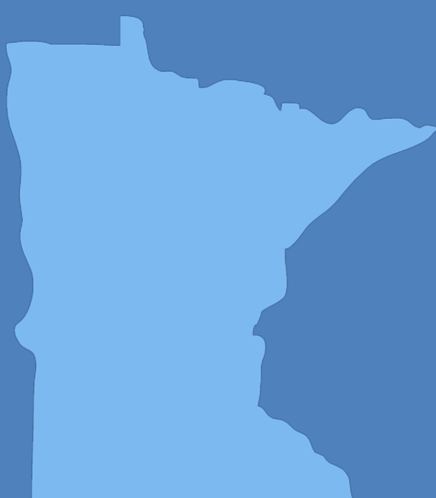
MPCA Air Dispersion Modeling Practices Manual



Minnesota Pollution Control Agency

September 2016

Minnesota Pollution Control Agency Air Dispersion Modeling Practices Manual

Risk Evaluation & Air Modeling Unit

Air Assessment Section

Environmental Analysis and Outcomes Division

Minnesota Pollution Control Agency

Saint Paul, Minnesota

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Acronyms

ACFM	Actual Cubic Foot per Minute
ADJ_U*	Adjusted surface friction velocity
ARM	Ambient Ratio Method
AQRV	Air quality related value
ASOS	Automated Surface Observing System
AWOS	Automated Weather Observing System
BPIPPRM	Building Profile Input Program for PRIME
CAA	Clean Air Act
CAD	Computer-aided drafting
CEM	Continuous emission monitor
CO	Carbon Monoxide
DEM	Digital elevation model
DSBD	Direction-specific building dimensions
EAW	Environmental assessment worksheet
EBD	Equivalent or better dispersion
EIS	Environmental impact statement
EPA	Environmental Protection Agency
FAC	Facility Abbreviation Code
[FAC]FSnnn	User-specified identifiers
[FAC]SVnnn)	Stack/vent identifiers
FLM	Federal Land Manager
GEP	Good engineering practice
GIS	Geographic Information System
GIO	Minnesota Geospatial Information Office
g/s	grams per second
HC	hydrocarbons
H_2S	Hydrogen Sulfide
ISO	Independent Transmission System Operator
K	Kelvin
m	meters
MPCA	Minnesota Pollution Control Agency
MSBD	Minor source baseline date
NACAA	National Association of Clean Air Agencies

NAAQS	National Ambient Air Quality Standard
NED	National Elevation Data
NEI	National Emissions Inventory
NEPA	National Environmental Policy Act
NLCD	National Land Cover Database
NO_2	Nitrogen dioxide
NO_x	Nitrogen oxides
NSR	New Source Review
O_3	Ozone
OLM	Ozone Limiting Method
OR	offset ratio
Pb	Lead
P.E.	Permit Engineer
$PM_{2.5}$	Particulate Matter less than 2.5 microns
PM_{10}	Particulate matter less than 10 microns
PSD	Prevention of Significant Deterioration
PVMRM	Plume Volume Molar Ratio Method
ROI	Range of Influence
SCC	Source Classification Code
SCRAM	Support Center for Regulatory Air Models
SER	Significant Emission Rate
SIA	Significant impact area
SIC	Standardized Industry Classification
SIL	Significant impact level
SIP	State Implementation Plan
SO_2	Sulfur dioxide
SQRM-D	Square root mean distance method
TEP	Total Equivalent Primary
TSP	Total Suspended Particulate
$\mu g/m^3$	Micrograms per cubic meter
USGS	U.S. Geological Survey
U.S.	United States
UTM	Universal Transverse Mercator
VOC	Volatile Organic Compounds

Introduction

This Air Quality Modeling Practices Manual (Manual) is provided by the Minnesota Pollution Control Agency (MPCA) to describe air quality dispersion modeling demonstration practices used to meet federal or state air quality program requirements. This Manual provides recommendations for developing a modeling demonstration that accounts for the most recent National Ambient Air Quality Standard (NAAQS).

This Manual does not substitute for provisions or regulations of the Clean Air Act (CAA) or any state statute or rule, nor is it a regulation itself. It does not affect the rights or procedures available to the public nor does it impose binding, enforceable requirements on any party, community, or tribe. Tribes within the state of Minnesota work directly with the U.S. Environmental Protection Agency (EPA) regarding federal rules and regulations, therefore, it is recommended that tribal governments carefully review the Manual contents and consider which aspects are useful in informing air quality-related tribal actions and projects. Additionally, this Manual may not apply to particular situations based upon unique or unusual circumstances.

Photochemical modeling and the modeling of Class I impacts are briefly addressed in this Manual but are largely outside its scope. Please contact MPCA staff for further directions if photochemical or Class I modeling is needed for your project.

The form and content of this Manual reflects changes presented by the Minnesota Legislative and Executive branches of government to enhance permitting efficiencies. In order to implement these directives more efficiently, the MPCA has created an electronic modeling protocol form available through MPCA's e-Services, and a final report form to facilitate the review and approval of air quality dispersion modeling projects. The current MPCA review and approval process, along with a description of the MPCA electronic protocol form and final report form, is found in Section 4. In addition, links to the MPCA Air Dispersion Modeling website are included throughout the Manual.

The following features of this Manual are important to note:

- The content of this Manual is a compilation of modeling practices developed from a variety of state and federal air quality modeling guidance documents, with the EPA's Appendix W forming the foundation for this work.
- In the event of a conflict between this document and current EPA modeling guidance, any sources subject to federal Prevention Significant Deterioration (PSD) or State Implementation Plan (SIP) requirements should follow current EPA modeling guidance.
- Manual review and modification will be ongoing throughout the year to update existing practices as well as incorporate new practices. The MPCA welcomes your feedback on new and existing practices throughout the year; these will be considered for major changes to the Manual which are published once a year.

The MPCA recognizes that modeling simulations are variable and that modeling must account for unique features of a project that can challenge the utility of standard modeling practices. Minor deviations from the approaches presented in this Manual can typically be approved at the staff level which is often the situation with Non-PSD permit projects. In situations where major modeling practice deviations or non-standard modeling practices are involved, MPCA management will review the request to evaluate the application of the non-standard approach and decide whether it is appropriate on a case-by-case basis. Documentation of the non-standard approach should contain, at a minimum:

- the modeling issue encountered that cannot be resolved by standard modeling approaches;

- the relevant literature or data that supports the use of a non-standard approach; and,
- a detailed discussion of the suitability of the proposed non-standard approach based on the details of the relevant literature or data and its relationship to the details of the facility, meteorology, terrain or other relevant factors as determined through consultation with the MPCA.

It is important to recognize that previous decisions on non-standard modeling approaches may not apply to current practices in light of new knowledge, modeling updates and changes in terrain and meteorology data. To initiate a review of a non-standard approach, you are asked to contact the MPCA prior to submitting the protocol and arrange for a consultation. The purpose of this initial contact is to characterize the issues and discuss information and related data that support the use of non-standard approaches prior to submittal for review. Please consult Ruth Roberson, Supervisor of the MPCA Risk Evaluation and Air Modeling Unit, at 651-757-2672 or ruth.roberson@state.mn.us prior to submittal if you encounter a situation where you anticipate a significant departure from the Manual or submittal process.

Overview

This Manual is separated into four sections: 1) When to model; 2) How to model; 3) Submittal process, forms, and online services; and, 4) Contacts and resources. The structure follows the form of the MPCA process for completing an air quality dispersion model demonstration. Once an air quality modeling simulation is compiled and run, additional work may be necessary to address emission reduction and determine culpability in situations where multiple sources are involved. As a special topic on source culpability and cumulative air modeling analysis, especially within the context of Air Quality Permitting and Environmental Review, please review the MPCA memorandum in Appendix A. Three sections that will be used most frequently include the following:

Section 1: When to model. One of the most frequently asked questions in air regulation pertains to when an air quality dispersion modeling demonstration may be necessary for a project. This section provides a description of four programs where an air quality dispersion modeling demonstration may be necessary: PSD permitting; Non-PSD permitting; Environmental Review; and, SIP.

Section 2: How to model. There are three parts to this section: Modeling Basics; Setting up the Model; and, Additional Considerations. Part One, Modeling Basics, is an overview of the fundamentals of air dispersion modeling. Part Two, Setting up the Model, provides instruction of the development of a modeling demonstration consistent with MPCA program-specific needs. Part Three, Additional Considerations, addresses unique regulatory modeling situations.

Section 3: Submittal Process, forms, and online services. The state of Minnesota Legislature directed the MPCA and other state-level agencies responsible for environmental or natural resource permitting to streamline their administrative practices. Minn. Stat. §116.03, subd. 2b (a) states:

> It is the goal of the state that environmental and resource management permits be issued or denied within 150 days of the submission of a permit application. The commissioner of the Pollution Control Agency shall establish management systems designed to achieve the goal.

The MPCA has responded to this legislation by developing internal and external practices that clarify expectations for modeling protocols and reports as well as streamline the review and approval of air quality dispersion modeling demonstrations. The MPCA now requests all modeling protocols be submitted electronically through the MPCA's air modeling e-Service, which is expected to further increase the efficiency of the review process. This section of the Manual presents the various online forms used to develop and approve an air quality dispersion modeling demonstration.

Section 1: When to model

This section provides an illustration and description where air quality dispersion modeling may be needed to demonstrate compliance with specific program regulations.

The four paths

Air dispersion modeling is frequently used in four administrative programs administered by the MPCA. These four programs are described below in Table 1 and provide a brief overview of the expected administrative outcome and specific program contact information, the decision thresholds considered, and a general understanding of the scope of a program-specific modeling demonstration.

Table 1. Overview of the four administrative programs that include dispersion modeling

Program	Administrative outcome and contact	Decision threshold considered	Modeling scope
Prevention of Significant Deterioration (PSD) Air Quality Permits	Permit *Dick Cordes, P.E.* *(651) 757-2291* richard.cordes@state.mn.us	Compliance with applicable air quality standards	PSD modeling requirements are well-established and address compliance with applicable NAAQS and increment as well as cumulative air quality issues.
Non-PSD Permits	Permit *Dick Cordes, P.E.* *(651) 757-2291* richard.cordes@state.mn.us	Compliance with applicable air quality standards	The Non-PSD permits include federal Part 70 permits and Title V permits as well as State-Only air quality permits. The scope of modeling for these projects varies greatly.
Environmental Review	Environmental Impact Assessment *Dan Card* *(651) 757-2261* dan.card@state.mn.us	Determination of potentially significant and irreversible environmental impacts at the direct, indirect and cumulative scale of impact.	Air dispersion modeling may be conducted at either the screening mode or refined mode of modeling. Impacts assessment must include direct, indirect and cumulative air analysis. Air modeling may be necessary for a project even if no air quality permit is required.
State Implementation Plan (SIP)	Air quality assessment and control plans *MaryJean Fenske, P.E.* *(651) 757-2354* maryjean.fenske@state.mn.us	Compliance with applicable air quality standards	Two Tiers: Project-specific modeling: Some projects undergoing modeling for an air quality permit may have additional SIP requirements. Modeling requirements are SIP-dependent. SIP development modeling: As specified by EPA and typically conducted by the MPCA. Most SIP-development modeling requires input data from selected facilities. Facilities identified as having a modeled noncompliance are notified by the MPCA and may be required to do additional modeling.

Prevention of significant deterioration (PSD) air quality permits

The PSD program is a federal air quality permitting program authorized under the CAA that applies to major sources (or modifications to major sources) located in areas that are either in attainment or considered unclassifiable with the NAAQS. In the event that a source located in an area of non-attainment seeks a federal air permit under this program, a nonattainment New Source Review (NSR) permit is required. In either situation, air dispersion modeling is used to evaluate potential air quality impacts (e.g., compliance with the NAAQS), along with an additional impacts analysis (e.g., impacts to ground, vegetation, visibility, etc.), as a result of air emissions from a facility.

Determining whether a project is subject to PSD or NSR is based on the annual emissions of PSD pollutants. This information can be found through the EPAs PSD program website page. For example, the construction of a new facility that triggers the PSD program for a criteria pollutant would likely need to model to demonstrate compliance with the applicable NAAQS and increment. Similarly, if a facility is a major stationary source under the PSD program, a modification with an emission increase greater than provided in Table 2 would require modeling of each pollutant that exceeds its Significant Emission Rate.

Table 2. PSD significant emission rates (SERs)

Pollutant	SER (tons/year)
Carbon Monoxide (CO)	100
Nitrogen Oxides (NO_X)	40
Sulfur Dioxide (SO_2)	40
Particulate Matter less than 10 microns (PM_{10})	15
Particulate Matter less than 2.5 microns (Direct $PM_{2.5}$ Emissions only)	10
Ozone (O_3)	40
Volatile Organic Compounds (VOC)	40
Lead (Pb)	0.6

The PSD program manages air quality, in part, through a unique concept known as a PSD Increment. A PSD Increment reflects the amount of air pollution that is allowed to increase in a given geographic area. The rationale for this approach is a means to keep areas where air is “clean” (or below the NAAQS) from significantly deteriorating.

A PSD increment is location-specific, meaning that each PSD increment analysis is created from the pollutant-specific ambient air quality baseline conditions of the county in which the project is located. The pollutant-specific ambient air quality baseline concentration is determined at the time the first complete PSD permit application for an area (in this case, a county) is submitted to the MPCA. The pollutant-specific PSD increment is designated by federal regulation. Air quality dispersion modeling is used to examine potential air quality compliance issues with the PSD Increment. Tribal lands within the state of Minnesota work directly with the EPA for PSD increment analyses.

Table 3. NAAQS, PSD increments, and significant impact levels in micrograms per cubic meter ($\mu g/m^3$)

Pollutant	Averaging Period	Primary NAAQS ($\mu g/m^3$)	Secondary NAAQS ($\mu g/m^3$)	PSD Class II Increment ($\mu g/m^3$)	PSD Class I Increment ($\mu g/m^3$)	Significant Impact Level ($\mu g/m^3$)
SO_2	1-Hour	196[3]	To be determined	To be determined	To be determined	7.86 (EPA interim value)
	3-Hour	None	1,300[B, 2]	512[2]	25	25
	24-Hour	365[2]	None	91[2]	5	5
	Annual	60[A,1]	None	20[1]	2	1
PM_{10}	24-Hour	150[4]	150	30[2]	8	5
	Annual	50[C]	50	17[1]	4	1
$PM_{2.5}$	24-Hour	35[5]	35	9	2	1.2[D]
	Annual	12[1]	15	4	1	0.3[D]
NO_2	1-Hour	188[5]	To be determined	To be determined	To be determined	7.52 (EPA interim value)
	Annual	100[1]	100	25[1]	2.5	1
CO	1-Hour	40,000[2]	40,000	None	None	2,000
	8-Hour	10,000[2]	10,000	None	None	500
O_3	1-Hour	235	235	None	None	None
	8-Hour	157	None	None	None	None
Pb	Rolling 3-Months	0.15[3]	0.15[2]	None	None	None

[A] Minnesota state annual SO_2 standard. Federal annual standard is 80 $\mu g/m^3$.
[B] Minnesota state 3-hour SO_2 standard for Northern Minnesota is 915 $\mu g/m^3$.
[C] Minnesota state annual PM_{10} standard (EPA revoked the federal annual PM_{10} NAAQS). Most recent annual arithmetic mean.
[D] This value has been vacated by the Federal Court. EPA has proposed a new strategy for this pollutant.
Modeled form of the applicable NAAQS and MAAQS reflect the high first high ([1]H1H), high second high ([2]H2H), high fourth high ([3]H4H), high sixth high ([4]H6H), and high eight high ([5]H8H). Superscripts in the table above correspond to the superscripts for each modeled form of the applicable ambient air quality standard.
Note: PSD Class I Area 24-Hour value is generally 1 $\mu g/m^3$ [$PM_{2.5}$ is 0.07 $\mu g/m^3$] (MPCA interim value is 0.2 percent of NAAQS).
Minnesota ambient air quality standards are located at: https://www.revisor.leg.state.mn.us/rules/?id=7009.0080
Minnesota episode levels can are located at: https://www.revisor.leg.state.mn.us/rules/?id=7009.1060
National ambient air quality standards are listed at: http://www.epa.gov/air/criteria.html

Non-PSD air quality permits

The category of Non-PSD permits includes Part 70 Federal Permits, State Only Permits, and Minor Source Permits (e.g., Registration series permits). The determination of “When to Model” for these permits varies considerably. The MPCA considers the following criteria to determine when NAAQS modeling may be needed:

1. Triggering PSD, nonattainment area New Source Review, or environmental review
2. The installation of a non-emergency internal combustion engine
3. The facility is located in a nonattainment or maintenance area for a related pollutant
4. Existing modeling that indicates a potential threat to the NAAQS
5. An increase in emissions of a related pollutant
6. Public interest (including Environmental Justice)

Though these criteria are broad, owners or operators may better predict when modeling may be necessary through proactive work in advance of potential investment in new facilities or modifications. Owners or operators may review existing modeling results for their own and nearby facilities. Air quality monitoring or modeling results approaching the numeric value of the NAAQS, PSD increments, or visibility thresholds are more likely to lead to modeling requests. Owners or operators may also work cooperatively with their local communities to improve residents' understanding of their current operations and future plans. Ideally, this type of cooperation would allow resolution of local concerns.

Modeling for Part 70 Federal permits and Title V permits are currently based on pollutant-specific annual emission thresholds. The requirements to conduct Title V modeling (or Part 70 Federal Permit modeling) are divided into three information requirement cases:

1. Full dispersion modeling
2. Modeling information only
3. No modeling required

The level of modeling data prepared and submitted is based on maximum allowable emissions (i.e., potential-to-emit for uncontrolled sources) and recent actual emissions. Table 4 summarizes applicability and submittal requirements for each case. Please note that permits issued prior to 2001 must follow their existing permit conditions; however, the most current air dispersion model and applicable ambient air quality standards apply. In addition, note that the values provided in Table 4 are historical trigger values and reflect the 1993 modeling policy as amended over time. The 1993 policy was developed from the type of Title V sources in operation at that time. The MPCA is currently reviewing this approach based in part on new NAAQS.

Table 4. Title V refined dispersion modeling classification based on pollutant-specific emissions (Actual or Allowable)

	Pollutant	Actuals (TPY)	Allowables (TPY)
Case 1 Full Dispersion Modeling	NO_x	> 1,000	> 100
	PM_{10}	> 100	> 100
	SO_2	> 250	> 100
Case 2 Modeling Information only	NO_x	< 1,000	> 100
	PM_{10}	< 100	> 100
	SO_2	< 250	> 100
Case 3 No Modeling Required	NO_x	< 1,000	< 100
	PM_{10}	< 100	< 100
	SO_2	< 250	< 100

Case 1. Full dispersion modeling requirement

The Full Dispersion Modeling Requirement applies if facility allowable emissions are greater than 100 tons/year of PM_{10}, NO_X, or SO_2, provided, actual emissions exceed 100 tons/year PM_{10}, 250 tons/year SO_2, or 1,000 tons/year NO_X. Under this case scenario, full dispersion modeling for all three pollutants (PM_{10}, NO_X, and SO_2) may be necessary, when any of the three pollutants exceeds its corresponding Case 1 threshold. An exception to this approach occurs if the actual emissions of a "non-triggering" pollutant have been below 40%of that pollutant's threshold for ten years.[1] Full dispersion modeling may

[1] The following example may be helpful.

also be requested if evidence exists that modeling would predict an exceedance of the NAAQS or MAAQS. This has recently come to include 24-hour $PM_{2.5}$, and new short-term (1-hour) ambient standards for NO_X and SO_2.

Title V or Federal Part 70 Permit sources with the *Full Dispersion Modeling Requirement* should conduct "full" (or refined) air dispersion modeling using AERMOD and BPIP-PRIME. Facilities are expected to follow the process described in this Manual for the development, review, approval and completion of a Non-PSD modeling demonstration.

Case 2. Requirement for modeling information

Requirement for Modeling Information applies if facility allowable emissions exceed 100 tons/year for PM_{10}, NO_X, or SO_2 and actual emissions are below 100 tons/year PM_{10}, 250 tons/year SO_2, and 1,000 tons/year NO_X. As with the Full Dispersion Modeling Requirement, evidence of possible modeled violations of ambient air quality standards may also trigger the Modeling Information Requirement.

Sources with the Modeling Information Requirement in their Title V permit submit relevant data about the facility without actually conducting modeling. The Modeling Information includes location data for stacks, fugitive sources, buildings, and property boundaries (or fence lines). It also includes verifying or supplementing facility data archived by the MPCA. The data may be related to the stacks, fugitives, buildings, property boundaries, fence lines and also emissions.

Instructions for submitting Title V modeling information and a factsheet discussing the applicability of the modeling information requirement can be found on the MPCA website.

Case 3. No modeling requirement

At this time, facilities with allowable or actual emissions less than 100 tons/year for PM_{10}, NO_X, or SO_2 will not be asked to submit modeling information by their Title V permit. Please note that there are state programs and/or situations where refined air quality modeling is used to fulfill requirements that are part of a state decision on a project (e.g., environmental review).

"NAAQS notes" policy information

In 2005, MPCA staff identified facilities that may be exceeding the NAAQS through a cursory screening of 249 facilities using air modeling to determine facility eligibility for an innovative permitting option being developed at the time by the MPCA. In what has become to be known as "***NAAQS Notes***" modeling, the MPCA determined that a number of facilities had modeled exceedances of the applicable NAAQS. The "NAAQS Notes" cursory screening analyses assumed the following (Table 5):

A facility with actual SO_2 emissions of 350 tons per year, PM_{10} emissions of 90 tons per year, and NO_X emissions of 200 tons per year would be required to fulfill the Case 1 requirements for SO_2 and PM_{10} pollutants. However, since NO_X emissions fall below 400 tons per year (40 percent of the 1,000 ton per year threshold), the Case 2 requirements would apply to NO_X.

Table 5. Screening input assumptions for the NAAQS Notes project

Stack Height	Estimated as the average stack height values for facilities with the same Standardized Industry Classification (SIC) code designation in the national emissions inventory
Modeled Emissions	Actual emissions as reported in the 2001 emission inventory
Hours of Operation	2,000 annual operating hours
Distance to Property Line	50 meters

The MPCA cannot issue an air quality permit where there is knowledge or likelihood that the operation of the facility under the permit would cause or contribute to violations of the NAAQS (40 CFR pt.50; Minn. Stat. § 116.07, subds. 4(a) and 9; Minn. R. 7007.0800, subds. 1, 2, and 4; Minn. R. 7009.0010-7009.0080). Facilities that were identified in the 2005 NAAQS Notes screening must demonstrate that their facility will comply with the applicable NAAQS, and should consider the use of a refined air quality dispersion modeling demonstration or ambient air quality monitoring.

Environmental review

Air dispersion modeling is typically part of an air quality permit process; however, as noted above in the ***When to Model*** section, there are other programs within the MPCA that may require an air dispersion model. The MPCA's ***Environmental Review*** program is typically the primary non-permit and non-regulatory program where air dispersion modeling can be used to analyze air quality impacts. If a project is undergoing an environmental assessment worksheet (EAW) or an environmental impact statement (EIS), air quality modeling may be required to address potential air quality impacts.

Air modeling for an environmental review project is not necessarily dictated by the needs of an air quality permit. Within the environmental review program, air quality modeling may include cumulative effects modeling or air deposition analysis as well as an ***air toxic analysis***. The decision to model for an environmental review project is determined on a case-by-case basis in consultation with the MPCA Environmental Review Project Manager and MPCA Air Quality Staff. Environmental review programs on tribal lands within the state of Minnesota are handled directly between the tribe and the EPA through the National Environmental Policy Act (NEPA). If you are planning a project that is subject to environmental review, the MPCA encourages you to contact the Environmental Review program in advance of preparing your assessment documents. For more information on air quality assessment and environmental review, please see the MPCA website.

Additionally, the air dispersion modeling information needed in an EAW may be different from those in an EIS. The EIS air quality modeling is subject to a scoping process that may include additional air quality analysis such as deposition, refined inhalation risk analysis, etc. An EAW is a screening document that is designed to reveal if there are any potentially significant and irreversible environmental impacts that would require further analysis through an EIS. The air quality modeling demonstration in an EAW is often similar (if not the same) as that submitted for a PSD or NAAQS modeling demonstration, though Environmental Review may require additional analysis on a case-by-case basis. As such, an air dispersion modeling analysis would account for any applicable ambient air quality standards or inhalation health risk values in order to determine if there are any modeled exceedances or potentially adverse environmental impacts. An EIS is a more thorough environmental analysis that may require more refined air quality dispersion modeling.

State implementation plans

A State Implementation Plan (SIP), created through Title I, Section 110 of the CAA, is a document that is adopted by a state and approved by the EPA. It is legally binding under both state and federal law, and may be enforced by authorities at either level. It is important to note that Tribal lands within Minnesota are not bound by a SIP, rather, tribes work directly with EPA to demonstrate compliance with federal regulations. The SIP document includes the regulations and other administrative approaches for meeting federal air quality standards and CAA requirements.

The SIP focuses on regulation of the criteria air pollutants, which are those pollutants for which EPA has set a NAAQS to protect human health. Air toxics, or hazardous air pollutants, are regulated under other portions of the CAA and are not included in the SIP. Air quality dispersion modeling for a SIP, if required, falls into two categories: ***attainment demonstrations*** and ***permit modeling***. Each approach is unique and presents air quality dispersion modeling as a means to evaluate compliance with the applicable NAAQS pollutant.

The development of an ***attainment demonstration*** is fairly straightforward. When the MPCA submits a SIP to EPA, one of the components of the SIP submittal may be air dispersion modeling that reflects the geographic area of interest. Air dispersion modeling conducted for either a revision to an existing plan or for a SIP submittal for attainment demonstration will typically follow NAAQS modeling methodologies.

That is, modeling that considers the impact of the facility, nearby sources, and background concentrations. However, additional details related to the SIP modeling may be outlined in EPA guidance documents and therefore should be considered.

Under certain circumstances, ***permit modeling*** and the SIP intersect. Individual facilities within a SIP maintenance area that make modifications to the facility or increase emissions may be required to submit air dispersion modeling reflecting the changes to ensure compliance with existing SIP conditions. Air dispersion modeling conducted for facilities within a SIP maintenance area should follow the air dispersion modeling process and procedures outlined in **Section 2: How to Model**.

More detailed information on Minnesota SIP.

Section 2: How to model

The MPCA follows the applicable EPA regulations and guidance when developing or reviewing ambient air quality models for Title V permits or PSD-related analysis. This Manual describes specific practices that facilitate the efficient review and approval of a modeling protocol and report, including specific direction on the development of various inputs for the model. In addition, this section also describes conditions that are unique to permitting under the CAA such as SIP modeling and unique PSD requirements.

Part I. Modeling basics

Air quality dispersion models use mathematical formulas that represent atmospheric processes, terrain characteristics, building parameters, and pollutant-specific emission data. Regulatory air dispersion models are designed to generate unbiased modeled ambient air quality concentrations, based on existing or proposed operational data. For this reason, regulatory models are designed to be *conservative*, meaning that they are designed to over-predict ambient air quality impacts that might occur in real-world situations. Since the air quality dispersion models may over-predict ambient air quality concentrations, it should not be assumed that a modeled prediction indicates a real-world pollution condition. A predicted exceedance of an air quality standard or guideline may indicate the likelihood of a potential air quality violation. As a result, a modeled exceedance of a standard or guideline value may be used as the basis to modify allowable emission rates, stack parameters, operating conditions, or to require SIP review for criteria pollutants. For additional discussion of model accuracy and uncertainty, please see ***Section 9.0 of 40 CFR 51, Appendix W.***

Preferred models

The MPCA follows the EPA's *Guideline on Air Quality Models* codified in 40 CFR § 51, Appendix W, to determine acceptable models and approaches for use in air quality dispersion modeling and impact analyses. As new models are accepted by the EPA, the *Guideline on Air Quality Models* is updated.

There are a variety of refined dispersion models available for use to predict ambient air concentrations from an emission source. The EPA has preferred dispersion models for evaluating pollutant dispersion within 50 km of the source (i.e., ***Near-field***) and for pollutant transport greater than 50 km (i.e., ***Far-field***). ***Near-field*** modeling is the most common air dispersion modeling and is used to evaluate a variety of PSD and NAAQS issues. ***Far-field*** dispersion modeling is typically related to a ***Class I*** analysis and may or may not include chemical transformation.

In general, refined ***near-field*** modeling requires much more detailed information about the facility and the surrounding area, along with complex models to calculate ambient impacts, in comparison to screening modeling. The primary model used for the refined air quality dispersion modeling is the most recent version of EPA's AERMOD modeling system. Currently, the AERMOD modeling system can be downloaded from EPA's Support Center for Regulatory Air Models (SCRAM) website.

AERMOD is a steady-state, multiple-source, Gaussian dispersion model. AERMOD is the EPA preferred refined model for estimating impacts at receptors located in simple or complex terrain. It is applied as a near-field dispersion model for Class II and increment modeling simulations. AERMOD can predict ambient concentrations using onsite, representative, or worst-case meteorological data sets. AERMOD is capable of calculating downwind ground-level concentrations due to point, area, and volume sources and can accommodate a large number of complex sources and receptors. AERMOD incorporates algorithms for the simulation of aerodynamic downwash induced by buildings and can also address complex terrain using built-in model algorithms. The AERMOD model does not address or simulate atmospheric chemistry processes.

A second preferred model is the CALPUFF software. The CALPUFF model is typically used to assess impacts at **Class I** areas. CALPUFF incorporates more sophisticated physics and chemistry and requires more extensive data input than AERMOD. CALPUFF is a multi-layer, multi-species, non-steady-state puff dispersion model that simulates the effects of time and space-varying meteorological conditions on pollution transport, transformation, and removal.

CALPUFF can be applied on scales of tens to hundreds of kilometers. It is almost exclusively used in **far-field** analysis for **Class I** evaluations. It includes algorithms for sub-grid scale effects (such as terrain impingement), as well as longer-range effects (such as pollutant removal due to wet scavenging and dry deposition, chemical transformation, and visibility effects of particulate matter concentrations). The ***User's Guide for the CALPUFF Dispersion Model*** provides more information on the CALPUFF model.

Depending upon the situation, the MPCA may approve alternative air dispersion models on a case-by-case basis; however, be aware that the most recent version of EPA's AERMOD modeling system is the preferred regulatory model. Under most circumstances, alternative model evaluation may require approval by EPA Region V. More detailed information regarding preferred and alternative dispersion modeling, including models available for download, is available at EPA's Support SCRAM website.

Basic model inputs

The MPCA uses EPA's AERMOD dispersion model for refined Class II air quality dispersion modeling demonstrations. Modeling demonstrations require specific inputs that reflect facility operations as well as sources in the nearby area. These inputs include the types of emissions, emission rates, and related pollutant release characteristics. Buildings and related structures are also included as inputs as well as discrete points where ambient air quality concentrations are predicted known as receptors. Terrain data and meteorological information are also included as part of the modeling demonstration and should reflect the spatial setting of the actual project under review.

The following is a description of typical model input variables along with a description of the MPCA expectations for review and approval. Please note that the descriptions presented below correlate to the MPCA modeling protocol forms and related AQDM-02 spreadsheet (see Section 3).

Facility and source identifiers

Facilities should use the AQDM-02 Protocol Spreadsheet to provide relevant source information. Such as stack parameters, emission rates, and emission factors. All sections of the AQDM-02 must be filled out and reviewed by the MPCA before an applicant receives approval of a submitted protocol. Facilities may add additional tabs/worksheets to the workbook to provide more detailed calculations. Please note that the AQDM-02 replaces the former SAM spreadsheet. When filling out the AQDM-02 please use facility and source identifiers that are consistent with the following criteria:

- The three-character Facility Abbreviation Code (FAC).
- Standardized AERMOD source ids and corresponding BPIP source id's. Stack/vent identifiers ([FAC]SVnnn) should match those used in the facility air permit. See the Source Characterization section for details.
- Non-stack/vent sources (e.g., fugitive emissions from roads, storage piles, and material handling) may use other user-specified identifiers (e.g., [FAC]FSnnn). See the Source Characterization section for details.

When filling out the e-Service protocol form:

- Model IDs should match the AERMOD source ids in the AQDM-02
- Subject item IDs will be assigned automatically to existing sources.
- For new sources, please enter the AERMOD source ID in the Subject Item ID field.

Meteorology

The current MPCA pre-processed meteorological data sets were developed with AERMET version 14134, as well as the EPA pre-processor AERMINUTE version 14337 with the use of EPA's surface characteristics tool, AERSURFACE version 13016. MPCA pre-processed meteorological data sets developed with the most recent versions of AERMET, AERMINUTE, and AERSURFACE for the years 2009 – 2013 are available online. The MPCA-processed data sets include adjustments for measured monthly snow cover and seasonal determinations. Previous versions of meteorological data sets are no longer available online but can be provided upon request by contacting Daniel Dix at, e-mail: daniel.dix@state.mn.us or 651-757-2326.

The MPCA is aware of the interest in using an adjusted surface friction velocity (ADJ_U*) in regulatory dispersion modeling demonstrations. At this time, the ADJ_U* approach has not been approved by the EPA for use as a regulatory modeling default. Approval to use ADJ_U* will continue to be made on a case-by-case basis unless the status of ADJ_U* changes to a default option.

In order to accommodate ADJ_U* requests for project use, the MPCA is following the existing EPA Appendix W to provide for consistent and timely review and approval. Specifically, the MPCA is following the Guideline Criteria for Alternative Models (Section 3.2.2(b) through (e)) and the specific Request for Approval under Section 3.2.2(b)(2) and 3.2.2(d) of the current Appendix W.

If you anticipate using the ADJ_U* approach, please contact the MPCA Risk Evaluation and Air Modeling Unit Supervisor, Ruth Roberson, at (651) 757-2672 or ruth.roberson@state.mn.us to discuss your proposal further. You may provide your request to use ADJ_U* either prior to submitting an air quality modeling protocol or along with it. Be aware that requesting the use of ADJ_U* will require additional MPCA review time. Contacting MPCA early in the modeling protocol development process is suggested as it provides project proposers an opportunity to familiarize agency staff with project details, identify specific data, and agree on analytical expectations needed to support the request, review and approval.

