

Report on Air Dispersion Modeling Techniques by MPCA Air Dispersion Modeling Staff from July – August, 2012	
Facility:	Northern Metals Recycling AQ Permit ID: 05300480 2800 Pacific St. N., Minneapolis, MN 55411
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A court order, issued on March 26, 2012, prompted MPCA staff to cease all work related to the facility Northern Metals Recycling. MPCA provided existing information as requested through various Data Practices Act (DPA) requests submitted to the MPCA by Northern Metals. This information was mostly pertaining to ambient air monitored concentrations, SAM spreadsheets, and EIS needs decisions, but new work was not conducted by MPCA staff after the March 26<sup>th</sup>, 2012, court order. On May 10, 2012, an agreement was reached between Northern Metals and the MPCA to create a First-Approximation Modeling Optimizing Useful Set-ups (FAMOUS) data packet. This data packet was sent electronically to Northern Metals, and their consultants at Barr Engineering, on May 15, 2012. The data packet was considered a partial data packet as it contained files relevant only to the pollutant PM<sub>2.5</sub> (particulate matter with a diameter less than or equal to 2.5 micrometers). These files included background concentration files with background values in various time frames, as well as nearby sources<sup>1</sup> to Northern Metals.

On May 23, 2012, the MPCA received a request from Barr Engineering, asking for refined modeling inputs for a set of nearby sources that were included in the FAMOUS data packet. The data packet had contained about 145 nearby sources, which was comprised of all facilities within 50 km of Northern Metals that hold an air permit. Barr Engineering narrowed down the nearby sources to facilities that were within 1 km of Northern Metals and facilities that had PM<sub>2.5</sub> emission rates greater than 20 lb/hr in the data files. This resulted in the number of nearby sources expected to have significant concentration gradients in the vicinity of Northern Metals being narrowed to 14 facilities (see Table 1 below). As this additional request was considered to be a normal part of the process with the FAMOUS data packets, MPCA staff gathered all relevant information pertaining to these facilities. This included past air dispersion modeling files, stack parameters, building dimensions, air emission calculations, etc. The gathered information was sent electronically to Barr Engineering on June 6, 2012. Barr Engineering followed up with a request to MPCA staff for updated stack parameters from one facility on June 22, 2012. The requested information was delivered later that afternoon to Barr Engineering via email.

Table 1: Nearby Sources That Additional Information Was Requested For		
Facility Name	Facility Air Permit ID #	Facility Address
CEMSTONE Products	05300374	65 26 <sup>th</sup> Ave. N., Minneapolis, MN
GAF Materials Corp.	05300043	50 Lowry Ave. N., Minneapolis, MN
Aggregate Industries	05300458	65 26 <sup>th</sup> Ave. N., Minneapolis, MN
Packaging Corp.	05300055	1821 Marshall St. NE, Minneapolis, MN
Web Label Printing	05301028	2518 2 <sup>nd</sup> St. NE, Minneapolis, MN
Hard Chrome Inc.	05300247	2631 2 <sup>nd</sup> St. NE, Minneapolis, MN
Xcel Energy – Riverside	05300015	3100 Marshall St. NE, Minneapolis, MN
Endres Processing LLC	03700280	13420 Courthouse Blvd., Rosemount, MN
Xcel Energy – Black Dog	03700003	1400 E. Black Dog Road, Burnsville, MN
District Energy	12300063	76 Kellogg Blvd. W., St Paul, MN
Schwing America Inc	05300004	5900 Centreville Rd., White Bear Lake, MN
Anchor Glass Container	13900005	4108 Valley Industrial Blvd., Shakopee, MN
Marathon Petroleum (St. Paul Park Refining)	16300003	300 3 <sup>rd</sup> St., St. Paul Park, MN
Xcel Energy – Allen S. King	16300005	1103 King Plant Rd., Bayport, MN

<sup>1</sup> Nearby sources are defined in Appendix W to 40 CFR Part 51 – Guideline on Air Quality Models, section 8.2.3.b as “All sources expected to cause a **significant concentration gradient** in the vicinity of the source or sources under consideration for emission limit(s)...” (emphasis added)

