package_Vol_1-Mine_Site_v13_DEC2014.pdf and Large Figs. 14 of Water Modeling Data Package Volume 1 - Mine Site (.pdf page 492 of Water_Modeling_Data_Package_Vol_1-Mine_Site_v13_DEC2014.pdf)
Establishing contaminant flow paths:	Section 5.2.3 and Large Figs. 28-29 of Water Modeling Data Package Volume 1 - Mine Site (.pdf page 114 and 511 of Water_Modeling_Data_Package_Vol_1-Mine_Site_v13_DEC2014.pdf) and Section 5.2.3.7 of Water Modeling Data Package Volume 1 - Mine Site (.pdf page 124 of Water_Modeling_Data_Package_Vol_1-Mine_Site_v13_DEC2014.pdf)
Establishing gradients along contaminant flow paths:	Section 5.2.3.1 of Water Modeling Data Package Volume 1 - Mine Site (.pdf page 118 Water_Modeling_Data_Package_Vol_1-Mine_Site_v13_DEC2014.pdf)
Establishing hydraulic conductivity along contaminant flow paths:	Section 5.2.3.7 of Water Modeling Data Package Volume 1 - Mine Site (.pdf page 125 of Water_Modeling_Data_Package_Vol_1-Mine_Site_v13_DEC2014.pdf) and Section 3.2.5.5 and Large Fig. 18 of Attachment B Groundwater Modeling of the NorthMet Mine Site (.pdf page 662 and 702 of Water_Modeling_Data_Package_Vol_1-Mine_Site_v13_DEC2014.pdf)
"Infiltration" along contaminant flowpaths for calculation of baseflow:	Section 5.2.4.3.5 of Water Modeling Data Package Volume 1 - Mine Site (.pdf page 141 of Water_Modeling_Data_Package_Vol_1-Mine_Site_v13_DEC2014.pdf)

Pit inflows used for "overall water balance in the probabilistic model" (contaminant transport model):	Section 5.2.3.7 of Water Modeling Data Package Volume 1 - Mine Site (.pdf page 125 of Water_Modeling_Data_Package_Vol_1-Mine_Site_v13_DEC2014.pdf) and Section 6.1.2.3.2 of Water Modeling Data Package Volume 1 - Mine Site (.pdf page 177 of Water_Modeling_Data_Package_Vol_1-Mine_Site_v13_DEC2014.pdf)
.....	

Table 4. Parameters used in GoldSim modeling. from the Water_Modeling_Data_Package_Vol_1-Mine_Site_v13_DEC2014.pdf