There are approximately 80 meteorological surface observing stations in the state of Minnesota, consisting of ASOS (Automated Surface Observing System) and AWOS (Automated Weather Observing System) sites. The overwhelming majority of sites are located on airport property and follow siting guidelines laid out in the Federal Meteorological Handbook. During 2009 through 2011, 87 stations from Minnesota, Wisconsin, South Dakota, and North Dakota were examined using preliminary processing to determine usability for modeling purposes. Usability was based on the amount of missing and calm hours per year for each surface station for the years 2000 – 2008. From the original 87 surface stations examined during that time, 46 stations were then further processed to include site-specific yearly-averaged moisture conditions, corrected locational data, and the years 2009 and 2010. This preliminary processing provided the foundation to our meteorological data and informs which sites are processed in future updates. Currently, there are over 20 surface stations that are suitable for use in current modeling demonstrations. This information is available on our website.

Selecting the appropriate meteorological data for a modeling demonstration is a critical factor in the representation of the project. The MPCA follows the EPA guidance on the selection of meteorological data sets for air quality modeling demonstrations. Specifically, 40 CFR pt. 51, Appendix W, 8.3.a. states that the following should be considered when choosing representative meteorological data:

- The proximity of the meteorological monitoring site to the area under consideration
- The complexity of the terrain.
- The exposure of the meteorological monitoring site.
- The period of time during which data are collected.
- Section 8.3.c further states that "of paramount importance is the requirement that all meteorological data used as input to AERMOD must be both laterally and vertically representative of the transport and dispersion within the analysis domain." It also states, "the surface characteristics input to AERMET should be based on the topographic conditions in the vicinity of the meteorological tower."

In order to determine the most representative meteorological station for use, it is recommended that the subject source consider meteorological sites with similar features. Other considerations include:

- Wind direction and wind speed patterns
- Terrain influences on wind patterns
- Surface characteristics (albedo, Bowen ratios, surface roughness), based on surrounding land use
- Proximity
- AERMINUTE (to minimize calm hours, if applicable, per EPA guidance)

In areas of the state where complex or highly variable terrain occurs (river valleys, lake shores, northeast Minnesota, etc.), it is recommended that a meteorological set be chosen based mainly on surface characteristics, wind patterns, land use, and terrain. In areas of Minnesota where terrain is relatively flat and invariable, then proximity, surface characteristics, land use, and wind patterns should be examined. No matter the subject source and the reliance on past meteorological sites, please provide explanation/reasoning for your choice of met sets in the e-Service modeling protocol form.

For any questions regarding the choice of a meteorological data set(s) for your source, please contact MPCA air dispersion modeling staff to discuss. **Note:** *Facilities wishing to use on-site meteorological data or other meteorological data should submit a written request for MPCA approval*.

Terrain data

The MPCA prefers that any elevation/terrain information provided for a near-field dispersion modeling analysis be presented in a GeoTiff format. The United States Geological Survey (USGS) provides elevation data that can be retrieved from their website; however, they have discontinued the delivery of elevation data in the GeoTiff format. Please note that if you are using third-party software, the acquisition of elevation data from USGS and conversion to a GeoTiff format is automated. Elevation data should be projected in the National Elevation Data (NED) format.

The spatial projection of modeling features (e.g., buildings, stacks, etc.) should always be performed using Universal Transverse Mercator (UTM) coordinates. The use of UTM coordinates is consistent with the state of Minnesota Geospatial Information Office (GIO) standards. Consistent with the GIO data standards, the MPCA requests that all model coordinates are in UTMs with the NAD83 horizontal data coordinate system projected as Zone 15 Extended. The Zone 15 Extended places all geospatial data in the boundaries of the state of Minnesota, rather than having the state split into Zones 14, 15, and 16. The digital elevation model (DEM) data that is reviewed and approved during the Protocol stage is the geospatial data set of record for a project. Please be aware that the USGS updates elevations frequently without notice. In situations where a substantial amount of time has passed from the approval of a protocol to the final report, the MPCA may request updated terrain files. Terrain data can affect the outcome of a modeling demonstration.

Buildings and structures

Airflow over and around structures significantly impacts the dispersion of plumes from point sources. Modeling of point sources with stack heights that are less than good engineering practice (GEP) stack height should consider the impacts associated with building wake effects (also referred to as building downwash). GEP stack height is the height needed for a stack to avoid excessive ambient concentrations due to downwash. Downwash impacts should also be considered from stacks that are greater than GEP. As a working practice, excessive downwash is considered by EPA to be a 40% increase in concentrations in a modeled scenario modeled with and without the buildings in question. In the GEP definition, note that Hg = GEP stack height, Hb = height of nearby structure, and L = lesser dimension (height or projected width) of nearby structure. GEP stack height is calculated as the highest of the following four numbers:

- 213.25 feet (65 meters)
- For stacks in existence on January 12, 1979, and for which the owner or operator has obtained all applicable preconstruction permit approvals required under 40 CFR 51 and 52, Hg = 2.5Hb
- For all other stacks, Hg = Hb + 1.5L
- The height demonstrated by a fluid model or field study approved by the reviewing agency, which ensures that the emissions from a stack do not result in excessive concentrations of any air pollutant as a result of atmospheric downwash, wakes, or eddy effects created by the source itself, nearby structures, or nearby terrain obstacles.

When calculating pollutant impacts, AERMOD has the capability to account for building downwash produced by airflow over and around structures. In order to do so, the model requires special input data known as direction-specific building dimensions (DSBDs) for all stacks below the GEP stack height. Methods and procedures to determine the appropriate entries to account for downwash are discussed in EPA's *User's Guide to the Building Profile Input Program (EPA, 1995)*.

Due to the complexity of the GEP guidance, the EPA has developed a computer program that calculates the downwash parameters for AERMOD. The Building Parameter Input Program Prime (BPIPPRM) must be used for downwash analyses for input to AERMOD. Many AERMOD vendors include BPIPPRM within their software which is the same as BPIP but includes an algorithm for calculating downwash values for input into the PRIME algorithm which is contained in AERMOD. If you are not using third-party AERMOD software, please use the most current version of BPIPPRM to determine downwash parameters. Currently, BPIPPRM can be downloaded from EPA's SCRAM website.

In the event that an AERMOD modeling demonstration requires tiered structures, the manner in which the structures are created can have unrealistic impacts on the model outcomes. Typically, when a multi-tiered building is offered in an air quality dispersion modeling exercise, the tiers are stacked as presented in Figure 1. The "tiered division" presented below left is the MPCA preferred building submittal. A "blocked division" or computer-aided drafting (CAD) approach (right) is not preferred.

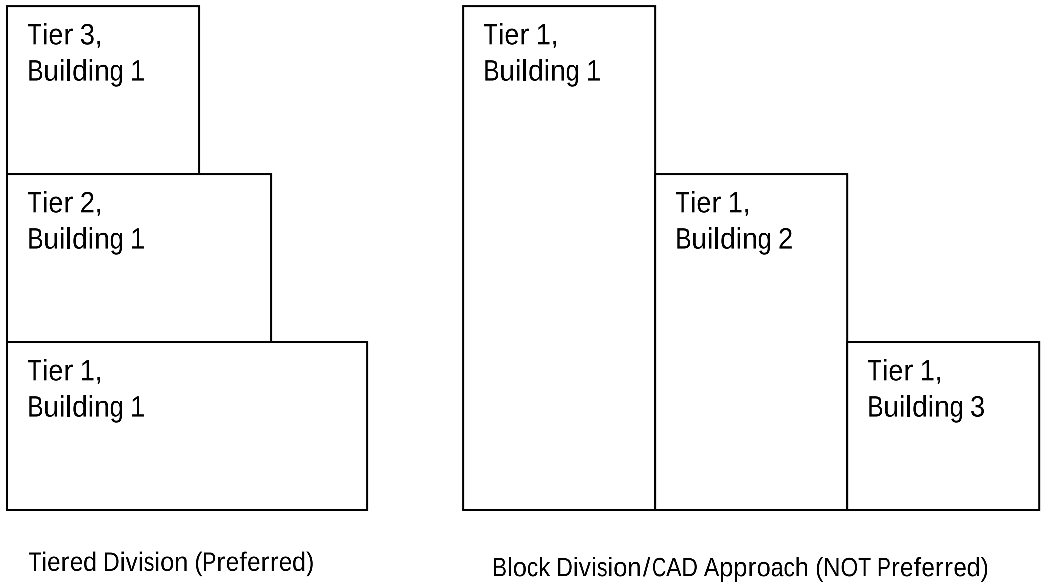

Figure 1. Building layout

While SCREEN3 is no longer an EPA regulatory approved screening tool, it is used for limited evaluations in some air programs. In the event that SCREEN3 is used for your project, you may still need to account for building downwash. To account for downwash in the SCREEN3 model, it is necessary to enter a building or structure height and the respective maximum and minimum horizontal dimensions. Generally, include the building with the dimensions that result in the highest GEP stack height for that source to evaluate the greatest downwash effects. AERSCREEN is capable of using input generated from BPIPPRM. Building downwash effects are not considered for non-point sources.

Source characterization

Regulatory modeling should reflect the actual characteristics of the proposed emission sources. Several different source types are used to characterize emissions releases. The different source types are described below. The MPCA suggests that the most explicit means of characterizing an emission source be used to complete the modeling demonstration. The following description of source characterization reflects the input parameters used in AERMOD. Please use the MPCA AQDM-02 modeling protocol spreadsheet to complete this phase of the modeling demonstration.

Point sources

The point source is the most common type of source used to represent stacks, vents, and related emission sources. The point source approach is a well-defined means of representing the release of pollutants into the ambient air. Several factors should be considered in the development of a point source. At a minimum, the following parameters in Table 6 are required to model a point source:

Table 6. Point source input parameters

Source Identification	The MPCA employs the following designation for identification of point source emissions: **ABCSV 001**. The ***ABC*** designation represents the three-letter code of the company as required under the MPCA permit. The ***SV*** letters designate this source as a Stack-Vent point source. The three-digit number after the letters (***001***) represents the number of the stack for the company. This number should correspond to the MPCA number consistent with the air permit and related data management system. Deviations from this approach, particularly with respect to stack-vent number, may cause delays in review and approval.
Release Type	The AERMOD dispersion model provides for the ability to model a point source with different release characteristics. These characteristics reflect an emission release from a point source that is ***vertical***, ***horizontal*** or ***capped***. If a vertical release is designated, no further work is needed beyond the basic characterization presented here. If a source is a horizontal release or capped, special approaches are required to simulate the actual emission release from the stack-vent. The MPCA will consider the use of a reduced velocity (0.001 m/s) or the approach described in the ***1993 EPA Model Clearinghouse*** Memorandum. At this time, the MPCA will not consider the non-default option in AERMOD.
Stack Location	The location of the stack is a critical component of the point source characterization and should be based on the most accurate geospatial information available. This information would include three measures: the ***X coordinate*** (in meters); ***Y coordinate*** (in meters); and the ***base elevation*** (also in meters). Measures should be reported using the Universal Transverse Mercator (UTM) system in Zone 15 (extended) in the NAD 1983 series, consistent with state of Minnesota geostatistical data standards.
Release Height	The release height represents the height of the stack above the base elevation (in feet or meters).
Emission Rate	The emission rate is pollutant specific and represents the various processes that are directed to and release from the point source stack/vent. For modeling purposes, the emission rate should be presented in units of grams per second (g/s). AERMOD is able to use the emission rate value in calculating both concentration and deposition values.
Inside Stack Diameter	This value represents the diameter of the stack at the point of release. It should be presented in meters or feet.
Exhaust Flow Rate of Velocity	This value represents the rate at which stack gas exits the stack. Typically, the MPCA uses the Actual Cubic Foot per Minute (ACFM) measure for this parameter (ft^3 /min).
Exhaust Temperature	The exhaust temperature parameter should be provided in units of Kelvin (K) wherever possible. AERMOD provides for the ability to designate whether the stack temperature is a ***fixed*** value, or whether it is ***ambient*** or ***above ambient***. The ***fixed*** value allows for the temperature to remain the same through the modeled simulation. This is the most common approach. Meteorology has no impact on this value. With ***ambient*** temperatures, meteorology is the driving factor. In these situations, a value of "0" should be provided. For temperatures ***above ambient***, meteorology still plays a role; a negative value is entered (for a constant Delta T) and is added to the meteorological value to determine the exit temperature.

Volume sources

A volume source is a three-dimensional representation of an air emission source. Volume sources have a variety of applications in dispersion modeling and typically are categorized as elevated and surface-based. At the facility level, they are typically elevated sources used to characterize emission releases from industrial sources such as building roof monitors, multiple vents, conveyor belts, roads, drop points from loaders, and material storage piles. As a surface-based representation, they are also used to characterize fugitive emissions from roads (paved or unpaved), working faces of sand or gravel operations and related surfaces.

Table 7. Volume source input parameters

Source identification	The MPCA has designated two approaches for source identification nomenclature. For volume source characterization that reflects a facility, the volume source should be identified as **ABCVL001**. The **ABC** designation reflects the three-letter company code; consistent with the approach used in point source identification. The **VL** represents the volume source characterization. The **001** aligns to the numbering of the volume source. For **roads** or related **linear or surface-based emission source** in sequence or related arrangements, the designation is slightly different. The source identification should be **XXXVL001**, whereby the **XXXX** represents a four-letter feature code (user-defined). The remaining portion of the source identifier functions in the same manner as the facility-based volume source identifier.
Spatial Features	Spatial features for a volume source delineate an area of emission activity rather than a specific point of emission; however, the representation of the volume source emission on a Cartesian grid is represented as a point. The underlying assumption for this approach is the point representation of the volume source center. Spatial representation includes three measures: the *X coordinate* (in meters); *Y coordinate* (in meters); and the *base elevation* (also in meters). This is consistent with the manner in which point source locations are reported. Measures should be reported using the Universal Transverse Mercator (UTM) system in Zone 15 (extended) in the NAD 1983 series, consistent with state of Minnesota geostatistical data standards.
Source release parameters	
Emission Rate	For modeling purposes, the pollutant-specific emission rate should be presented in units of grams per second (g/s). AERMOD is able to use the emission rate value in calculating both concentration and deposition values.
Source Release Height above ground (h_e),	As a general rule, the release height for a volume source is equal to one-half of the source height. When representing a building or related structure, this is a reasonable approach; however, when representing a road or other surface-based emission source, the following approach should be used: h_e = Vehicle Height*1.7/2 Once the source release height has been determined, it should be entered in the MPCA spreadsheet as meters or in feet.
Initial lateral dimension of the volume (σ_{yo}), and the initial vertical dimension of the volume (σ_{zo}).	Initial lateral and vertical dimensions (initial sigmas) are based on the geometry and location of the source. They are determined by using the actual physical dimensions of the source of interest (i.e., actual height, actual width, and actual length. It is important to note that the base of a volume source must be a square. If the source cannot be characterized as square, then the source should be characterized as a series of adjacent volume sources. The following procedures for estimating the initial lateral dimension (S_{yo}) and the initial vertical dimension (S_{zo}) are provided below.

Initial Lateral Dimension	Procedure
Single Volume Source	S_{yo} = side length/4.3

	Line Source Represented by Adjacent Volume Sources	S_{yo} = side length/2.15
	Line Source Represented by Separated Volume Sources	S_{yo} = center to center distance/2.15
	Initial Vertical Dimension	**Procedure**
	Surface-Based Source (he ~ 0)	S_{zo} = vertical dimension of source/2.15
	Elevated Source (he > 0) on or Adjacent to a Building	S_{zo} = building height/2.15
	Elevated Source (he > 0) not on or Adjacent to a Building	S_{zo} = vertical dimension of source/4.3

Area sources

An area source is used to characterize emissions from low level or ground level releases where there is no plume rise. Examples include storage piles, slag dumps, wastewater treatment ponds, earthen basins and lagoons. Under certain circumstances, an area source may be used to represent fugitive emissions. The use of an area source in AERMOD assumes that the emitting surface area is a homogenous, uniform emitting surface with a release height above the ground at which wind speed is measured.

Table 8. Area source input parameters (area surface, area poly, area line, area circle

Source Identification	The MPCA employs the following designation to identify area source emissions: **XXXAS001**. The ***XXXXX*** designation represents a user-defined five-letter code for the area source. The ***AS*** letters designate this source as an area source. The three-digit number after the letters (***001***) represents the number of the area source if there are multiple area sources in the modeling demonstration.
Orientation Angle from North (degrees)	Area source orientation in AERMOD is to the north, unless otherwise specified via the **angle parameter**. If an **angle parameter** is not designated, AERMOD assumes a north-south and east-west orientation. The angle parameter that is used in AERMOD must be positive for clockwise rotation and negative for counterclockwise rotation. This is because **angle parameter** in AERMOD is applied relative to a north orientation. The **angle parameter** is defined as the north of the side that is clockwise from the vertex (X and Y coordinate location), i.e., the side with Y side length. Functionally, if the **angle parameter** is input and the value is different from 0.0 degrees, then the model will rotate the area clockwise around the vertex defined in the X coordinate and Y coordinate input fields.
Area Source Location	Three inputs are required to spatially plot an area source on a Cartesian grid: the **X-coordinate**; the **Y-coordinate** and the **base elevation**. The **X coordinate** represents the vertex of the area source that occurs in the southwest quadrant of the source. The **Y coordinate** represents the vertex of the area source that occurs in the southwest quadrant of the source. Measures should be reported using the Universal Transverse Mercator (UTM) system in Zone 15 (extended) in the NAD 1983 series, consistent with state of Minnesota geostatistical data standards. The **base elevation** for the source is the elevation above mean sea level and should be submitted in meters.
Release Height	The **release height** represents the height above the base elevation where pollutants are entrained in the ambient air as a function of wind speed. This height is measured in meters and reflects a number of factors that are site and case specific.
Emission Rate	The **emission rate** for area sources is an emission rate per unit area entered in grams per second per square meter ($g/(s\text{-}m^2)$). The same emission rate is used for both concentration and deposition calculations.
Note on Mechanically-Generated Emissions and Area Sources	In the event that an area source is used to represent a mechanical emission (e.g., vehicles), the **initial vertical dimension of the plume** can be included as an input to the area source. This practice is consistent with and similar to the **initial vertical dimension** described in the volume source calculation illustrated above. The rationale for this approach is that the mechanically generated emissions may present turbulent mixing near the source that would present an initial depth. This approach would generally not be applicable for passive area source emissions. If this approach is employed, the value should be reported in meters (m).

When developing an area source, it is important to consider the **aspect ratio**, defined as the ratio of length to width. The **aspect ratio** should not exceed a 10:1 ratio. If it is determined that this ratio is exceeded, the area source should be subdivided to meet the 10:1 aspect ratio limitation.

Flares

Flares are typically modeled similar to point sources and are considered a control device for a wide variety of sources. A flare source is simulated similar to a point source; however, it includes a buoyancy flux reduction relative to radiative heat loss. It also accounts for flame length in the estimation of plume height. Additionally, the heat release from the flare is utilized to calculate plume rise. AERMOD interfaces created by third party vendors typically automate the flare feature input. The following is a generic method that pertains to the "typical" flare used in an air modeling simulation. The method will be relatively accurate depending on flare parameters such as heat content, molecular weight of the fuel, and velocity of the uncombusted fuel/air mixture. Hence, this method may not be suitable for all conceivable situations. In this case, the applicant may submit a properly documented method for consideration by MPCA staff. The preferred flare characterization is described as follows:

Table 9. Flare source input parameters

Source Identification	The MPCA employs the following designation for identification of flare source emissions: **ABCFL001**. The **ABC** designation represents the three-letter code of the company as required under the MPCA permit. The **FL** letters designate this source as a flare point source. The three-digit number after the letters (**001**) represents the number of the flare for the company. This number should correspond to the MPCA number consistent with the air permit and related data management system. Deviations from this approach, particularly with respect to flare number, may cause delays in review and approval.
Source Location	The location of the flare is a critical component of the source characterization and should be based on the most accurate geospatial information available. This information would include three measures: the X coordinate (in meters); Y coordinate (in meters); and the base elevation (also in meters). Measures should be reported using the Universal Transverse Mercator (UTM) system in Zone 15 (extended) in the NAD 1983 series, consistent with state of Minnesota geostatistical data standards.
Effective Release Height	Specify the effective release height above the ground in meters or feet. The effective release height should be given as the stack height plus the flare height.
Source Release Parameters	
Emission Rate	The emission rate is pollutant specific and represents the various processes that are directed to and released from the flare. For modeling purposes, the emission rate should be presented in units of grams per second (g/s). AERMOD is able to use the emission rate value in calculating both concentration and deposition values.
Gas Exit Temperature	The exhaust temperature parameter should be provided in units of Kelvin (K) wherever possible. AERMOD provides for the ability to designate whether the stack temperature is a ***fixed*** value, or whether it is ***ambient*** or ***above ambient***. The ***fixed*** values allow for the temperature to remain the same through the modeled simulation. This is the most common approach. Meteorology has no impact on this value. With ***ambient*** temperatures, meteorology is the driving factor. In these situations, a value of "0" should be provided. For temperatures ***above ambient***, meteorology still plays a role. The value entered is added to the meteorological value to determine the exit temperature.
Stack Inside Diameter	This value represents the diameter of the stack at the point of release. It should be presented in meters.
Gas Exit Velocity/ Gas Exit Flow Rate	This value represents the rate at which stack gas exits the stack. Typically, the MPCA uses the Actual Cubic Foot per Minute (ACFM) measure for this parameter (ft^3 /min).

As a regulatory requirement, flares must meet the requirements of 40 CFR § 60.18, as well as a minimum reduction of 98% for all combustible components of the original emission.

Open pit sources

The open pit approach is used to model fugitive particulate emissions from open pit sources (e.g., surface mines, rock quarries, Frac sand operations, etc.). The algorithm simulates particulate emissions that have an initial dispersion in three dimensions with little or no plume rise. A key feature of the open pit approach is the use of an "effective area" for modeling the pit emissions based on meteorology. The open pit algorithm employs a numerical integration area source algorithm that is used to model the impact of particulate emissions from the effective area sources. In order to develop an open pit source, the following parameters are needed:

Table 10. Open pit sources

Source Identification	The MPCA employs the following designation to identify open pit source emissions: **XXXXXOP001**. The ***XXXXX*** designation represents a user-defined five-letter code for the area source. The ***OP*** letters designate this source as an open pit source. The three-digit number after the letters (***001***) represents the number of the open pit source if there are multiple open pit sources in the modeling demonstration.
Source Location	Three inputs are required to spatially plot an area source on a Cartesian grid: the **X-coordinate**; the **Y-coordinate** and the **base elevation**. The **X coordinate** represents the vertex of the area source that occurs in the southwest quadrant of the source. The **Y coordinate** represents the vertex of the area source that occurs in the southwest quadrant of the source. Measures should be reported using the Universal Transverse Mercator (UTM) system in Zone 15 (extended) in the NAD 1983 series, consistent with state of Minnesota geostatistical data standards. The **base elevation** for the source is the elevation above mean sea level and should be submitted in meters (m).
Effective Pit Depth	The **effective depth** of an open pit is determined through a simple arithmetic relationship defined as: Effective Pit Depth (E_{pd}) = Pit Volume (P_v)/ (Pit Width (P_w) x Pit Length (P_l))
Release Height	The average release height is a value that is above the base of the pit and measured in meters. The meteorological-influenced emission character of the open pit source characterization prohibits a release height greater than the effective depth of the pit.
Open Pit Emission Rate	The open pit emission rate is similar to that used with the area source characterization. The emission rate for open pit sources is input as an emission rate per unit area. The emission rate should be entered in grams per second per square meter (g/(s-m^2)). Consistent with other source characterizations, the same emission rate is used for both concentration and deposition calculations.
Orientation Angle from North	**Open pit source** orientation is similar to the **area source** orientation in AERMOD. It is to the North, unless otherwise specified via the **angle parameter**. If an **angle parameter** is not designated, AERMOD assumes a north-south and east-west orientation. The angle parameter that is used in AERMOD must be positive for clockwise rotation and negative for counterclockwise rotation. This is because **angle parameter** in AERMOD is applied relative to a North orientation. The **angle parameter** is defined as the North of the side that is clockwise from the vertex (X and Y coordinate location), i.e. the side with Y side length. Functionally, if the **angle parameter** is input and the value is different from 0.0 degrees, then the model will rotate the area clockwise around the vertex defined in the X coordinate and Y coordinate input fields.

Notes: As you construct the open pit source, it is important to pay attention to the aspect ratio of the pit, per EPA AERMOD guidance. The aspect ratio of an open pit source should be less than 10 to 1, consistent with an area source. Some third-party vendors have coded exceptions to this rule; however, in the event that you exceed the aspect ratio of 10:1, you may proceed with a warning message. Equivalency runs between third-party vendor software and the EPA AERMOD executable may be needed to evaluate performance. Since the pit algorithm generates an effective area for modeling emissions from the pit, and the size, shape and location of the effective area is a function of wind direction, an open pit cannot be subdivided into a series of smaller sources. It is suggested that a rectangular shape of equal surface area be used as an approximation. The MPCA will review the use of the Open Pit source for this practice.

Emission point co-location

Typically, this is a very rare situation in Minnesota. Conceptually, regulatory dispersion modeling should be as explicit as possible, reflecting the actual characteristics of the proposed or existing emissions sources from a project. This means that the practice of co-locating emission points should only be pursued in well-justified situations. As an example, co-locating may be appropriate in situations when the number of stacks or vents at a large facility exceeds the capability of the model. This is an unusual situation. It would not be acceptable to simply co-locate stacks or vents for convenience or as a means to reduce model run time. If you are considering co-locating emission sources, determine if the emission sources:

- Emit the same pollutant(s)
- Have the same source release parameters
- Are located within 100-meters of each other

The MPCA may allow co-location of individual emission sources on a case-by-case basis. A concern with this approach is that slight movements in the location of large emission sources may have significant impact on the modeling results for NAAQS, PSD increment, and visibility analyses.

Receptors

A receptor is a specific location in the modeling domain where the model needs to provide results (i.e., concentration, deposition). Definitions of both state and federal ambient air affect the placement of receptors (See Table 12 and Table 13). For further discussion of EPA and ambient air, please see **Appendix D.**[2] Depending upon the purpose of the modeling study, some or all of the following types of receptors may be appropriate:

General receptors

These are receptors that are placed regularly throughout the modeling domain. The distance between receptors should allow graphics or mapping software to characterize gradients of concentration or deposition. Receptors are typically spaced closer together near to the sources and further apart at longer distances. See Table 12 and Table 13 for a discussion of receptor placement.

Fence line receptors

If the modeling study needs to determine the highest concentration outside a property boundary or fence line, then place receptors at equal distances along that boundary.

Sensitive receptors

A discrete receptor should be placed at each location with a known sensitive receptor (e.g., building air intakes, school, playground, hospital, and sensitive ecosystem). Please note that sensitive receptors located on tribal lands may not be easily identifiable through aerial maps or state databases; it may be necessary for these areas to be included in a modeling demonstration where there is tribal interest or

[2] Appendix D is currently under revision and will be available as a Working Practice Memorandum in the Fall of 2016. Please contact MPCA modeling staff with any questions regarding ambient air issues until the revised document is available.

potential impact. In the event that this situation emerges and additional tribal information is needed, please contact the MPCA modeling unit for further direction.

On-site receptors

Depending upon the purpose of the modeling demonstration, you may not need to report modeling results for receptors located within a boundary or fence line; however, in modeling demonstrations where nearby sources are included, onsite receptors are useful in the event a culpability analysis is needed. Please discuss with the MPCA modeling unit if you have specific questions about your project and onsite receptors.

Flagpole receptors

A flagpole receptor is defined as any receptor located above ground level (e.g., to represent the roof or balcony of a building). The default value is assumed to be 0.0 m (i.e., ground-level receptors).

Please note that flagpole receptors are unique and have specific applications. Flagpole receptors, when used, are a small number of all receptors (ground-level receptors and above ground-level receptors) used to protect NAAQS. Flagpole receptors are rarely needed for most PSD projects because most PSD projects occur in rural areas or small towns, and these areas often lack sufficiently tall structures that are close enough to require their use (e.g., within ~1mile). However, they are needed in dense urban environments with multiple tall buildings such as the downtown areas of Minneapolis, St. Paul, Duluth, Rochester, and other major cities. Examples include upper-level open-air decks, restaurants, tennis courts, balconies, patios, pools, parking ramps, and the like at hotels, motels, apartments, schools, colleges, hospitals, etc. More examples: bridges, public observation towers, lookouts, etc.

Better ambient protection is necessary for situations involving more public exposure (e.g., "**public prone**" and "**non-industrial/non-worker**" cases). If a facility is in an urban environment where above grade FLAGPOLE receptors are needed to evaluate key multiple heights (especially tall structures within ~1 mile), several possible approaches (least rigorous to most rigorous) are:

Table 11. Approaches to flagpole receptor application

Approach A	Blatant FLAGPOLE omissions	Approach A should be used cautiously and will be heavily scrutinized. MPCA will discourage its use if similar or higher predictions are likely elsewhere. We will also discourage its use to minimize questions by EPA and others, and, to a lesser extent, to promote more efficient (automated) ground-level receptor grids using Approach B.
Approach B	Ground-level receptors in lieu of FLAGPOLE receptors	Approach B is expected to apply to most situations (i.e., all situations not covered by Approach A or C).
Approach C	Multiple levels (e.g., BPIP corners and fractional heights)	Approach C may apply to several "**non-industrial**" situations. Full multi-level analyses may be needed but shortcuts are possible for multiple adjacent structures with different heights. Check photos, BPIP files, etc.

When flagpole receptors may be necessary for a facility's air dispersion analysis, the modeling protocol should describe the procedures that will be used to determine what approach will fit the buildings in the receptor area. The facility shall determine which buildings, if any, should use Approach A, Approach B, or Approach C.

The placement and type of receptor varies between NAAQS modeling for Title V, PSD and SIP-related projects versus modeling for the MAAQS. Table 12 illustrates the placement and type of receptor for

NAAQS-related Title V, PSD/SIP modeling, while Table 13 illustrates the placement and type of receptor for MAAQS modeling.

Table 12. Ambient air receptor locations for NAAQS analysis under the Title V, Federal PSD or SIP modeling demonstrations.

Federal Citation	40 CFR § 50.1(e)	
Federal Definition of Ambient Air for purposes of the NAAQS	"Ambient air means that portion of the atmosphere, external to buildings, to which the general public has access." EPA has interpreted this to mean that areas owned or controlled by an owner/operator and enclosed by a fence or other effective physical barriers are not considered ambient air.	
Receptor Locations	**What to Consider:**	**Recommended Receptor Placement**

Facility Modeling	1. Model ***all*** areas (on and off company property) to see if any modeled NAAQS violations occur.
	2. **Special note:** EPA's interpretation of ambient air relies on public access being precluded by a fence or other physical barriers. The evaluation of physical barriers that preclude public access is a determined on a case-by-case basis in conjunction with the EPA. An "effective fenceline" could be established by posting signage and surveillance of property (e.g., cameras, patrols) and may be considered by EPA on a case-by-case basis. The MPCA does not encourage this approach. Permittees should be aware that this approach must be well-documented and may become a part of the facility operating permit.
		· Discrete receptors every 10 m along fence lines, if any.
		· Nested discreet Cartesian grid for source under review. Receptors beyond the fence line (or facility footprint absent a fence) should be located as follows:
		· 50 m spacing between the fence line or facility boundary out to 1km.
		· 100 m spacing from 1km to 2 km.
		· 250 m spacing from 2km to 5 km.
		· 500 m spacing from 5km to 10 km.
		· 1,000 m spacing from 10 km to the edge of the domain.
		· Please note the following:
		  · The areal extent of the receptor grid should be based on the significant impact radius analysis.
		  · A "Hot Spot" analysis may be necessary for areas beyond 10 km that model concentrations above the applicable SIL.
		  · Discrete FLAGPOLE receptors as appropriate (especially in dense urban environments).
		  · Discrete receptors at PSD Class I locations as appropriate – ask Federal Land Managers.

Table 13. Ambient air receptor locations for MAAQS modeling purposes

State Citation	Minn. R. 7009.0020 (Prohibited Emissions):	
State Definition of Ambient Air for purposes of the MAAQS	"No person shall emit any pollutant in such an amount or in such a manner as to cause or contribute to a violation of any ambient air quality standard beyond such person's property line, provided however, that in the event the general public has access to the person's property or portion thereof, the ambient air quality standards shall apply in those locations. The general public shall not include employees, trespassers, or other categories of people who have been directly authorized by the property owner to enter or remain on the property for a limited period of time and for a specific purpose."	
Receptor Locations	**What to Consider:**	**Recommended Receptor Placement**

MAAQS Modeling Campus settings	Areas on and off company property. This approach accounts for all areas; MPCA makes ambient air determinations within a property boundary in situations where the public has access. This option is intended for sources with campus-like settings (e.g., colleges, universities, and research & development centers) or the public is invited to enter a property.	· Discrete receptors every 10m along the property boundary or along areas of the property where the public has access, if any.
		· 50 m spacing from the property boundary out to 1km.
		· 100 m spacing from 1km to 2 km.
		· 250 m spacing from 2km to 5 km.
		· 500 m spacing from 5km to 10 km.
		· Please note the following:
		  · The areal extent of the receptor grid should be based on the significant impact radius analysis.
		  · A "Hot Spot" analysis may be necessary for areas beyond 10 km that model concentrations above the applicable SIL.
		  · Discrete FLAGPOLE receptors as appropriate (especially in dense urban environments).
		  · Discrete receptors at PSD Class I locations as appropriate – ask Federal Land Managers.

MAAQS Modeling Industry settings	Off-property locations (property line & beyond) and public roads/trails running through company property. This option is intended for sources without a campus-like setting (e.g., mining, refining, manufacturing, power plants, pulp/paper, etc.).	· Same as above; however, include discrete receptors every 100m on public roads/trails running through company property.

Part II – Setting up the model

The EPA has provided two levels of review to assess potential air quality impacts: preliminary and full impact analysis (See Table 14). The ***Preliminary Analysis*** is conducted to determine:

- If an additional air quality analysis is needed, and, if it is
- Define the impact area within which a ***full impact analysis*** (i.e., refined modeling) is conducted

The ***Preliminary Analysis*** uses the pollutant-appropriate significant impact level (SIL) and may include either the proposed project or the entire facility, depending on the situation. A SIL is a *de minimis* concentration value that is specific to an air pollutant and form of ambient standard (See Table 3, for a list of pollutant-specific SIL values). The information developed from the ***Preliminary Analysis*** is used to determine if a full impact analysis is required for the PSD increment analysis, NAAQS analysis, or both.