On June 27, 2012, the MPCA received, via email, supplemental air dispersion modeling information for PM<sub>10</sub> and PM<sub>2.5</sub> NAAQS modeling for Northern Metals. The information supplied to the MPCA included the MPCA Air Quality Dispersion Modeling Protocol form (AQDMP-01) and attachments to the AQDMP-01 form, as well as an electronic zip file containing air dispersion modeling files, spreadsheets, etc. This zip file included modeling input and output files, where the Northern Metals facility was modeled at an emission rate of 4.2 lb/hr (or 0.53 g/s), along with emissions from the nearby sources listed in Table 1 (with the exception of Web Label Printing, which had ceased operations in 2007) and an hourly varying background. Modeling also took into account Northern Metals' hours of operation, which were incorporated by using an hourly emission file. The hourly background concentration file was provided by MPCA staff within the FAMOUS data packet received on May 15, 2012. Use of an hourly background concentration paired with modeled concentrations on an hourly basis is a refined technique commonly referred to as "paired sums" or "paired in time".

Air modeling output files from the June 27, 2012, submittal initially showed that the modeled domain area exceeded the 24-hour PM<sub>2.5</sub> National Ambient Air Quality Standards (NAAQS) of 35 µg/m<sup>3</sup>, with the total maximum 8<sup>th</sup> highest modeled concentration being 52.6 µg/m<sup>3</sup>. However, from that overall modeling, it was demonstrated that Northern Metals' contribution to the overall modeled concentration was 0.04 µg/m<sup>3</sup>. (See Table 2 for more information.) MPCA staff started review of the supplemental air modeling information upon receipt. Of main concern to MPCA staff was the emission rates and stack parameters assumed for some of the nearby sources. Even though staff had provided modeling files and emissions information to Barr Engineering, it was noted at the time by staff that much of the information that was provided did not have PM<sub>2.5</sub> specific emissions, nor did we have individual stack and emissions data for all of the sources. Since the purpose at the time of the request was to provide any data that was relevant and available, the MPCA did not closely scrutinize the data prior to sending the data to Northern Metals.

<b>Group</b>	<b>Contribution to Overall Concentration (µg/m<sup>3</sup>)</b>	<b>% of Contribution</b>
Northern Metals Recycling	0.04	0.08%
Background	24.01	45.62%
Xcel Energy - Black Dog	1.06	2.01%
District Energy	0.24	0.46%
St. Paul Park Refining	0.31	0.59%
Xcel Energy – Allen S. King	0.04	0.08%
Xcel Energy – Riverside	0.08	0.15%
Flint Hills Resources	0.10	0.19%
Endres Processing	0.01	0.02%
GAF Materials	0.16	0.30%
Hard Chrome	0.01	0.02%
Anchor Glass	0.01	0.02%
Schwing America	0.00	0.00%
Packaging Corp.	0.09	0.17%
Cemstone	0.46	0.87%
Aggregate Industries	26.01	49.42%
Total Modeled Concentration	52.63	

Subsequent to MPCA staff review of the air modeling information, emissions rates, and stack parameters, Barr Engineering conducted additional modeling runs for Northern Metals. The results from the first of this additional modeling were emailed to MPCA staff on July 3, 2012, as a two-page PDF document (no modeling files were submitted). The PDF indicated that additional refinements were made to the emission rates of the nearby source Aggregate Industries, as the facility had never modeled and holds a Minnesota State Option D Registration permit, which was applied for on July 27, 1995. The additional refinements included the calculation of PM<sub>2.5</sub> emission factors, to replace the PM<sub>10</sub> emission factors originally used in the June 27, 2012, modeling submittal. Also, paved road sources were assumed to have a nominal 80% control, which was determined by Barr Engineering through aerial photographs and site observations. This resulted in the total maximum 8<sup>th</sup> highest modeled concentration,

including hourly backgrounds via the paired sums method, to be 38.9  $\mu\text{g}/\text{m}^3$ . This was a significant drop in the overall modeled concentration from June 27, 2012, though still above the 24-hour  $\text{PM}_{2.5}$  NAAQS of 35  $\mu\text{g}/\text{m}^3$ .