Table 1-1 **Input Variables for the Mine Site Model**

Variable Name	*Units*	*Deterministic/ Uncertain*	*Sampling/ Calculation Frequency*	*Distribution*	*Mean or Mode*	*Standard Deviation*	*Minimum*	*Maximum*	*Description*	*Source of Input Data*	*Modeling Package Section*
Grey cells indicate changes from the previously published version											
Climatic Variables											
Annual_Precip_Cuberoot	[$in^{1/3}$]	Uncertain	Annual	Trunc. Normal	3.05	0.16	0	N/A	Cube root of the annual precipitation	HiDen Climate network for Mine Site (1980-2010 climate normal)	Water Section 5.2.1 *Climate Inputs*
Monthly_Precip_Factors	[%]	Deterministic	N/A	Constant	Vector by month. Reference Table 1-11				Factors for partitioning annual precipitation to monthly	HiDen Climate network for Mine Site (1980-2010 climate normal)	Water Section 5.2.1 *Climate Inputs*
Annual_Evap	[in/yr]	Uncertain	Annual	Normal	20.8	1.33	N/A	N/A	Annual evaporation from open water	HiDen Climate network for Mine Site (1980-2010 climate normal); Baker (1979)	Water Section 5.2.1 *Climate Inputs*
Monthly_Evap_Factors	[%]	Deterministic	N/A	Constant	Vector by month. Reference Table 1-11				Factors for partitioning annual open water evaporation to monthly	Baker (1979) for partitioning ratios	Water Section 5.2.1 *Climate Inputs*
Snowmelt	[--]	Deterministic	N/A	Constant	4	N/A	N/A	N/A	Month when snowmelt occurs	USGS Gage Data	Water Section 6.1.3.3 *Water Balance, Mine Pits*
Freezeup	[--]	Deterministic	N/A	Constant	11	N/A	N/A	N/A	Month when freezeup occurs, consistent with WWTF design team definition	USGS Gage Data	Water Section 6.1.3.3 *Water Balance, Mine Pits*
Background Chemistry											
GW_Conc_Surf	[mg/L]	Uncertain	Realization	Transformed Normal	Vector by Constituent. Reference Table 1-12				Surficial groundwater concentrations in the Partridge River watershed	Analysis of PolyMet background water quality data	Water Section 5.3.1 *Background Groundwater*
GW_Conc_Bed	[mg/L]	Uncertain	Realization	Transformed Normal	Vector by Constituent. Reference Table 1-12				Bedrock groundwater concentrations in the Partridge River watershed	Analysis of PolyMet background water quality data	Water Section 5.3.1 *Background Groundwater*
SW_Conc_RO	[mg/L]	Uncertain	Month	Lognormal	Vector by Constituent. Reference Table 1-13				Calibrated surface runoff concentrations in the Partridge River watershed	Calibration of model to baseline conditions	Water Section 5.3.1 *Background Surface Runoff*
SW_Conc_PMP	[mg/L]	Deterministic	N/A	Constant	Vector by Constituent. Reference Table 1-13				Concentration leaving the Peter Mitchell Pits	2004-2007 WQ modeling at SW-001	Water Section 5.5.3.1 *Other (Non-Project) Loads*
Flow_PMP	[cfs]	Deterministic	N/A	Constant	2.6	N/A	N/A	N/A	Flow from Peter Mitchell Pit dewatering to SW-001	Calibration of model to baseline conditions	Water Section 5.5.3.1 *Other (Non-Project) Loads*
Flow_PMP_end	[yr]	Deterministic	N/A	Constant	55	N/A	N/A	N/A	Mine Year when flow from Peter Mitchell Pit ends, equivalent to year 2070	Northshore Mine Plan	Water Section 5.5.3.1 *Other (Non-Project) Loads*
SW_Conc_Partridge	[mg/L]	Deterministic	N/A	Constant	Matrix by Constituent and location. Reference Table 1-14				Baseline existing chemistry in Partridge River used to evaluate model	2004-2010 Monitoring Data of Partridge River	Water Section 4.4.4.1 *Water Quality ,Partridge River*
Load_Colby	[kg/yr]	Deterministic	N/A	Constant	Vector by Constituent. Reference Table 1-13				Calibrated additional loading to Colby Lake	Calibration of model to baseline conditions	Water Section 5.5.3.1 *Other (Non-Project) Loads*
Groundwater Flowpath Characteristics											
I_ops	[--]	Uncertain	Realization	Uniform	Vector by flowpath. Reference Table 1-15				Average hydraulic gradient along aquifer	Mine Site MODFLOW model	Water Section 5.4.1 *Groundwater Flowpath Modeling*
I_close	[--]	Uncertain	Realization	Uniform	Vector by flowpath. Reference Table 1-15				Average hydraulic gradient along aquifer in closure	Mine Site MODFLOW model	Water Section 5.4.1 *Groundwater Flowpath Modeling*
Thick	[m]	Deterministic	N/A	Constant	Vector by flowpath. Reference Table 1-15				Aquifer thickness	Assumed value	Water Section 5.4.1 *Groundwater Flowpath Modeling*
EL_Pit	[ft]	Deterministic	N/A	Constant	Vector by flowpath. Reference Table 1-15				Pit surficial outflow elevation	GIS data/calculations	Water Section 5.4.1 *Groundwater Flowpath Modeling*
Width	[m]	Deterministic	N/A	Constant	Vector by flowpath. Reference Table 1-15				Flowpath width	GIS data/calculations	Water Section 5.4.1 *Groundwater Flowpath Modeling*
L_Upstream	[m]	Deterministic	N/A	Constant	Vector by flowpath. Reference Table 1-15				Length upstream of stockpile	GIS data/calculations	Water Section 5.4.1 *Groundwater Flowpath Modeling*
L_Stock	[m]	Deterministic	N/A	Constant	Vector by flowpath. Reference Table 1-15				Source (stockpile) length	GIS data/calculations	Water Section 5.4.1 *Groundwater Flowpath Modeling*
L_Eval_1	[m]	Deterministic	N/A	Constant	Vector by flowpath. Reference Table 1-15				Length to Evaluation Point #1	GIS data/calculations	Water Section 5.4.1 *Groundwater Flowpath Modeling*
L_Eval_2	[m]	Deterministic	N/A	Constant	Vector by flowpath. Reference Table 1-15				Length to Evaluation Point #2	GIS data/calculations	Water Section 5.4.1 *Groundwater Flowpath Modeling*
L_Eval_3	[m]	Deterministic	N/A	Constant	Vector by flowpath. Reference Table 1-15				Length to Evaluation Point #3	GIS data/calculations	Water Section 5.4.1 *Groundwater Flowpath Modeling*
L_Total	[m]	Deterministic	N/A	Constant	Vector by flowpath. Reference Table 1-15				Total flowpath length	GIS data/calculations	Water Section 5.4.1 *Groundwater Flowpath Modeling*