A ***full impact analysis*** consists of separate analyses for the NAAQS and PSD increments and will consider emissions from the proposed source(s) or source modifications, and any existing nearby sources. In addition, a NAAQS analysis will require a pollutant-specific background concentration. The ***full impact analysis*** is conducted for Class II modeling (both PSD and Non-PSD demonstrations) and Class I (increment and AQRVs) areas. The distinction between PSD and Non-PSD modeling is significant. A Non-PSD modeling demonstration is much simpler by comparison as it accounts for the applicable NAAQS (or MAAQS) and includes appropriate nearby sources and a background concentration. PSD modeling will require an applicable NAAQS demonstration along with an Increment. Table 14 provides an overview of the stages and steps for both PSD and Non-PSD projects.

Table 14. Full impact air dispersion modeling development process

Stage One – Preliminary Analysis If modeled values are below the applicable SIL, no further modeling will likely be needed. If modeled values exceed the applicable SIL within the Preliminary Analysis modeling domain, proceed to Stage Two.	
Stage Two – Full Impact Analysis/Refined Modeling	
Step One: Impact Area Evaluation	PSD Projects
	Non-PSD Projects
Step Two: Emission Inventory and Nearby Sources	PSD Projects
	Non-PSD Projects
Step Three: Full Impact Analysis/Refined Modeling	PSD Projects
	Non-PSD Projects
Step Four: Compliance Demonstration	PSD Projects and Non-PSD Projects

Stage one – preliminary analysis modeling

Preliminary Analysis is a SIL-based evaluation used to address two objectives: 1) determine if further refined modeling is needed to assess modeled air quality conditions; and, 2) define the extent of a modeling domain based on the extent of modeled concentrations above the applicable SIL value. In the development of the Preliminary Analysis, the MPCA suggests that a nested discrete Cartesian receptor grid should be used, consistent with the receptor placement described in Table 12 for the final modeling demonstration.

The Preliminary Analysis modeling uses AERMOD to conduct a facility-only SIL evaluation. Preliminary Analysis should consider an *initial* radius of 50 km from the center of the source under review; however, some sources may require a larger radius, depending on the nature of the source emissions. If this is the situation, consider that the largest radius using AERMOD is 50 km, consistent with the limitations of the model. If this is the case, an alternative dispersion model may be required.

The Preliminary Analysis SIL-evaluation is a “bare-bones” modeling demonstration, in comparison to refined modeling, including terrain and building downwash; however, excluding nearby sources and background concentrations. The Preliminary Analysis should be conducted for both PSD projects and Non-PSD projects that undergo air dispersion modeling. The EPA has noted that “The Preliminary Analysis models only the significant increase in potential emissions of a pollutant from a proposed new source, or the significant net emissions increase of a pollutant from a proposed modification.” If the results of the SIL modeling conducted in the Preliminary Analysis indicate that the proposed project exceeds the SILs, further NAAQS and/or PSD increment modeling is likely required. If the facility or project modeling results in modeled concentrations below the pollutant-specific SIL, no further modeling analysis will be needed to complete the air quality assessment. The next step is to determine the extent of the evaluative domain (i.e., radius from the source in kilometers) that will be considered as the modeling domain for the air quality analysis.

The area delineated by this analysis is often referred to as the significant impact area or "SIA." If the results of the modeling are below the SIL, no additional modeling analysis may be necessary unless special circumstances exist (e.g., protection of the NAAQS or increment, environmental review).

Stage two – full impact analysis/refined modeling

If the Preliminary Analysis indicates an exceedance of the applicable SIL, or the MPCA determines that the project threatens air quality conditions, further air quality modeling is needed to demonstrate compliance with the applicable NAAQS or increment. Depending on whether the proposed project is within the PSD program determines the nature of the modeling demonstration. For PSD projects, a "**Full Impact Analysis**" is required to determine if the proposed project will exceed PSD increment values or the applicable NAAQS. For non-PSD projects, the analysis is "**Refined Modeling**" for the applicable NAAQS. Whether the project holds a PSD or non-PSD permit, the modeling demonstration should include a nearby source inventory and background concentration to account for unidentified emission sources or activities. The following discussion identifies the four steps common to each approach with details relevant to each programmatic path.

Step one – impact area evaluation

When determining the scope of the modeling demonstration for PSD and Non-PSD projects, it is important to determine the area of potential impact, referred to as the SIA in order to determine if there are nearby emission sources that could affect the compliance status of the emission source under review. The basis for the determination of the project specific impact area is the ***Preliminary Analysis*** using the applicable SILs as previously discussed. The development of an impact area is an activity that applies to ***PSD*** and ***Non-PSD*** projects alike. Please note that the SIL evaluation should consider each averaging time and related SIL value separately. A SIL exceedance of a NAAQS short-term averaging time does not necessitate the evaluation of other averaging times for the same pollutant. Please contact MPCA modeling staff with any questions.

Impact area evaluation-PSD projects

For the purpose of PSD modeling, the impact area is the geographic area of interest identified through the pollutant-specific Preliminary Analysis using the appropriate SIL value.

The impact area radius discussion offered by EPA is an important construct in the development of a modeling demonstration. The first item offered by the EPA language provided above is the use of the SIA as the definitive boundary of the modeling demonstration. This is based on the output of the Preliminary Analysis where the initial modeling radius is suggested as 50 km. The underlying assumption is that the source under review will result in an SIA that is less than 50 km in radius. For nearly all sources, this is a reasonable assumption. In rare situations, the boundaries of the Preliminary Analysis will have to be adjusted to a greater distance as the source under review generates an SIA that is greater than 50 km. If the SIA is greater than 50 km, the default radius of 50 km is used as this value reflects the functional limits of AERMOD.

Please note that there is a distinction between the final modeling demonstration radius based on the impact area and the search radius used to develop the ***nearby source emission inventory***. As a practice, it is important to review all emission sources out to 50 km from the source under review in order to evaluate if any large source may have an adverse impact on ambient air quality conditions for the source under review. The purpose of this review is to determine if a nearby source has a significant concentration gradient such that it would impact the source under review. Nearby sources that have an impact on the source under review should be included as explicit sources within the modeling demonstration. The details pertaining to the development of a nearby source emission inventory are found on page 35 of this document.

The ***Preliminary Analysis*** should include an evaluation for each pollutant averaging time in order to develop a pollutant and averaging-time specific impact area. Ultimately, the impact area used for the full impact/refined modeling analysis of a particular pollutant is the largest of the areas determined for that pollutant. A graphical example of a modeled impact area is provided in Figure 2. The impact area is a key feature in the PSD project analysis as it provides the boundaries for the development of the nearby source emission inventory for the modeling demonstration.

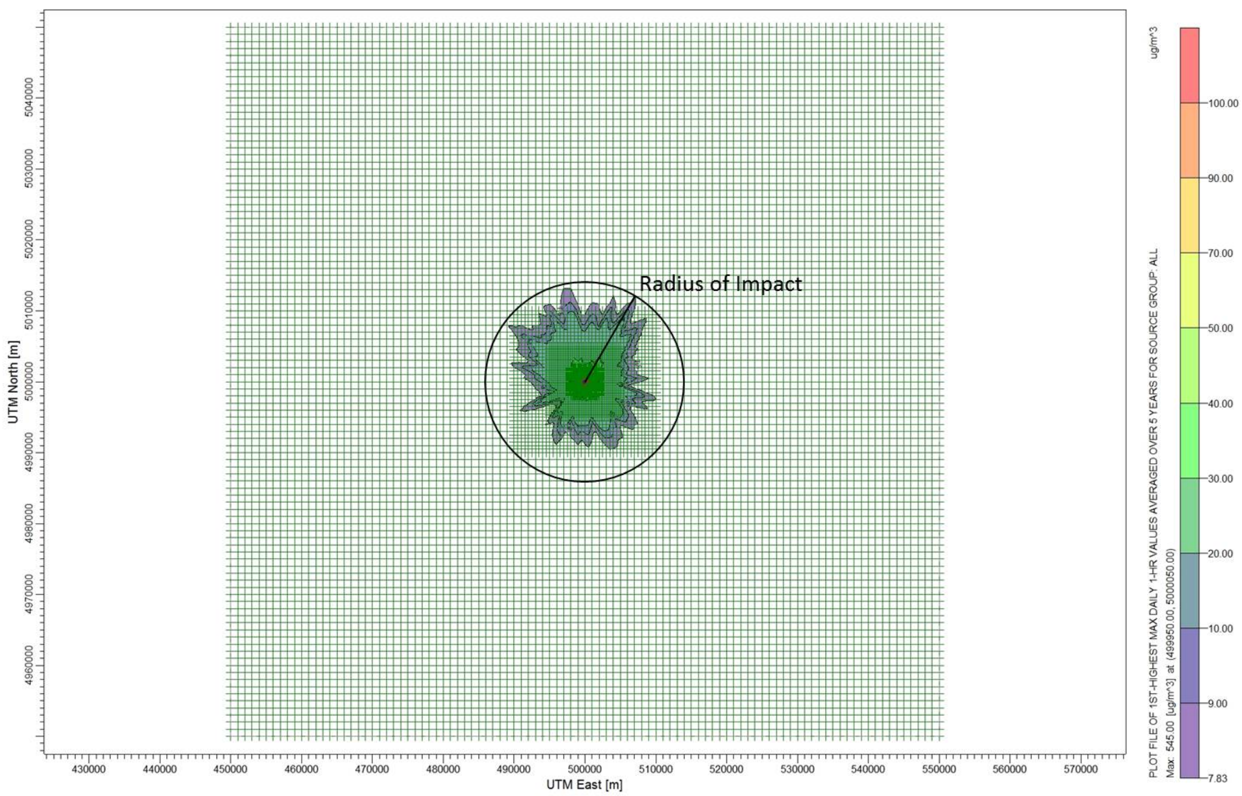

Figure 2. Example of a preliminary analysis with an initial 50 km modeling domain using AERMOD. Based on this analysis for the one-hour SO_2 NAAQS, the modeling domain should have a radius of 30 km (i.e., the 1-hour SO_2 7.5 μg/m^3 contour extends out to 30 km)

Impact area evaluation- non-PSD projects

While there is no specific requirement to conduct a ***Preliminary Analysis*** for most non-PSD projects, best modeling practice would consider a ***Preliminary Analysis*** in order to determine the extent of the modeling grid. For Non-PSD projects, a review of nearby sources 50 km from the source under review is considered a reasonable effort and strongly suggested. The benefit of this approach is that a SIL analysis may provide adequate information to forgo additional air quality modeling if the results of the analysis demonstrate that the project is below the applicable SIL values. A project undergoing an ***environmental review*** may be asked to model sources outside the SIL-defined extent to account for cumulative effects. This approach also applies to ***"NAAQS Notes***" projects.

Step two - emission inventory and nearby sources

Once the impact area has been established, it will be necessary to determine which nearby emission sources to include in the modeling demonstration. After the nearby emission sources have been determined, an emission inventory will be needed to account for all the nearby emissions that may adversely affect the compliance status of the source under review.

The determination and development of a nearby source emission inventory is more involved in the PSD program as the PSD increment analysis presents several unique analyses to determine if increment is being consumed or expanded. The NAAQS analysis, whether it is for a PSD project or a Non-PSD project, requires the determination of nearby sources and an applicable background concentration to account for sources and activities that are not explicitly modeled and may affect the compliance status of the source under review. See ***Emission Inventory and Nearby Sources for PSD or a Non-PSD project*** section for approaches to develop an emission inventory for your project***.***

Emission inventory and nearby sources – PSD projects

For PSD projects, the modeling demonstration typically includes a NAAQS analysis and an increment analysis. The PSD modeling demonstration requires that nearby sources that may affect the compliance status of the source under review should be modeled explicitly in the PSD demonstration. The PSD Increment inventory and the NAAQS inventory differ with respect to compilation and operation.

The development of an increment emission inventory (Increment Inventory) is a critical feature of the overall PSD increment analysis. The Increment Inventory accounts for all of the sources in the impact area and, in certain situations, beyond that consume PSD increment. The Increment Inventory also provides information on emissions increases and decreases, which have occurred from sources since the applicable baseline date. Please contact the MPCA for specific data related to the sources of interest. The EPA has noted that increment consumption (and expansion) will generally be based on changes in actual emissions reflected by the normal source operation for a period of two years. In order to develop the Increment Inventory, project proposers should prepare data that reflects the increment consumption and expansion within the impact area.

Increment consumption reflects the amount of ambient air in the applicable NAAQS that is “consumed” by pollutants from an emission source. According to EPA:

> Emission increases that consume a portion of the applicable increment are, in general, all those not accounted for in the baseline concentration and specifically include:
>
> > actual emissions increases occurring after the **major source baseline date**, which are associated with physical changes or changes in the method of operation (i.e., construction) at a major stationary source; and, actual emissions increase at any stationary source, area source, or mobile source occurring after the **minor source baseline date**.
>
> For increment expansion, the EPA considers two ways to add or expand increment:
>
> > The most common case is the reduction of actual emissions from any source after the minor source baseline date. Any such emissions reduction would increase the amount of available increment to the extent that ambient concentrations would be reduced.
> >
> > The less common case of increment expansion can result from the reduction of actual emissions after the major source baseline date, but before the minor source baseline date, if the reduction results from a physical change or change in the method of operation (i.e., construction) at a major stationary source.

Note: *A source must have existed and been in operation on or before the baseline date to be considered for increment expansion. The source must be shut down as part of the project or have lower actual emissions to expand the increment. That is, there is no credit for contemporaneous shutdowns or for sources permitted after the baseline date that have reduced emissions, have been shut down, or will be shut down as part of the current project, since modeling is used to determine the amount of increment consumed or expanded. Therefore, a source that did not exist—or was not operating—on the baseline date would not have contributed to the air quality at that time, and there would be no need to model the source with an emission rate of zero. Omit these sources from the inventory.*

The need for a detailed inventory is the key to developing credible and valid increment values. This means that to account for changes in emissions or other source parameters, it is possible that input values will be calculated as a combination of negative numbers and positive numbers to account for a difference in baseline and current/proposed project conditions, consistent with EPA Guidance:

> If the change in the actual emissions rate at a particular source involves a change in stack parameters (e.g., stack height, gas exit temperature, etc.) then the stack parameters and emissions rates associated with both the baseline case and the current situation must be used as input to the dispersion model. To determine increment consumption (or expansion) for such a source, ***the baseline case emissions are input to the model as negative emissions***, along with the baseline stack parameters. In the same model run, ***the current case for the same source is modeled as the total current emissions associated with the current stack parameters***. [via positive emissions] This procedure effectively calculates, for each receptor and for each averaging time***, the difference between the baseline concentration and the current concentration (i.e., the amount of increment consumed by the source).***

In general, the MPCA follows a "two entry approach" to evaluate PSD increment, consistent with EPA Guidance, whereby:

- Negative emission rates for MSBD conditions
- Positive emission rates for post-MSBD conditions

An example of an input file developed for a PSD increment analysis is provided in Figure 3. Please note that negative emission values are not available for NO_2 due in large part to the screening nature of all three NO_2 modeling methods. If you encounter a situation where an NO_2 PSD increment analysis is required for a project, please contact the MPCA modeling staff for direction on addressing this situation.

The NAAQS inventory for a PSD project does not take into account negative emission values as described in the PSD increment analysis. The NAAQS inventory or a PSD project should reflect the allowable emissions for each of the nearby sources. Wherever possible, the identified nearby sources should be

modeled as refined or representative stack sources. It is important to recognize that there is the possibility that the NAAQS inventory will not be consistent with the PSD increment inventory. This may result in additional work to fully account for the PSD increment and NAAQS analysis.

```
** UMBR

SO SRCPARAM   UMBR1     0.777  60.96  547.04  15.38  1.448
SO SRCPARAM   UMBR1    -0.777  60.96  547.04  15.38  1.448
SO SRCPARAM   UMBR2     0.554     65   449.8   9.14  2.103
SO SRCPARAM   UMBR3    54.103  69.27   544.6   14.6  2.937
SO SRCPARAM   UMBR4    54.103  69.27     499  13.76  2.048
SO SRCPARAM   UMBR5     2.522  62.48  505.37   2.33  2.731
SO SRCPARAM   UMBR6     7.129  55.78   505.4   8.05  1.969
SO SRCPARAM   UMBR6    -7.129  55.78   505.4   8.05  1.969
SO SRCPARAM   UMBR7     3.538  56.12  615.93  14.43  1.436
SO SRCPARAM   UMBR7    -3.538  56.12  615.93  14.43  1.436
SO SRCPARAM   UMBR8     0.262  21.64  811.15   3.47  0.914
SO SRCPARAM   UMBR9     5.985  45.72  422.04  13.47  3.132
SO SRCPARAM   UMBR10    0.605  45.72  422.04   9.14  1.113
SO SRCPARAM   UMBR11    0.605  45.72  422.04   9.14  1.113
SO SRCPARAM   UMBR12    0.529  45.72  422.04   9.14  0.787
SO SRCPARAM   UMBR13    1.151   9.04   433.2  11.72  1.524
SO SRCPARAM   UMBR14    3.087  35.05     422  13.32   3.15
SO SRCPARAM   UMBR15    1.975  10.67     422    1.5  2.751
SO SRCPARAM   UMBR16    0.927  10.67     422    0.9  2.438
SO SRCPARAM   UMBR17    0.041   3.96     422   0.67  0.595
SO SRCPARAM   UMBR18    0.082  18.59  449.82    7.8  0.254
SO SRCPARAM   UMBR18   -0.082  18.59  449.82    7.8  0.254
SO SRCPARAM   UMBR19    0.277   5.49  616.48   9.41  0.305
SO SRCPARAM   UMBR20    1.245  21.85   415.4   8.65  1.717
SO SRCPARAM   UMBR21    0.266    6.1  616.48  20.43  0.203
SO SRCPARAM   UMBR22    2.784   7.47  810.93  41.11  0.203
SO SRCPARAM   UMBR22   -2.784   7.47  810.93  41.11  0.203
SO SRCPARAM   UMBR23   55.000   7.47  810.93  41.11  0.203
SO SRCPARAM   UMBR23  -13.162   7.47  810.93  41.11  0.203
SO SRCPARAM   UMBR24     0.28    6.1  616.48   13.7  0.254
SO SRCPARAM   UMBR25    1.061   4.57  616.48  18.02  0.305
SO SRCPARAM   UMBR26    0.443    6.1  616.48  15.33  0.254
SO SRCPARAM   UMBR27    0.346   9.14   824.3   39.5  0.157
SO SRCPARAM   UMBR28    6.137  58.52     622   7.26  2.134
SO SRCPARAM   UMBR29    3.682  40.54   744.3   8.22  2.134
SO SRCPARAM   UMBR30    3.207   60.5   449.8    4.6   2.07
SO SRCPARAM   UMBR31    7.129  55.78   505.4   8.05  1.969
SO SRCPARAM   UMBR32    3.712  58.83   505.4   2.29  3.341
SO SRCPARAM   UMBR33    3.694  62.03   491.5   2.51  2.502
```

Stacks Removed from the Facility.

Change in emissions from a stack.

The Umbrella Corporation (Fictitious) has undergone a dramatic renovation of their facility. When the company was initially constructed, they were subject to the PSD program and operated with 33 stacks. The renovation has the facility removing five stacks and modifying emissions at one stack. The Increment emission file scenario (left) reflects these changes.

Figure 3. Example increment emission input file (portion)

Emission inventory and nearby sources – non-PSD projects

The Non-PSD emission inventory is similar to the PSD NAAQS inventory. The primary goal of a Non-PSD modeling demonstration is compliance with the applicable NAAQS and MAAQS; however, the modeling also accounts for area attainment with the applicable NAAQS. This means that Non-PSD modeling demonstrations are as rigorous as the PSD modeling demonstrations; however, under certain circumstances, additional emission sources may be included to account for emission sources of public interest that would not normally be included in a PSD analysis. The nearby source emission inventory should represent allowable emissions for the applicable sources. Please see the ***Nearby Source Selection, Background Concentration and Characterization*** section to review the various approaches used to develop a background concentration for a Non-PSD project. Please note that this approach also applies to "***NAAQS Notes***" projects.

Step three – full impact analysis/refined modeling

The modeling demonstration for a PSD and Non-PSD differ in their scope of analysis. The Full Impact Analysis is specific to PSD projects and typically includes both a PSD increment analysis and a cumulative NAAQS analysis. Under certain circumstances, a ***MAAQS*** analysis may also be required. For ***Non-PSD*** projects, Refined Modeling includes a cumulative NAAQS analysis and may include specific MAAQS pollutants on a case-by-case basis.

Full impact analysis/refined modeling – PSD projects

The Full Impact Analysis expands the preliminary analysis by considering background concentrations and emissions from both the proposed project as well as other sources in the impact area. The Full Impact Analysis may also consider other significant sources outside the impact area the source under review. The results from the full impact analysis are used to demonstrate compliance with NAAQS/MAAQS and PSD increments. The source inventory for the cumulative NAAQS/MAAQS analysis includes all nearby sources that have significant impacts within the proposed source impact area, while the source inventory for the cumulative PSD increment analysis is limited to increment-effecting sources (new sources and changes to existing sources that have occurred since the applicable increment baseline date).

The Full Impact Analysis is limited to receptor locations within the proposed project's impact area. The modeled concentrations from the NAAQS/MAAQS cumulative impact analysis are added to representative ambient background concentrations and the total concentrations are compared to the NAAQS/MAAQS. Conversely, the modeled air quality impacts for all increment-consuming sources are directly compared to the PSD increments to determine compliance (without consideration of ambient background concentrations).

Full impact analysis/refined modeling – non-PSD projects

For Non-PSD projects, the modeling demonstration is focused on determining compliance with applicable ambient air quality standards (e.g. MAAQS) and also accounts for domain-area attainment with the applicable NAAQS. Typically, modeling demonstrations for Non-PSD projects are referred to as Refined Modeling demonstrations. The content of a Refined Modeling demonstration will include the source under review, sources identified in the impact area analysis, and a background concentration to account for emission sources and related activities that are not explicitly modeled. The nearby sources are typically modeled as explicit sources; however, the MPCA may suggest other source characterizations. Please note that this approach is also frequently applied to "***NAAQS Notes***" projects.

Step four – compliance demonstration

An applicant for a PSD permit must demonstrate that the proposed source will not cause or contribute to air pollution in violation of any PSD increment or applicable NAAQS/MAAQS. An applicant for a Non-PSD (State Only) permit must demonstrate that they will comply with the applicable NAAQS/MAAQS. This compliance demonstration, whether a PSD or Non-PSD source, must result in one of the following conditions:

1. The proposed new source or modification will not significantly contribute (i.e., greater than an applicable SIL value) to a modeled exceedance of the applicable NAAQS.
2. The proposed new source or modification, in conjunction with existing sources, will not cause or contribute to a modeled exceedance of any applicable NAAQS/MAAQS or PSD increment; or,
3. In the event that a modeled exceedance is identified, the proposed new source or modification, will not cause or contribute to a modeled exceedance. If the new source or modification contribution is greater than an applicable SIL value, measures should be taken to secure sufficient emission reduction to offset the modeled adverse air quality impact.

To facilitate the NAAQS and PSD compliance demonstration, the MPCA has included a specific table of modeled concentrations and increment consumption categories in the Air Quality Modeling Report form. This form is designed to present the modeled information for a project in a single form.

Nearby source selection, background concentration, and characterization

Three dispersion modeling variables that collectively represent off-site emissions are critical to the development of an appropriate pollutant-specific background concentration, and ultimately, outcome of a modeling simulation. The three variables include:

- The selection of the nearby emission sources
- Characterization of the nearby emission sources
- Pollutant-specific background concentration

The MPCA refers to this trio of input variables as a "triple helix" of off-site source emission attributes. Collectively, these three attributes combine to create the ambient air quality concentration conditions for a given pollutant in a given area. Modeling decisions regarding the selection of nearby sources, its characterization and the specific pollutant-specific background concentration result in an overall ambient air quality pollutant concentration for the modeling domain that reflects the explicitly identified sources as well as unidentified emission sources/activities for that geographic area. The relationship between these three attributes is illustrated in Figure 4.

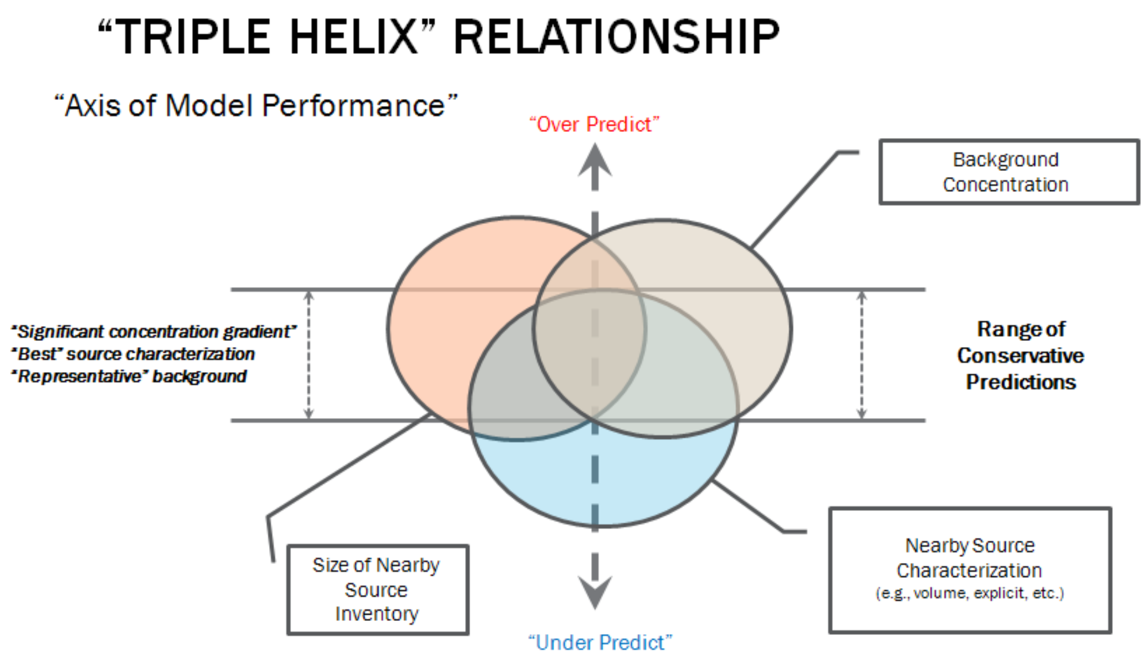

Figure 4. "Triple Helix" relationship between nearby sources, background concentration and size of the nearby source inventory

Nearby source selection

Care should be taken in the selection of nearby sources and characterization of nearby sources, along with the background value selected to represent unidentified off-site emission sources or activities. To facilitate the selection of relevant nearby sources, the MPCA has developed a Geographic Information System (GIS) based approach using geospatial data and the National Emission Inventory (NEI) data that can be used to create a project-specific nearby source emission inventory. The tool is known as the GIS Look-Up tool and can be obtained from the MPCA by contacting the Air Modeling unit, at AirModeling.PCA@state.mn.us, or, downloading it from our website.

In addition, the MPCA has provided a short online video tutorial to assist you in the use of the tool.

Please be aware that the MPCA information does not cover facilities in neighboring states, provinces, or tribal lands. Based on project location, facilities in nearby states, provinces, or tribal lands may be considered as potential candidates for a nearby source inventory. The project proposer will need to contact the state or provincial permitting authority to obtain the relevant permitting and emission information. Tribal air quality permits in Minnesota are managed through the EPA Region 5 office in Chicago, Illinois. The MPCA expects any facilities located outside the state of Minnesota or on tribal lands that are included in a nearby source inventory to be modeled using permitted allowables.

Linkage between source selection and characterization

The development of a nearby source inventory is based on the likelihood that a nearby emission source will have a significant concentration gradient that affects or impacts the source under review. Per EPA's guidance in Appendix W (Section 8.2.3. a.):

> Nearby Sources: All sources expected to cause a *significant concentration gradient* [italics added] in the vicinity of the source or sources under consideration for emission limit(s) should be explicitly modeled. *The number of such sources is expected to be small except in unusual situations*. [italics added] Owing to both the uniqueness of each modeling situation and the large number of variables involved in identifying nearby sources, no attempt is made here to comprehensively define this term. Rather, identification of nearby sources calls for the exercise of professional judgment [sic] by the appropriate reviewing authority (paragraph 3.0(b)). This guidance is not intended to alter the exercise of that judgment [sic] or to comprehensively define which sources are nearby sources.

The MPCA reviewed existing nearby emission source inventory selection methods that have undergone EPA Modeling Clearinghouse review, and, alternatively, developed related tools that reflect the core principle of the significant concentration gradient. The typical approach used in all nearby source selection approaches is a rough approximation of the significant concentration gradient to evaluate nearby sources based on a nearby sources annual emission inventory, along with the distance between the nearby source and the source under review. This information, along with some form of criteria (e.g., pollutant-specific SIL) is used to determine which nearby sources should be explicitly modeled in a modeling demonstration.

The primary approach relied on by the MPCA is the square root mean distance method (SQRM-D). The MPCA has automated this approach in the MPCA GIS Look-Up tool, available online. The following description is provided to explain how the GIS Look-Up tool works and assist you in the development of a nearby source emission inventory for a modeling demonstration. The GIS Look-Up Tool (Tool) is available online and is currently using the 2011 through 2013 N Data. Updates to the emission data will be provided when they are made available to the MPCA. A video demonstration of the tool is also available.

Step 1 – The Tool Identifies all emission sources within a 50 km radius of the source under review. Nearly all modeling demonstrations will start with a 50 km search radius for nearby sources; however, some projects may require a greater radius depending on the nature and impact of pollutant emissions observed during the Preliminary Analysis.

Step 2 – Based on the nearby source facilities identified in Step 1, the Tool will remove all sources that have less than one ton per year of emitted criteria pollutants (actuals). The result is the *initial nearby source emission inventory*.

Step 3 – The Tool converts the *initial nearby source emission inventory* to the *final nearby source emission inventory* using the SQRM-D approach. Please be aware that the size of the initial nearby source emission inventory is also a key factor in determining which nearby source selection tool to use. The Tool relies on an initial emission inventory of more than five facilities; however, if the initial inventory contains five or less nearby source facilities, the MPCA suggests that an alternative approach be considered. Currently, the MPCA recommends the use of either the MNLookup Tool (available online) or the state of Oregon's Range of Influence (ROI) approach.

The value of five was selected as a boundary to separate the nearby source analysis into two categories as this value represents a defendable population/sample size for the calculation of a mean. The ability to calculate the mean distance of nearby sources is a key feature of the SQRM-D approach automated in the GIS Look-Up tool as the square root of the mean becomes the “key determinant” of the significant concentration gradient analysis. For initial nearby source emission inventories with less than five sources, the calculation of an arithmetic mean is not appropriate and the ROI, MNLookup tool, or other MPCA approved approaches should be used.

Step 4 – At this point in the evaluation, you should have a pool of nearby source facilities to consider including in the final air quality modeling demonstration. The MPCA recognizes that it is possible to remove some of the selected near source facilities from a modeling demonstration when such factors as wind speed and direction (relative to the source under review), the relevant form of the ambient air quality standard, and, the distance between the nearby source and the source under review, are considered. Establishing the removal of potential nearby source requires thorough documentation to explain why a potential nearby source was removed from the final air quality modeling demonstration inventory. Please note that if this practice is applied to a modeling demonstration and documentation is not provided that explains the removal of near source facilities, the protocol may be considered incomplete.

Step 5. - After completion of the step described above, it is important to evaluate the final nearby source emission inventory to determine if the selected facilities are still in operation or if any major change has occurred that should be accounted for in the modeling demonstration, as well as to confirm that modeled emissions are current and correct.

The modeling domain established through the selection of nearby sources should also include the radius of impact developed through the Preliminary Assessment using the appropriate SIL.

Nearby source characterization

Characterization of those nearby sources to include in a modeling analysis should be done using one of two methods. When facility information and stack parameters are available nearby sources should be modeled explicitly. This includes a source that would normally be characterized as a volume or area source. When there is no detailed facility information and a stack vent or vents would likely be present (e.g., registration permits), the emissions and stack parameters must be estimated and characterized in the air dispersion model in the most representative manner. Based on evaluation of source characterization methods, MPCA’s current recommendation is that facilities follow the EPA screening procedure given below for representative stacks.

1. Merged Parameters for Multiple Stacks

Sources that emit the same pollutant from several stacks with similar parameters that are within about 100m of each other may be analyzed by treating all of the emissions as coming from a single representative stack. For each stack compute the parameter M:

$$M = \frac{h_s V T_s}{Q}$$

where:

- M = merged stack parameter which accounts for the relative influence of stack height, plume rise, and emission rate on concentrations
- h_s = stack height (m)
- $V = (\pi/4)\, d_s^2\, v_s$ = stack gas volumetric flow rate (m^3/s)
- d_s = inside stack diameter (m)
- v_s = stack gas exit velocity (m/s)

- T_s = Stack temperature (K)
- Q = Emission rate (g/s)

The stack that has the lowest value of M is used as a "representative" stack. Then the sum of the emissions from all stacks is assumed to be emitted from the representative stack.

2. Process-based Representation

This approach should only be pursued in consultation with the MPCA and should be used only after receiving MPCA approval of the method. The stack and related parameters can be found using national database of SCC or SIC codes.

The use of volume source characterizations where explicit or representative stack information is available is discouraged and may not meet MPCA approval. The rationale for this position reflects the over or under predictive qualities of volume sources revealed in an MPCA comparison of nearby source characterization approaches.

Background concentration

Section 8.2 of the *Guideline on Air Quality Models* (EPA, 2005)[3] illustrates the use of background concentrations in a NAAQS analysis. Background concentrations of regulated criteria pollutants must be included in cumulative NAAQS analyses for both PSD and non-PSD applications. A different pollutant-specific concentration is needed for each applicable averaging period.

Background concentrations are developed based on air quality monitoring data collected from the area of the proposed project or from similar areas determined to be reasonably representative. Facilities should either use the MPCA ambient air quality design values or propose pollutant-specific background concentrations based on their own analyses following the practices illustrated in this section. In rare situations, a model-based background may be used. The proposed background concentration should be well-documented within the modeling protocol submitted to the MPCA.

If a design value is unavailable or not appropriate for the environmental setting, the use of ambient monitoring data to estimate background concentrations is the MPCA's preferred approach. Background concentrations using ambient monitoring data may be developed using a single monitor or, under certain situations, interpolation techniques using multiple monitors if the source under review is located within the array of the monitors.

