MINNESOTA POLLUTION CONTROL AGENCY
520 Lafayette Road North
St. Paul, MN 55155-4194

AQDM-06

Air Quality Dispersion Modeling (AQDM) results form
(Previously AQDMR-01)

Doc Type: Air Dispersion Modeling

Acronym information on page 9

Instructions: Permit applicants required to conduct air dispersion modeling should submit two paper copies of the completed *Air Quality Dispersion Modeling results form* (*AQDM-06)* and all accompanying files to:

Air Quality Permit Document Coordinator
Minnesota Pollution Control Agency
520 Lafayette Road North
St. Paul, MN 55155-4194

Applicants may also submit an electronic version via email, in addition to the two paper copies. This is highly recommended. Please note that all assumptions made in the air dispersion modeling analysis could result in air permit requirements.

Electronic copies of the forms and accompanying files should be emailed to: AirModeling.PCA@state.mn.us. **Note:** The air modeling e-Service may not be used to submit air modeling results.

Facility information

Tempo AI ID number: 423 AQ facility/permit ID number: 13700345 Today's date (mm/dd/yyyy): 12/01/2017

Three-letter modeling facility ID (ex., XEK = Xcel Energy Allen S. King, MEC = Mankato Energy Center, etc.): PMM

Facility name: Poly Met Mining Inc.

Facility street address: 6500 County Road 666

City: Hoyt Lakes County: St. Louis Zip code: 55750 State: MN

Facility contact: Kevin Pylka Report prepared by: Jennifer Koenen (Barr Engineering Co)

Facility contact phone: (218) 471 - 2162 Preparer phone: (952) 832 - 2682

Facility contact email address: kpylka@polymetmining.com Preparer email address: jkoenen@barr.com

*UTM coordinates of facility (NAD83, zone 15 extended **only**): x = 564,719.00 m East, y = 5,271,989.00 m North

**This should be the central location of the facility/source.*

These results are associated with (check all that apply):

- ☐ AERA or Dispersion/Deposition modeling for air toxics
- ☐ Environmental assessment worksheet
- ☐ Environmental impact statement
- ☐ Modeling information request
- ☐ Modeling Impacts from animal feedlots
- ☐ Siting an air monitoring station
- ☐ Siting a meteorological station
- ☐ Permit condition
- ☐ Permit modification
- ☐ Prevention of significant deterioration
- ☐ Screening modeling
- ☒ Special project
- ☐ State implementation plan

Project description (50 words or less)

PolyMet plans to construct and operate a mine, to reactivate portions of the LTV Steel Mining Company facility and to build a hydrometallurgical concentrate processing facility at the former LTVSMC site. This report covers the complete NorthMet Project (Project). More detail is available Section 2 of the air permit application (v2, December 2017).

Files to accompany modeling results

Include the following files with the completed modeling report form. Use checkbox to indicate that all applicable files are included.

1. ☒ AERMOD input files (*.inp, *.adi, *.ami)
   ☒ AERMOD output files (*.out, *.ado, *.amo)
   ☒ AERMOD plot files (*.plt)
   ☒ AERMOD post files (*.pst) *(If applicable)*
   ☐ AERMOD event files (*.evi, *.evo) *(If applicable)*
   ☒ AERMOD miscellaneous/other files (MAXDCONT, .DAT, .emi, etc.) *(If applicable)*
2. AERMET files: ☒ *.sfc ☒*.pfl
3. BPIP-PRIME files: ☒ Input (*.bpi) ☒ Output (*.bpo, *.sum) *(If applicable)*
4. AERMAP files: ☒ Terrain (*.dem(s), *.tif [NED files]), ☒ Input (*.ami), ☒ Output (*.rou, *.sou, etc.) *(If applicable)*
5. Background data files: ☐ Background concentrations for applicable pollutants (seasonal, monthly, daily, hourly, etc.) *(If applicable)*
6. Modeling results: ☒ Figures (*.jpeg, *.pdf), ☐ GIS Maps (*.shp)
7. AQDM-02 spreadsheet: ☒ *(Provide the final spreadsheet [i.e., AQDM-02] and indicate/highlight changes.)*
8. Paved roads results: ☐ *(If applicable)*
9. SIL analysis and results: ☐ *(If applicable)*
10. Hourly O_3 file: ☒ *(If applicable)*
11. AERA forms: ☐ *(If applicable)*
12. Other files and supporting documents (paved roads fugitive dust modeling output files, etc.):

    Model results post-processing technical memorandum (Modeling Results Post-Processing Memo.docx), included as Attachment Q4-A.