The second subsequent refined modeling run, and its associated files and documents, were emailed to MPCA staff between July 16 and July 17, 2012. Additional refinements to the air dispersion modeling inputs were made to the nearby sources. The emission rate for the main stack at Xcel Energy's Black Dog plant was updated, because the emission rate that was sent to Barr Engineering did not reflect the permit-required control efficiency of the existing electrostatic precipitator (ESP). Building and stack heights were refined and updated in the modeling input files for the nearby sources Packaging Corp., Cemstone Products, and Aggregate Industries. These three facilities hold Minnesota State Option D Registration permits, and therefore, building and stack height information were not available for these facilities. Barr Engineering obtained field measurements, using a laser range finder, to determine the stack and building heights for Packaging Corp., Cemstone Products, and Aggregate Industries. Additional refinements were made to Aggregate Industries, by using the assumed 80% control of paved roads (the same that was used in the July 3, 2012, submittal), but also including 50% control of the stockpile handling emissions. These were based again on aerial photographs and observations of the site and material handling. Due to these refinements, the total maximum 8<sup>th</sup> highest modeled concentration, with the hourly background concentrations, came out to be 34.98  $\mu\text{g}/\text{m}^3$ , which is approximately at the 24-hour  $\text{PM}_{2.5}$  NAAQS of 35  $\mu\text{g}/\text{m}^3$ . See Table 3 below for details about contributions to the total modeled concentration.

<b>Group</b>	<b>Contribution to Overall Concentration (<math>\mu\text{g}/\text{m}^3</math>)</b>	<b>% of Contribution</b>
Northern Metals Recycling	0.02	0.06%
Background	24.85	71.06%
Xcel Energy - Black Dog	0.12	0.34%
District Energy	0.22	0.63%
St. Paul Park Refining	0.82	2.34%
Xcel Energy – Allen S. King	0.02	0.06%
Xcel Energy – Riverside	0.02	0.06%
Flint Hills Resources	0.29	0.83%
Endres Processing	0.01	0.03%
GAF Materials	0.02	0.06%
Hard Chrome	0.00	0.00%
Anchor Glass	0.02	0.06%
Schwing America	0.00	0.00%
Packaging Corp.	0.01	0.13%
Cemstone	0.86	2.46%
Aggregate Industries	7.69	21.99%
Total Modeled Concentration	34.98	

The third subsequent, and final, refined modeling run from Barr Engineering was emailed to MPCA staff on July 23, 2012. Another refinement to information for Aggregate Industries was made, addressing the facility's aggregate heater stack. Initially, this stack was modeled as a ground-level volume source due to the lack of stack information, which led to the heater stack contributing the most to Aggregate Industries' modeled impacts. For this third refined modeling run, the heater stack was modeled as a point source in AERMOD, using stack parameters based on literature reviews and field observations. A refinement was made to Northern Metals as well, with an increase in the emission rate from 4.2 lb/hr to 4.5 lb/hr. These additional refinements led to the total maximum 8<sup>th</sup> highest modeled concentration, with the hourly background concentrations, to be 33.5  $\mu\text{g}/\text{m}^3$ , which is below the 24-hour  $\text{PM}_{2.5}$  NAAQS of 35  $\mu\text{g}/\text{m}^3$ .

MPCA air permit engineering staff completed their review of the nearby source's emissions rates and stack parameters on July 19, 2012, though Cemstone and Aggregate Industries' emissions were not finalized until July 23, 2012. At this point, the MPCA air dispersion modeler began inputting the reviewed emissions into AERMOD, in preparation of conducting MPCA's internal modeling runs. MPCA leadership decided and staff was informed on July 20, 2012, that the Agency would be internally conducting and finalizing the air dispersion modeling for use in

the EAW and the draft air permit. The first MPCA model run for Northern Metals was conducted on July 27, 2012,. MPCA used nearly the same model options and parameters that had been used in previous modeling submittals from Barr Engineering. The main differences between MPCA's modeling and past modeling submitted by Barr Engineering were as follows: replaced/updated nearby sources' input where needed with internally reviewed parameters, used a uniform background concentration of  $30 \mu\text{g}/\text{m}^3$  instead of the paired sums approach with hourly background concentrations, and changed the emission rate for Northern Metals from 4.2 lb/hr to 3.6 lb/hr (as was directed by MPCA leadership).

The biggest difference in emissions rates from nearby sources was seen at GAF Industries. The change resulted from replacing past modeled emission rates with the permitted emission rates from GAF Industries Minnesota State Individual air permit. Modeling had been conducted internally by MPCA air dispersion modeling staff in 2005 for GAF Industries and from which provided a set of emission rates that was recommended for incorporation into the permit. During the review of emission rates and source parameters, it was determined that the recommended set of emission rates was never incorporated into GAF Industries' permit. This resulted in a large increase in the emission rates from the asphalt and shingle manufacturer.