Single-site monitor background concentrations

If a project proposer intends to use a single monitor, whether it is located in Minnesota or outside of the state, please consider the following:

1. A *description* of monitoring data proposed as representative of the project area. The description should include: 1) the statistics of the data set; and, 2) the quality control/assurance measures conducted for the data (Note: This also applies to raw data provided by the MPCA). Examples of acceptable statistics include correlation or covariance-related analysis of surface roughness that describe the relationship between the two sites.
2. A *discussion* of the similarity between the monitor location and the project area. A discussion should be provided that compares the two areas and supports the use of the monitoring data for the project site. Factors to consider:

[3] https://www3.epa.gov/scram001/guidance/guide/appw_05.pdf [Retrieved August 3rd, 2016]

   A. The density and diversity of emission sources around the monitoring location. The purpose of this factor is to determine if there are similarities between the monitoring location and the source under review.
   B. A determination of how well the monitor captures the influence of nearby sources that are not affected by the project.
   C. Differences in land use and terrain between the two locations that may influence air quality.
   D. Similarity in monitor siting and probe height.
   E. Purpose of the monitoring activity and the geographic scale of representation.
3. A *detailed assessment* of the relationship between the meteorology of the project area and the area where monitoring data was obtained. For example, a wind-rose analysis that depicts the similarity between the project site and monitoring site in question, wind speed analysis (focus on frequency of calm periods) and surface roughness comparison, as described above.
4. The *distance* between the monitor and the source under review. As a working assumption, monitors closer to the project will likely have concentrations most similar to those observed at the source under review. It is important to note that if more than one monitor is available for a modeling demonstration, preference should be given to *the closest representative monitor*. As discussed below, extrapolation or related averaging techniques should not be used for modeling demonstrations where the source under review is not included within the nest of multiple monitors. There is an assumption that the closer a monitor is to a source the more representative it will be of the ambient conditions. Be aware that this is an oversimplification. Care should be taken to consider and document the type of pollutant, spatial distribution of sources, atmospheric characteristics of the pollutant (e.g., transformation, deposition, etc.) and meteorological conditions that justify the use of the monitor.
5. The *approach* used to edit out ambient air data from the monitoring data for sources that will be explicitly modeled. This is consistent with the definition of "background concentration" under Appendix W.

Please note that air monitoring data and annual summary of ambient air quality monitoring data for Minnesota can be found at on the MPCA website.

Multi-site monitor background concentrations

There are certain situations where a source under review is surrounded or nested within a series of ambient air quality monitors. In these situations, a background value can be developed based on interpolation techniques. The approaches that may be employed for this type of effort include simple weighted averaging/inverse distance applications to a variety of geostatistical approaches (e.g., Voronoi Neighbor). Each of these approaches may be complicated by the form of the NAAQS under assessment. Please consult with the MPCA to determine the best approach to take if you intend to develop a background concentration using interpolation methods.

Alternate approaches

Use of other methods to calculate a background concentration, in particular, modeled or pairing approaches, will be evaluated by the MPCA on a case-by-case basis after a determination by the MPCA Modeling Unit that a monitor-based approach is not appropriate. It is important to note that if an alternative background concentration approach is proposed for a PSD project, the EPA is the reviewing and approving agency.

Proposals for alternative background concentration calculation methods, whether for a NAAQS analysis or PSD project, should be thoroughly described and included as an attachment to the modeling protocol.

Background concentrations of regulated criteria pollutants must be included in cumulative NAAQS analyses for both PSD and non-PSD applications. A different pollutant-specific concentration is needed for each applicable pollutant averaging period.

Background concentrations are developed based on air quality monitoring data collected from the area of the proposed project or from similar areas determined to be reasonably representative. Facilities must either use the MPCA ambient air quality design values found on the MPCA modeling website or propose pollutant-specific background concentrations based on their own analyses following the practices identified in the MPCA background concentration spreadsheet. Please note that air monitoring data for Minnesota can be obtained through our website. For additional ambient air quality data needs, please contact Kellie Gavin, Ambient Air Quality Data Manager, at kellie.gavin@state.mn.us or 651-757-2379.

Use of other (alternate) methods to calculate a background concentration such as modeled-based approaches (e.g., MNRiskS), will be evaluated by the MPCA on a case-by-case basis after a determination by the MPCA that traditional monitor-based approaches are not appropriate (e.g., nearby representative monitor site/s). If a project proposer alleges that an alternate approach is more appropriate, substantial documentation may be necessary to justify the claim. Each request will be considered on a case-by-case basis. It is important to acknowledge that if an alternative background concentration approach is proposed for a PSD project both the MPCA and the EPA are reviewing and approving agencies.

Intermittent emissions

Questions have been raised about how to address the modeling of emissions from units that operate intermittently, particularly in regard to modeling for compliance with short term ambient air quality standards (e.g., the one-hour standards for SO_2 and NO_2, and to a lesser degree, the 24-hour standards for PM_{10} and $PM_{2.5}$). The MPCA has reviewed the existing permitting practice with respect to modeling intermittent emissions and offers the following approach to determine when to include sources with intermittent emissions as well as how to model them. Please consider the following:

- Units with unpredictable intermittent emissions (such as bypass emissions) must be modeled at the maximum emission rate or according to permit conditions.
- By default, emergency generators complying with existing permit conditions that embody Best Management Practices (BMPs) need not be modeled.
  - One possible exception to this is large generators (greater than 500 hp) and/or generators located near an ambient boundary; the MPCA will inform you of the need to model such units on a case-by-case basis. Because of this, the modeling protocol should identify the size and location of emergency generators that will not be modeled.
- Emergency generators without BMP permit conditions and non-emergency generators must be modeled at 8,760 hours per year with the following exception:
  - Generators that operate in an orderly, routine manner (and that will continue to operate in that manner) may be modeled using modeling inputs based on that routine. In most cases, the applicant must provide a site-specific history of operation (for an existing facility) or data on industry-specific practices (for new sources) to support the proposed modeling scenario.
- Emergency generators at neighboring sources need not be modeled.
- Internal Combustion Engines participating in Energy Demand Response Programs by way of peak shaving should be modeled using seasonal, monthly, and/or hourly emission scalars based on meteorological analysis of Temperature-Humidity Index (THI) data (See Appendix C):

- THI values during the warm season months play an integral part in the correlation of when a facility is likely to participate in peak shaving.
- Permit language will be required for those engines participating in peak shaving with modeled ambient levels > 90% of the NAAQS.

For the purpose of this discussion, emergency generators are generators that operate primarily during emergencies and during maintenance and testing periods. Emergency generators cannot be used for peak shaving or to generate income for a facility to supply power to an electric grid or otherwise supply power as part of a financial arrangement with another entity. However, an emergency generator may be operated up to 15 hours per year during periods in which the Regional Transmission Organization (in this case, the Midwest ISO) has determined there are emergency conditions that could lead to a potential electrical blackout, such as unusually low frequency, equipment overload, capacity or energy deficiency, or unacceptable voltage level.

Pollutant considerations

Depending on the project characteristics and applicable air quality permit or related regulatory action, both the NAAQS and the MAAQS may be considered within your modeling exercise. Most of the NAAQS pollutants are fairly straightforward to model. For example, CO, PM_{10}, SO_2 are typically not subject to chemical transformation adjustments or post-processing. Default approaches for these pollutants are often part of the AERMOD software package.

Secondary formation of $PM_{2.5}$, NO_2, Pb and several pollutants within the MAAQS (Total Suspended Particulate (TSP) and hydrogen sulfide (H_2S)) have specific and noteworthy approaches that are important factors to the success of a modeling project if these items become pollutants of concern.

PM_{10} design values

Compliance with the 24-hour PM_{10} NAAQS is based on the expected number of 24-hour exceedances of a particular level (currently 150 $\mu g/m^3$), averaged over three consecutive years.[4] Currently, the NAAQS is met when the expected number of exceedances is less than or equal to 1.0.[5]

The contributions from the project, any nearby sources, and background concentrations from other sources are combined for a given analysis year, as described further below. An example of how to calculate design values for the 24-hour PM_{10} NAAQS is included.

Necessary Data

This design value calculation requires the following data:

- *Air quality modeling results*: Five years of meteorological data will be used to complete air quality modeling for the project and any nearby sources. For PM_{10}, the sixth-highest 24-hour modeled concentration should be calculated for each receptor. Note that AERMOD can be configured to give you these values directly. Users with one year of site-specific meteorological data should select the 2nd highest 24-hour PM_{10} concentration.
- *Air quality monitoring data*: Three consecutive years of certified ambient air monitoring data.

[4] The 24-hour PM_{10} NAAQS and supporting technical documentation can be found in 40 CFR Part 50.6.

[5] The term "expected" means that the actual number of observed exceedances is adjusted upwards when observations are missing for some days, to reflect the air quality statistically expected for those days. The design value for the 24-hour PM_{10} NAAQS is the next highest observed (monitored or modeled) concentration after the concentrations that could be above 150 $\mu g/m^3$ without causing the expected number of exceedances to be greater than 1.0

Calculating Design Values

The 24-hour PM_{10} design value is calculated at each receptor by directly adding the sixth-highest modeled 24-hour concentrations (if using five years of meteorological data, 2^{nd} highest if using onsite meteorological data) to the appropriate monitor value for the 24-hour background concentration from three years of monitoring data, based on the number of background concentration values from the monitor as described in Table 15.

Table 15: Monitor Value Used for Design Value Calculation

Number of Observations from the Monitor	Monitor Value Used for Design Value Calculation
< 347	Highest Monitor Value
348 -695	Second Highest Value
696 -1042	Third Highest Value
1043 -1096	Fourth Highest Value

Example: 24-Hour PM_{10} NAAQS Comparison

Provided below is an example illustrating design value calculations for comparison with the 24-hour PM_{10} NAAQS.

Step 1: From the air quality modeling results the sixth-highest 24-hour concentration is identified at each receptor. These sixth-highest concentrations are the sixth highest that are modeled at each receptor, regardless of year of meteorological data used. AERMOD was configured to produce these values.

Step 2: The sixth-highest modeled concentrations (i.e., the concentrations at Rank 6) are compared across receptors, and the receptor with the highest value at Rank 6 is identified. For this example, the highest sixth-highest 24-hour concentration at any receptor is 15.218 $\mu g/m^3$. (That is, at all other receptor, the sixth-highest concentration is less than 15.218 $\mu g/m^3$.) Table 16 shows the six highest 24-hour concentrations at this receptor.

Table 16: Receptor with the Highest Sixth-Highest 24-Hour Concentration

Rank	Highest 24-Hour Concentrations
1	17.012
2	16.709
3	15.880
4	15.491
5	15.400
6	15.218

Step 3: In this example, the background monitor collects data every third day (1-in-3 sampling) and have a total of 360 daily readings in the most recent three-year period. The appropriate 24-hour background concentration from the three most recent years of monitoring data is identified. The information in Table 15 has been repeated in Table 17 below, along with the highest four values from the background monitor:

Table 17: Highest Values from the Chosen Background Monitor (360 Readings in the Most Recent Three Year Period)

Number of Background Concentration Values from the Monitor	Monitor Value Used for Design Value Calculation	Highest Values from the Chosen Background Monitor
<347	Highest Monitor Value	112.490
348-695	Second Highest Value	86.251
696-1042	Third Highest Value	75.821
1043-1096	Fourth Highest Value	75.217

Because the monitor has 360 readings in the most recent three-year period, the second highest 24-hour background concentration is used for the design value calculation. The second-highest value is 86.251 μg/m³.

Step 4: The sixth-highest 24-hour modeled concentration of 15.218μg/m³ from the highest receptor (from Step 2) is added to the second-highest 24-hour background concentration of 86.251μg/m³ (from Step 3):

$$15.218 + 86.251 = 101.469$$

This total is then compared to the PM_{10} 24-hour NAAQS of 150 μg/m³; results indicate no violation of PM_{10} 24-hour NAAQS.

Annual PM_{10} Design Value

Unlike the 24-hour PM_{10} NAAQS, the annual PM_{10} design value follows the form of the MAAQS. The annual PM_{10} design value is calculated as the annual arithmetic mean based on the most recent year of certified ambient air quality data. Please contact Kellie Gavin, Ambient Air Quality Data Manager, at kellie.gavin@state.mn.us or 651-757-2379 for the most recent certified annual data.

$PM_{2.5}$

In 2006, the EPA modified the $PM_{2.5}$ NAAQS to a percentile based 24-hour standard averaged over a three-year period and an annual standard with a similar averaging time period. The new $PM_{2.5}$ NAAQS feature lower numeric values. The 24-hour standard is 35 μg/m³while the annual value is 12 μg/m³.

Modeling the new $PM_{2.5}$ NAAQS presents special challenges. The lower numeric values of the 24-hour and annual standards offer potential difficulties in modeling compliance for a source under review in light of the typically (and relatively) high background values in urban areas as well as the paucity of $PM_{2.5}$ emission data for nearby sources. An additional factor considered in a modeling analysis is the need to account for $PM_{2.5}$ pre-cursors (SO_2 and NO_2) under certain conditions (e.g., PSD projects).

Secondary formation of $PM_{2.5}$

In a March 23, 2010, memo EPA addressed methods for modeling cumulative $PM_{2.5}$ in order to meet the 24-hour $PM_{2.5}$ NAAQS. In that memo EPA expressed concerns that current modeling demonstrations disregarded secondary formation of $PM_{2.5}$ in the modeling analysis. Specifically, AERMOD, EPA's preferred model, does not consider atmospheric chemistry to account for secondary formation of $PM_{2.5}$. EPA offered a screening approach "Tier 1" which is admittedly very conservative (modeled H1H + monitored background).

In May 2014, the EPA provided updated modeling guidance on the implementation of $PM_{2.5}$ that addresses secondary formation issues. The guidance provides a means by which to determine whether a project must include secondary formation of $PM_{2.5}$ as part of a modeling demonstration. The following four cases illustrate the proposed approach:

Table 18: EPA suggested assessment cases that define needed air qulaity analyses

Assessment Case	Description of Assessment Case	Assess Primary Impacts of Direct $PM_{2.5}$ Emissions?	Assess Secondary Impacts of Precursor Emissions of NOx and/or SO_2?
Case 1: No Air Quality Analysis	Direct $PM_{2.5}$ emissions < 10 tpy SER NO_x and SO_2 emissions < 40 tpy SER	NO	NO
Case 2: Primary Air Quality Impacts Only	Direct $PM_{2.5}$ emissions ≥ 10 tpy SER NO_x and SO_2 emissions < 40 tpy SER	YES	NO
Case 3: Primary and Secondary Air Quality Impacts	Direct $PM_{2.5}$ emissions ≥ 10 tpy SER NO_x and/or SO_2 emissions ≥ 40 tpy SER	YES	YES
Case 4: Secondary Air Quality Impacts Only	Direct $PM_{2.5}$ emissions < 10 tpy SER NO_x and/or SO_2 emissions ≥ 40 tpy SER	NO	YES

The MPCA has adopted this approach to determine when a proposed project must include secondary formation of $PM_{2.5}$ in a modeling demonstration, consistent with EPA guidance. Please keep in mind that under this approach, Cases 2 and 3 would both consider a modeled compliance demonstration for direct $PM_{2.5}$ emissions through dispersion modeling.

The MPCA has provided a technical approach to model secondary formation consistent with the four tiers presented above. The National Association of Clean Air Agencies (NACAA) document, released on January 11, 2011, provided a modeling approach to account for secondary formation of $PM_{2.5}$. The approach suggests the use of an offset ratio method to estimate the equivalent $PM_{2.5}$ from the existing emissions of NO_x and SO_2 from combustion stacks. The estimated value is the Total Equivalent Primary $PM_{2.5}$, and is a refinement to EPA's Case 3 method.

Functionally, the approach operates in the following manner. The offset ratio (OR) represents the amount of NO_x or SO_2 that contributes the $PM_{2.5}$ concentrations through secondary formation. Use of the OR yields a value called the total equivalent primary $PM_{2.5}$ emission rate ($TEP_{PM2.5}$).

$$TEP_{PM2.5} = \text{Primary } PM_{2.5}\ [TPY] + [SO_2\ TPY]/A_{OR} + [NO_X\ TPY]/B_{OR}$$

Where:

- The bracketed values are provided in consistent units of mass per time (e.g., pound per hour, gram per second).
- A_{OR} is a value that conservatively estimates the conversion of SO_2 to fine particulate.
- B_{OR} is a value that conservatively estimates the conversion of NO_X to fine particulate.

The modeled $PM_{2.5}$ NAAQS sources that also emit NO_X and SO_2 from combustion added an additional rate to their direct $PM_{2.5}$ emissions to reflect the $PM_{2.5}$ created from secondary formation. The MPCA has conducted a regional photochemical model to develop SO_2 and NO_x coefficients that can be used in this calculation for projects in Minnesota that must account for the secondary formation of $PM_{2.5}$. Currently, the MPCA suggests an A_{OR} value of 10 and a B_{OR} value of 100.

Secondary formation of O_3

When a permit action is a major modification under PSD for O_3 emissions of 40 tons per year or more and/or NO_X emissions of 40 tpy or more, the applicant must provide a qualitative or quantitative analysis of the impacts of the increase in VOCs and NO_X on the ambient O_3 concentration. This analysis is not included with a project's modeling demonstration and is managed through the permitting program.

Pb

Individual facilities modeling for the criteria pollutant Pb will need to use the pollutant ID of OTHER in AERMOD, and select the monthly averaging period. See Section 8.1 of 40 CFR Part 51 "*Guideline on Air Quality Models*" for information on source emissions for a monthly averaging period. The design value for the Pb NAAQS is a rolling three-month average, as compared to the quarterly average of the old Pb NAAQS. At this time, AERMOD cannot calculate the Pb NAAQS' design value. The U.S. EPA has developed a post-processor called LEADPOST to calculate the design value. LEADPOST takes the post file from the AERMOD output and uses it to calculate a rolling three-month average concentration at each modeled receptor. As such, modeling for lead requires that post files be selected from the output pathway in AERMOD. MPCA modeling staff recommends that one AERMOD post file be generated for the source group ALL, as opposed to generating a post file for every source.

For detailed information regarding the approach to set-up and run LEADPOST, please visit EPA's AERMOD page on their SCRAM website.

NO_2

Typically, emission calculations and modeling are performed for NO_x, however, the NAAQS and PSD increments are for NO_2. The Guideline on Air Quality Models provides a multi-tiered screening approach for estimating annual NO_2 concentrations from point sources.

For Tier 1, assume total conversion of NO to NO_2. If the concentration from Tier 1 exceeds the NAAQS and/or PSD increments for NO_2 proceed to Tier 2.

Tier 2 is known as the Ambient Ratio Method (ARM). The application of the ARM approach is a simple multiplication method applied to the ambient concentrations generated from the Tier 1 analysis. The NO_2/ NO_x coefficient for this calculation is 0.8 for 1-hour NO_2 and 0.75 for annual NO_2; however, these values are subject to change as EPA is reviewing various variable ARM values to account for the new NAAQS the physical conditions of transformation. A refined version of the ARM approach, referred to as ARM2, has been approved for use under specific cases, by EPA, as described in the September 30, 2014, EPA memorandum.

The Tier 3 "detailed screening methods" approaches include two options: the Plume Volume Molar Ratio Method (PVMRM) and the Ozone Limiting Method (OLM). Both approaches depend on the following: O_3 concentrations and in-stack NO_2/NO_x ratios. The PVMRM routine calculates the molar ratio of O_3 to NO_x in an effluent plume at receptor locations using dispersion (quasi -instantaneous) rates that differ from those that are being used by AERMOD to calculate the NO_x concentration. These are described as relative vs. continuous diffusion rates. This molar ratio is multiplied by the NO_x concentrations provided by AERMOD to calculate the NO_2 concentrations in the plume. PVMRM includes a method to simulate multiple NO_x sources by accounting for how the plumes merge and combine. Note that ambient NO_2/NO_x ratios are calculated from ambient monitoring data. If a representative O_3 monitoring site can be found (e.g., Anoka County Airport for urban areas), an alternative NO_2/NO_x ratio can be utilized.

In-stack ratio of NO_2/NO_x is also required. Unless approved by MPCA in advance, alternative ambient NO_2/NO_x ratios should not be used in lieu of the national annual default value of 0.50.

The second Tier 3 option is the use of the OLM. The theoretical support for the OLM approach reflects combustion temperatures and conversion of NO. The relatively high temperatures in the primary combustion zone typical of most conventional combustion sources primarily promote the formation of NO over NO_2 by the following thermal reaction:

$N_2 + O_2$ ==> 2NO (NO formation in combustion zone)

In lower temperature regions of the combustion zone or in the combustion exhaust, the NO that is formed can be converted to NO_2 via the reaction:

2 NO + O_2 ==> 2 NO_2 (In-stack formation of NO_2)

An important note: In addition, other reactive species can convert NO to NO_2 during and immediately following combustion as can oxidation catalysts in the exhaust—such as oxidation catalysts used to control CO and VOCs.

Thus, a portion of the NO_x exhausted is in the form of NO_2. This is referred to as the in-stack NO_2/NO_x ratio, which is in general different from the ambient ratio such as that used in the ARM.

Historically, a default value of 10 percent of the NO_x in the exhaust was assumed to be NO_2. It is assumed that no further conversion by direct reaction with O_2 occurs once the exhaust leaves the stack because of the much lower temperature once the exhaust mixes with the ambient air. Thus the remaining percentage of the NO_x emissions is assumed to be NO.

As the exhaust leaves the stack and mixes with the ambient air, the NO reacts with ambient O_3 to form NO_2 and molecular oxygen (O_2):

NO + O_3 ==> NO_2 + O_2 (Oxidation of NO by ambient O_3)

The OLM assumes that at any given receptor location (ground level) the amount of NO that is converted to NO_2 by this reaction is controlled by the ambient O_3 concentration. If the O_3 concentration is less than the NO concentration, the amount of NO_2 formed by this reaction is limited. If the O_3 concentration is greater than or equal to the NO concentration, all NO is assumed to be converted to NO_2.

In the presence of radiation from the sun, ambient NO_2 can be destroyed:

NO_2 + sunlight ==> NO + O (Photo-dissociation of NO_2)

As a conservative assumption, the OLM ignores this reaction. Another reaction that can form NO_2 in the atmosphere is the reaction of NO with reactive hydrocarbons (HC):

NO + HC ==> NO_2 + HC Oxidation of NO by reactive HC

The OLM also ignores this reaction. Applications of OLM option in AERMOD should routinely utilize the "OLMGROUP ALL"

Case-by-case methods including the Tier 3 options should not be used unless approved by both the MPCA and the EPA in advance. Please consult with MPCA modeling staff to facilitate the review and approval by EPA.

Minnesota Ambient Air Quality Standards

The state of Minnesota is unique in that it has state-level ambient air quality regulations that were developed prior to the recent NAAQS (1-hour SO_2, 1-hour NO_2). The Minnesota Ambient Air Quality Standards (MAAQS) are deterministic standards and can be found online. The MAAQS and NAAQS overlap with respect to most pollutants; however, the current NAAQS are more restrictive. There are two MAAQS pollutants that are not included in the NAAQS: Total Suspended Particulate (TSP) and Hydrogen Sulfide (H_2S). Typically, these pollutants are included in non-PSD projects on a case-by-case basis or in certain situations, may become part of an environmental review. As a regulatory practice, in the event that a MAAQS is lower than an applicable NAAQS, or there is a specific MAAQS standard that differs in averaging time from the applicable NAAQS, the MPCA requires the modeling demonstration to include these MAAQS analysis. Modeling these pollutants is typically in a non-default mode within AERMOD. Please confer with MPCA Air Quality Modeling staff if you encounter a need to model TSP or H_2S.

Part III - additional considerations

The development of a modeling demonstration may require additional attention to account for other programmatic activities. The following is a brief discussion of topics relevant to the PSD program, SIP program and General Modeling issues that may affect a project. In addition, the MPCA is including a simple NAAQS/MAAQS analysis that is authorized through specific permit language known as an Equivalent or Better Dispersion demonstration.

PSD special topics

As noted above, several PSD topics are treated with greater detail. These topics include visibility screening, particulate matter from offsite roads, and Class I increment modeling.

Class I AQRV modeling

Facilities performing PSD modeling must show they will not adversely impact any Class I areas. Projects located within 300 km of a Class I area should notify the Federal Land Managers (FLMs), including the state or tribal governing body, where applicable, of the proposed project. Some contact information is listed below. Whether a project needs to perform a visibility analysis depends on the size of the facility/project and how close it is to the Class I areas, Class I areas in Minnesota include the Boundary Waters Canoe Area Wilderness (Forest Service) and Voyagers National Park. Other nearby Class I Areas includes Rainbow Lake Wilderness (Forest Service) in Wisconsin and Isle Royale National Park in Michigan. As of this update, there are several Tribes within Minnesota pursing Class I designation; Tribes designated as Class I areas will be included upon completion of the designation process.

Contact list:

John Notar (John_Notar@nps.gov)
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PO Box 25287
Denver, CO 80225-0287
303-969 2079

Tim Allen (Tim_Allen@fws.gov)
U.S. Fish and Wildlife Service
National Wildlife Refuge System
Branch of Air Quality
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US Forest Service
2150 Centre Ave, Bldg. A
Fort Collins, CO 80526
970-295-5981

$PM_{2.5}$ and PM_{10} emissions from off-site roads

PSD projects must account for the increase in emissions related to the proposed project. Although explicit modeling of project-related vehicle traffic on off-site roads is generally not required, appropriate $PM_{2.5}$ and PM_{10} background concentrations should be used to account for such nearby vehicle traffic impacts on ambient $PM_{2.5}$ and PM_{10} levels. Depending on the circumstances of the project, an additional impacts analysis, consistent with 40 CFR § 52.21 (n) and (o), may be required. Projects subject to environmental review may require more detailed analysis of off-site road traffic emissions.

PSD Class I increment modeling

Class I areas are of special national or regional scenic, recreational, natural, or historic value for which the PSD regulations provide special protection. Under the Clean Air Act, the FLM and the Federal official with direct responsibility for management of Federal Class I parks and wilderness areas (i.e., Park Superintendent, Refuge Manager, Forest Supervisor) is charged with the affirmative responsibility to protect that area's unique attributes, expressed generically as air quality related values (AQRVs). The permitting authority, MPCA, is responsible for administering the PSD program and ensuring that the NAAQS and increments are protected within the state. The permit applicant should contact the appropriate FLM as soon as plans for a new major source or modification have begun (NSRWM, 1990). The PSD regulations specify that the reviewing authority furnish written notice of any permit application for a proposed major stationary source or major modification to the FLM and the official charged with direct responsibility for management of any lands within the area. The purpose of this document is to document and describe procedures and expectations for analyzing PM_{10}, $PM_{2.5}$, NOx, SO_2 increments in Class I areas. For further details on Class I increment modeling, please refer to Appendix B.

PSD increment and future growth

The goal of the PSD program is to ensure that air quality in areas with clean air does not significantly deteriorate, while maintaining a margin for future industrial growth. The PSD regulations do not prevent sources from increasing emissions. Instead, they are designed to:

- Protect public health and welfare.
- Preserve, protect, and enhance the air quality in national parks, national wilderness areas, national monuments, national seashores, and other areas of special national or regional natural, recreational, scenic, or historic value.
- Insure that economic growth will occur in a manner consistent with the preservation of existing clean air resources.
- Assure that any decision to permit increased air pollution in any area to which this section applies is made only after careful evaluation of all the consequences of such a decision and after adequate procedural opportunities for informed public participation in the decision making process.

The MPCA is responsible for the implementation of the federal PSD program in Minnesota; tribal lands within the state of Minnesota are permitted through the EPA or through the respective tribe's permitting program. Our primary goal is to protect the applicable NAAQS and overall air quality, consistent with the bullets provided above. The MPCA also recognizes the need to balance future growth and economic viability with the protection of ambient air quality. It is within the scope of future growth that the MPCA identifies three categories where growth occurs: New facilities, modifications of existing facilities, and expansion of facilities. Each of these categories of growth has the potential to consume increment and adversely impact air quality.

In order to manage future growth and economic viability, the MPCA has considered the practice of conserving an amount of one unit of a pollutant-specific SIL value ("One-SIL") within an increment analysis for future growth. This approach is intended as a goal. If it is not possible to achieve a "One-SIL" value for future growth, then a modeling exercise that demonstrates compliance with the increment value is sufficient to preserve future growth and protect the ambient air standards. A facility's permit may include requirements to remodel any future changes so the compliance with the NAAQS continues.

How to estimate "maximum" past actual 24-hour emissions

Estimating past actual annual emissions is much easier (via emission inventory data) than estimating ***maximum*** past actual 24-hour emissions (i.e., researching old facility records). A common reoccurring question is how to estimate maximum short-term emissions. EPA speaks to this in "NSR Advisory Memorandum 1: TSP PSD Increment Consumption in North Carolina" dated May 3, 1985. See Appendix B.8 which states:

> one would expect to see such maximums occur at five percent of the total 24-hour operating time periods (which means non-operating time periods don't count in making this determination). The use of the five percent guideline is intended only to rule out the possibility that a source could deliberately operate only a few times at very high rates in order to decrease increment consumption at some future time.

NSR advisory memorandum 1 should be used to estimate maximum past actual short-term (three-hour and 24-hour) emissions for minor source baseline date (MSBD) conditions. If you have additional questions regarding emission estimating, please contact your MPCA permit engineer.

General modeling information

The following are comments that reflect some general direction of the development of an air quality modeling demonstration.

Model defaults and non-defaults

The AERMOD model was designed to develop modeling demonstrations that support the EPA's regulatory programs, specifically permitting of PSD and non-PSD sources. In nearly all cases, the regulatory modeling options should be the default mode of operation for any modeling demonstration. MPCA modeling staff recognizes that there are specific situations when a non-regulatory default is required. Typically, these situations involve the approach taken to address an ambient standard (e.g., NO_2 and the OLM); unique stack and terrain features as well as various approaches to developing a deposition modeling demonstration. Please be aware that the use of a non-regulatory default for a modeling demonstration will require approval from the EPA and the MPCA in the case of PSD permit modeling demonstrations. For all other permits where air quality dispersion modeling is required, the MPCA is the review and approval authority.

Class I modeling

The meteorological data needed for a Class I modeling demonstration are substantially different than those required for Class II areas. Typically, CALPUFF Class I modeling demonstrations require gridded meteorological data. The MPCA does not provide processed gridded meteorological data; however, several public and private sector sources make this information available, in some cases, for a fee. Please review the Class I Modeling Guidance in Appendix B for further details.

Urban/rural considerations

It is necessary to classify the land use in the vicinity of emission sources since rates of dispersion differ between urban and rural areas. In general, urban areas cause greater rates of dispersion because of increased turbulent mixing and buoyancy-induced mixing. This mixing is due to the combination of greater surface roughness caused by more buildings and structures. In addition, urban areas also exhibit greater amounts of heat released from concrete and similar building materials.

EPA guidance identifies two procedures to make an urban or rural classification for dispersion modeling: the land-use procedure and the population density procedure. Both procedures require the evaluation of characteristics within a 3 km radius from a facility. Of the two procedures, the land-use procedure is preferred. The land-use procedure specifies that the land use within a 3 km radius of the source should be determined using the typing scheme developed by Auer (1978).

If the sum of land use types I1 (heavy industrial), I2 (light to moderate industrial), C1 (commercial), R2 (compact new residential), and R3 (compact old residential) is greater than or equal to 50 percent of the area within a 3 km circle, then the area should be classified as urban. Otherwise the area should be classified as rural. Table 19 illustrates the land use categories used in the urban/rural consideration based on the 2011 National Land Cover Database (NLCD) classification.

Table 19. The 2011 NLCD land-use classification system

NLCD Land Cover Classification Legend
11 Open Water
12 Perennial Ice/ Snow
21 Developed, Open Space
22 Developed, Low Intensity
23 Developed, Medium Intensity
24 Developed, High Intensity
31 Barren Land (Rock/Sand/Clay)
41 Deciduous Forest
42 Evergreen Forest
43 Mixed Forest
51 Dwarf Scrub*
52 Shrub/Scrub
71 Grassland/Herbaceous
72 Sedge/Herbaceous*
73 Lichens*
74 Moss*
81 Pasture/Hay
82 Cultivated Crops
90 Woody Wetlands
95 Emergent Herbaceous Wetlands
* Alaska only

The MPCA has automated this analysis through a GIS application known as the Urban vs. Rural Selection Tool, is available online. A video demonstration of the tool is also available online.

Insignificant activities

The federal Part 70 program requires each state to include an insignificant activities provision in its Title V Operating Permit Program. Minn. R. 7007.1300, subp. 1 to subp. 4 fulfills this requirement for Minnesota. However, identifying an emission source or an emission unit as an "insignificant activity" under Minnesota's air quality permitting rule does not mean that is it is automatically omitted from a modeling demonstration. In fact, sources and activities deemed insignificant for permitting under Minn. R. 7007.1300, subps 3-4 and Minn. R. 7008.4100-4110 should be included in a modeling demonstration. Exception to this provision is allowed if Best Management Practices are used to create enforceable provisions in an air quality permit (e.g., emergency generators, fire pumps, road dust maintenance plans).

Equivalent or better dispersion

The MPCA has developed an approach to evaluate whether proposed small changes at a facility will result in equivalent or better dispersion (EBD) and thus still protect NAAQS and MAAQS.

The main goal of the EBD approach is to protect ambient standards while simultaneously avoiding full refined modeling for minor changes at a facility. The EBD approach attempts to reuse/edit portions of the existing modeling input data to account for emission changes and/or dispersion changes at the facility in order to evaluate the net change of predicted concentrations (typically within a pollutant specific SIL value). The current approach is based on well-known PSD increment concepts which evaluate the change between previous and proposed modeling conditions.

Another goal of the EBD approach is to reduce the administrative review and response time of the MPCA modeling review for projects with minor dispersion changes. MPCA has created a single form that accounts for both the modeling protocol and modeling results/report in order to expedite our review of EBD analyses while documenting the relevant information and modeled output. This form is submitted via e-Service.

The EBD language began in the 1980's as part of a SIP proposal whereby a facility located within a SIP area would not be required to conduct a refined modeling demonstration when a minor change was being proposed if they could demonstrate that the change resulted in equivalent or better dispersion characteristics based on a pollutant-specific SIL value. As a result, facilities located within a SIP maintenance area could demonstrate through a simple analysis with readily available information that their proposed change would be equivalent or better than had been previously modeled.