Section 1. Modeling protocol

1. The Air Dispersion Modeling presented in this report is based on a protocol that has been:
   ☒ Approved ☐ Conditionally approved ☒ *MPCA approval date (mm/dd/yyyy): 08/03/2016
   **This is the date given on AQDM-04 form*
2. Does this modeling submittal **completely** follow the approved protocol? ☐ Yes ☒ No
   If yes, proceed to Section 3.
   If no, proceed to Section 2.

Section 2. Changes to approved/conditionally approved modeling protocol

Table 1: Protocol changes (Please indicate which sections in the approved/conditionally approved protocol have been changed.)

Modeling protocol by sections

Section name	Change/No change
Modeling purpose	Change
Terrain	No Change
Buildings	Change
Model selection and options	Change
Point sources	Change
Volume sources	Change
Area sources	Change
Area source coordinates	No Change
Paved roads fugitive dust	No Change
Receptors	Change
Meteorological data	Change
Area of impact analysis	No Change
Background values	Change
Nearby sources	Change
Pollutant based considerations	Change
Attachments	Change
AERA forms	No Change

Section 2.1: Detailed changes to modeling protocol

Please provide specific information corresponding to those sections in Table 1 where changes are indicated.

Modeling purpose

MPCA approved change: ☒ Yes ☐ No Date (mm/dd/yyyy): 11/17/2016

Describe changes:

Modeling conducted for NAAQS/MAAQS only. 1-hour averaging period evaluated for SO2 and NO2, 24-hour averaging period for PM10, and 24-hour and annual averaging periods for PM2.5.

Terrain

MPCA approved change: ☐ Yes ☐ No Date (mm/dd/yyyy):

Describe changes:

Buildings

MPCA approved change: ☒ Yes ☐ No Date (mm/dd/yyyy): 08/10/2017

Describe changes:

Minor changes were made to the Project Plant Site and Mine Site designs related to the Plant Site Waste Water Treatment Plant (WWTP) and the Mine Site Waste Water Treatment Facilities which resulted in the removal and addition of emission sources, revised building dimensions, and adjustments to access road layouts. At the Plant Site, the WWTP building was replaced in BPIP to reflect the revised Waste Water Treatment System (WWTS) design. Also, two additional stacks were added to the plant site SV086 (pebble crusher) (STRU 107) and SV087 (WWTS lime silo vent) (STRU 108).

Model selection and options

MPCA approved change: ☒ Yes ☐ No Date (mm/dd/yyyy): 01/26/2017

Describe changes:

In December 2016 and January 2017, EPA released updates to the regulatory model (AERMOD v16216r and AERMET v16216). The modeling analysis was conducted using these updated versions of AERMET and AERMOD.

Point sources

MPCA approved change: ☒ Yes ☐ No Date (mm/dd/yyyy): 08/10/2017

Describe changes:

Two additional stacks were added to the plant site SV086 (pebble crusher) (STRU 107) and SV087 (WWTS lime silo vent) (STRU 108).

Volume sources

MPCA approved change: ☒ Yes ☐ No Date (mm/dd/yyyy): 08/10/2017

Describe changes:

The mine site eliminated the WWTF building vent (WWTFBV) and replaced it with a volume source (MSMISC) that includes emissions from EQUI 148 (lime transfer to tank) and EQUI 174 to EQUI 183 and EQUI 618 to EQUI 627 (propane fired space heaters) and is located at the Mine Site Fueling and Maintenannce Facility (MSFMF). The access road layout at the Mine Site was adjusted to reflect the removal of the WWTF.

Area sources

MPCA approved change: ☒ Yes ☐ No Date (mm/dd/yyyy): 09/14/2017

Describe changes:

PolyMet received clarification on the appropriate parameters for modeling OPENPIT sources, which necessitated modifications to the source parameters given in the modeling protocol. Specifically, the OPENPIT source elevation was changed to be at the top of the pit and the volume of the pit was adjusted to reflect the excavated volume (i.e., the airspace within the pit). The OPENPIT parameters in the modeling protocol had the source elevation at the bottom of the pit and the volume of the pit as a simple calculation of length x width x depth (note that OPENPIT and AREA sources are required by AERMOD to be rectangles). For this analysis, the top of the pit was specified as the same elevation as for the primary haul roads outside of the pits (491.95 m) and the

excavated volumes were calculated from the rock movement schedule.

