Wisconsin Air Dispersion Modeling Guidelines

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Air Management Program
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Air Dispersion Modeling Guidelines for Major PSD Projects

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OVERVIEW

This document provides general information about the dispersion modeling and additional impact requirements associated with the ambient air assessment of a Prevention of Significant Deterioration (PSD) permit application. Dispersion modeling analyses are used to support the limitations contained in the air permit. Due to uncertainties in both the emission estimates and the compliance tests used to demonstrate emission limits are being met, dispersion modeling is used to set a theoretical limit on the emission rate rather than basing the emission rate on physical characteristics of the emission source.

Applicants are responsible for completing the dispersion modeling and analyses according to the requirements set forth in Chapter NR 405, *Wisconsin Administrative Code*, and consistent with Federal Guidance 40 CFR Part 51 Appendix W (Guideline on Air Quality Models). Additional information can be found in the U.S. Environmental Protection Agency (USEPA) Draft New Source Review Workshop Manual (October 1990) and the USEPA Support Center for Regulatory Atmospheric Modeling (SCRAM) website at: http://www.epa.gov/scram001.

All PSD permit actions require an air quality analysis of ambient air impacts to be submitted as part of a complete application. This analysis includes an assessment of existing (pre-construction) air quality, an air dispersion modeling analysis, an additional impacts analysis, and an evaluation of any adverse impacts to any Class I area including analysis of impacts to Air Quality Related Values (AQRVs).

Prior to commencing an air quality analysis in support of a PSD application, applicants or their designated consultant should provide the Wisconsin Department of Natural Resources (WDNR) with a dispersion modeling protocol. This protocol should detail the models and inputs that will be used for the modeling analysis and reference current WDNR and USEPA guidance.

Pre-construction ambient air monitoring may be required for criteria pollutants where the impact of the new or modified source is above the Significant Monitoring Concentrations (SMC) or if the applicable pollutant is particulate matter with aerodynamic diameter of 2.5 microns or less ($PM_{2.5}$).

The air dispersion modeling analysis is required to demonstrate that applicable emissions from the proposed new or modified major source, in conjunction with applicable emissions from other existing sources, will not cause or exacerbate a violation of applicable National Ambient Air Quality Standard (NAAQS) or PSD increment. The initial analysis evaluates the potential increase of emission from the project or the net increase associated with the modification to determine if the emissions have a significant impact. If a full impact analysis is required, existing emission units at the facility are included along with applicable nearby facilities, as well as regional background concentrations. The full impact analysis also considers the impact of precursor emissions on secondarily formed pollutants.

The additional impact analysis is required to evaluate the impact of the proposed project emissions on growth, soils, vegetation and wildlife, and visibility impairment. Growth impact analysis quantifies growth resulting from both construction and operation of the proposed project and assesses resulting air quality impacts. Impacts to soils, vegetation, and wildlife are also assessed based on the proposed emissions. Visibility impairment analysis considers plume visibility from PSD Class II areas separate from viewing a steam 'cloud' released by a stack.

As of February 2016 there are two PSD Class I areas in Wisconsin: the Rainbow Lake Wilderness Area and certain lands of the Forest County Potawatomi Community. Proposed projects within 100 km of a Class I area should assess impacts of criteria pollutant emissions upon the Class I area. Further, PSD applicants anywhere in Wisconsin, even when located further than 100 km from a Class I area, should contact the Federal or Tribal land manager of each area to establish the requirements of Class I increment assessment and AQRV analysis for those areas.

DISPERSION MODELING PROTOCOL

WDNR recommends that all PSD applicants provide a detailed modeling protocol prior to submitting the permit application. This protocol should describe all models, methods, and procedures that will be used to complete the air quality analysis. The protocol should follow the form and headers of this guidance document. It should provide complete information related to the modeled emissions inventory and any correspondence with USEPA. Upon review, WDNR can communicate the acceptability of the proposed methodology prior to the applicant or consultant performing the analysis. This interaction will reduce the chance of inadvertent exclusion of required information and provide the applicant with current methods and guidance. Adjustments to the protocol may occur as the analysis progresses; however, the protocol establishes a common understanding of the dispersion modeling requirements between the facility and WDNR.

PRE-CONSTRUCTION MONITORING

Ambient monitoring data for any criteria pollutant that the applicant proposes to emit in amounts above PSD thresholds may be required as part of the analysis. The data should represent the 12-month period immediately preceding receipt of the PSD application.

WDNR has discretionary authority to exempt an applicant from this data requirement if either the predicted ambient impact concentrations due to the proposed significant net emission increase (i.e. the highest modeled concentration using the applicable averaging time) are below the prescribed SMC or the existing ambient pollutant concentrations are less than the prescribed SMC.