The EBD is most frequently used with MPCA Air Quality Permits and is typically not available for projects undergoing environmental review or where a SIP explicitly omits the use of this approach. In situations where a SIP is silent on the use of an EBD, prior approval must be received from EPA prior to pursuit of the analysis. Please review the language of your air quality permit with the MPCA Air Quality Permit Program to discuss the use of an EBD demonstration for any proposed changes at your facility. The details of the EBD modeling approach and case study example can be found in Appendix E.

Protocol and final report submittal requirements

As previously noted, pursuant to an Executive Order and new state legislation, the MPCA is committed to processing permit applications within 150 days of receipt of a permit application. The MPCA has transitioned to an e-Service submittal process. While the information required for submittal remains similar, there are some differences in the forms required. The e-Service online delivery system launched

September 2016. MPCA will allow for a transition period of 60 days from the go-live date before requesting all protocol submittals through e-Services. Both the current and e-Services submittal process is described further in the following section.

Section 3: Submittal process, forms, and online services

When it has been determined that a facility should conduct air dispersion modeling for permitting, environmental review (EAW, EIS), and/or SIP requirements, the facility should complete and submit for approval the air dispersion modeling protocol. Once the modeling protocol has been approved the facility will be notified via the protocol approval notification form, the facility may then conduct air dispersion modeling consistent with methodologies identified in the protocol. Modeling results should then be submitted with the permit application or applicable documents (EAW, EIS, SIP). Any deviations from the approved modeling methodology should be in consultation with the MPCA and should be documented either by resubmittal of the protocol form or in the modeling results form.

Submittal process:

- Complete and submit MPCA's Air Dispersion Modeling Protocol (via **AQDM-01** or **e-Service**) and attach a modeling protocol spreadsheet (**AQDM-02**) and any other required attachments.
- Protocol approval notification and Protocol Review Form: receipt of the Protocol Approval Notification (**AQDM-04 & AQDM-05**).
- Obtain and complete the MPCA Air Dispersion Modeling Results form (**AQDM-06**).
- Submit AQDM-06 with permit application and/or EAW, EIS, and/or SIP documents.

As previously noted, the MPCA has transitioned to an e-Service online delivery system. The MPCA will allow for a transition period of 60 days before requesting all protocol submittals through e-Services. Table 20 below provides an overview of the forms required in the previous and e-Service submittal process. If you have any questions regarding requirements for submittal, please contact the Air Modeling Unit AirModeling.PCA@state.mn.us.

Modeling protocol forms

MPCA approved modeling protocols are required before submitting modeling reports. MPCA forms/spreadsheets for modeling protocols and modeling reports are available on our website.

The forms were developed foster better communication regarding MPCA expectations to air permit applicants/consultants, to standardize and streamline of review of air dispersion modeling submittals, to identify/fix common mistakes and time consuming steps, and to use less paper.

Table 20: Required forms for project submittals.

Process		Required forms	
		Previous: Initial submittal for all modeling demonstrations require 2 hard copies of each form and supporting electronic files to be mailed to MPCA	**e-Services**: All forms and supporting files submitted through e-Service, no hardcopies required
Ambient Air Dispersion Modeling Protocol for Criteria Pollutants			
Facility Submittal	Air Dispersion Modeling Protocol submittal	AQDM-01 AQDM-02	AQDM e-Service form AQDM-02 AQDM-11 (if applicable) AQDM-12 (if applicable)
Facility Submittal	Air Dispersion Modeling Protocol re-submittal (if applicable)	AQDM-01 with changes incorporated AQDM-02 with changes incorporated	AQDM-1.5 AQDM-02 with changes incorporated
MPCA Review	Internal review process, MPCA only	MPCA protocol approval notification forms AQDM-04 & AQDM-05	
Ambient Air Dispersion Modeling Report for Criteria Pollutants			
Facility Submittal	Air Dispersion Modeling Report submittal (submit with permit application and/or EAW, EIS, and/or SIP documents)	AQDM-06	AQDM-06
MPCA Review	Internal review process, MPCA only	MPCA report approval notification form AQDM-07	
Equivalent or better dispersion (EBD) for criteria pollutant modeling			
Facility Submittal	EBD Submittal Form for Criteria Pollutant Modeling	AQDM-08	AQDM-08
MPCA Review	Internal review process, MPCA only	MPCA EBD review and approval notification forms AQDM-09 & AQDM-10	

AQDM-01 Modeling Protocol: The AQDM-01 Modeling Protocol is the protocol form in use until e-Services before the 60 day transition period ends. Information is captured in the form through simple checkboxes and fields for text. Should a facility need to resubmit a protocol, the AQDM-01 form should be used to update information for the resubmittal.

e-Service Modeling Protocol: The e-Service Modeling Protocol is a standardized online modeling protocol form that combines simple checkboxes, dropdown lists, and text to document a facility's air dispersion modeling approach. The online form provides flexibility in that it can accommodate various facility specific modeling approaches. For more information on the fields to be filled out in e-Services and what attachments will be required, click here. Applicants are also required to list additional/supporting files used to support modeling demonstrations.

AQDM-1.5: The AQDM-1.5 is a protocol resubmittal form used to capture changes from an initial e-Service protocol submittal. If changes are needed in order to approve a modeling protocol, the air modeler will request this form to be filled out specifying what changes are being made to the initial submittal. The air modeler will then enter those changes in MPCA's air modeling database. In some instances, if numerous changes are needed, a new e-Service submittal may be requested.

AQDM-02: The AQDM-02 is a spreadsheet that captures stack parameters, emission rates and emission factors. All sections of the AQDM-02 must be filled out and reviewed by the MPCA before an applicant receives approval of a submitted protocol. Facilities may ADD ADDITIONAL tabs/worksheets to the workbook to provide more detailed calculations. ***Please note the following***:

- The AQDM-02 replaces the SAM spreadsheet
- The MPCA will not accept password protected spreadsheets or .PDF versions of a spreadsheet.

The **AQDM-02** requests the following information:

- Specific locations for all stacks and release points, along with information pertaining to the manner in which emissions are discharged to the atmosphere (e.g., stacks with “rain caps”, stacks with unobstructed vertical releases, “gooseneck” stacks, lateral discharges, vents, and fugitive releases)
- Potential or permitted allowable emissions, emission factors and references per emission release point.

Source Parameter Worksheets:

- Values in “emission rate” fields should be a calculated emission rate.
- Values in Area Source “emission rate” fields should be in g/m^2/sec.
- List all operating scenarios to be modeled.

Sheet 1: Point Source Parameters

Enter stack parameters into spreadsheet tab “Stack Parameters” in the **AQDM-02** spreadsheet. A **Model Input Key** table provides descriptions along with the required units for stack parameters. Input cells are colored green. Field headings and **Model Input Key** cells are locked and cannot be altered. An Example is provided at the top of the sheet.

Sheet 2: Area Source Parameters

Enter area source parameters into spreadsheet tab “*Area Source* Parameters” in the **AQDM-02** spreadsheet. A **Model Input Key** table provides descriptions along with the required units for area source parameters. Input cells are colored green. Field headings and **Model Input Key** cells are locked and cannot be altered. An Example is provided at the top of the sheet.

Sheet 3: Volume Source Parameters

Enter stack parameters into spreadsheet tab “Stack Parameters” in the **Modeling Parameters** spreadsheet. A **Model Input Key** table provides descriptions along with the required units for stack parameters. Input cells are colored green. Field headings and **Model Input Key** cells are locked and cannot be altered. An Example is provided at the top of the sheet.

Sheet 4: Emission Calculations

Enter fugitive source, stack vent and emission unit information and all relevant emission factors, equations, and references into the **Emission Calculations Table** found in the “Emission Calculations” tab. An Example is provided at the top of the sheet. Input cells are colored green, field headings and “EXAMPLE” cells are locked and cannot be altered. *Indicate in the **Description** field whether emissions are ‘controlled’ or ‘uncontrolled’.*

Sheet 5 and higher: User generated sheets. Additional sheets can be added to include information such as nearby sources, continuous emission monitor (CEM) data, background calculations, etc.

Further information: Direct any questions or comments regarding forms AQDM-01, e-Service, and AQDM-02 to one of the air dispersion modelers listed in the Contacts and Resources section.

Modeling results

The results of an air quality dispersion modeling demonstration should be provided using the MPCA Air Quality Dispersion Modeling Report (AQDM-06) form. This form is used to determine compliance with the applicable ambient air quality standards and if specific permit provisions should be included in an MPCA air quality permit. The following is a more detailed description of the form as well as content expectations.

AQDM-06: The content expectations of the **AQDM-06** (modeling report) document are similar to the expectations presented in the e-Service protocol form; however, there are some notable differences.

The first distinction between the protocol and the report is the type of files that are needed to accompany the project submittal. With the protocol, the only files needed for review are the input files, including BPIP, Terrain (.tif file) and appropriate meteorology, background, etc. The modeling report requires input files (if they have been modified since the initial review and approval by MPCA) as well as the output files (e.g., .plt, .pst, etc.).

Another important distinction is the documentation of changes that occurred between the MPCA review and approval of the protocol and the submittal of the final modeling report. The MPCA has streamlined the process for amendments or modifications of an MPCA approved modeling protocol. Each section of the protocol is represented in the modeling report review form that provides for an opportunity to identify and justify each modification in the approved protocol. Most changes can be addressed via e-mail and telephone calls with MPCA air modeling unit staff. The project proposer is required to document all the changes made to the protocol, including times and approvals provided by the MPCA, as part of the report submittal. Please note that most changes to a post-approval protocol will likely be addressed through this process. There are circumstances that would warrant a new protocol for a project instead of a simple review, approval and documentation process described above. Please consult with your MPCA air modeling unit staff assigned to the project in the event that you anticipate changes to an approved protocol to determine if the modification can be made via the modeling report or if a new modeling protocol is necessary to update the project modeling.

Modeling results are discussed in Section 4 of the modeling report and reflect the demonstration of compliance for the applicable PSD increment, NAAQS, MAAQS, or SIL's.

Section 5 of the form is provided for any discussion or comments that the project proposer would like to include as part of the modeling demonstration. This may include specific operating assumptions, rationale for changes along with dates of MPCA contacts, etc. There is no specific limit to the length of the discussion; however, if a lengthy discussion is anticipated, attachments should be used to present the full breadth of the information.

The modeling report is designed to provide for attachments, maps, graphs and related items. Please note that the AQDM-06 form is the primary form used in the MPCA review. Any other documents or reports provided in support of a modeling demonstration are subordinate to the MPCA form and must be included as attachments to the AQDM-06 form.

EBD for criteria pollutant modeling

The main goal of the EBD approach is to protect ambient standards while simultaneously avoiding full refined modeling for minor changes at a facility. The EBD approach attempts to reuse/edit portions of the existing modeling input data to account for emission changes and/or dispersion changes at the facility in order to evaluate the net change of predicted concentrations (typically within a pollutant specific SIL value). The current approach is based on well-known PSD increment concepts which evaluate the change between previous and proposed modeling conditions.

Another goal of the EBD approach is to reduce the administrative review and response time of the MPCA modeling review for projects with minor dispersion changes.

AQDM-08: MPCA has created a single form that accounts for both the modeling protocol and modeling results/report in order to expedite our review of EBD analyses while documenting the relevant information and modeled output. Note: This form does not apply to PSD or Environmental Review related projects.

Minnesota Pollution Control Agency review forms

The MPCA uses several forms for internal review that become part of the administrative record for each modeling demonstration. The specific forms that are included in the record are:

- Air Quality Dispersion Modeling Protocol Review Form (**AQDM-05**)
- Air Quality Dispersion Modeling Protocol Approval Notification Form (**AQDM-04**)
- Air Quality Dispersion Modeling Report Review Form (**AQDM-07**)
- EBD Review Form for Criteria Pollutant Modeling (**AQDM-09**)
- EBD Approval Notification Form (**AQDM-10**)

The first two review forms (AQDM-05 & AQDM-04) are used to evaluate the protocol and provide specific comments pertaining to deficiencies and uncertainty. The second form (AQDM-04) specifically is used as the document that informs a project proposer whether the protocol is approved, conditionally approved or not approved.

A similar form is used to review the modeling demonstration submitted, via the AQDM-07 form. The MPCA review process for the modeling report looks at the consistency between the approved protocol and the final modeling demonstration as well as the demonstration of compliance. Where deviations occur between the modeling protocol and report, the MPCA will review the discrepancies to determine if the deviations are justifiable unless previously approved by the MPCA. Once a modeling report is approved by the MPCA, the final approval of the modeling report, via the AQDM-07 form, is provided to the project proposer and the MPCA permitting engineer.

The process for EBD review is similar to the modeling report review. Once an EBD is approved by the MPCA, the final approval is provided to the project proposer and the MPCA permitting engineer via the AQDM-09 and AQDM-10 forms.

Additional e-Service Attachments

Two new forms have been created to capture data that was previously captured on the AQDM-01 modeling protocol form:

AQDM-11: The SIL Analysis and Results Form captures the results of the preliminary analysis modeling from Part 2, Stage One described earlier in this document.

AQDM-12: The Paved Roads Results Form captures the results of modeling done to determine whether or not paved road fugitive dust will need to be included explicitly in a modeling demonstration and whether or not paved road fugitive dust permit conditions may be required.

Section 4: Contacts and Resources

Contacts and resources

Contacts: http://www.pca.state.mn.us/air/modeling.html#contacts.

Resources: http://www.pca.state.mn.us/air/modeling.html#resources.

Guidance: http://www.pca.state.mn.us/air/modeling.html.

Air Permitting, SIP and Environmental Review Modeling

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- Meteorology
- Prognostic Meteorological Data
- Air Quality Index
- PSD modeling and Title V modeling for individual sources
- Geographic Information System

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Appendix A - Source culpability as a result of Cumulative Air Modeling Analysis

DEPARTMENT: POLLUTION CONTROL AGENCY

STATE OF MINNESOTA SF-00006-05 (4/86)
Office Memorandum

DATE: October 13, 2015

TO: Don Smith, P.E.
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Air Quality Permits Section
Industrial Division

Bill Sierks
Manager
Environment & Energy Section
Resource Management & Assistance Division

FROM: Frank Kohlasch
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Environmental Analysis and Outcomes Division

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SUBJECT: Source Contribution Analysis for Modeled Exceedances in a Cumulative Modeling Analysis

The purpose of this memorandum is to describe how the Risk Evaluation and Air Modeling (REAM) unit will support the Minnesota Pollution Control Agency (MPCA) Environmental Review Program and Air Quality Permitting program using an existing Environmental Protection Agency (EPA)-approved modeling technique, referred to as a Source Contribution Analysis, to address modeled exceedances of a project under review, a nearby source, or a combination of sources that contribute to a modeled exceedance. The function of this technique is to identify which facilities in the model are significant contributors to modeled noncompliance. Of particular concern is the modeled status of the project that is subject to either environmental review or permitting. Projects subject to either of these programs with modeled noncompliance, or, alternatively are significant contributors to a modeled noncompliance, will not be able to obtain a permit or environmental review approval until the facility is able to implement controls or practices that result in significant reductions.

The Source Contribution Analysis is offered as a means to meet two regulatory objectives:

1. To provide an EPA-accepted modeling technique used to separate modeled emissions from the proposed project and other contributing sources where a modeled exceedance of an applicable ambient air quality standard is revealed; and,
2. To support program-specific decision factors for the MPCA to consider when presented with modeled exceedances and the results of a Source Contribution Analysis.

While the modeling technique described in this memorandum may have wide application; each modeled exceedance scenario should be considered on its own unique facts. The regulated community may offer alternatives to the approach presented in this memorandum for consideration by the agency.

Primary Program and Regulatory Considerations

The MPCA REAM unit has applied the Source Contribution Analysis to a variety of projects. The following is a short summary of the applicable air quality standards and the relevant programs where the Source Contribution Analysis can be applied to facilitate Air Quality Permitting and Environmental Review.

National Ambient Air Quality Standards (NAAQS) and Minnesota Ambient Air Quality Standards (MAAQS)

The air quality regulatory focus for MPCA Air Quality Permitting and Environmental Review is the National Ambient Air Quality Standards (NAAQS) and the Minnesota Ambient Air Quality Standards (MAAQS). Under the Clean Air Act sections 110(a)(1) and (2), Minnesota is required to demonstrate via its State Implementation Plan (SIP) that the state's existing rules and statutory authorities provide for the implementation, maintenance and enforcement of the NAAQS. This type of SIP submittal is known as an "infrastructure SIP" because it relies upon the existing "infrastructure" of a State's air quality management program. An infrastructure SIP must include "enforceable emission limitations and other control measures, means, or techniques, as well as schedules and timetables for compliance..." that will ensure NAAQS compliance. It must also provide for air quality modeling, as needed, to predict the effects of emissions on the NAAQS. Though not federally required, the MAAQS are included in the infrastructure SIP and are applied to facilities in a similar fashion as the NAAQS (See Minn. R. 7009.0080). Ultimately, Minnesota meets the obligations of the NAAQS and manages the MAAQS through a number of rules and statutes, specifically relying on Minn. R. 7009.0020, which prohibits emissions that cause or contribute to a violation of ambient air quality standards. The MPCA administers the NAAQS and MAAQS through a variety of programs; however, the Environmental Review and Air Quality Permitting programs most frequently encounter modeled air quality noncompliance issues.

Cumulative Effects and Environmental Review Modeling

Minnesota's Environmental Policy Act (MEPA) authorizes the existence of an environmental review program, administered by the Environmental Quality Board (EQB) and implemented by various state and local units of government using EQB rules. Project proposers with actions subject to MEPA must consider the direct, indirect and cumulative potential effects of the proposed project. The MPCA Environmental Review program frequently uses air dispersion modeling to assess the cumulative potential effect of a proposed project on air quality as part of the Environmental Assessment Worksheet. Although a modeled exceedance of an ambient air quality standard (NAAQS or MAAQS) is usually considered significant for environmental review purposes, EQB rules (Minn. R. 4410.1700, subp. 7(B) specifies criteria for a responsible governmental unit to consider in their assessment of cumulative potential effects:

1. Whether the cumulative potential effect is significant. We believe this means assessing whether the totality of the modeled air emissions (project + background + other nearby sources) exceed an ambient standard or is otherwise significant;

2. Whether the contribution from the project is significant when viewed in connection with other contributions to the cumulative potential effects;

3. The degree to which the project complies with approved mitigation measures specifically designed to address the cumulative potential effect. The rule says that mitigation measures must be specific and reasonable expected to address to mitigate the environmental effects; and,

4. The efforts of the proposer to minimize the contribution from the project.

The Source Contribution Analysis approach featured in this memorandum is a reasonable and effective means to separate modeled emission sources and evaluate emission contributions from the proposed project and other nearby sources, consistent with item #2, as listed above.

Air Quality Permit Modeling

The Prevention of Significant Deterioration program 40 CFR § 52.21(b) requires a demonstration that certain new or modified activities will not adversely affect ambient air quality. Typically, this demonstration requires ambient air modeling to show that the predicted impacts are small (i.e., *de minimis*) or that the impacts of the project's emissions, when combined with background emissions and the emissions from neighboring sources, comply with the NAAQS. Since MPCA's ability to protect ambient air quality depends on the contributions of individual sources with nearby and long-range emissions (including small stationary sources and non-point sources), a modeled demonstration must consider the cumulative contributions from all sources.

Source Contribution Analysis

The Source Contribution Analysis was designed by EPA and presented as a means to separate facility contributions in a cumulative modeling analysis. The specific approach to complete a Source Contribution Analysis is found in the *User's Guide for the AMS/EPA Regulatory Model-AERMOD*[1]. This analysis is applied at each receptor in the modeling domain where modeling shows an exceedance of the applicable NAAQS or MAAQS. The results of this analysis are frequently used to determine if a project under review will require additional controls or limits to manage their emissions. Typically, MPCA uses EPA's pollutant-specific significant impact level (SIL) (usually two to four percent of the numeric value of the applicable NAAQS), where available, to evaluate the need for emission reductions. This approach meets the needs of separating the cumulative contributions of multiple modeled sources for MPCA's environmental review and air quality permitting programs.

MPCA Evaluation to Modeled Exceedances

Using the modeled results and source separation technique identified above, the contributing or culpable sources (i.e., source under review and/or nearby sources) will be evaluated by MPCA permitting and environmental review management to determine the most appropriate program-related action based on several factors that include, but are not limited to:

- Modeled contribution to ambient concentrations
  - Modeled percent contribution to the NAAQS/MAAQS at highest receptor
  - Number of receptors with a modeled exceedance to which the facility contributes
- Quantity of facility emissions
- Permit Considerations
  - Permit status (renewal date) and permit type
  - Permit application in house
- Potential upcoming projects
- EPA guidance and input
- Source location, especially in an Environmental Justice area

[1] http://www.epa.gov/scram001/7thconf/aermod/aermodugb.pdf [Retrieved August 13, 2015] See specifically, EVENT processing.

Typical options for MPCA consideration will reflect the nature of the action and which source is subject to the modeled exceedance. For example:

- For the project under review seeking a permit or completing environmental review:
    - Require emission rates in a permit such that they model below the applicable SIL or screening value. Under this scenario, no further analysis would be required for the project under review.
- For modeled noncompliance of nearby sources:
    - Review modeled emissions to determine that they are correct and consistent with the most recent air quality permit. If not, additional information may be gathered and remodeling may be required;
    - In the event that the modeled emissions appear correct, document accordingly to ensure that a requirement to model or demonstrate compliance is placed in a future permit issued to the facility; or,
    - Request new modeling information from the relevant culpable nearby sources for re-modeling purposes.

This is not an exhaustive list of options and reflects reasonable possibilities based on modeled data and project information. Other options will likely emerge as each project situation and facts will vary.

Review of the Practice and Integration into Modeling Guidance

This memorandum is intended to describe the practice of applying a Source Contribution Analysis where cumulative modeling identifies a modeled exceedance of either the source under review or one of the modeled nearby sources. Ultimately, this practice will be included in the MPCA Modeling Guidance if it is found to be serviceable in administering the MPCA's Environmental Review and Air Quality Permitting programs. Procedurally, this memorandum will operate as the MPCA working practice on this subject until the 2016 revision of the MPCA Modeling Guidance is completed. During this period the memorandum is in effect, the MPCA will review the performance of this approach and discuss the application of the analysis with project proposers that have used this practice on their projects. If the MPCA determines that this practice should be included in the Modeling Guidance, it will be added to the complement of modeling practices during the next guidance revision cycle and this memorandum will be archived.

FK:vs

Attachment

Appendix B

MPCA

DRAFT
Class I Cumulative Increment Analysis

Roberson and Cole

1/26/2011 Update

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Class I Increment Modeling

Introduction

Class I areas are of special national or regional scenic, recreational, natural, or historic value for which the PSD regulations provide special protection. The Federal Land Manager (FLM) of each Class I area is charged with the affirmative responsibility to protect that area's unique attributes, expressed generically as air quality related values (AQRV's). The permitting authority, MPCA, is responsible for administering the Prevention of Significant Deterioration (PSD) program and ensuring that the NAAQS and increments are protected within the state. The permit applicant should contact the appropriate FLM as soon as plans for a new major source or modification have begun (NSRWM, 1990). The PSD regulations specify that the reviewing authority furnish written notice of any permit application for a proposed major stationary source or major modification to the FLM and the official charged with direct responsibility for management of any lands within the area. The purpose of this document is to document and describe procedures and expectations for analyzing PM_{10}, $PM_{2.5}$, NO_x, SO_2 increments in Class I areas.

Minnesota Class I Areas

Minnesota Class I areas are designated as mandatory Federal Class I areas that are managed by either the National Parks Service (NPS) or the Forest Service (FS). Class I areas within outside of Minnesota may also need to be considered, these includes areas in Wisconsin and Michigan that are managed by either the NPS or the Fish and Wildlife Service (FWS).

	Class I Area	Managing Agency
1.	Voyageurs National Park(VNP)	NPS
2.	Boundary Waters Canoe Area (BWCA)	FS
3.	Isle Royale (IR, MI)	NPS
4.	Rainbow Lake (RL, WI)	FS

Class I SIL Analysis

Applicability

Source applicability is based on a sources proximity to a Class I area, the most current recommendation is that all major sources or major modifications within 300 km of a Class I area should conduct an impact analysis of the affected Class I area(s). FLM and/or the reviewing agency may request that sources beyond 300 km also conduct an impact analysis (NSRWM, 1990).

EPA Preferred Model: CALPUFF

The current regulatory version of the CALPUFF Modeling System includes:

- CALPUFF version 5.8, level 070623
- CALMET version 5.8, level 070623
- CALPOST version 6.221, level 070622

General Steps for Modeling Facility Impacts Against Class I SILs

1. Model Selection
2. Model Setup and Run
3. Review Results and Determine need for a Cumulative Increment Analysis

1. **Model Selection:** CALPUFF/CALMET modeling system is the EPA preferred model for far-field air dispersion modeling. Facilities should use EPA preferred model when conducting and Impact Analysis of Minnesota Class I Areas. However, when a facility is within 50K of a Class I area it

may be appropriate to us a model designed to estimate near-field impacts when conducting a SIL analysis. In this case the EPA preferred model is AERMOD. It is recommended that facilities discuss with the reviewing agencies, prior to conducting modeling, the best strategy for conducting the Class I SIL Analysis.

2. **Model Setup and Run:**
   a. CALPUFF chemistry option should be turned OFF for Increment modeling.
   b. Receptor Grid (Class I area receptor grids are provided by the NPS and can be found at http://www.nature.nps.gov/air/Maps/Receptors/index.cfm).
      i. The entire Class I receptor grid should be modeled.

         The intent of the PSD program is to track increment, modeling the entire grid accomplishes this. Additionally, this is consistent with the state of the practice.

   NOTE: FLM may request that additional receptors be placed in FLM Class II areas for increment, visibility, and acid deposition modeling.

   c. Met Data: T he most recent and readily available MM5data should be used to generate met data files with grid spacing no less than 4km to ensure proper wind field development.

   NOTE: EPA headquarters has begun processing updated data for MM5.

   d. Terrain and Land Use Data: USGS DEM 90 meter data.
   e. Emissions:
      i. The emissions inventory associated with the facility sources should be modeled for each relevant pollutant and time period.
   f. Source characterization:
      i. Point, volume, area, etc.
3. **Review Modeling Results:**
   a. No Modeled Exceedance of SIL at any Receptor: No further increment modeling analysis may be required – however if FLM believe AQRV will be affected they and/or the reviewing agency may request a cumulative impact analysis (NSRWM, 1990).
   b. Modeled Exceedance of SIL at any Receptor: If there is a SIL exceedance at any receptor in the affected Class I area(s) a cumulative increment modeling analysis should be performed. There are no instances for which only portions of the Class I receptor grid should be used in a modeled impact analysis or cumulative increment analysis. Precedent dictates modeling of the entire Class I Area receptor grid.

Class I Cumulative Increment Modeling Analysis

Facilities should submit a modeling protocol and receive the reviewing agency's approval prior to conducting Class I Cumulative Increment analysis.

All major sources or major modifications within 300 kilometers of a Class I area should conduct an impact analysis of the affected Class I area(s) as described in the SIL analysis section above. Sources within 300 km of Class I areas should be included in the cumulative increment modeling analysis (EPA Memorandum, August, 2009). FLM and/or the reviewing agency may request that sources beyond 300 km also be included in the impact analysis.

EPA Preferred Model: CALPUFF

The current regulatory version of the CALPUFF Modeling System includes:

- CALPUFF version 5.8, level 070623
- CALMET version 5.8, level 070623
- CALPOST version 6.221, level 070622

General Steps for Modeling Cumulative Increment Analysis

Since the CALPUFF model cannot model negative emissions, two model runs are required to obtain increment impacts at Class I receptors. One model run is of the increment expansion emissions and the second model run is of the increment consumption emissions (see next section: Class I Cumulative Increment Inventory Development – Guidance). The final impact analysis is the air concentration at each Class I receptor for every hour of modeled data. Post processing using CALSUM and CALPOST allows the summation of the emissions at each receptor for the specified pollutant and averaging time, the final output grid is the net concentration at each Class I receptor.

1. **Model Selection:** CALPUFF/CALMET modeling system is the EPA preferred model for far-field air dispersion modeling. Facilities should use EPA preferred model when conducting an Impact Analysis of Minnesota Class I Areas.

2. **Model Setup: Use EPA Default Settings:**

    a. Modeling Domain: The modeling protocol should identify the modeling domain, including the domain coordinates, as well as verify that the domain will extend at least 50 km beyond each class I area included in the analysis.

    b. Receptor Grid: Class I area receptor grids are provided by the NPS and can be found at http://www.nature.nps.gov/air/Maps/Receptors/index.cfm.

        i. The entire Class I receptor grid should be modeled, **NOT** just those receptors where SILs were exceeded.

    NOTE: The intent of the PSD program is to track increment, modeling the entire grid accomplishes this. Additionally, use of the entire grid is consistent with the state of the practice.

    c. Met Data: T he most recent and readily available MM5data should be used to generate met data files with grid spacing no less than 4km to ensure proper wind field development.

    NOTE: EPA headquarters has begun processing updated data for MM5.

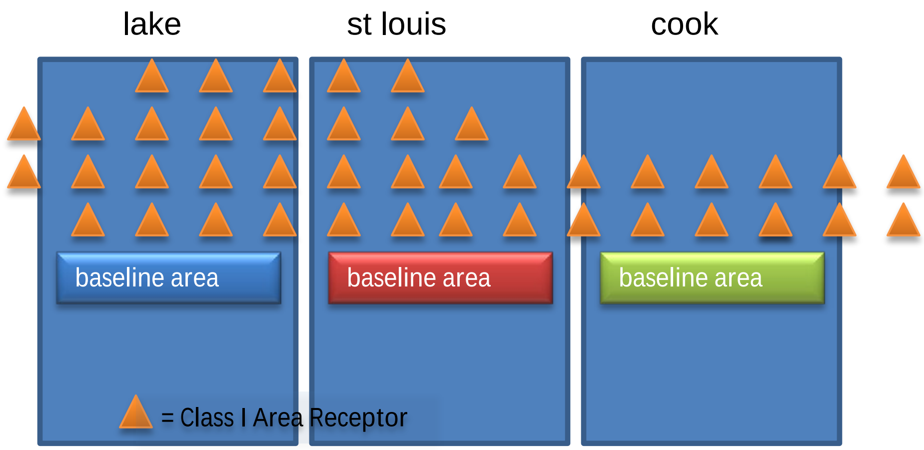
    d. Terrain and Land Use Data: USGS DEM 90 meter data.

3. **Emissions Data:** See next section - Emissions Inventory: Class I Cumulative Increment Inventory Development

4. **Modeling Runs for Multiple Baseline Areas:**

    In Minnesota, sources that may impact the Class I areas, BWCA and VNP, extend across multiple baseline areas (counties). Since a separate inventory is needed for each baseline area (county) or section 107 area (major source baseline areas) for each class I area, pollutant and averaging time, there will be multiple increment expansion and consumption model runs corresponding to a pollutant, its averaging time, and the baseline area inventories. Since CALPUFF cannot model negative emissions, facilities must conduct one model run for the increment expansion emissions and one model run for the increment consumption emissions for each pollutant, averaging time, and baseline area inventory (See Example). CALSUM is used to scale (set negative) the expansion concentrations. CALPOST is used to set CALPUFF output for each receptor for each model run and to sum the impacts at each receptor. *Each model run shown in the Example below is for the entire Class I receptor grid.*

Example:
Class I Area: BWCA
Baseline Areas (Counties): Lake, St. Louis, Cook
Pollutant: SO_2
Averaging period: Annual



Model Runs:
Lake Co. SO2 annual expansion
Lake Co. SO2 annual consumption
St Louis Co. SO2 annual expansion
St Louis Co. SO2 annual consumption
Cook Co. SO2 annual expansion
Cook Co. SO2 annual consumption

Figure 1: Schematic showing current modeling Class I Cumulative Increment for multiple counties with multiple baseline dates.

5. **Post Processing: CALPOST and CALSUM:**
CALPUFF increment expansion and consumption model runs should be post processed using CALSUM and CALPOST. CALSUM is used to scale the impacts of the increment expansion and consumption runs. The scaling factors for increment consuming and increment expanding are +1 and -1 respectively (http://www.src.com/calpuff/FAQ-answers.htm#2.6.1). Then CALPOST is used for summing the net increment consumption at each receptor. The facility should ensure that the files being combined are for identical time periods, have the same number of receptors and all receptors were modeled in the same order in each CALPUFF run (http://www.src.com/calpuff/FAQ-answers.htm#2.6.1).

NOTE: A single CALPUFF run can be used to model impacts for all pollutants and averaging times.

6. **Determine Class I increment impacts**:

Each pollutant and averaging time identified in SIL runs.
   a. Case 1: No increment violation at any Class I area receptor
      i. Modeling is complete

   b. Case 2: Impacts equal to or exceed increment for given pollutant and averaging period.
      i. Refer to reviewing authority's permitting program

7. **Submittals to MPCA, the Reviewing Agency:**
   a. Written report of Modeling Protocol
   b. Summary of emission inventory used and any screening conducted
   c. 1 of each of the following sample input files
      i. CALPUFF
      ii. CALMET
      iii. CALPOST
      iv. POSTUTIL(if applicable)

http://www.cleanairinfo.com/regionalstatelocalmodelingworkshop/archive/2010/Documents/Presentations/NPS-PROTOCOL-for-CLASS-I-CLASS-II.pdf

After Protocol Review and Approval Submit:

   d. Written report of Modeling Results

   e. Modeling Files
      i. CALPUFF
      ii. CALPOST
      iii. CALSUM
      iv. POSTUTIL (if applicable)
      v. Met
      vi. Terrain

References:

1. New Source Review Workshop Manual, Prevention of Significant Deterioration and Nonattainment Area Permitting, 1990. http://www.epa.gov/ttn/nsr/gen/wkshpman.pdf
2. Federal Land Manager's Air Quality Related Values Work Group (FLAG): Phase I Report – Revised 2010. Natural Resource Report NPS/NRPC/NRR—2010/232. http://www.nature.nps.gov/air/Pubs/pdf/flag/FLAG_2010.pdf
3. EPA, OAQPS Memorandum, Clarification of EPA-FLM Recommended Settings for CALMET. August 31, 2009. http://www.epa.gov/ttn/scram/CALMET%20CLARIFICATION.pdf
4. EPA Regional/State/Local Dispersion Modelers Workshop. June 10-12, 2008, Denver (Englewood), CO. http://www.cleanairinfo.com/regionalstatelocalmodelingworkshop/archive/2008/index.htm
5. 9th Modeling Conference, October 9, 2008. http://www.epa.gov/ttn/scram/9thmodconfpres.htm http://www.epa.gov/ttn/scram/9thmodconf/calpuff_status9mc.pdf

Emission Inventory

Class I Cumulative Increment Inventory Development – Guidance

1. Model the proposed facility/modification emissions to determine impacts at Class I receptors.
2. Develop a cumulative increment emissions inventory for any pollutant that exceeds the applicable Class I significant impact level (SIL).
3. The cumulative inventory is based on emission changes since the applicable baseline date for the Section 107 area (county) where the receptor is located that experienced impacts above the SIL. Emission changes are expressed in pound per hour (lb/hr) for the applicable SIL averaging period, and then converted to gram/second (g/s) emission rates for modeling. The lb/hr rates are determined by determining the annual average ton-per-year (tpy) emissions for the most recent two-year period, and subtracting the annual average tpy emissions for the two-year period immediately preceding the applicable baseline date for the pollutant. The tpy emissions are converted to lb/hr emissions using annual equivalent operating hours at 100 percent capacity.
4. Separate inventories unique to each pollutant and applicable baseline date will need to be developed and modeled.