The OPENPIT source alogrithm calculates an effective AREA source (less than the footprint of the pit) to simulate the recirculating zone in the pit with emissions occurring from a smaller area on the upwind side of the pit. The model also calculates an escape fraction to account for emissions remaining in the pit.

Area source coordinates

MPCA approved change: ☐ Yes ☐ No Date (mm/dd/yyyy): _____

Describe changes:

Paved roads fugitive dust

MPCA approved change: ☐ Yes ☐ No Date (mm/dd/yyyy): _____

Describe changes:

Receptors

MPCA approved change: ☒ Yes ☐ No Date (mm/dd/yyyy): 09/14/2017

Describe changes:

The separate Mine Site and Plant Site receptor grids were combined into a single NAAQS Class II receptor grid. The receptor grid was modified to reflect the effective fenceline that delineates the area within the property boundary where PolyMet has demonstrated the ability to restrict public access and as described in detail in the Ambient Air Boundary Control Plan (Air Permit Application, Appendix Q3 (v2, December 2017)). The changes to the OPENPIT sources (described in the Area Sources section above) required an adjustment to the effective fenceline at the Mine Site. The Mine Site Protocol text stated that the receptor grid would use 100 m spacing from the ambient air boundary (as the boundary was formerly called) out to 1 km. After discussion with the MPCA, the receptor grid spacing from the effective fenceline out to 1 km was changed to 250 m. No changes were made to the receptor density in areas of maximum modeled concentrations.

Meteorological data

MPCA approved change: ☒ Yes ☐ No Date (mm/dd/yyyy): 01/26/2017

Describe changes:

The 2009-2013 adjusted u Hibbing dataset was reprocessed to use the most recent version of AERMET (v16216). The approved protocol meteorological dataset was processed using AERMET v15181.*

Additionally, the approved protocol contained an alternative model demonstration for the use of adjusted u as ADJ_U* was a BETA option at that time. The ADJ_U* meteorological data processing option is now a regulatory default option in AERMOD (i.e., no longer a BETA option) and processing with ADJ_U* no longer requires an alternative model demonstration for its use.*

Area of impact analysis

MPCA approved change: ☐ Yes ☐ No Date (mm/dd/yyyy): _____

Describe changes:

Background values

MPCA approved change: ☒ Yes ☐ No Date (mm/dd/yyyy): 02/02/2017

Describe changes:

The PM2.5 24 hour and annual background concentrations were updated to the most recent 3 years of Virginia, MN monitor data (2014-2016). The 2016 dataset was provided by MPCA staff.

Nearby sources

MPCA approved change: ☒ Yes ☐ No Date (mm/dd/yyyy): 12/16/2016

Describe changes:

Previous modeling submitted for the NorthMet Project, including the modeling submitted with the August 2016 air permit application, incorporated emissions from the Cliffs Erie Pellet Yard based on potential to emit calculations provided by MPCA in 2011. Those emission calculations submitted by Cliffs Erie, were based on operations at the facility at that time.

On June 15, 2016, Cliffs Erie submitted a registration permit application, reflecting the current operational status of the facility. On July 18, 2016 MPCA issued the requested registration permit. Fugitive emission calculations based on current operations at the Cliffs Erie site were included with the registration permit application. Those emissions were based on 2015 actual processing rates and have been corrected for current operations at the facility. The emission rates were reported as 0.05 tons PM10/year and 0.00 tons PM2.5/year.

The MPCA square root mean distance (SQRM-D) tool is used as a first cut to identify nearby sources for inclusion in modeling. On Page 35 of the MPCA Modeling Practices Manual, the following statement in reference to the SQRM-D tool is included: "the Tool will remove all sources that have less than one ton per year of emitted criteria pollutants (actuals)". As shown above, in the most recent actual emission calculations submitted by Cliffs Erie, the rates of all criteria pollutants are well below one ton per year and can be accounted for in the background concentrations added to the modeled air concentrations.