Another significant difference in the internal MPCA modeling was the change from the paired sums approach, using hourly-generated background concentrations, to using a uniform background concentration from a single ambient air quality monitor. At the beginning of July 2012, conversations between MPCA and U.S. Environmental Protection Agency (EPA) Region 5 modeling staff, regarding the use of the paired sums approach in other MPCA modeling projects, indicated that Region 5 modeling staff did not feel the paired sums approach had the technical justification for use in modeling exercises, and indicated that they would not support the use of the technique to model potential impacts for air quality permits. Based on these conversations, the MPCA decided that the paired sums technique could not be used in any future or on-going modeling projects, including modeling for Northern Metals. Therefore, the MPCA reverted to a standard method of including background in modeling that is described in EPA modeling guidance. The standard method adds a uniform concentration from an appropriate and representative ambient air quality monitor to the modeled concentrations from the facilities included in the model. MPCA monitor 963 was considered the most representative ambient air monitor for the area, in which the 2009 – 2011 24-hour  $\text{PM}_{2.5}$  design value was  $30 \mu\text{g}/\text{m}^3$ . This was the same background value that was used in MPCA's air modeling of Northern Metals in the beginning of 2012.

The result of these changes to the modeling conducted by the MPCA led to a total predicted modeled concentration of  $76.5 \mu\text{g}/\text{m}^3$ , which included the background concentration of  $30 \mu\text{g}/\text{m}^3$ . The three biggest contributors to this modeled concentration was GAF Industries ( $43.6 \mu\text{g}/\text{m}^3$ ), background levels ( $30 \mu\text{g}/\text{m}^3$ ), and Northern Metals ( $1.5 \mu\text{g}/\text{m}^3$ ). Before any additional post-processing was conducted (i.e., subtracting a plant's contribution from the total concentrations for receptors on that plant's non-ambient air property), Barr Engineering and Northern Metals were informed of the results and sent the draft MPCA modeling results. It was also determined that Northern Metals modeled by themselves, with no nearby sources included in the model, resulted in a modeled concentration of  $7.7 \mu\text{g}/\text{m}^3$ ; that when added to the background concentration of  $30 \mu\text{g}/\text{m}^3$ , resulted in a total modeled concentration of  $37.7 \mu\text{g}/\text{m}^3$ .

Because the July 27, 2012, model run showed an exceedance of the 24-hour  $\text{PM}_{2.5}$  NAAQS, from Northern Metals, at an emission rate of 3.6 lb/hr, the MPCA conducted a second model run, this time modeling Northern Metals at an emission rate of 1.83 lb/hr. The 1.83 lb/hr emission rate was the original rate modeled by the company in January 2010 to support their stipulation agreement that settled in April 2010. With the nearby sources included, the total modeled concentrations remained unchanged, including Northern Metals' contribution to the total concentration. However, Northern Metals modeled individually at 1.83 lb/hr resulted in a modeled concentration of  $3.9 \mu\text{g}/\text{m}^3$ . Added to a background concentration of  $30 \mu\text{g}/\text{m}^3$ , this resulted in Northern Metals demonstrating compliance with the 24-hour  $\text{PM}_{2.5}$  NAAQS. MPCA air permitting staff are starting conversations with GAF Industries, as well as some of other nearby sources (Cemstone, Aggregate Industries, etc.), to determine if MPCA source parameters are still up-to-date and to consider changes to these facilities permits. It is felt by MPCA staff that Northern Metals has the facility controlled as strictly as possible.

Table 4: Summary of Modeling Results for PM <sub>10</sub> and PM <sub>2.5</sub> NAAQS and MAAQS						
Pollutant	Averaging Time	NM Modeled Impacts (µg/m <sup>3</sup> )	Background Concentration (µg/m <sup>3</sup> )	Total Modeled Concentration (µg/m <sup>3</sup> )	NAAQS / MAAQS (µg/m <sup>3</sup> )	Percentage of NAAQS / MAAQS
PM <sub>10</sub>	24-hour	12.7	49	61.7	150	41.1%
PM <sub>10</sub>	Annual	1.5	21	22.5	50	45.0%
PM <sub>2.5</sub>	24-hour	3.9	30	33.9	35	96.9%
PM <sub>2.5</sub>	Annual	1.5	10	11.5	15	76.7%