<u>Example</u>

A new source is proposed to be constructed in Carlton County, Minnesota. Modeling of the proposed source's allowable emissions indicates exceedance of the SO_2 SIL at receptors in the Boundary Waters Canoe Area (BWCA) Class I areas in St Louis, Lake, and Cook Counties, and exceedance of the PM_{10} SIL at receptors in the BWCA Class I areas in St Louis and Lake Counties.

The applicable baseline dates for these counties and pollutants are shown below:

County	SO_2 Baseline Date	PM_{10} Baseline Date
St Louis	1986 (MiSBD)	1979 (MiSBD)
Lake	1992 (MiSBD)	1999 (MiSBD)
Cook	1975 (MaSBD)	1975 (MaSBD)

Three separate SO_2 increment inventories will need to be prepared (one inventory for each unique county SO_2 baseline date). In addition, two separate PM_{10} increment inventories will need to be prepared (one inventory for each unique county PM_{10} baseline date).

An SO_2 increment inventory would be prepared for St Louis County based on its 1986 SO_2 minor source baseline date (MiSBD), another SO_2 increment inventory prepared for Lake County based on its 1992 SO_2 MiSBD, and a third SO_2 increment inventory would be prepared for Cook County based on it 1975 SO_2 major source baseline date (MaSBD). The same approach would be taken for PM_{10} inventories for St Louis and Lake Counties.

Each inventory for a county where the MiSBD has been triggered (St Louis and Lake) will in general, include sources within 300 km of the Class I area (BWCA) where the SIL was exceeded. Actual emission changes of the specific pollutant at any stationary or mobile source since the applicable MiSBD, along with actual emission changes at major sources since the MaSBD due to a physical change (i.e. construction) or a change in the method of operation, are used to determine the increment emissions for each source in the county inventory.

The inventory for the county where the MaSBD is in effect (Cook County) is composed of emission changes since the 1975 SO_2 MaSBD. However, unlike for St Louis and Lake Counties, the Cook County SO_2 emission increment inventory is composed only of actual emission increases at major sources due to a physical change (i.e. construction) or a change in the method of operation, and, actual emission decreases at major sources due to a physical change (i.e. construction) or change in the method of operation providing those decreases are federally enforceable in a permit or State Implementation Plan. The inventory also is composed only of this set of major sources generally within 300 km of the BWCA.

NOTE: Contact the MPCA Permitting Unit or the project permit engineer for information regarding emission inventory submittals.

References:

1. October 1990 New Source Review Workshop Manual, Chapter C Air Quality Analysis
2. April 5, 1999 EPA memorandum 'Request To Clarify Prevention of Significant Deterioration (PSD) Baseline Area and Corresponding Baseline Date for Breton National Wildlife and Wilderness Area' from Bill Harnett to Robert E. Hannesschlager and Winston E. Smith (attached).
3. April 2006 Federal Land Manager 'Class I Cumulative Increment Inventory: Guidance for determining the increment-consuming/expanding sources to include in the PSD analysis.'(attached).
4. April 18, 2008 EPA memorandum 'Issues Regarding Class I Increment Analysis Inventories.' (attached).

breton 5.wpd

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
RESEARCH TRIANGLE PARK, NC 27711

April 5, 1999

OFFICE OF
AIR QUALITY PLANNING
AND STANDARDS

MEMORANDUM

SUBJECT: Request to Clarify Prevention of Significant Deterioration (PSD) Baseline Area and Corresponding Baseline Date for Breton National Wildlife Refuge and Wilderness Area

FROM: Bill Harnett, Acting Director William Harnett
Information Transfer & Program Integration Division (MD-12)

TO: Robert E. Hannesschlager, P.E., Acting Director
Multimedia Planning and Permitting Division (6PD)

Winston E. Smith, Director
Air Pesticides & Toxics Management Division (4-APTMD)

This responds to your memorandum to John Seitz, dated May 4, 1998. You requested guidance for establishing an inventory of sources to assess the air quality impacts at Breton National Wildlife Refuge and Wilderness Area (Breton)--a Class I area under the Prevention of Significant Deterioration (PSD) program. In particular, you presented three questions establishing the needed inventory and then offered two possible approaches for responding to the questions. Your staff and mine have discussed these questions, and we gave preliminary responses to participants of the Breton air quality study at the meeting in Biloxi, Mississippi on January 21, 1999. Participants of the meeting included representatives from EPA Regions IV and VI; the Minerals Management Service; Fish and Wildlife Service; the States of Alabama, Louisiana and Mississippi; and several onshore and offshore industries.

Some participants recently requested an official written response from EPA to clarify the PSD policy for carrying out the Breton air quality study. This memorandum provides EPA's position concerning the appropriate policy for determining the amount of PSD increment currently being consumed at Breton by sources in the adjoining States and by sources offshore. Our policy is most like the approach which you provided as Alternative 2 in your May 4, 1998 memorandum.

<u>Question 1</u>: How do we develop a PSD emission source inventory (or conversely, a baseline source inventory) developed for Class I areas with an impact region encompassing many States?

<u>Response</u>: In a baseline source inventory, you (the study group) should include information about any source whose emissions are determined to affect the increment in the area of concern.

Sources whose emissions affect the increment fall into one of two categories:

- Major stationary sources whose emissions increased or decreased as a result of construction occurring after the major source baseline date; and
- Any source (stationary source, area source, mobile source) whose emissions increased or decreased on or after the minor source baseline date.

For Breton, the major and minor source baseline dates are these:

- The major source baseline date is fixed by regulation for each applicable pollutant (January 6, 1975 for particulate matter and SO_2 and February 8, 1988 for NO_x).

- The minor source baseline date may vary from one area to another. So do two things:

-- First identify the applicable baseline area. From the information in your earlier communications, Breton is in the Southern Lousiana-Southeast Texas Interstate Air Quality Control Region (AQCR).

-- Then determine whether such an area already has a minor source baseline date. Again, from the information in your earlier communications, the minor source baseline dates for the Louisiana portion of the AQCR are August 1977 for particulate matter and SO_2, and February 1988 for NO_x. As explained in our response to question 2, the minor source baseline dates associated with other nearby States are irrelevant to the increment analysis at Breton.

For a typical increment analysis, most of the sources affecting the increment normally would be located in the baseline area associated with the applicable minor source baseline date, and only a few would be located outside that baseline area. However, because of Breton's unique location, many sources whose emissions could consume its increment might be outside Breton's baseline area. You've chosen an acceptable way to identify those emissions by including sources located, at a minimum, within a radius of 100 kilometers of Breton. Adjust this approach as necessary. For example:

- Inside the 100-kilometer radius, you needn't include small sources with only trivial impacts.

- Outside the 100-kilometer radius, you should screen very large sources for the potential impacts of their emissions and for possible inclusion in the inventory.

<u>Question 2</u>: Because baseline areas are limited to intrastate regions, how do emissions from sources in one State affect the increments in another State when the States have different minor source baseline dates?

<u>Response</u>: When you calculate the amount of increment consumed in a particular baseline area, only the minor source baseline date applicable to that baseline area is relevant. Baseline areas are limited to intrastate regions because of an EPA policy that prevents emissions from a source in one State from triggering the minor source baseline date (and establish the baseline area) in another State. See 45 FR at 52716, August 7, 1980. However, once the minor source baseline date and corresponding baseline area are established in any portion of a State, EPA believes that any change in air quality occurring in such area should affect the PSD increments for the area, regardless of the location of any source contributing to the change. This is consistent with Congress' intent that the maximum allowable increase in pollutant concentration (increment) in a baseline area generally be measured against the area's change in air quality which occurs following the establishment of its minor source baseline date. See statutory definition of "baseline concentration" at section 169(4) of title I of the Clean Air Act.

Clearly, sources located outside the affected baseline area may contribute to a change in air quality within the affected baseline area. For emissions changes from such sources to affect the increment in the same way as emissions generated inside the affected baseline area, it is necessary to relate those changes to the area's minor source baseline date. Thus, as explained in our response to question 1, the only minor source baseline date relevant to increment consumption at Breton is the minor source baseline date established for the baseline area associated with Breton.

Question #3: Should the PSD inventory include Outer Continental Shelf (OCS) sources?

Response: Yes, EPA's position is that the PSD inventory should include OCS sources, where appropriate. Congress, in declaring its purpose for the PSD provisions in section 160 of the Act, addressed the potential for increased air pollution without distinguishing between the types of air pollution sources. EPA's longstanding policy has been that baseline concentrations reflect actual air quality in an area and that any emissions not included in the baseline count against the increment.

Congress did identify certain circumstances (some permanent, others temporary) for which States could decide to exclude certain emissions from the increment-consumption process, but emissions from offshore sources was not among those exclusions. In 1990, Congress explicitly addressed the potential for air quality problems resulting from offshore sources by adding section 328 of the Clean Air Act. New section 328 sought to protect Federal and State ambient air quality standards, ensure compliance with the PSD requirements, and spread the burden of achieving these goals more equitably between onshore and OCS sources.

In 1992, EPA issued regulations at 40 CFR part 55 to implement the section 328 requirements. The EPA believes that emissions from OCS sources may affect increments whether or not an OCS source itself is subject to 40 CFR part 55. However, the only emission increases at OCS sources that count against the increments at Breton are those increases which occur after Breton's minor source baseline date. Also, emission reductions at OCS sources will expand the amount of available increment at Breton when the reductions improve the air quality at Breton after its minor source baseline date.

I hope that this information helps the Breton air quality study group to determine the air quality impacts causing Breton's PSD increment to be consumed. If more questions come up, please contact Dan deRoeck at 919/541-5593, or E-mail at deroeck.dan@epamail.epa.gov.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
RESEARCH TRIANGLE PARK, NC 27711

APR 18 2008

OFFICE OF
AIR QUALITY PLANNING
AND STANDARDS

MEMORANDUM

SUBJECT: Issues Regarding Class I Increment Analysis Inventories

FROM: Dennis Atkinson, Meteorologist
Model Clearinghouse Director, C439-01

TO: Jeff Robinson, Chief
Air Permits Section (6PD-R)

THRU: Tyler Fox, Leader
Air Quality Modeling Group, C439-01

INTRODUCTION

In response to your memo of April 18, 2008, the Model Clearinghouse has reviewed your proposed resolution of the issues presented, in order to properly and adequately account for cumulative impacts of emissions from all increment affecting sources in the Class I increment analysis associated with the proposed Prevention of Significant Deterioration (PSD) permit for AEP SWEPCO John W. Turk, Jr. power plant in Hempstead, AR. Recognizing the difficulty of the situation presented by the applicant's exclusion of a significant number of increment affecting sources from the original dispersion modeling analysis, we concur with your assessment of the key technical and guidance issues raised and with the general approach presented in your submittal in addressing this application.

BACKGROUND

The original Class I increment analysis submitted by AEP SWEPCO indicated numerous increment exceedances for 24-hour SO_2 at the Caney Creek Class I Wilderness Area, but the proposed source was less than the EPA proposed Class I significant impact level (SIL) for SO_2 on the high, second high (H2H) days at each violating receptor. EPA Region 6 commented in July 2007 and again in April 2008 that the applicant had inappropriately excluded increment-contributing sources. As a result of this exclusion, the modeled impacts from the original increment inventory did not provide sufficient information to conclude that the applicant did not cause or contribute to exceedances of the SO_2 increment in Caney Creek already identified in their previous modeling submittal, or potential exceedances that may occur on additional days due to cumulative impacts from excluded sources.

After reviewing the increment inventory data files provided by the applicant, it was apparent that the applicant had eliminated several hundred sources from Arkansas, Louisiana, Oklahoma, and Texas. Subsequent discussions with the applicant revealed that they had used an emissions over distance (Q/D) approach to eliminate increment consuming sources from their final modeled inventory (a Q/D value of less than 20 was used as a threshold to exclude sources, with Q in TPY and D in kilometers). Cursory review of the emissions total of the sources eliminated from the original modeled inventory indicated that a majority of the emissions reside in the same general area upwind of the Class I area as the source currently under permit review. Since there were a number of additional modeled impacts that were within 5%-10% of the 24-hour SO_2 increment level, Region 6 expressed a concern regarding the potential that the applicant could contribute significantly to additional increment exceedance periods that would not have been identified due to the elimination of those sources from the increment inventory. Based on these concerns, Region 6 requested that the applicant resubmit the Class I increment modeling including all increment affecting sources, pursuant to Section 7.2.1(a) of 40 CFR Part 51, Appendix W, hereafter referred to as the *Guideline on Air Quality Models* (or *Guideline*). In response to the request from Region 6 to include all increment-contributing sources, the applicant proposed the use of an alternative approach to identify sources to be eliminated from the additional modeled increment inventory.

CLARIFICATION OF RELEVANT GUIDANCE

We concur with your assessment that the key issue of concern in this case is the requirement, clearly stated in Section 7.2.1.1(a) of the *Guideline*, to include impacts from all increment-contributing sources in an analysis of impacts on PSD increments. The full text of the relevant paragraph is quoted here for reference:

> "7.2.1.1 Design Concentrations for SO_2, PM– 10, CO, Pb, and NO_2
>
> a. An air quality analysis for SO_2, PM–10, CO, Pb, and NO_2 is required to determine if the source will (1) cause a violation of the NAAQS, or (2) cause or contribute to air quality deterioration greater than the specified allowable PSD increment. For the former, background concentration (subsection 8.2) should be added to the estimated impact of the source to determine the design concentration. **For the latter, the design concentration includes impact from all increment consuming sources.**" [emphasis added]

This paragraph makes a clear distinction between the requirements of air quality analyses for compliance with the NAAQS as opposed to PSD increments. For NAAQS compliance modeling, a further distinction is made between estimated impacts from the source under review and background concentrations which need to be added to the source's impact for comparison to the NAAQS. Reference is made to Section 8.2 for further guidance regarding the estimation of background concentration. Table 8.2 in Section 8.1 addresses the emission input requirements for NAAQS compliance demonstrations, and distinguishes between the proposed source, "nearby source(s)", and "other source(s)". A footnote to Table 8.2 indicates that impacts from the latter category can often be represented by an appropriate determination of the "background concentration" from an analysis of monitored ambient air quality data. Section 8.2.3(b) provides the following criterion for determination of which sources to include in a NAAQS modeling analysis:

> "8.2.3 Recommendations (Multi-Source Areas)
>
> b. Nearby Sources: All sources expected to cause a significant concentration gradient in the vicinity of the source or sources under consideration for emission limit(s) should be explicitly modeled."

Our purpose in citing the sections of the *Guideline* related to requirements for NAAQS compliance demonstrations is to emphasize the clear distinction between the requirements for the emissions inventory needed for NAAQS compliance as opposed to PSD increment compliance. Procedures that may be applicable to determining which sources need to be explicitly modeled for NAAQS compliance <u>cannot</u> be applied for PSD increment compliance inventories. There is nothing comparable to the "monitored background" component typically included in a NAAQS demonstration for PSD analyses, and no technical or regulatory basis for "screening out" or otherwise excluding impacts from increment affecting sources from a cumulative (net) increment analysis.

As noted in your submittal, we also recognize the potential computational challenge of modeling a very large number of sources that may be identified as increment affecting sources, especially across a large domain that may be required for demonstrating compliance with the increments for a distance Class I area using the CALPUFF modeling system. In such situations, we believe it is appropriate and consistent with the *Guideline* to utilize a combination of screening and refined modeling techniques as a more efficient method to estimate the cumulative contribution to increment than to include all sources in the refined modeling analysis. Section 4.2.1.1(a) of the *Guideline* states that *"Where a preliminary or conservative estimate is desired, point source screening techniques are an acceptable approach to air quality analyses."* Section 4.2.1.1(b) further stipulates that *"Agreement should be reached between the model user and the appropriate reviewing authority on the choice of the screening model for each analysis, and on the input data as well as the ultimate use of the results."*

MODEL CLEARINGHOUSE RECOMMENDATION

As stated in the Introduction, we concur with your assessment of the key technical and guidance issues raised and with the general approach presented in your submittal to address this application. Although the exclusion of a significant number of sources from the original increment modeling analysis does not conform with the *Guideline* and presents a difficult situation to resolve, we agree that a reasonable and technically sound approach to provide additional assurance that the proposed source will not contribute significantly to potential PSD increment violations is feasible and can be justified for this specific case based on the information available. The most direct option to resolve the issue, which would not require any further justification by the applicant or review by the Clearinghouse, would be to perform additional refined modeling of the increment-consuming sources excluded from the original analysis to complete the impact assessment. Short of that more direct approach to resolve the issue, some mix of refined and screening-level estimates is the only alternative, provided that an acceptable level of justification and assurance can be given that the final assessment will be protective of air quality levels.

The *Guideline* references several existing screening techniques, for both simple and complex terrain applications. However, the use of an emission/distance ratio (Q/D) as a screening technique is not addressed in the *Guideline*, and we will not address its use as a screening technique in a generic sense with this response. Our review and concurrence with your proposal merely acknowledges that use of a Q/D threshold as a tool to identify which sources to explicitly account for in the refined modeling vs. sources to be accounted for in an aggregate sense, based on the inclusion of pseudo-sources within the refined modeling, is technically reasonable given the specific circumstances of this case.

We concur with your conclusions, based on an analysis of backward trajectories to determine air mass histories on days that exceeded, that the focus for including impacts from additional sources beyond 50 km from the Class I area can be limited to the 90º sector focused on transport from the south, including the proposed facility. We see no benefit to further supplementing the inventory for sources beyond 50 km from the Class I area and outside the 90º sector. However, we also want to emphasize that such a determination could not have been made *a priori*, and can only be justified in this specific case based on the information available from the original incomplete modeling analysis.

This concurrence by the Model Clearinghouse is limited solely to this application. If you have any further questions or comments, please contact Dennis Atkinson at (919) 541-0518 or Tyler Fox at (919) 541-5562.

cc: Roger Brode, C439-01
Mark Evangelista, C439-01
Tyler Fox, C439-01
Bill Harnett, C504-01
Michael Ling, C504-01
Raj Rao, C504-03
Richard Wayland, C304-02
Regional Modeling Contacts

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 6
1445 ROSS AVENUE, SUITE 1200
DALLAS, TX 75202-2733

APR 1 8 2008

MEMORANDUM

SUBJECT: Proposed Screening Technique for Class I Increment Analysis

FROM: Adina Wiley, Environmental Engineer (6PD-R)

Erik Snyder, Lead Regional Modeler (6PD-L)

Jeff Robinson, Chief
Air Permits Section (6PD-R)

TO: Dennis Atkinson, Model Clearinghouse Coordinator
Air Quality Modeling Group

This memo seeks your concurrence with Region 6's intent to accept a screening technique (with the inclusion of emissions from screened-out sources included in the modeling as a few pseudo sources) for the Class I increment analysis associated specifically with the proposed Prevention of Significant Deterioration (PSD) permit for AEP SWEPCO John W. Turk, Jr. power plant in Hempstead, AR. This screening technique will be used to augment the existing modeled Class I increment inventory submitted in January 2007.

BACKGROUND

The original Class I increment analysis submitted by AEP SWEPCO indicated numerous increment exceedances for 24-hour SO_2 at the Caney Creek Class I Wilderness Area, but the proposed source was less than the EPA proposed Class I significant impact level (SIL) for SO_2 on the high, second high (H2H) day at each violating receptor. EPA Region 6 commented in April 2007 and again in July 2007 that the applicant had inappropriately excluded increment-contributing sources and that the modeled impacts from the original increment inventory did not provide sufficient information to conclude that the applicant did not cause or contribute to exceedances of the SO_2 increment in Caney Creek already identified in their previous modeling submittal, or potential exceedances on additional days due to cumulative impacts from excluded sources. Our regulatory interpretation is that removal of increment consuming sources without consideration of their potential contribution to an increment impact analysis is prohibited under Section 7.2.1.1(a) of 40 CFR Part 51, Appendix W (*Guideline on Air Quality Models ("Guideline")*).

To develop a more comprehensive understanding of the modeled increment exceedances in Caney Creek, we conducted an air mass history analysis of the CALPUFF modeling results for days when the modeled SO_2 levels were within 10% and greater of the 24-hour SO_2 increment. Using NOAA's HYSPLIT model, backward trajectories relative to the Caney Creek Class I area were run four times a day for all days at or above 90% of the 24-hour SO_2 increment. Air mass history maps were generated using a computer program developed by EPA Region 7. The maps indicate the probability of an air mass passing over a particular region prior to arrival. Used in this context, the air mass history maps provide an indication of potential source regions on days when the modeled SO_2 increment is near or exceeds allowable levels. The air mass history maps indicate two significant areas of potential influence on the high days in Caney Creek. The area of highest probability extends predominantly south from Caney Creek towards eastern Texas and Western Louisiana. This area is in the same general area as the proposed AEP source upwind of the Class I area. Previous PSD modeling for the Western Farmers Hugo Unit 2 in Oklahoma also identified this area as an area of concern for days near or above the 24-hour SO_2 increment, reinforcing the necessity to adequately capture potential increment impacts from sources that lie within that region.

After reviewing the increment inventory data files provided by the applicant, it was apparent that the applicant had eliminated several hundred sources from Arkansas, Louisiana, Oklahoma, and Texas. Subsequent discussions with the applicant revealed that they had used an emissions over distance (Q/D) approach to eliminate increment consuming sources from their final modeled inventory (a Q/D value of less than 20 was used as a threshold to exclude sources, with Q in tons per year (TPY) and D in kilometers). We were aware of additional large SO_2 sources that should have been included in the modeled inventory. These sources are in the same upwind air mass as the proposed source. Cursory review of the emissions total of the sources eliminated from the original modeled inventory indicates that a majority of the emissions reside in the same general area upwind of the Class I area as the source currently under permit review. Since there were a number of additional modeled impacts that were within 5%-10% of the 24-hour SO_2 increment level, we believed that this created the potential that the applicant could contribute significantly to additional increment exceedance periods that would not have been identified due to the elimination of those sources from the increment inventory. We requested that the applicant resubmit the Class I increment modeling including all sources, pursuant to Appendix W, section 7.2.1.1(a).

In response to our request to include all increment-contributing sources, the applicant proposed the use of an alternative approach to identify sources to be eliminated from the modeled increment inventory. We continue to believe that it is inappropriate to use screening techniques to eliminate sources from the modeled increment inventory. However, we also recognize the unique computational challenge this may create with explicitly modeling several hundred sources for the three simulation years using the CALPUFF modeling system. Therefore, while we continue to believe it inappropriate to eliminate sources from the model increment inventory, we believe that screening techniques can be used in this case to provide a preliminary and conservative estimate of the impact of more distant sources in a cumulative increment analysis without the necessity of explicit characterization of such sources in a refined modeling application.

EPA Region 6 Evaluation

The most correct method from both a technical and regulatory perspective should have been to include impacts from all increment affecting sources (both consuming and expanding sources), rather than using screening techniques to eliminate the impacts of some sources from an inventory. However, recognizing the potential computational challenge of modeling several hundreds sources for three simulation years with the CALPUFF modeling system, we believe it should be possible to utilize a combination of screening and refined modeling techniques to estimate the cumulative contribution to increment. Exceedances of the 24-hour SO_2 increment have already been identified by previous modeling; therefore, EPA Region 6 seeks to implement a method to account for the potential impacts of increment consuming sources, but to focus the inclusion of the additional increment affecting sources to areas that our analysis indicates a higher potential for cumulative impact with the current source under review.

Region 6 evaluated the following options:

1. An emissions over distance (Q/D) screening methodology developed by the United States Forest Service (USFS) and National Park Service (NPS). According to applicant, the USFS/NPS screening methodology has been used in PSD permitting actions in EPA Regions 3 and 9. In the FLM screening methodology, the source emission rate is divided by the distance to the Class I area. If the ratio is greater than 0.8 for SO_2, then the source is included in the cumulative increment analysis.

2. A Chi-Over-Q technique developed by the applicant using the existing increment inventory to establish a basis for determining impact from non-modeled sources. Chi, the predicted concentration for the existing source, is divided by the emission rate Q for the existing source. This analysis is completed for all sources in the inventory; 69 sources in this instance. The χ/Q values are then plotted as a function of distance from Caney Creek and best-fit linear and power law equations are generated. These equations can be used to estimate the emission rates that generate an impact above the proposed Class I SIL for 24-hour SO_2.

3. All major and minor sources within a 50 km radius of the Class I area would be included if facility emissions were greater than 2 lb/hr. Outside of the 50 km radius, a 90° degree sector can be established to bracket the geographic area identified in our

air mass history analysis. All identified sources within the area encompassed by the 90° sector would then be added into the existing increment inventory for further analysis when the facility (all sources at one facility) exceeded a 2 lb/hr emission level. The proposed AEP facility is located near the middle of this sector, so this analysis would likely assess if the proposed source could significantly contribute to an increment violation.

SUMMARY OF ISSUE AND PROPOSED RESOLUTION

Region 6 recognizes that Appendix W requires all increment consuming and expanding sources be included in an increment analysis. The proposed approach is a tiered process related to distance and wind sector that will be used in addition to the existing SO_2 increment inventory of 44 sources. The focus will be to augment the inventory with emissions for additional sources with a greater probability of contributing to a cumulative impact with the current source under review.

Region 6 proposes that all sources within a 50 km radius of the Class I area, regardless of size, are to be explicitly modeled (including one large minor source 57 km north of the Class I area). Explicitly modeling all sources within 50 km accounts for the potential influence of recirculating wind patterns on cumulative impacts.

Outside of the 50 km radius, but within the 90-degree sector (centered south of the Class I area), a Q/D threshold of 0.8 will be used to identify the additional sources on a facility-wide basis that will be explicitly modeled (with Q expressed in TPY and D in km). The total facility SO_2 emission rate will be used in the Q/D analysis; facilities with a Q/D ratio greater than 0.8 will be explicitly modeled. Facilities less than or equal to 0.8 will be grouped and modeled as pseudo-point source(s) to generate a conservative screening-level estimate. The pseudo-point source location(s) will be determined after examining the locations and characteristics of the facilities below the Q/D threshold. Sources below the threshold will be grouped first based on their location from the Class I area; initial groups will be based on discrete distance bands from the Class I area. Within these distance bands, the pseudo source characteristics will be determined from the facility-wide SO_2 emission rates from the screened sources. A facility-wide SO_2 emission rate of 40 TPY or less will characterized as a low-level (height above ground) source; an emission rate of 40-250 TPY SO_2 will be a mid-level source; and an emission rate greater than 250 TPY will be a high-level source.

Once the additional sources are included in the increment inventory as described above, either explicitly or as pseudo-sources, the permit applicant will need to reassess increment consumption at the Caney Creek Class I Wilderness Area. For each predicted increment violation, the applicant must demonstrate that the proposed source is below the proposed 24-hour SO_2 Class I significant impact level for the permitting process to proceed.

Requested Action Items:

Please review our interpretation of Section 7.2.2.1 (a) of the *Guideline* as it relates to this project. Please also clarify if our proposed procedures are technically justified and consistent with guidance.

Region 6 believes that the 90-degree sector analysis as described above is the most technically defensible compromise option in this situation as it is most consistent with Appendix W requirements to account for impacts from all sources, but will target the additional modeling effort on the area of potential contribution of the proposed source, which also coincides with the main area of concern identified by the previous Hugo, OK Class I analysis.

Please call either Erik Snyder at 214-665-7305 or Adina Wiley at 214-665-2115 if you have any questions or need further information on this issue.

cc: Tyler Fox, OAQPS AQMG

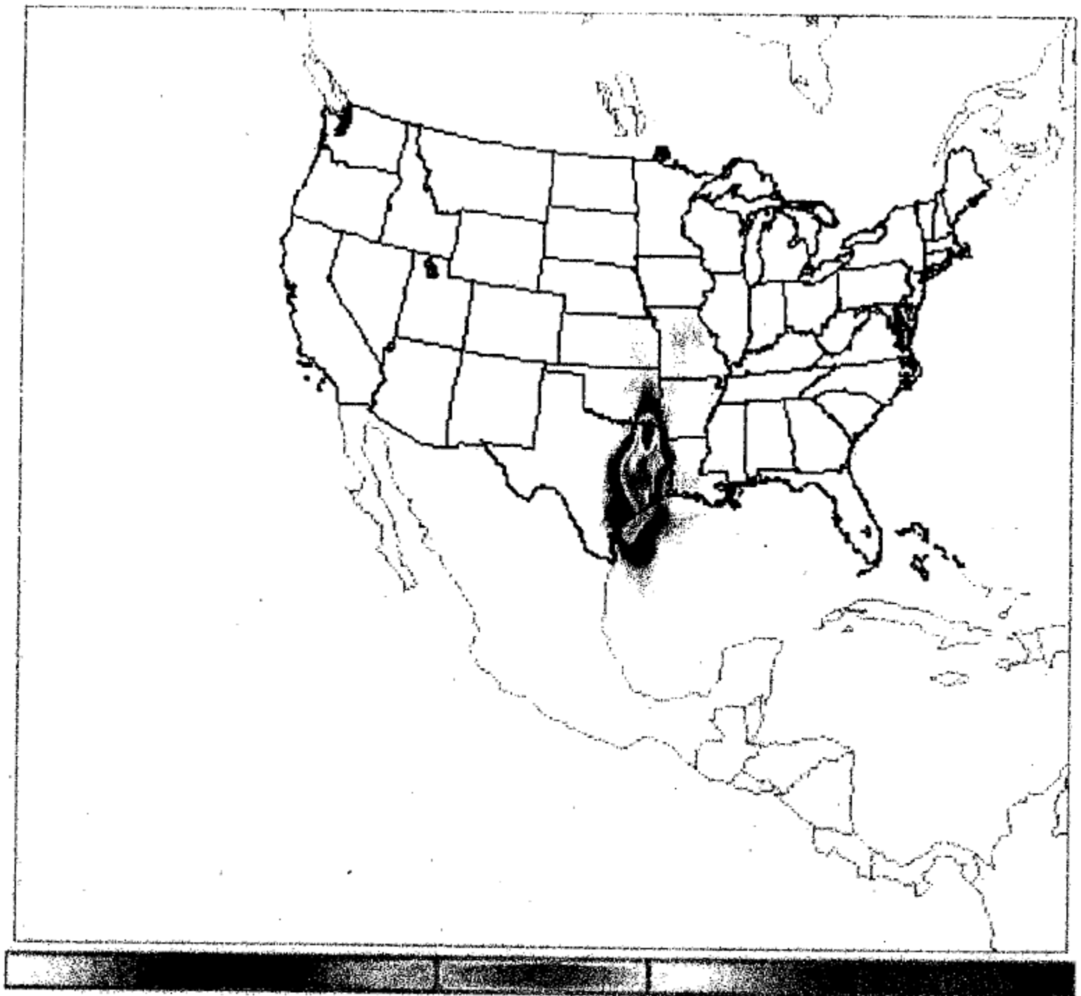


Figure 1 - 48-hour air mass history map for Caney Creek Wilderness Area during periods when modeled SO_2 is greater than or equal to 90% of the 24-hour SO_2 increments. Due to map projection differences, the air mass history is shifted to the West compared to the actual location of the Caney Creek Wilderness.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
RESEARCH TRIANGLE PARK, NC 27711

OCT 01 2008

OFFICE OF
AIR QUALITY PLANNING
AND STANDARDS

MEMORANDUM

SUBJECT: Clarification of Region 6 Clearinghouse Request on "Proposed Screening Technique for Class I Increment Analysis"

FROM: Richard A. Wayland, Director
Air Quality Assessment Division (C304-02)

TO: Jeff Robinson, Chief
Air Permits Section (6PD-R)

The purpose of this memorandum is to provide clarification on language in the April 18, 2008 memo from Region 6 to our Model Clearinghouse for concurrence on their proposed screening techniques for Class I increment analysis. Based on review of the Region 6 memo by EPA's Office of General Council (OGC), it is necessary to provide these clarifications to be consistent with guidance in EPA's *Guideline on Air Quality Models* ("*Guideline*"), published as Appendix W to 40 CFR Part 51, and current interpretation of that guidance by OGC. We are therefore providing the language changes outlined below to the Region 6 memo to ensure this consistency with the Guideline.

The first clarification relates to the characterization by Region 6 of requirements under the Guideline contained in the first paragraph of their "Background" section, i.e.,

> "Our regulatory interpretation is that removal of increment consuming sources without consideration of their potential contribution to an increment impact analysis is prohibited under Section 7.2.1.1(a) of 40 CFR Part 51, Appendix W (*Guideline on Air Quality Models* ("*Guideline*"))."

The review by OGC necessitates the following language change:

> "Our understanding is that removal of sources in the affected areas from an emissions inventory without consideration of their potential contribution to an increment impact analysis is inappropriate under Section 7.2.1.1(a) of 40 CFR Part 51, Appendix W (*Guideline on Air Quality Models* ("Guideline")). This provision establishes the objective to include the impact of all increment consuming sources in the design concentration."

The second clarification relates to the fourth paragraph of their "Background" section, i.e.,

> "In response to our request to include all increment-contributing sources, the applicant proposed the use of an alternative approach to identify sources to be eliminated from the modeled increment inventory. We continue to believe that it is in appropriate to use screening techniques to eliminate sources from the modeled increment inventory. However, we also recognize the unique computational challenge this may create with modeling several hundred sources for the three simulation years using the CALPUFF modeling system. Therefore, while we continue to believe it inappropriate to eliminate sources from the model increment inventory, we believe that screening techniques can be used to provide a preliminary and conservative estimate of the impact of more distant sources in a cumulative increment analysis without the necessity of explicit characterization of such sources in a refined modeling application."