Table 4, continued.

Table 1-1 **Input Variables for the Mine Site Model**

Variable Name	*Units*	*Deterministic/ Uncertain*	*Sampling/ Calculation Frequency*	*Distribution*	*Mean or Mode*	*Standard Deviation*	*Minimum*	*Maximum*	*Description*	*Source of Input Data*	*Modeling Package Section*
Grey cells indicate changes from the previously published version											
Groundwater Flow Variables											
Bedrock_Porosity	[--]	Deterministic	N/A	Constant	0.05	N/A	N/A	N/A	Porosity of the bedrock flowpaths	Mine Site MODFLOW model (Bedrock units)	Water Section 5.4.1 *Groundwater Flowpath Modeling*
Surficial_Porosity	[--]	Deterministic	N/A	Constant	0.3	N/A	N/A	N/A	Porosity of the surficial flowpaths	Assumed value, e.g. Fetter, 2001	Water Section 5.4.1 *Groundwater Flowpath Modeling*
K_Flowpath	[m/d]	Uncertain	Realization	Triangular	Vector by flowpath. Reference Table 1-15				Hydraulic conductivity of the surficial and bedrock material	Mine Site MODFLOW model (Duluth Complex), constraints discussed in Water Section 5.4.1	Water Section 5.4.4 *Groundwater Transport in GoldSim*
Recharge_min	[in/yr]	Deterministic	N/A	Constant	0.36	N/A	N/A	N/A	Minimum allowed recharge in surficial aquifer (for checking calculated value)	Mine Site MODFLOW model	Water Section 5.4.1 *Groundwater Flowpath Modeling*
Recharge_max	[in/yr]	Deterministic	N/A	Constant	1.8	N/A	N/A	N/A	Maximum allowed recharge in surficial aquifer (for checking calculated value)	Mine Site MODFLOW model	Water Section 5.4.1 *Groundwater Flowpath Modeling*
Surficial_Density	[kg/m3]	Deterministic	N/A	Constant	1,500	N/A	N/A	N/A	Dry (bulk) Density of the surficial deposits	USDA St. Louis County Soil Survey Database	Water Section 5.4.1 *Groundwater Flowpath Modeling*
Kd_Surficial	[L/kg]	Deterministic	N/A	Constant	Vector by Constituent. Reference Table 1-16				Sorption coefficients for the surficial aquifer (As, Sb, Cu, Ni)	EPA screening-level values	Water Section 5.4.3 *Sorption*
Stream Reach Characteristics											
Segment_Area	[m^2]	Deterministic	N/A	Constant	Vector by location. Reference Table 1-17				Cross sectional area of each segment upstream of each node	RS26 geomorphic surveys	Water Section 5.5 *Surface Water Modeling*
Segment_Length	[m]	Deterministic	N/A	Constant	Vector by location. Reference Table 1-17				Length of river upstream of each node	GIS data	Water Section 5.5 *Surface Water Modeling*
Colby_Volume	[acre-ft]	Deterministic	N/A	Constant	5,300	N/A	N/A	N/A	Colby Lake storage volume from RS73B	DNR bathymetric maps (summarized in RS73B)	Water Section 6.1.5 *Water Balance, Colby Lake*
Contributing_Area	[acre]	Deterministic	N/A	Time Series	Matrix by location and year. Reference Table 1-18				Contributing watershed area to each river node (incremental), used to calculate recharge	XPSWMM Model GIS analysis	Water Section 5.6.4 *Modeling Future Conditions*
Stream Flow Variables											
Streamflow_SW006_(Month)	[cfs]	Uncertain	Timestep	User-defined	Imported from worksheet. Reference Table 1-19				Randomly sampled daily streamflow at SW-006 for each month	USGS gage data (corrected for PMP dewatering)	Water Section 5.6.5 *Developing Probabilistic Model Inputs*
Inc_Flow_Factor_(Month)	[--]	Deterministic	N/A	Time Series	Imported from worksheet. Reference Table 1-20a through 1-20l				Factor to multiply Q at SW006 to get the incremental inflow between nodes for each month	XP-SWMM model results (relative differences)	Water Section 5.6.5 *Developing Probabilistic Model Inputs*
GW_Inc_Baseflow	[cfs]	Deterministic	N/A	Time Series	Imported from worksheet. Reference Table 1-21				Baseflow adding to evaluation points via natural groundwater	XP-SWMM model results scaled to observed baseflow at SW-006	Water Section 5.6.5 *Developing Probabilistic Model Inputs*