Based on this information developed after PolyMet submitted and MPCA approved the protocol, PolyMet did not include Cliffs Erie in the supplemental modeling described in this report.

Pollutant based considerations

MPCA approved change: ☒ Yes ☐ No Date (mm/dd/yyyy): 08/03/2016

Describe changes:

The Plant Site protocol identified the hourly ozone file as PMP_O3_5Y.dat. The hourly ozone file submitted with the protocol and used in the modeling analysis is Fernberg-Ely_2009-2013_ppb.csv.

Attachments

MPCA approved change: ☒ Yes ☐ No Date (mm/dd/yyyy): 08/10/2017

Describe changes:

The MPCA requested that the modeling report provide greater detail on post-processing procedures (Attachment Q4-A). Additionally, because the AQDM-06 form will also be submitted in version 2 of the NorthMet air permit application as Appendix Q4, attachments are identified to document the modeling protocol as requested by MPCA (Attachment Q4-B Modeling Protocols, and Attachment Q4-C Modeling Protocol Approval Correspondence).

AERA forms

MPCA approved change: ☐ Yes ☐ No Date (mm/dd/yyyy): _____

Describe changes:

Section 3. Paved roads fugitive dust (Optional)

Facilities that have indicated in their e-Services submittal the exclusion of paved roads in the air dispersion modeling should provide the results of that modeling in Table 1. Results should **not** include fugitive dust from paved roads.

Table 1: Model results for paved roads fugitive dust exemption policy. (See tables 2 and 3 for categories and requirements)

	Averaging period	NAAQS ($\mu g/m^3$)	Total modeled NAAQS concentration (includes Background and Nearby Sources) (ug/m^3)	% of NAAQS	PSD Class II increments ($\mu g/m^3$)	Modeled class II increment impact concentrations ($\mu g/m^3$)	% of Class II increments
PM_{10}	24-hour	150	134.40	89.60%	30		0.00%
	Annual	-	-	-	17		0.00%
$PM_{2.5}$	24-hour	35	31.40	89.71%	9		0.00%
	Annual	12	11.1	92.50%	4		0.00%

Table 2:

	NAAQS				PSD Class II increments			
	NAAQS/MAAQS result(s) w/	**Cat. 1**	**Cat. 2**	**Cat. 3**	***PSD Class II result(s) (%)***	**Cat. 1**	**Cat. 2**	**Cat. 3**

	background and nearby sources (%)							
PM_{10}	**!Undefined Bookmark, TEXT190**	*# < 60%*	*60% < # < 95%*	*95% < #*	0.00%	*# < 35%*	*35% < # < 75%*	*75% < #*
$PM_{2.5}$	93.00%	*# < 80%*	*80% < # < 95%*	*95% < #*	0.00%	*# < 40%*	*40% < # < 80%*	*80% < #*

Table 3:

Cat 1:	Paved road fugitive emissions not required to be modeled, and no paved road fugitive dust permit conditions. Requirements in Minn. R. 7011.150 apply.
Cat 2:	Paved road fugitive emissions not required to be modeled, with paved road fugitive dust permit conditions determined by levels of traffic at the facility.
Cat 3:	Paved road fugitive emissions **are** required to be modeled, with site-specific paved road fugitive dust permit conditions. Re-modeling and/or addition of paved road fugitive emissions source group required.

Section 4. Modeling results

Table 2: Pollutants and averaging periods (Check all the boxes for each pollutant and averaging period(s) modeled.)

		Standard			
Pollutant	**Averaging period**	**NAAQS**	**MAAQS**	**Increment**	**SIL**
CO	1-hr	☐	☐	☐	☐
	8-hr	☐	☐	☐	☐
Lead	Rolling 3 mo. Avg	☐	☐	☐	☐
	Quarterly Avg	☐	☐	☐	☐
NO_2	1-hr	☒	☒	☐	☐
	Annual	☐	☐	☐	☐
SO_2	1-hr	☒	☒	☐	☐
	3-hr	☐	☐	☐	☐
	24-hr	☐	☐	☐	☐
	Annual	☐	☐	☐	☐
PM_{10}	24-hr	☒	☒	☐	☐
	Annual	-	-	☐	☐
$PM_{2.5}$	24-hr	☒	☒	☐	☐
	Annual	☒	☒	☐	☐

Table 3: NAAQS/MAAQS modeling results (Enter modeling results along with the percent of standard.)