The review by OGC necessitates the following language change:

> "In response to our request to include all increment-contributing sources, the applicant proposed the use of an alternative approach to identify sources to be eliminated from the modeled increment inventory. We generally believe that it is inappropriate to use screening techniques to eliminate sources from the modeled increment inventory. However, we also recognize the unique computational challenge this may create with modeling several hundred sources for the three simulation years using the CALPUFF modeling system. Therefore, we believe that screening techniques can be used to provide a preliminary and conservative estimate of the impact of more distant sources in a cumulative increment analysis without the necessity of explicit characterization of such sources in a refined modeling application."

The third, and final, clarification relates to the first paragraph of their "EPA Region 6 Evaluation" section, i.e.,

> "The most correct method from both a technical and regulatory perspective should have been to include impacts from all increment affecting sources (both consuming and expanding sources), rather than using screening techniques to eliminate the impacts of some sources from an inventory. However, recognizing the potential computational challenge of modeling several hundreds sources for three simulation years with the CALPUFF modeling system, we believe it should be possible to utilize a combination of screening and refined modeling techniques to estimate the cumulative contribution to increment. Exceedances of the 24-hour SO_2 increment have already been identified by previous modeling; therefore, EPA Region 6 seeks to implement a method to account for the potential impacts of increment consuming sources, but to focus the inclusion of the additional increment affecting sources to areas that our analysis indicates a higher potential for cumulative impact with the current source under review."

The review by OGC necessitates the following language change:

> "The preferred method from both a technical and regulatory perspective is to include emissions from all sources in the affected area (both increases and decreases) rather than using screening techniques to eliminate the emissions of some sources from an inventory. However, recognizing the potential computational challenge of modeling several hundred sources for three simulation years with the CALPUFF modeling system, we believe it is possible to utilize a combination of screening and refined modeling techniques to estimate the cumulative contribution to increment from all sources in the area. Exceedances of the 24-hour SO_2 increment have already been identified by previous modeling; therefore, EPA Region 6 seeks to implement a method to account for the potential impacts of all sources in the area, but to focus the explicit characterization of source emissions to areas where our analysis indicates a higher potential for cumulative impact with the current source under review."

This memorandum will be added to the Model Clearinghouse record along with the original request memo from Region 6 and the OAQPS model clearinghouse response memo.

cc: Bill Harnett
Tyler Fox
Raj Rao
Michael Ling
Roger Brode

Permit Determinations

- Please Contact MPCA Permitting Program
    - Minnesota Pollution Control Agency 651-296-6300, 800-657-3864

Appendix C
MPCA

Working with Intermittent Emissions from Internal Combustion Engines by Facilities Participating in Economic Demand Response (EDR) Programs:

Correlating Peak-Shaving and Temperature Humidity Index (THI)

Daniel Dix and Jim Sullivan
6/10/2015

Introduction

A growing trend in the electrical energy industry is the increasing use of demand response, otherwise known as (Emergency) or Economic Demand Response (EDR). This approach comprises a number of programs across the nation including the state of Minnesota. EDR is designed to reduce load on the complex electrical grid that powers residential consumers. A variety of methods are implemented during EDR such as energy efficient techniques and practices, load shifting from peak usage hours, and/or load shedding by use of on-site electrical generation. These programs offer financial incentives for participants from industrial, commercial, and institutional sectors where the use of existing or planned emergency generator(s) is a worthwhile option. Examples are hospitals, airports, large data centers, universities, etc. Thus, identification in this working practice proposal of these programs as not just emergency, but economic demand response generators, is critical in the application of required air permitting regulations and in turn necessary air dispersion modeling demonstrations.

Definitions

For the most part, this discussion addresses non-emergency generators involved in economic demand response (EDR) activities. EDR activities encompass several practices referred to by a variety of terms, including peak-sharing, peak-shaving and load-shedding. A common element of EDR activities is that the owner of the non-emergency generator typically receives a financial benefit for participating in the EDR activity.

For the purpose of this discussion, *emergency generator* will generally agree with the definition of *emergency stationary RICE* provided in 40 CFR § 63.6675.

Demand Response (Peak-Shaving)

Relevant Factors

Demand response participants typically install back-up generators primarily for use in emergency situations, mainly in the form of power failures within the electrical grid. These generators are usually diesel-powered stationary engines and have capacities of 500 kilowatt (KW) or more. They fall under the Internal Combustion Engines (ICE) category within the Environmental Protection Agency (EPA) rules and guidelines, as they generate a number of criteria pollutants including Sulfur Dioxide (SO_2), Nitrogen Dioxide (NO_2), Particulate Matter (PM) and Carbon Monoxide (CO) as well as several hazardous air pollutants (HAPs). The EPA developed standards and compliance methods for reciprocating engines, including generators used in demand response, under the New Source Performance Standards (NSPS) for newly-constructed units and under the National Emission Standards for Hazardous Air Pollutants (NESHAP) for both new and existing engines. The specific federal standards are: 40 CFR Part 63, Subpart ZZZZ[1], 40 CFR Part 60, Subpart IIII,[2] and 40 CFR Part 60, Subpart JJJJ. [3] While the state of Minnesota also regulates emissions from ICEs,[4] the federal standards are more comprehensive.

Emission limitations, work practice and schedules, monitoring and record keeping are just some of the requirements found within these regulations. The rules and usage allowance of emergency generators is complex and in flux, with confusion emerging at both industry and regulatory agencies. Participation in demand response programs (in particular, whether a source receives some type of compensation in exchange for agreeing to be cut off from the grid or to supply

[1] National Emission Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines
[2] Standards of Performance for Stationary Compression Ignition Internal Combustion Engines
[3] Standards of Performance for Stationary Spark Ignition Internal Combustion Engines
[4] Minn. R. 7011.2300 (Standards of Performance for Stationary Internal Combustion Engines)

power to the grid) is an important factor of whether these ICE are determined emergency or non-emergency use. In a prior version of these rules, the EPA had allowed for 100 hours per year for maintenance and testing with 50 of those hours acceptable for demand response. This changed when the USEPA published a final rule on January 30, 2013. This rule revision phased out the peak shaving allowance for ICE classified as emergency engines. As of May 2014 the peak shaving allowance was eliminated for ICE classified as emergency engines. An engine may participate in emergency demand response programs for a limited number of hours per year and still be classified an emergency engine. However, an engine that participates in a peak shaving (economic demand response) program is now treated as a non-emergency engine. Non-emergency engines are subject to more stringent requirements than emergency engines. Non-emergency engines may even require add-on controls in order to be compliant.

Proposed Modeling Solutions

Given the new regulatory requirements, it is critical for facilities (and consultants) to apply the most accurate air dispersion modeling scenarios possible for these demand response generators. A variety of methods to characterize these scenarios have been proposed and tried on a case-by-case basis, with variations on the facility location, hours to potentially operate in a demand response agreement made with an energy utility company, generator types and sizes, grade of diesel fuel used, and/or if a newer natural gas-powered engine(s) is being used. The traditional standard solution is to model "8760" (equivalent to 24 hours per day for 365 days) to cover 24/7 operations, year-round. Another methodology that has been proposed is EMVAP[5] with the argument that the hours of usage are random and hard to predict. Another strategy is using EMISFACT (emission scalars) keywords in AERMOD to account for varying emissions. Operational restrictions resulting from the use of seasonal, monthly and/or hourly emission scalars can result in permit conditions.

The Minnesota Pollution Control Agency (MPCA) air dispersion modeling group is proposing a method to further hone in on the actual usage hours and operations which EMISFACT can be based upon. This new method uses a known energy utility industry practice that determines when "peak shaving" would be necessary as part of a demand response by a contracted participant. This is known as the Weighted Temperature Humidity Index (THI_t).

The THI_t is a formula that takes into account not only the standard Temperature Humidity Index (THI) but also the existing weather conditions of the current and previous two days. The THI_t was developed for the US Weather Bureau [now known as the National Weather Service (NWS)] to calculate temperatures in relation to what it would feel like at 100% humidity (thus THI values never exceed the actual air temperature). It takes into account air temperatures and humidity conditions, dry bulb and wet bulb temperatures, respectively. Wet bulb temperature is the lowest value that would be reached if evaporation of moisture took place in the parcel. The higher the humidity, the higher the wet bulb temperature and the more difficult it is for the human body to cool down. The THI_t calculation for existing weather conditions of dry bulb and wet bulb temperatures involving previous days uses a weighting means. The current day's THI receives a weight of 10, the previous day's THI a 3 and two days ago a 1. This helps the power utilities companies to anticipate electric usage. The formula for THI_t is:

$THI_t = 17.5 + 0.55*DryBulb_t + 0.2*WetBulb_t$ (Association of Edison Illuminating Companies, 2009)

It is found that a value of 70 is when people generally begin to experience discomfort due to heat and humidity and grow increasingly uncomfortable when the index exceeds 80. Values in excess of 85 fall into the exceedingly uncomfortable category. Table 1 summarizes these values.

[5] USEPA Support Center for Regulatory Atmospheric Modeling, 10th Conference on Air Quality Modeling, Summary of Public Comments

Table 1: Range of Temperature-Humidity Index Values that Negatively Affect People

Temperature-Humidity Index	
<70	Comfortable
70-75	Becoming Uncomfortable
75-80	Uncomfortable
>80	Very Uncomfortable

**In the 1980s, the National Weather Service went to the Heat Index (HI) which is an apparent temperature, i.e. "feels like". It was believed to be easier to understand and comprehend by the public to communicate the gravity of the impact of excessive heat days with values in degrees and much higher than actual air temperatures. For example, an air temperature of 95 ^{o}F with high humidity, say a dew point temperature of 72 ^{o}F, would reflect a heat index of 104 ^{o}F. See Table 2 for the full range of apparent temperatures that affect people. The formula for Heat Index is:*

Heat Index $= -42.379 + 2.04901523T + 10.14333127R - 0.22475541TR - 6.83783 \times 10^{-3}T^2 - 5.481717 \times 10^{-2}R^2 + 1.22874 \times 10^{-3}T^2R + 8.5282 \times 10^{-4}TR^2 - 1.99 \times 10^{-6}T^2R^2$

Table 2: Range of Heat Index Values that Negatively Affect People

Heat Index	
80F-85F	Fatigue possible
90F-103F	Heat stroke, heat cramps, etc.
103F-124F	Heat stroke, heat cramps, etc., more likely
>125F	***Heat stroke highly likely***

Electricity use depends on the profile of utilization of installed electricity-consuming equipment. Based on data nationally and in the state of Minnesota, demand response peak shaving takes place during the summer months when electrical demand is greatest due to the need to power air conditioning units in residential and business operations in lieu of higher air temperatures and humidity levels experienced. It is known that most energy utility companies have peak shaving contracts with a variety of large users such as hospitals, heavy industrial and data center locations, universities and other similar scale facilities. When these peaking events take place is also well understood by way of seasonal or monthly occurrence with facility peak shaving (generators running) data as well as a strong correlation with meteorological data (observed and forecast). Additional factors include human behavioral patterns of use (i.e. work days vs weekends/holidays, etc.) and "thermal inertia" effects on buildings. The temperature humidity index plays a critical part in this correlation and ability to plan generator usage for such purpose given its use by energy utility companies in electrical load planning and subsequent requests upon demand response peak shaving participants.

Steps/Process to Create a THI Database and Analysis

Surface Meteorological Data Collection

The MPCA air dispersion modeling group began the process to study and analyze temperature humidity index by downloading and processing raw meteorological observation data from several NWS ASOS and FAA AWOS sites including those in the Twin Cities: Minneapolis/St. Paul (KMSP), St. Paul Holman Field (KSTP), Crystal Airport (KMIC), Flying Cloud Airport (KFCM), as well as several greater MN locations including Rochester (KRST), Mankato (KMKT), Redwood Falls (KRWF), St. Cloud (KSTC), Duluth (KDLH), and International Falls (KINL). These sites allow for a very representative dataset for use by facilities located throughout the state that may partake in demand response peak shaving programs (See Figure 1a.). The years selected were 2006 through 2010 to encompass a five year segment comparable to what would be required in an AERMOD model run demonstration. (This has been updated to the 2009-2013 timeframe to match newly updated AERMOD processed meteorology files). *Additional stations are being added to ensure as complete of coverage of the state as possible (see Figure 1b). This is not designed to just match the (smaller) number of AERMOD processed meteorological sites, but to allow a full state coverage for many other purposes as well.

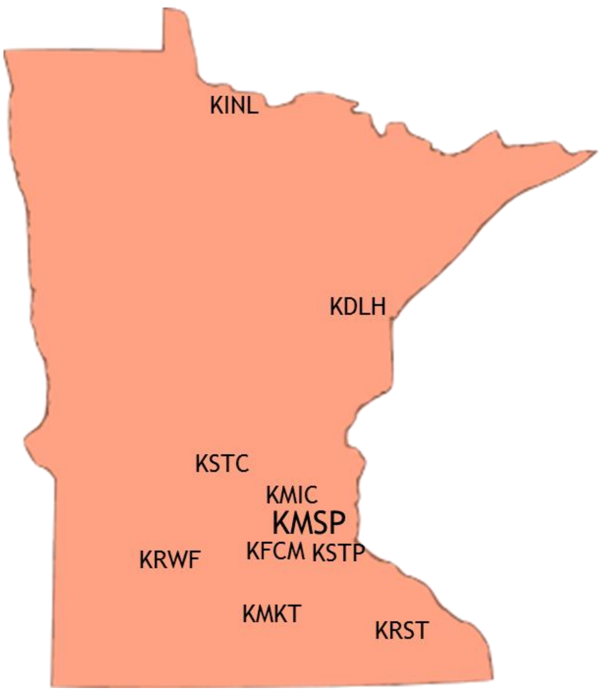


Figure 1a – Initial Set of Observation Sites

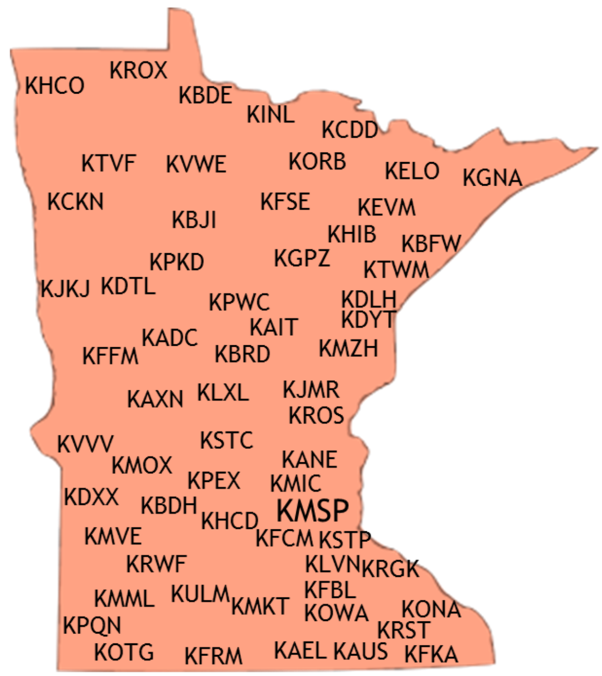


Figure 1b .Current Set of Observation Sites

Data Analysis and Index Calculations

Calculations were done for wet bulb temperatures, vapor pressure, and relative humidity from the raw observations to allow for the Weighted Temperature Humidity Index (THI_t) formula to be used on the resultant data. Heat Index was also computed as a frame of reference. Once calculated for the entire five year period at each hour, it was necessary to interpolate the trends and range of the data. The critical THI value, which the group considered the power utilities "bright line" value of 70, is the key in determining when demand response peak shaving actions would likely be necessary. These data are then run through simple statistical analyses to determine annual and mean graphs/usage curves to validate the best times of when peak shaving would occur, allowing for more detailed information to be entered into an air dispersion modeling demonstration.

An example is provided in Table 3 of a 'bright line' day of THI's exceeding 70, where a high likelihood of a demand response peak shaving episode would occur. Using data for July 2, 2012 from the Minneapolis/Crystal Airport (KMIC) in the northern suburbs of the Twin Cities, THI values actually reached into the mid-80s, a very uncomfortable day for people. Since it was a Monday during the workweek, the probabilities of increased electricity demand would be on the high side.

Table 3: Surface Observations from Minneapolis/Crystal Airport and Resultant THI and HI values

Station	Valid Time (GMT)	Temp F	Temp C	Dew Point F	Dew Point C	Vap Press (Mb)	RH	RH (raw)	WetBulb Temp C	Wetbulb Temp F	Temp-Humidity Index	Heat Index F
MIC	7/2/2012 10:53	75.02	23.90	71.96	22.20	26.71	90.22	0.9022	22.69	72.84	**73**	*75*
MIC	7/2/2012 11:53	78.08	25.60	71.96	22.20	26.71	81.5	0.815	23.17	73.71	**75**	*78*
MIC	7/2/2012 12:53	80.96	27.20	73.04	22.80	27.70	76.9	0.769	24.03	75.26	**77**	*86*
MIC	7/2/2012 13:53	84.02	28.90	73.04	22.80	27.70	69.64	0.6964	24.51	76.11	**79**	*90*
MIC	7/2/2012 14:53	87.08	30.60	73.04	22.80	27.70	63.14	0.6314	24.98	76.97	**81**	*95*
MIC	7/2/2012 15:53	89.06	31.70	71.96	22.20	26.71	57.18	0.5718	24.92	76.86	**82**	*96*
MIC	7/2/2012 16:53	93.02	33.90	69.98	21.10	24.98	47.22	0.4722	24.92	76.86	**84**	*99*
MIC	7/2/2012 17:53	93.92	34.40	71.06	21.70	25.91	47.64	0.4764	25.41	77.73	**85**	*101*
MIC	7/3/2012 18:53	96.08	35.6	69.98	21.1	24.98	42.96	0.4296	25.43	77.77	**86**	103
MIC	7/2/2012 19:53	96.08	35.60	71.06	21.70	25.91	44.57	0.4457	25.76	78.36	**86**	104
MIC	7/2/2012 20:53	98.06	36.70	71.06	21.70	25.91	41.96	0.4196	26.08	78.94	**87**	106
MIC	7/2/2012 21:53	98.06	36.70	71.06	21.70	25.91	41.96	0.4196	26.08	78.94	**87**	106
MIC	7/3/2012 22:53	96.98	36.1	66.92	19.4	22.49	37.62	0.3762	24.71	76.48	**86**	101
MIC	7/2/2012 23:53	95.01	35.00	68.01	20.00	23.34	41.5	0.415	24.66	76.40	**85**	*100*
MIC	7/3/2012 0:53	91.94	33.30	69.08	20.60	24.22	47.36	0.4736	24.46	76.03	**83**	*97*
MIC	7/3/2012 1:53	89.96	32.20	69.08	20.60	24.22	50.39	0.5039	24.13	75.43	**82**	*95*
MIC	7/3/2012 2:53	87.98	31.10	68.01	20.00	23.34	51.68	0.5168	23.45	74.21	**81**	*92*
MIC	7/3/2012 3:53	87.08	30.60	69.08	20.60	24.22	55.19	0.5519	23.64	74.55	**80**	*91*
MIC	7/3/2012 4:53	84.92	29.40	69.08	20.60	24.22	59.14	0.5914	23.28	73.90	**79**	*89*
MIC	7/3/2012 5:53	84.92	29.40	69.98	21.10	24.98	60.98	0.6098	23.58	74.44	**79**	*89*
MIC	7/3/2012 6:53	84.02	28.90	69.98	21.10	24.98	62.77	0.6277	23.43	74.17	**79**	*88*
MIC	7/3/2012 7:53	82.04	27.80	69.98	21.10	24.98	66.93	0.6693	23.10	73.58	**77**	*86*
MIC	7/3/2012 8:02	82.41	28.00	69.81	21.00	24.82	65.74	0.6574	23.10	73.57	**78**	*86*

Resultant Findings of Temperature Humidity Index (and Peak Shaving Episodes)

As assumed, the highest incidence of ‘bright line’ and higher THI values occurs during the warm season months of May, June, July, August and even into September. Despite a wide range of temperatures (and humidity levels) that can and do occur in Minnesota during the summer months, the pattern of the higher THI values is very evident. Values of 70 or higher during the 2008-2012 timeframe typically began in early to mid-June and continued through early September. The greatest values occurred during early to mid-July but with many incidences of higher values in late July and August as weather patterns ebb and flow with heat waves and cold fronts impacting the state. An interesting observation is the spike at the end of August into September. Though anecdotal, this feature is something unique to the Upper Midwest as temperatures will typically cool a few degrees compared to the peak summer season; however, dew points (i.e. humidity) tend to rise a few degrees in comparison. This is very apparent in Iowa and southern and central Minnesota as corn crops are peaking and retain a considerable amount of moisture along with prevailing southerly wind drawing moisture northward from the Gulf of Mexico. Dew points in the upper 70s to even 80 ^{o}F are commonplace during this time frame of the growing season. This can and does play an impact on human discomfort levels.

In Figure 2, a boxplot of the five year daily THI values from Minneapolis/St Paul (KMSP) shows this pattern of values during the summer months. Note the ‘bright line’ value of 70 as reference to high or low THI days. Also take into account the range of values of THI that can approach 90 on exceptionally hot days and as low as the lower 50s likely during a cool rainy day.

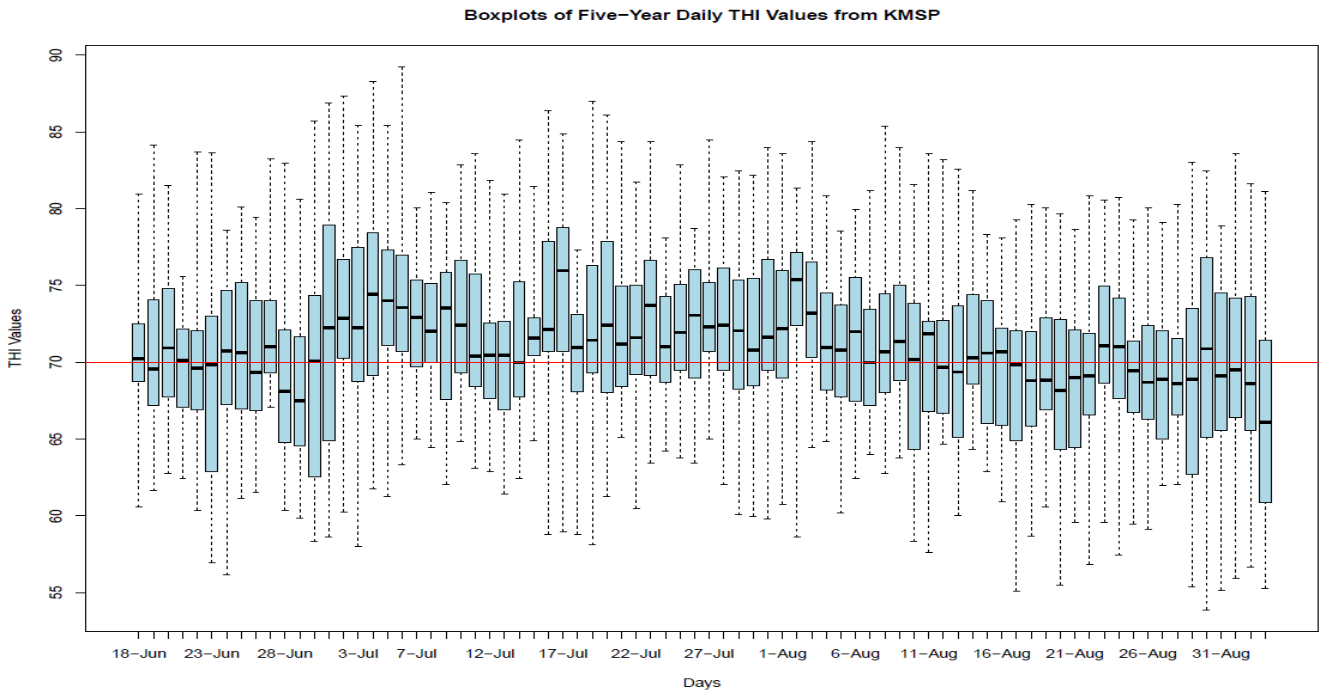


Figure 2: Boxplots of Five-Year Daily THI Values from Minneapolis/St. Paul (2008-2012)

Another output, (Figure 3) displays the mean THI values during the summer months with values above 70 starting around the 125th day of the year (May 5) and continuing to around the 275th (October 2) day in the calendar year. The peak days of the year fall in approximately days 150 (May 30) to 250 (September 7).

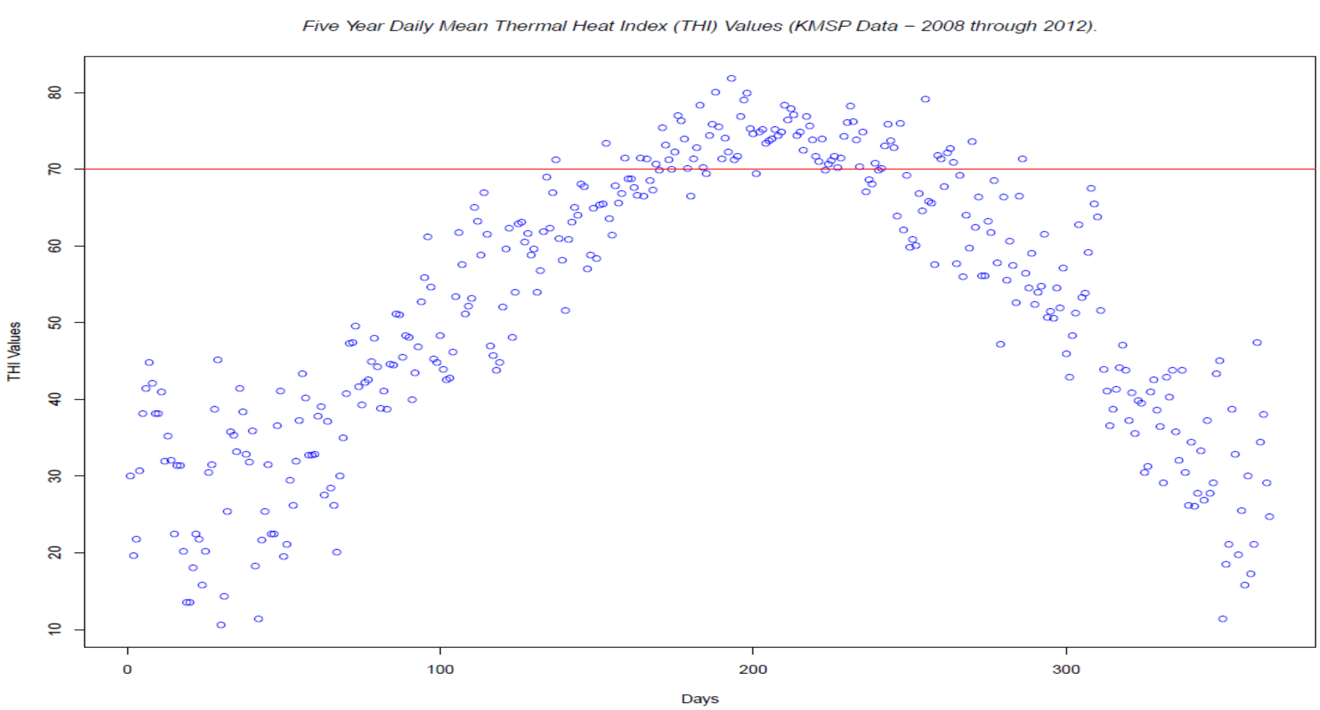


Figure 3: Scatter Plot of Five-Year Daily Mean THI Values from Minneapolis/St. Paul (2008-2012)

Upon studying the schedule of known demand response peak shaving (aka "load shedding") from various facilities in the Upper Midwest it again is very evident of when this occurs during the summer months of June through early September. The maximum number of days at twelve in July and August respectively are shown in Figure 4.

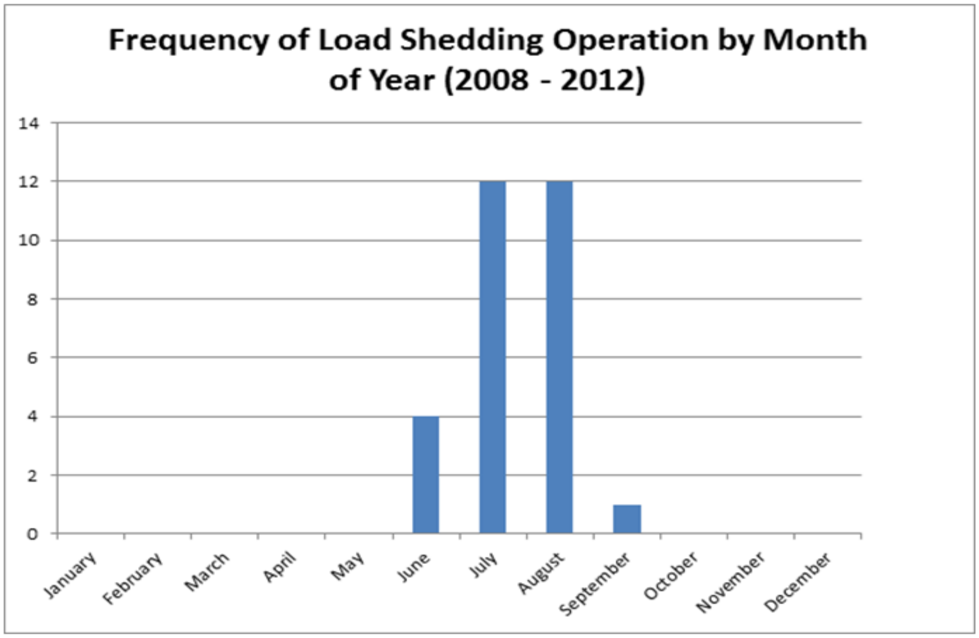


Figure 4: Average Frequency of Facility Peak Shaving Days (2008-2012)

A final representation of demand response peak shaving is a direct comparison of a facility's peak shaving episodes over a five year span to actual temperature-humidity index values during these situations. The data clearly shows not only the times when it took place (with the THIs exceeding the 'bright line' value of 70), but also the extremes of the derived index that peak shaving was enacted. Figure 5 gives the raw details of peak shaving episodes with a meteorological comparison of the day's maximum temperature recorded, the THI and Heat Index value.

Date	Day	Month	Year	Max T (F)	THI	HI (F)	
16	Monday	July	2012	98	**83**	99	
2	Monday	July	2012	98	**85**	105	
27	Wednesday	June	2012	92	**82**	98	
1	Thursday	September	2011	92	**83**	100	
2	Tuesday	August	2011	88	**82**	96	
1	Monday	August	2011	83	**80**	90	*AM hrs
20	Wednesday	July	2011	96	**86**	108	
19	Tuesday	July	2011	96	***88***	*119*	
18	Monday	July	2011	98	**87**	113	
7	Tuesday	June	2011	*102*	**83**	100	
12	Thursday	August	2010	91	**83**	100	
11	Wednesday	August	2010	92	**83**	100	
10	Tuesday	August	2010	88	**82**	98	
9	Monday	August	2010	94	**82**	96	
4	Wednesday	August	2010	88	**79**	90	
3	Tuesday	August	2010	94	**83**	99	
27	Tuesday	July	2010	93	**84**	103	
26	Monday	July	2010	86	**77**	86	
13	Thursday	August	2009	83	**77**	85	
23	Tuesday	June	2009	93	**81**	94	
18	Monday	August	2008	89	**77**	87	
4	Monday	August	2008	85	**78**	88	
1	Friday	August	2008	86	**75**	83	
31	Thursday	July	2008	85	**78**	87	
30	Wednesday	July	2008	89	**78**	87	
29	Tuesday	July	2008	93	**81**	94	
15	Tuesday	July	2008	89	**80**	91	
11	Friday	July	2008	92	**83**	100	
25	Wednesday	June	2008	88	**78**	86	

Avg THI	81.3
Lowest THI	75.0
Highest THI	88.0
Median THI	82.0

Avg Max T	91.1
Lowest Max T	83.0
Highest Max T	102.0

Avg HI	95.9
Lowest HI	83.0
Highest HI	119.0

Max T (F) - Maximum Temperature (degrees Fahrenheit)
THI - Temperature-Humidity Index (unitless)
HI - Heat Index (Apparent Temperature in degrees Fahrenheit)

Notes:
8/1/11 was coming off a hot weekend
7/4/12 was a Wed., but a holiday - temp of 100F/THI of 88/HI of 108F
No Pk Shaving days in May despite 2 days of THIs of 80/81

Figure 5: Specific Episodes of Actual Facility Peak Shaving Days (2008-2012)

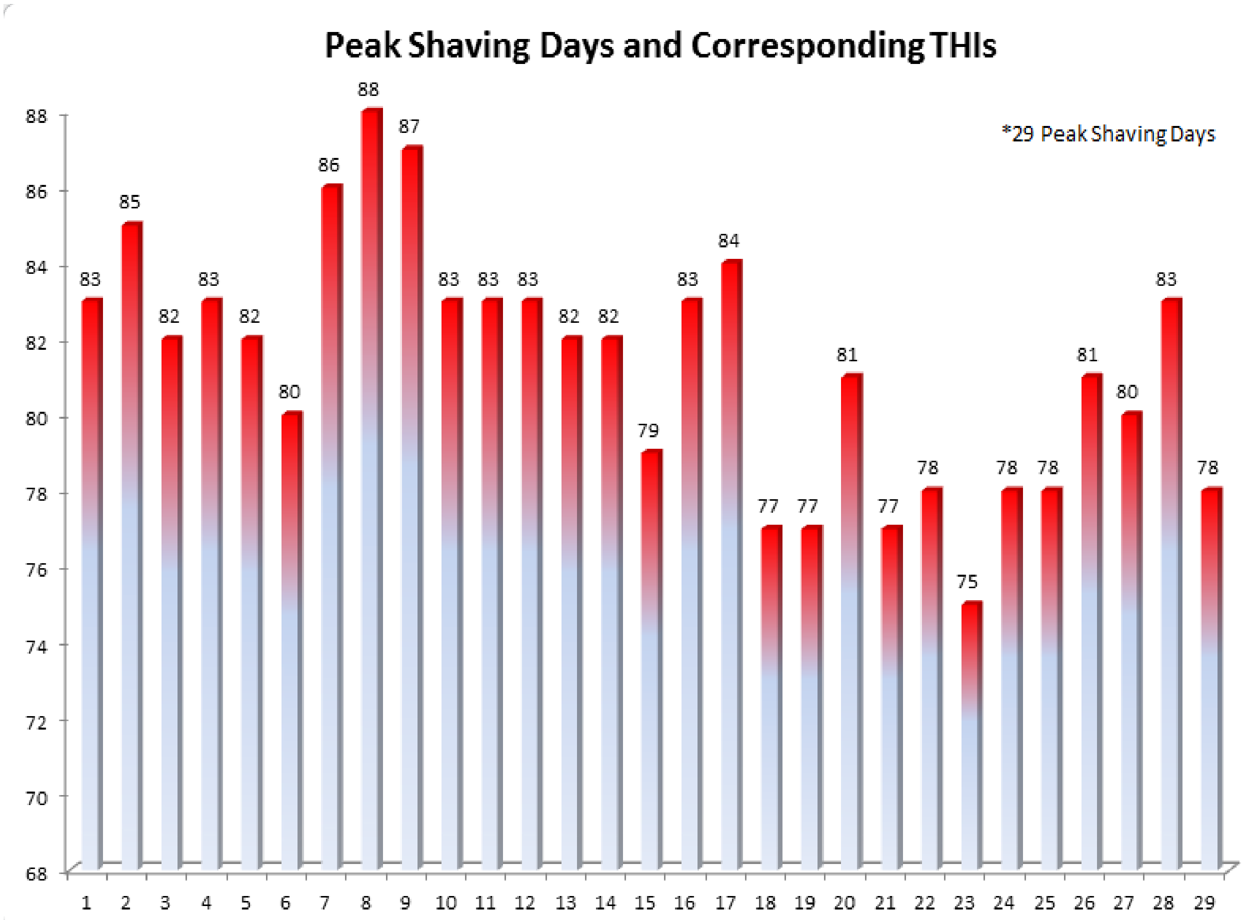


Figure 6: Episodes of Actual Facility Peak Shaving Days & THI Measures (2008-2012)

Figure 6 displays the peak shaving episodes in direct comparison to temperature-humidity index values registered and show a very distinct pattern of values above 75 on these days. From this dataset it can be noted that the industry 'bright line' of a THI of 70 is a planning for potential peak shaving, but no definite guarantee. As stated earlier, meteorological conditions, human behavioral patterns and thermal inertia all play an important role of when the energy utilities decide to invoke peak shaving.