Exhibit 6

Correspondence from GLIFWC to Co-lead Agency Project Managers
Discharge from PolyMet east pit at closure greater than previously reported
October 20, 2015

GREAT LAKES INDIAN FISH AND WILDLIFE COMMISSION

P. O. Box 9 • Odanah, WI 54861 • 715/682-6619 • FAX 715/682-9294

• MEMBER TRIBES •

MICHIGAN	WISCONSIN		MINNESOTA
Bay Mills Community	Bad River Band	Red Cliff Band	Fond du Lac Band
Keweenaw Bay Community	Lac Courte Oreilles Band	St. Croix Chippewa	Mille Lacs Band
Lac Vieux Desert Band	Lac du Flambeau Band	Sokaogon Chippewa	

Via Electronic Mail October 20, 2015

Michael Jimenez
Minerals NEPA Project Manager
Superior National Forest
8901 Grand Avenue Place
Duluth, MN 55808

Doug Bruner
Project Manager
United States Army Corps of Engineers, St. Paul District
190 Fifth St. East
St. Paul, MN 55101-1638

Lisa Fay
EIS Project Manager
Environmental Policy and Review
Division of Ecological Services
500 Lafayette Road
St. Paul, MN 55155

Re: Discharge from PolyMet east pit at closure greater than previously reported

NorthMet EIS Co-lead Agency Project Managers:

Following up on discussions of closure and post-closure discharge from the PolyMet mine pits, GLIFWC staff have conducted water budget analysis that indicates that east pit discharge is likely to be approximately an order of magnitude greater than reported in the pFEIS.

GLIFWC is acting in coordination with our member tribes, including the Fond du Lac Band, to review and contribute to the PolyMet EIS process. As you may know, GLIFWC is an organization exercising delegated authority from 11 federally recognized Ojibwe (or Chippewa) tribes in Wisconsin, Michigan and Minnesota.[1] Those tribes have reserved hunting, fishing and gathering rights in territories ceded in various treaties with the United States. GLIFWC's mission is to assist its

1 GLIFWC member tribes are: in Wisconsin -- the Bad River Band of the Lake Superior Tribe of Chippewa Indians, Lac du Flambeau Band of Lake Superior Chippewa Indians, Lac Courte Oreilles Band of Lake Superior Chippewa Indians, St. Croix Chippewa Indians of Wisconsin, Sokaogon Chippewa Community of the Mole Lake Band, and Red Cliff Band of Lake Superior Chippewa Indians; in Minnesota -- Fond du Lac Chippewa Tribe, and Mille Lacs Band of Chippewa Indians; and in Michigan -- Bay Mills Indian Community, Keweenaw Bay Indian Community, and Lac Vieux Desert Band of Lake Superior Chippewa Indians.

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member tribes in the conservation and management of natural resources and to protect habitats and ecosystems that support those resources. The proposed PolyMet mine is located within the territory ceded by the Treaty of 1854.