				Total modeled concentration (includes background and nearby sources) (ug/m^3)	**Percent of standard (%)**	
Pollutant	**Averaging period**	**NAAQS standard (ug/m^3)**	**MAAQS standard (ug/m^3)**		**NAAQS**	**MAAQS**
CO	1-hr	40,071.5	40,071.5			
	8-hr	10,304.1	10,304.1			
Lead	Rolling 3 mo. Avg	0.15	0.15			
NO_2	1-hr	188.0	188.0	107.1	57.0	57.0
	Annual	99.7	99.7			
SO_2	1-hr	196.4	196.4	89.7	45.7	45.7
	3-hr	1309.3	1309.3			
	24-hr	366.6	366.6			
	Annual	78.6	78.6			
PM_{10}	24-hr	150.0	150.0	134.4	89.6	89.6

$PM_{2.5}$	24-hr	35.0	35.0	31.4	89.7	89.7
	Annual	12.0	12.0	11.1	92.5	92.5

Table 4: Increment modeling results (Provide the increment modeling results along with the percent of standard.)

Pollutant	Averaging period	Class II increment (ug/m^3)	Total modeled concentration (includes other increment sources) (ug/m^3)	Percent of standard (%)
NO_2	1-hr	-	-	-
	Annual	25		
SO_2	1-hr	-	-	-
	3-hr	512		
	24-hr	91		
	Annual	20		
PM_{10}	24-hr	30		
	Annual	17		
$PM_{2.5}$	24-hr	9		
	Annual	4		

Table 5: SIL modeling results (Provide the SIL modeling results along with the percent of standard.)

Pollutant	Averaging period	SIL (ug/m^3)	Total modeled concentration (ug/m^3)	Percent of standard (%)
NO_2	1-hr	7.52		
	Annual	1		
SO_2	1-hr	7.86		
	3-hr	25		
	24-hr	5		
	Annual	1		
PM_{10}	24-hr	5		
	Annual	1		
$PM_{2.5}$	24-hr	1.2		
	Annual	0.3		
CO	1-hr	2000		
	8-hr	500		

Section 5. Discussion

Enter any discussion or comments on the information provided in this form (this can be used as a substitute for a written report):

This AQDM-06 will also be submitted as Appendix Q4 of the Conforming Air Permit Application in its entirety. As a requirement of the Conforming Air Permit Application, all of the relevant protocol submittals, technical memoranda, and correspondence since the Mine Site and Plant Site protocols were submitted in April 2016, are included as attachments to this AQDM-06 form. Modeling files will be submitted separately on a flash drive or portable hard drive. The Modeling Files directory listing (readme_NorthMet_ClassII.txt) is included as an attachment to this form (Attacment Q4-E). The contents of Appendix Q4 are listed at the end of this section.

There are several topics regarding the modeling results which merit additional explanation and which have more in-depth discussion in the attachments. Two of these topics involve post-processing of the modeling output to develop the final NAAQS modeled concentration (see Attachment Q4-A).

For all pollutants, cumulative impacts were assessed on all neighboring properties with the impacts due to emissions from each neighboring facility excluded from the receptors within that facility's property boundary. This methodology is consistent with EPA guidance on ambient air (e.g. Region V Ambient Air Issues - Dec 1986 - EPA SCRAM website Model Clearinghouse, Record No:87-V-09 which states: "controlled property … is non-ambient air. However, property of one company is ambient air with respect to emissions from its neighbor") and the approved modeling protocol. The appropriate modeled concentration was developed by creating source groups of all sources except the nearby source (e.g., NONSM for all sources except Northshore Mining sources),

and indentifying receptors on the nearby source property. For those receptors, the cumulative NAAQS model concentration from source group NONSM (plus background) was used instead of using the model concentration from source group ALL (plus background).

PM10 modeling required additional model runs and post-processing because Method 1 particulate deposition (depletion) was used for fugitive sources, but no deposition (no depletion) was used for point sources. The model cannot accommodate both deposition and non-deposition sources in the same model run, so two model runs were conducted (with and without deposition) and the results combined using POSTFILES (POSTFILES store the modeled concentration at each receptor for each hour of meteorological data). The attached technical memorandum (Attachment Q4-A) describes the post-processing steps in detail.