Another way to display the frequency of facility peak shaving operations is by days per week as a simulated distribution during the 12 week summer season (see Figure 7). The simulated hours of operation for the load shedding case study assumed that the hours of operation likely occurred no earlier than 2:00pm and no later than 10:00pm. The days of the week where operations occur in this scenario is Monday through Thursday, for the twelve weeks of summer as delineated by the THI curve (see Figure 3). The hours of operation were generated using the random function in Excel within a normal distribution function. The simulated distribution becomes the template for hours and days of operation for the load shedding generator.

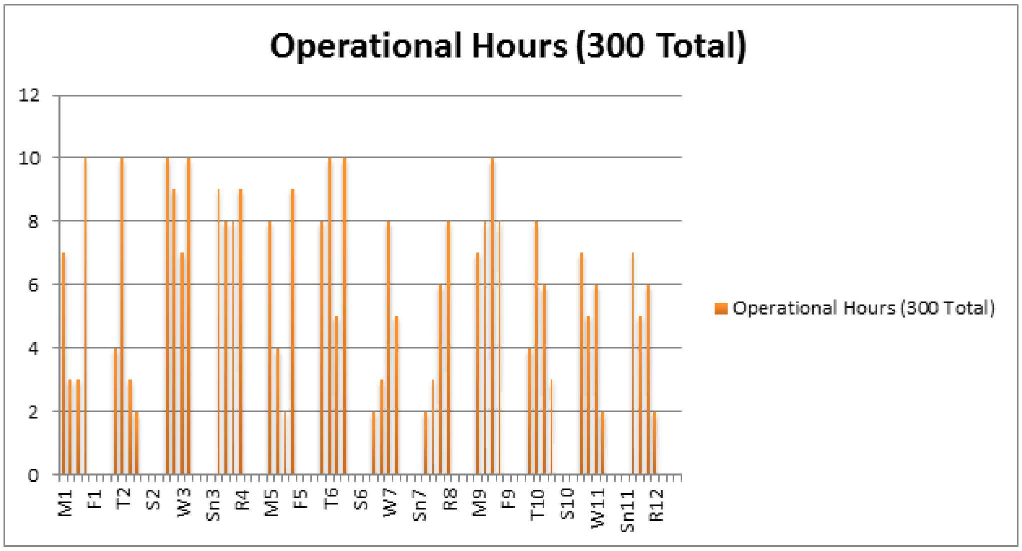


Figure 7: Theoretical Distribution of Peak Shaving (Load Shedding) during the summer months

Implementing Known Findings of THI into an AERMOD Model Run Demonstration

Source Data Modifications and Entries

In this method it is critical to not only know the sources and their ancillary information (stack dimensions, emission rates, temperatures, exit velocities, buildings and downwash, receptors), but also the frequency of the intermittent emissions that would be occurring. Modifying the SOURCE Pathway in the AERMOD model is key, beginning with Source Groups being assigned to the known generators (and corresponding stacks) that would be running during a demand response peak shaving event. Then within the Variable Emissions tool the information gained from the THI analysis becomes key. Using the "By Month / Hour / Day" option allows each generator to be proposed for use in peak shaving to be setup for the hours it would be operational. In this specific option, a user can input by month and the week the number of hours to run and a multiplier of the emission rate initially assigned to the generator stack. In the examples provided in Figures 8 and 9 the option choices are displayed. An important fact is that only the months of June, July and August have been entered with non-zero values, but the same could be done for May or September, if necessary.

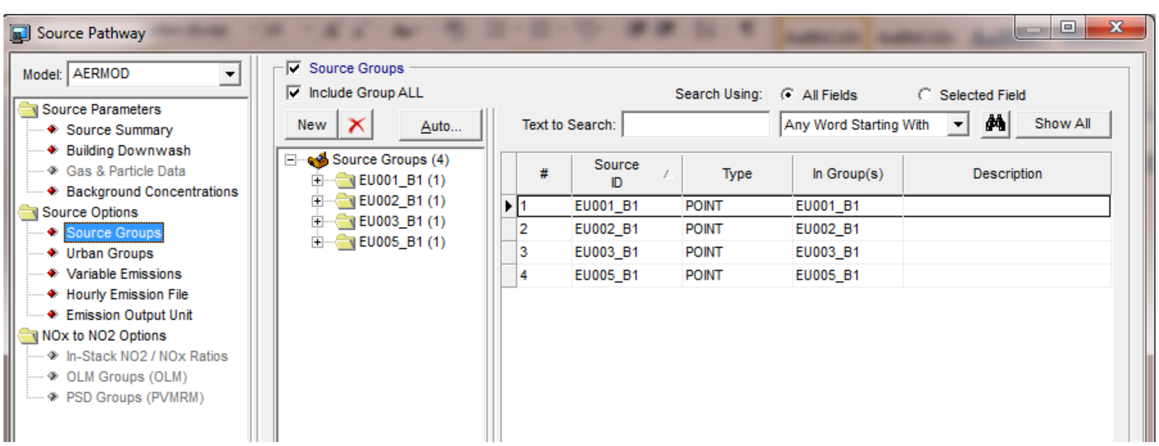


Figure 8: Source Groups for Generator Stacks Example

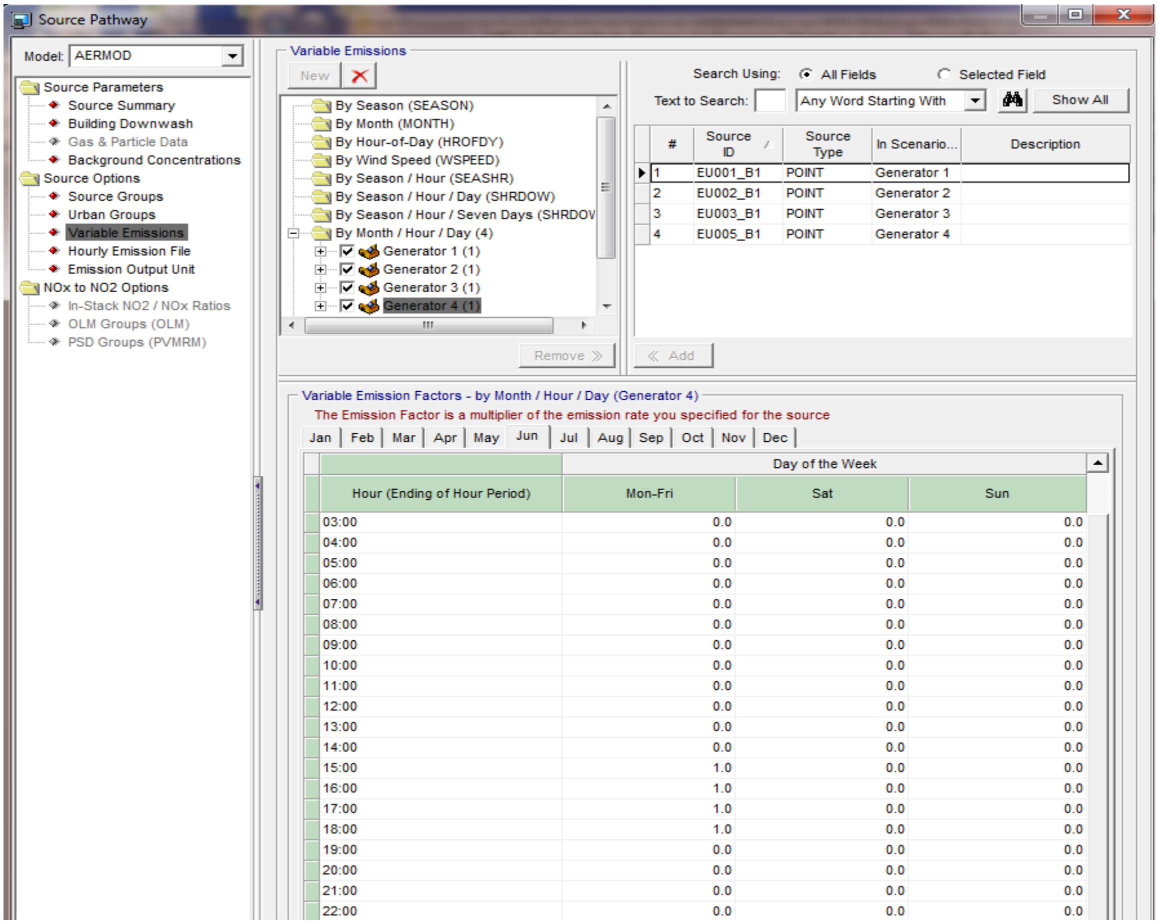


Figure 9: Variable Emissions: Entry for Hours of Day in Summer Months

Implementation

The method proposed above can be easily implemented into an AERMOD modeling demonstration. MPCA has processed and analyzed nearly all reporting surface weather observation sites across the Twin Cities metro and statewide to allow immediate use of the data for reference of temperature humidity index (THI) days. These data will continue to be updated and/or expanded to add additional sites to ensure greater statewide and regional coverage. MPCA will continue to work with other possible time-based variable emission options and scenarios to further develop the method.

Requirements for Permits

To ensure compliant operations along with improved, more realistic modeling results there will be certain requirements to abide by as detailed by the MPCA Air Permit division. Permit language will be required for those engines participating in peak shaving/load shedding/economic demand response (EDR) practices with modeled ambient levels ≤ 90% of the NAAQS. They will be:

Citation	Requirement
<Title I Condition: 40 CFR Section 52.21(k); Minn. R. 7007.3000> <Minn. Stat. Section 116.07, subds. 4a & 9; Minn. R. 7007.0100, subp. 7(A), 7(L), & 7(M); Minn. R. 7007.0800, subps. 1, 2 & 4; Minn. R. 7009.0010-7009.0080>	Operating Hours are limited to less than 300 hours per calendar year based on a 12-month rolling sum to be calculated by the 15th day of each month
Minn. R. 7007.0800, subp. 4	Monitoring. The Permittee shall install a non-resettable hour meter on EU001 prior to startup.
Minn. R. 7007.0800, subp. 5	Recordkeeping. For any calendar day or operation of EU 001, the Permittee shall record the hours of operation of EU 001 with the non-resettable hour meter. By the 15th day of each month, the Permittee shall calculate and record the total hours of operation for the previous calendar month and the 12-month rolling total.

Note: If modeled ambient levels ≥ 90% of the NAAQS additional special language will be required in the permit.

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Development of the Equivalent or Better Dispersion (EBD) Demonstration

I. Introduction

The Minnesota Pollution Control Agency (MPCA) staff adapted an Environmental Protection Agency (EPA) approach to evaluate whether the projected ambient impacts of proposed small changes at a facility result in equivalent or better dispersion (EBD). If so, the MPCA can be assured that the conclusions of previous National Ambient Air Quality Standards (NAAQS) and Minnesota Ambient Air Quality Standards (MAAQS) modeling demonstrations remain and the facility continues to demonstrate modeled compliance. The EBD approach is specific to the pollutant and averaging time that prompted requirements in the current permit and assumes that the previous modeled results were at least one significant impact level (SIL) value below the applicable ambient air quality standard. This write-up describes and illustrates the EBD approach.

A. Purpose

The main goal of the EBD approach is to protect ambient standards while simultaneously avoiding full refined modeling for minor changes at a facility. The EBD approach reuses/edits portions of the existing modeling input data to account for emission changes and/or dispersion changes at the facility in order to evaluate the net change of predicted concentrations. The EBD approach is based on well-known PSD increment concepts which evaluate the change between previous and proposed modeling conditions.

Another goal of the EBD approach is to reduce the administrative review and response time of the MPCA modeling review for projects with minor dispersion changes. MPCA staff desired a simpler way that would contain only the relevant changes to the initial regulatory modeling demonstration. In addition, a simpler form was created that accounts for both the modeling protocol and modeling results/report in order to expedite our review of EBD analyses while documenting the relevant information and modeled output.

B. History and Evolution of Equivalent or Better Dispersion (EBD)

EPA created the initial EBD analysis concept. It became an active tool in the 1980's as part of a State Implementation Plan (SIP) proposal whereby a facility located within a SIP area would not be required to conduct a complete refined air quality dispersion modeling demonstration as required by the traditional SIP structure when a minor facility change was being proposed. This approach allowed a facility located within a SIP maintenance area to demonstrate that the potential impacts from a proposed change would result in equivalent or better dispersion than had been previously modeled.

The MPCA now uses formal permitting language allowing the use of the EBD concept when anticipating a facility change that will require ongoing assurance of compliance with ambient standards. The modeling trigger language reflects the following themes:

- A list of modeled parameters (based on allowable emissions) in the permit that become the basis for future modeling evaluations;
- Distinction between EBD demonstrations vs. full refined modeling; however, both actions are often referred to as "modeling submittals."

- Changes to a facility that include the modeled parameters and a link to update modeling through an EBD analysis;
- Actions that occur should an EBD result in a value greater than the applicable pollutant-specific SIL (when one exists). This may include permit language that directs a permittee to conduct a full refined modeling demonstration. If the EBD output is less than the relevant pollutant-specific SIL value, and the baseline modeling was at least one-SIL value below the applicable NAAQS, the facility may not need to do further air quality modeling. For ambient air quality standards that do not have a SIL, MPCA should be consulted to discuss alternatives.

For non-PSD permits with EBD language, the MPCA staff provides review and approval. For PSD permits, the EPA must approve of the process prior to the pursuit of an EBD analysis. The EBD is typically not available for projects undergoing environmental review or where a SIP explicitly omits the use of this approach. In situations where a SIP is silent on the use of an EBD, prior approval must be received from EPA prior to pursuit of the analysis.

II. Modeling Approach ("How-to-Model")

This section of the memorandum describes and illustrates "how-to-model" features of EBD modeling. Attachment 1 is a conceptual example of EBD input files with "before" and "after" modeling inputs. Attachment 2 is a real world example of EBD input files with "before" and "after" modeling inputs.

A. Baseline Modeling

As noted in the November 25, 2013, MPCA EBD Memorandum, there is an assumption that the previous air dispersion modeling demonstrated compliance with the applicable NAAQS. This means that the last full NAAQS (MAAQS) modeling demonstration becomes the baseline for the EBD comparison. An important condition applies to this assumption: *the modeling demonstration must present a simulation that shows compliance with the NAAQS (MAAQS) applicable at the time of the permit action.* If a previous modeling demonstration does not offer this information, then an adequate baseline for analytical comparison is not available to complete the EBD. Please contact the MPCA Air Permit Section for additional direction on this issue.

B. Dispersion Model

Use the most current version of AERMOD. The primary reason for using the most current version of AERMOD is a function of consistency and accessibility. The MPCA staff designed the EBD approach as a model-version neutral method, meaning that the model version used to run the EBD does not affect the EBD output. The task of the model is to solve the Gaussian dispersion equation for the past and proposed case, at each receptor. The second task of the model is to present the output of the calculations as the difference between the two cases. All versions of AERMOD will be capable of making these calculations, meaning that input files developed from earlier versions of AERMOD should be fit for use in the most current version of AERMOD for EBD purposes. Please note that there may be situations where older modeling files pre-date AERMOD. Though not without challenge, you may try to convert the older files (e.g., ISC) to an AERMOD format.

C. Nearby Sources and Background Concentrations

EBD demonstrations do not require modeling nearby sources or ambient air quality background concentrations. It is assumed that the ambient air quality background concentration and related nearby source inventory were addressed in the initial modeling demonstration that has become the baseline for EBD comparison. If no previous modeling demonstration exists, please consult with MPCA modeling staff to discuss alternatives.

D. *Emissions and Dispersion*

EBD demonstrations evaluate the change in allowable emissions, consistent with the scope of the permit.

FYI: EBD input data resembles PSD increment input data. Both account for proposed changes at a facility by applying “before” (negative values) and “after” (positive values) scenarios. However, the “before” scenario in PSD-increment files use past actual emissions; EBD uses allowable emissions. The “after” scenario in PSD increment files use allowable emissions; EBD uses allowable emissions.

EBD demonstrations evaluate the change in dispersion; this too is consistent with the scope of the permit. FYI: Modeled parameters (detailed or summarized in the permit) are key features that affect the dispersion of pollutants from the emission sources at the facility. In order to assess the effect of proposed dispersion changes (e.g., stack parameters, building downwash, release height, sigma-yo, sigma-zo, etc.), it is important to lay out the types of emissions that should be considered and the manner in which they are characterized in the EBD evaluation. Please note that changes in buildings should also be accounted for in any EBD analysis.

E. Pollutant-Specific Issues

EBD demonstrations are pollutant and averaging-time specific. FYI: For the new NAAQS and MAAQS, this may not be much of an issue; however, for situations where the older NAAQS are applicable, new averaging times may be needed to reflect the form of the older standards (e.g., a three-hour averaging time for SO_2). This situation can arise with SIP maintenance projects or specific permit provisions.

A second issue that arises is the evaluation of NO_2 in EBD demonstrations. Many recent full refined NO_2 NAAQS modeling demonstrations have used the Tier 3 approach in AERMOD to account for the NOx/NO_2 transformation. While this is appropriate for full refined NO_2 NAAQS modeling, the EBD calculations are compromised by the negative emissions of the “before” scenario. The EBD approach presents a different challenge. The current AERMOD software will not compute a Tier Two or Tier Three approach when the PSD-increment concepts are applied in a modeling demonstration; this situation also occurs for EBD. The limitation is based on the use of negative numbers in the input file. A simple remedy is to use Tier One for the EBD analysis (which is not compromised by a negative emission rates).

F. Meteorology and Receptors

EBD demonstrations generally use the same meteorological data as was used in the latest full NAAQS (MAAQS) modeling. In cases where meteorological data is pre-AERMOD or MPCA has more recent AERMET data, the newer meteorological data is required for the EBD analyses. Please consult with the MPCA modeling unit if you believe that you will require new meteorological data for your project.

EBD analyses should use the same receptor data that was used in the last full modeling analysis, unless the facility proposes changes to ambient air (e.g., fencing changes; land purchase/sale), or the original terrain data used in the latest full refined NAAQS modeling is no longer supported by AERMOD. Please contact the MPCA modeling unit regarding the best terrain data for EBD work. Our current working practice is to use 1/3 minute arc NED data.

III. Data Interpretation

The MPCA will consider a project to have equivalent or better dispersion when the modeled output at each receptor is no greater than the applicable pollutant-specific SIL value, as reported to two decimal places (i.e., hundredth decimal place).

IV. Last Full NAAQS (MAAQS) Modeling Demonstration and the Cumulative Nature of EBD Analysis

The premise of an EBD demonstration is that the changes made subsequent to the last refined modeling demonstration result in an equivalent or better dispersion characteristic in comparison to the previous compliant modeled demonstration. In this way, the “equivalent or better” threshold is a comparison between what was modeled in the previous demonstration and the proposed changes. An additional and important assumption in this approach is the expectation that the last modeled compliance resulted in a modeled value that was at least one-SIL value below the applicable NAAQS. If this condition cannot be met, the EBD may not be applicable. If this condition is present, the EBD approach is likely suitable; however, repeated use to evaluate changes over time raise concern over baseline validity.

Based on MPCA staff review of this process, it is possible to submit multiple EBD analysis over time that reflect minor changes to a facility; however, in aggregate the changes may no longer represent facility dispersion characteristics and a new refined modeling demonstration would be needed to "true up" the baseline modeling. The rationale for this approach is specific to the sequential nature of the EBD and the impact changes have on the assumption of compliance established during the last refined modeling demonstration. Sequentially, the first EBD and contains just its changes. Subsequent EBD analyses contribute the following:

- The second EBD analysis contains its changes as well as changes in the first EBD analysis.
- The third EBD analysis contains its changes as well as changes in the first and second EBD analyses.
- The fourth set of changes incorporates all the previous changes, etc...

The aggregation as presented assumes no change to the model or meteorology. Significant changes to either could trigger a need for a new baseline if the model versions are out of date or incompatible. Please consult with MPCA modeling staff if you anticipate multiple EBD analysis for a project or have baseline modeling that is greater than five years old.

Attachments

Attachment #1 - Conceptual Example
Attachment #2 - Applied Example

Attachment #1 – Conceptual Example

Introduction

Equivalent or Better Dispersion (EBD) considers different impacts due to different emissions and/or different dispersion. EBD analyses consider different emissions (if any), different operating times (if any), different stack locations (if any), different stack parameters (if any), different building downwash (if any), different ambient receptors (if any), different meteorological data (if available), etc.

The EBD analysis should use positive emission rates for the "new" case, negative emission rates for the "old" case, and the most current version of AERMOD and most current meteorological data.

Each altered emission source is modeled with "old" and "new" inputs (e.g., LOCATION, SRCPARAM, BUILDHGT, BUILDLEN, BUILDWID, XBADJ, YBADJ, EMISFACT, HOUREMIS, etc.)

Example

Facility ABC with three altered stack/vents would have six AERMOD IDS and corresponding AERMOD conceptual inputs (e.g., AERMOD SO section; and other AERMOD sections if applicable):

- ABCSV001_OLD with old (negative) emission rate
  - Old Inputs:
  - LOCATION
  - SRCPARAM
  - BUILDHGT, BUILDWID, BUILDLEN, XBADJ, YBADJ
  - EMISFACT (or HOUREMIS)
  - ETC.
- ABCSV002_OLD with old (negative) emission rate
  - Old Inputs
- ABCSV003_OLD with old (negative) emission rate
  - Old Inputs
- ABCSV001_NEW with new (positive) emission rate
  - New Inputs
- ABCSV002_NEW with new (positive) emission rate
  - New Inputs
- ABCSV003_NEW with new (positive) emission rate
  - New Inputs

Use AERMOD SRCGROUP ALL and AERMOD output based on high-first-high (H1H) values, as well as applicable regulatory metrics (e.g., NAAQS).

Note: Except for "past" emissions and baseline dates, EBD inputs resemble PSD increment inputs.

Attachment #2 – Applied Example

Jarden Home Brands (JHB) is located in Cloquet, Minnesota. JHB has an air permit with the EBD requirement and has proposed changes to their combined boiler stack (SV020) as summarized below.

To comply with Permit #01700003-004 conditions requiring a PM_{10} and $PM_{2.5}$ dispersion equivalency demonstration for any stack parameters changes at the Jarden Home Brands – Cloquet, MN facility, Barr Engineering conducted an AERMOD modeling analyses of a flow rate change at the Combined Boiler Stack (JHBSV020). The goal of this evaluation is to demonstrate the stack parameter change provides equivalent or better dispersion characteristics than the previously modeled parameters for JHBSV020. The specific change was an increase in flow rate from the previously modeled 36,000 actual cubic feet per minute (acfm) to 46,000 acfm. Further, the remainder of the stack parameters and emission rates for JHBSV020 were unchanged. Per information received at the July 16, 2013, MPCA modeling guidance seminar regarding equivalent dispersion demonstrations, Barr used the identical air modeling files from the issuance of the August 2012 permit as the basis for this modeling. The results from the modeling compared the permitted stack parameters to the new stack parameters for the stack.

AERMOD SRCPARAM inputs for the JHB PM2.5 and PM10 EBD analyses are summarized below.

** JHBSV020 - Boiler Combined Stack

** BOILER STACK - 120' = 36.576m
** Diameter = 38" = 0.965m
** Temp = 250 deg F. = 394.26 K
** JHBSV020 - 36,000 acfm -> velocity - 23.221 m/s
** JHBSV20N - 46,000 acfm -> velocity - 29.671 m/s

SO SRCPARAM JHBSV020 -1.2096E+00 36.576 394.26 23.221 0.965
SO SRCPARAM JHBSV20N 1.2096E+00 36.576 394.26 29.671 0.965

EBD results indicate equivalent or better dispersion for annual PM2.5, 24-hour PM2.5, and annual PM10. EBD results do not indicate equivalent or better dispersion (two decimal places) for 24-hour PM10 (i.e., AERMOD SRCGROUP ALL had a HIGH 6^{th} HIGH value of 0.01204 ug/m3). So, full refined 24-hour PM10 NAAQS re-modeling was conducted using a PM10 background concentration of 50 ug/m3 based on 2012 data from MPCA Duluth Site 7545.

The full refined 24-hour PM10 NAAQS re-modeling results indicate continued modeled compliance at all ambient locations. Areas with predicted concentrations exceeding the 24-hour PM10 NAAQS are entirely on Sappi property and are mostly due to Sappi emission sources. Therefore, the proposed changes for the Jarden Home Brands (JHB) combined boiler stack (SV020) are acceptable.

Additional data files are on the MPCA x-drive:

X:\Agency_Files\Outcomes\Risk_Eval_Air_Mod\Air_Modeling\Projects\01700003_JardenHomeBrands\20131021_EBDv1\

Figure 1 Cloquet 24-Hour PM10 H6H Predicted Concentrations (including background)

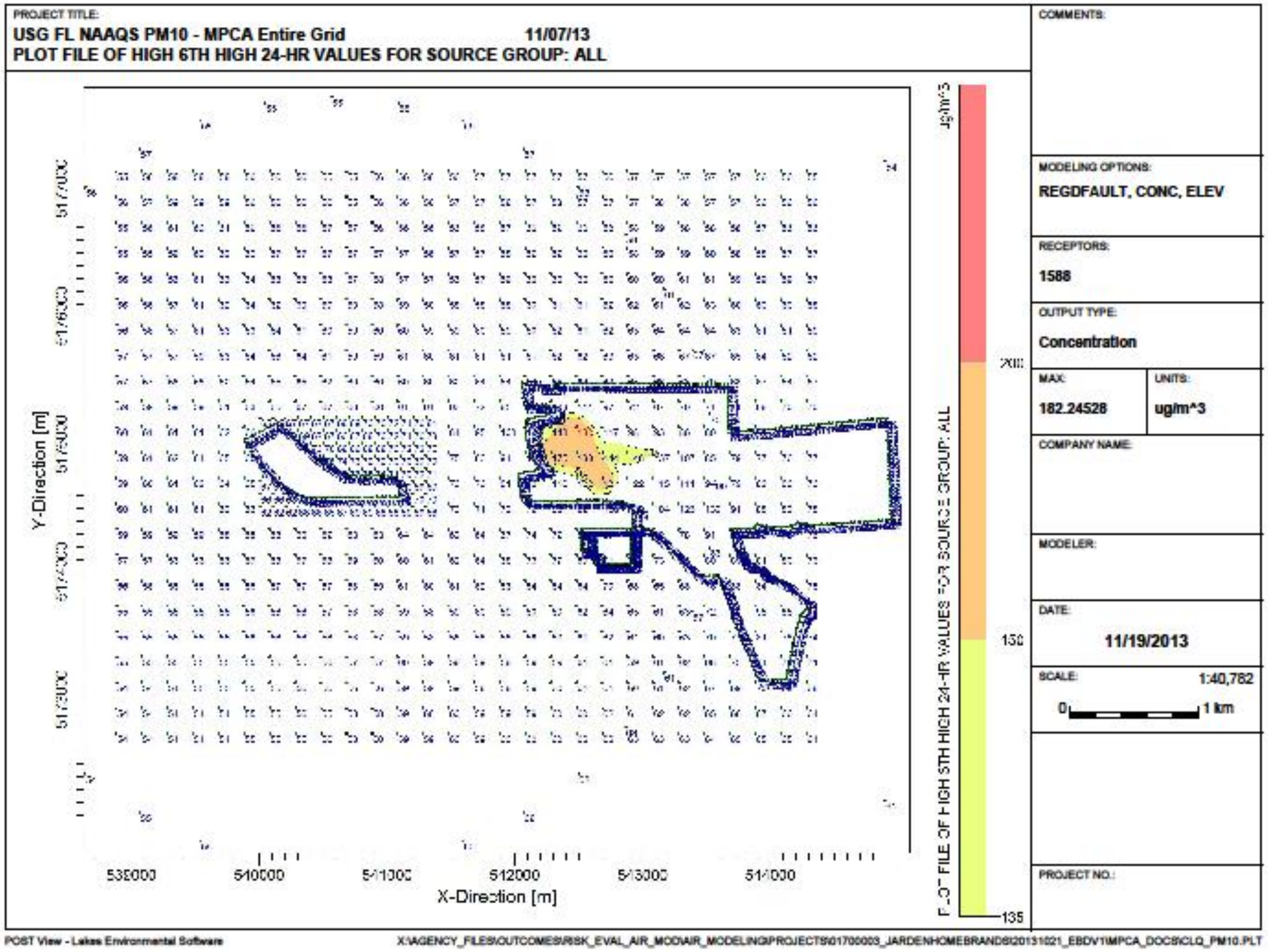

Figure 2 Eastern Cloquet 24-Hour PM10 H6H Predicted Concentrations (including background)

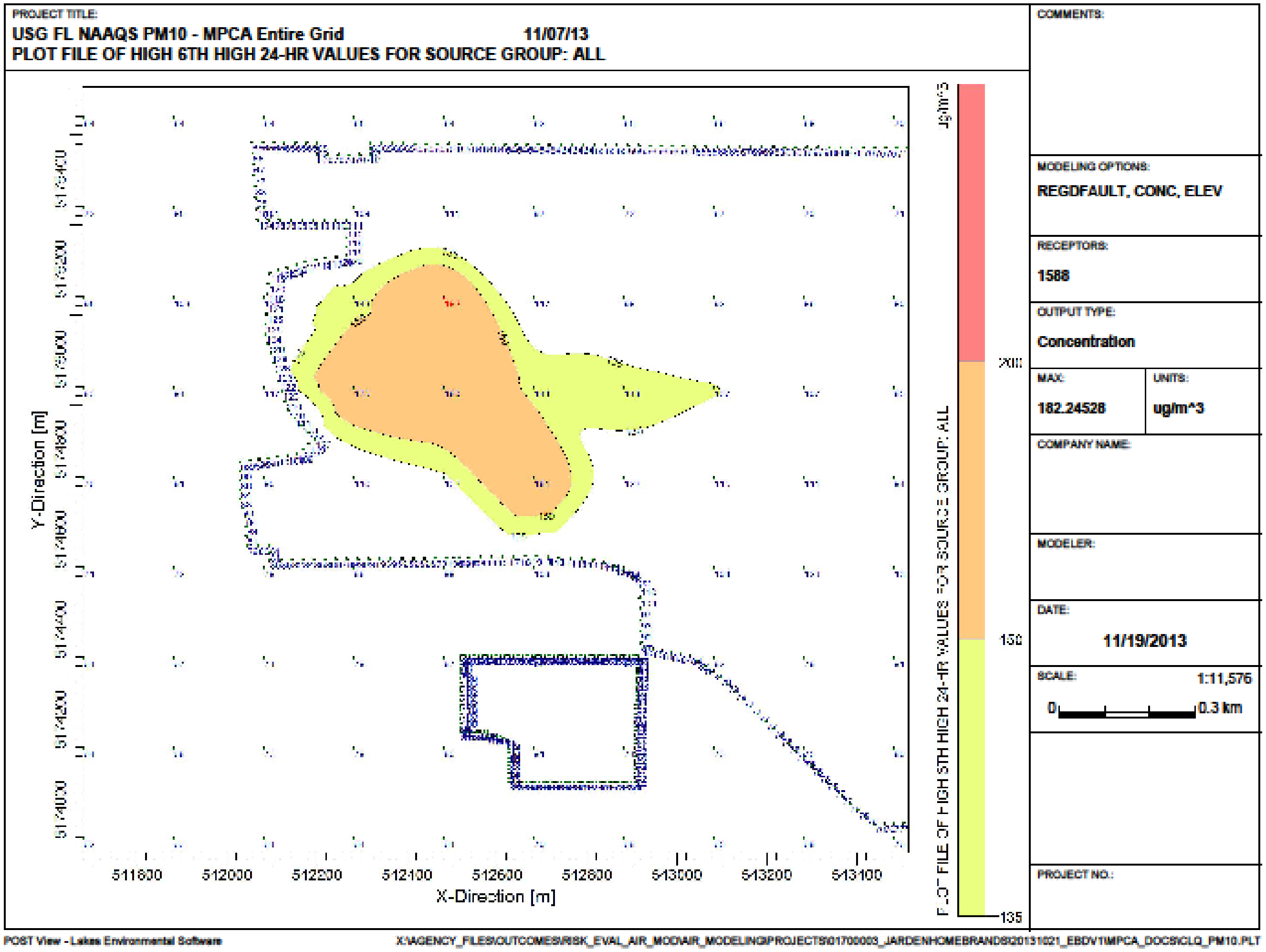

Figure 3 Jarden Home Brands (JHB) Property Line 24-Hour PM10 H6H Predicted Concentrations (including background)