Analysis indicates that post-closure groundwater flow from the east pit will be substantial:

The magnitude of the roles that water levels in the Peter-Mitchel (P-M) taconite pits play during post-closure continue to be under-appreciated. We first raised concerns about the effects of P-M pit water levels in 2009 as comments on the 2008 CPDEIS.

Flow direction is not the only factor affected by correctly implementing the P-M pit water elevations at closure. The volume of water leaving the PolyMet east pit is significantly greater if correct P-M pit water elevations are considered.

Both common sense (strong gradient to the north and more conductive bedrock to the north) and modeling, suggest that a substantial portion of the contaminants leaving the PolyMet east pit will move north in the post-closure period (see attached figure). Please note that because the mine pits are both deeply excavated into the bedrock but natural lakes are generally underlain with a lakebed, arguments related to the presence of Argo or other pit-side lakes are not hydrologically relevant to this issue; The connection between the PolyMet pits and the P-M pits is primarily through the relatively high conductivity Virginia Formation and Biwabik Iron Formation bedrock.

Our recent water budget analysis using the USGS utility ZoneBudget indicates that approximately 90% of the water leaving the 1595 foot elevation PolyMet east pit will travel north in bedrock toward the Peter-Mitchel pits when the P-M pits are at their correct closure elevation (1300 feet). Because of the 295 foot greater head pressure of the closed PolyMet east pit compared to the P-M pits and the relatively high conductivity of the Virginia and Biwabik Iron bedrock formations, it is not surprising that the majority of water leaving the PolyMet east pit would flow north.

Preliminary water budget analysis indicates that approximately 300 gpm will exit the PolyMet east pit through bedrock post-closure, when the P-M pits are at 1300 feet. This is in contrast to the total of 10 gpm that Barr Engineering estimated using the same mine pit inflow/outflow model but with P-M pit water elevations that were 316 feet too high (see attached figure). Contaminant transport analysis that accounts for approximately 300 gpm rather than 10 gpm of east pit groundwater discharge is likely to generate different conclusions for water quality at points of compliance.

Additional modeling, with the P-M pit water elevation at 1500 feet (the very long-term P-M pit water elevation), unsurprisingly, shows less flow from the PolyMet east pit (approximately 75 gpm), but the northward flow is still approximately 90% of the total flow from the east pit. The amount of east pit water loss when the P-M pits are at 1300, or at 1500 feet is large, but is of similar scale to the quantities of bedrock flow found by ERM in their bedrock cross-sectional models using MathCad. Those MathCad models were distributed prior to, and discussed in, the July 22 agency technical meeting. The estimates of substantial PolyMet pit outflow identified in this letter were made with the MODFLOW model that was designed by Barr Engineering to estimate mine pit inflow/outflow (Water Modeling Data Package v14, Attachment B, Table 4-4, pFEIS reference Polymet 2015m). A sensitivity analysis of how estimates of pit inflow/outflow at closure respond to boundary conditions (i.e. the P-M pit water levels are model boundary conditions) would further clarify the role that the taconite pits play in the hydrology of the PolyMet site.

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Regardless of whether the PolyMet east pit outflow at closure is 75 or 300 gpm, the scale of flow from the PolyMet pits when the P-M pits are set at their correct closure levels appears to be approximately an order of magnitude greater that the quantity of flow previously considered in contaminant transport. The large underestimate of water leaving the PolyMet east pit by PolyMet's consultant deserves additional evaluation, evaluation that should be conducted by independent experts.

Thank you for considering this issue. As we have in the past, we ask to have technical discussions with other agency staff so that an approach to clarify and address this issue can be developed.

Sincerely,

John Coleman

John Coleman, GLIFWC Environmental Section Leader

cc: Randall Doneen, Environmental Review Unit Supervisor, MN-DNR
Brenda Halter, Forest Supervisor, Superior National Forest
Tamera Cameron, Chief, Regulatory Branch, St Paul District of the Army Corps of Engineers
Kenneth Westlake, NEPA Coordinator, USEPA Region 5
Nancy Schuldt, Water Projects Coordinator, Fond du Lac Environmental Program
Neil Kmiecik, GLIFWC Biological Services Director
Ann McCammon Soltis, Director, GLIFWC Division of Intergovernmental Affairs