Note that in the Facility Information Section at the beginning of this form, in the selection list for 'These modeling results are associated with' there is no box for Permit Application which would be the most appropriate selection. The 'Special Project' box was checked as that seemed to be the closest condition for submitting these results.

Similarly, note that the changes made to the OPEN PIT sources were included in the Changes to Area Sources, as there is no selection for Changes to Open Pit Sources.

Appendix Q4 - Total Facility Class II Modeling

AQDM-06 (this form)

Large Figures (listed in Section 6 below)

Attachment Q4-A Modeling Results Post-Processing Memo

Attachment Q4-B Modeling Protocols

Class II Mine Site Air Quality Dispersion Modeling Protocol v3 APR2016.pdf

Class II Plant Site Air Quality Dispersion Modeling Protocol v3 APR2016.pdf

Mine Site Prot Addendum C2 memo v1 JUL2016.pdf

NorthMet AAB Memo v2 JUL2016.pdf

NorthMet Ustar Adjustment V1 JUL2016.pdf

Plant Site Prot Addendum C2 memo v2 JUL2016.pdf

NorthMet AERMOD Method 1 memo v2 AUG2016.pdf

Attachment Q4-C Modeling Protocol Approval Correspondence

Approval of the Class II PolyMet Mine Site & Plant Site Protocols.msg

Addendum - Contact with EPA on Deposition Issues.msg

Attachment Q4-D Modeling Files Directory (readme_NorthMet_ClassII.txt)

Attachment Q4-E AQDM-02

Section 6. Modeling results figures/maps

Insert a figure or map showing the facility emission sources, receptors, and the location of the modeled maximum concentration(s) for each applicable pollutant, corresponding averaging periods, and operating scenarios.

The following figures are included with this submittal:

Large Figure Q4-1 Process Plant Model Source Layout
Large Figure Q4-2 Tailings Basin Model Source Layout
Large Figure Q4-3 Mine Site Model Source Layout Yr 8
Large Figure Q4-4 Mine Site Model Source Layout Yr 13
Large Figure Q4-5 Cumulative NAAQS Receptor Grid
Large Figure Q4-6 1-hr NO2 NAAQS Cumulative Results
Large Figure Q4-7 1-hr SO2 NAAQS Cumulative Results
Large Figure Q4-8 24-hr PM2.5 NAAQS Cumulative Results Year 8
Large Figure Q4-9 24-hr PM2.5 NAAQS Cumulative Results Year 13
Large Figure Q4-10 Annual PM2.5 NAAQS Cumulative Results Year 8
Large Figure Q4-11 Annual PM2.5 NAAQS Cumulative Results Year 13
Large Figure Q4-12 24-hr PM10 NAAQS Cumulative Results Year 8
Large Figure Q4-13 24-hr PM10 NAAQS Cumulative Results Year 13

Acronyms

AERA	Air Emissions Risk Analysis
AERMAP	AERMOD Terrain Preprocessor
AERMET	AERMOD Meteorological Preprocessor
AERMOD	AMS/EPA Regulatory Model
AQ	Air Quality
AQDM	Air Quality Dispersion Modeling
AQDMR-01	Previous Modeling Results Form
BPIP-PRIME	Building Profile Input Program for PRIME
CO	Carbon Monoxide
EPA	U.S. Environmental Protection Agency
FAC	3-letter facility ID
MAAQS	Minnesota State Ambient Air Quality Standard
MPCA	Minnesota Pollution Control Agency
NAAQS	National Ambient Air Quality Standard
NO_2	Nitrogen Dioxide
OU	Operable Unit
Pb	Lead
PM_{10}	Particulate Matter less than 10 um in size
$PM_{2.5}$	Particulate Matter less than 2.5 um in size
PRIME	Plume Rise Model Enhancements
PSD	Prevention of Significant Deterioration Program
SIL	Significant Impact Level
SO_2	Sulfur Dioxide
SIP	State Implementation Plan
SMS	Standardized Mobile Source
$\mu g/m^3$	Micrograms per cubic meter ($\mu g/m^3$)
UTM	Universal Transverse Mercator