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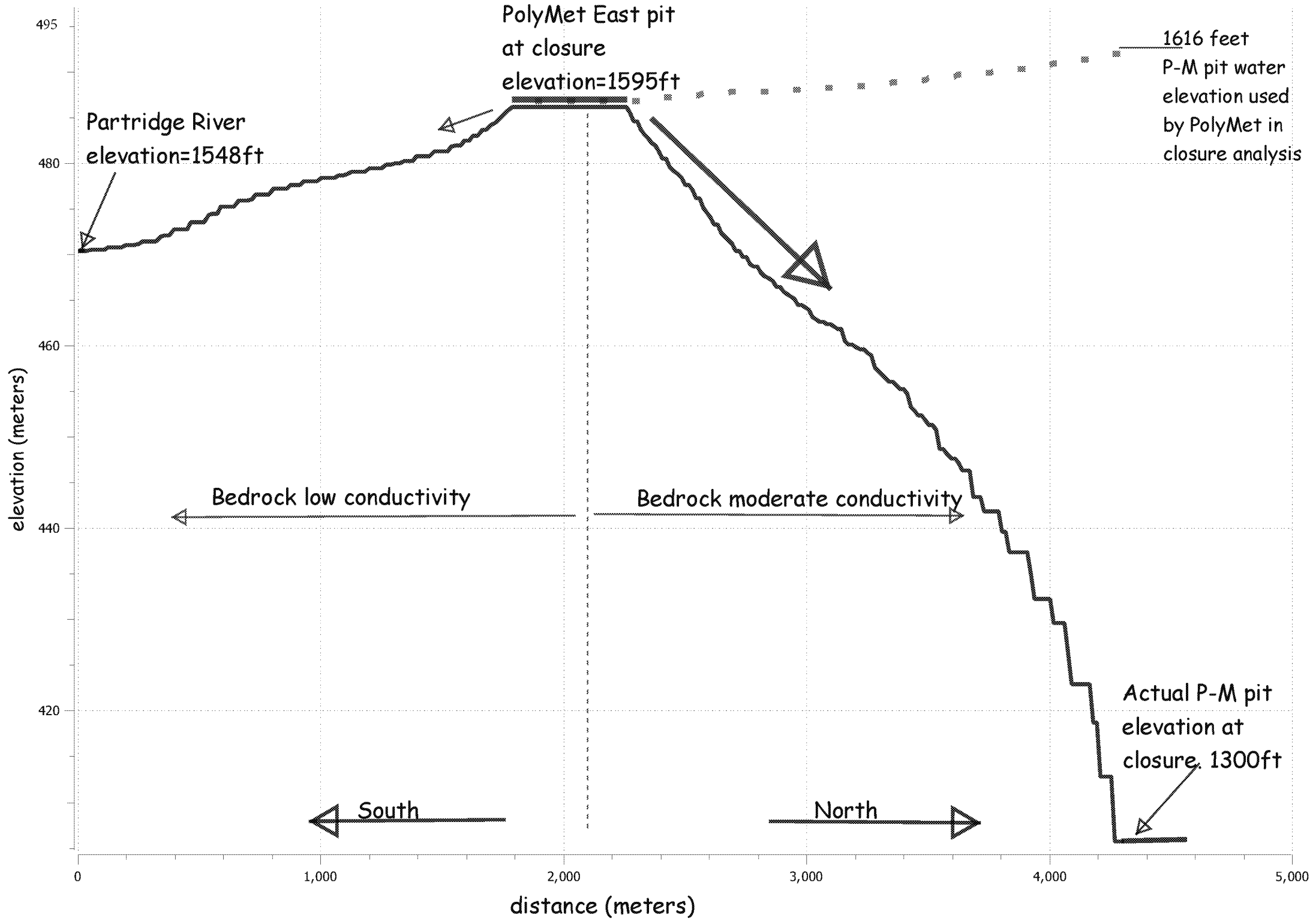
PolyMet East pit
at closure
elevation=1595ft
1616 feet
P-M pit water
elevation used
by PolyMet in
closure analysis
Partridge River
elevation=1548ft
Bedrock low conductivity
Bedrock moderate conductivity
Actual P-M pit
elevation at
closure. 1300ft
South
North
elevation (meters)
distance (meters)
495
480
460
440
420
0
1,000
2,000
3,000
4,000
5,000