Significant Monitoring Concentrations

POLLUTANT	SMC	AVERAGING TIME
CARBON MONOXIDE	575 µg/m^3	8-HOUR
NITROGEN DIOXIDE	14 µg/m^3	ANNUAL
PARTICULATE MATTER LESS THAN 10 MICRONS (PM_{10})	10 µg/m^3	24-HOUR
PARTICULATE MATTER LESS THAN 2.5 MICRONS ($PM_{2.5}$)	*See "January 22, 2013 D.C. Circuit Court Decision (SMC)"*	
SULFUR DIOXIDE	13 µg/m^3	24-HOUR
LEAD	0.1 µg/m^3	3-MONTH
MERCURY	0.25 µg/m^3	24-HOUR
BERYLLIUM	0.0010 µg/m^3	24-HOUR
FLUORIDES	0.25 µg/m^3	24-HOUR
VINYL CHLORIDE	15 µg/m^3	24-HOUR
TOTAL REDUCED SULFUR	10 µg/m^3	1-HOUR
HYDROGEN SULFIDE	0.20 µg/m^3	1-HOUR
REDUCED SULFUR COMPOUNDS	10 µg/m^3	1-HOUR

January 22, 2013 D.C. Circuit Court Decision (SMC)

On January 22, 2013 a decision was issued by the Washington D.C. Circuit Court that vacated the Federal $PM_{2.5}$ SMC. The court stated that USEPA exceeded its statutory authority by allowing an exemption from the $PM_{2.5}$ SMC. As a result, applicants should not rely on the $PM_{2.5}$ SMC to avoid compiling air quality monitoring data specifically for $PM_{2.5}$. All applicants should submit ambient $PM_{2.5}$ monitoring data in accordance with requirements whenever either direct $PM_{2.5}$ or any $PM_{2.5}$ precursor emissions are above the respective PSD Significant Emission Rate. Applicants may submit data collected from existing $PM_{2.5}$ regulatory monitoring networks if the data is representative of air quality in the area of concern for the year preceding receipt of the application. Applicants will generally be able to rely on existing WDNR monitoring data to satisfy the monitoring requirement but should contact WDNR if concerns arise.

SOURCE & MODEL INFORMATION

WDNR uses the latest version of the regulatory model AERMOD for dispersion modeling analyses. Source locations should be entered with Universal Transverse Mercator (UTM) coordinates in the 1983 North American Datum (NAD83). Ground elevations for sources entered into the model should be obtained from the facility; as-built ground elevations may be different from publicly available terrain information.

AERMOD can compute concentrations for point, area, or volume sources; emissions should be entered using the most representative source type. Each emission unit or process listed in the permit should be included in the analysis. If an emission unit vents out multiple locations, each release location should be included discretely as well. Analyzed emission rates should reflect the short-term maximum (hourly) permit limitation.

Based on USEPA dispersion modeling guidance, most locations in Wisconsin will use 'rural' dispersion coefficients. Only a portion of the Milwaukee metropolitan area is considered 'urban' under the Irwin/Auer land use technique. For facility locations within the 'urban' area, the analysis should use a population of 1,000,000 (based on Milwaukee County) and a roughness length of 1.0 meter in AERMOD. Refer to Appendix A for the location of the 'urban' area.

Source Parameters

The following information is necessary for each source that is entered into AERMOD

Point Source:

- Stack height as measured from the ground or finished floor elevation
- Stack inside circular diameter at the release point
- Exit gas velocity (refer to Operational Loads for more information); stacks that do not allow vertical unobstructed release of gas while the process is operating should be analyzed with an exit gas velocity of 0.01 ms^{-1} (POINTCAP or POINTHOR cannot be used)
- Exit gas temperature (refer to Operational Loads for more information); stacks emitting at outdoor ambient temperature should be analyzed with a gas temperature of -0.1 K

Area Source:

- Release height above ground
- Lateral dimensions of source, either square, rectangular, circular, or polygon
- Initial vertical mixed dimension, if applicable

Volume (or Line) Source:

- Center of initial volume above ground
- Initial estimate of lateral dispersion coefficient; volume sources are assumed to be small and square in the lateral dimension, so multiple volume sources may be needed for large and /or irregularly shaped emissions
- Initial estimate of vertical dispersion coefficient

Operational Loads or Scenarios

The emissions from certain stack vented emission units can have variable exhaust parameters (exit gas velocity and temperature) as emission rates vary. Other types of emission units may be either 'on' or 'off' with limited variation. The dispersion modeling analysis should capture all possible emission load scenarios for each unit.

For an emission unit, multiple load conditions can be analyzed separately and the resulting worst-case impact determined. One load scenario must reflect the stack conditions when emitting at the maximum permit emission rate. Alternatively, a single stack can be analyzed for an emission unit assuming the exit gas velocity and temperature expected to occur most often (normal conditions) along with the maximum permit limitation.

If all emission units at the facility cannot operate simultaneously, and the applicant will propose permit limitations to this effect, the dispersion modeling analysis can be adjusted to reflect this scenario. Similarly, if the facility proposes permit limitations on the hours of operation per day or per year, the dispersion modeling analysis can also be adjusted.

Flares

In accordance with USEPA Region V policy, external flares (those with visible flame) are modeled using the following methodology:

- Stack height is the level above ground of gas release
- Exit gas temperature is set to 1273 K
- Exit gas velocity is set to 20 ms^{-1}
- Stack diameter = $9.88E\text{-}4(Q_h)^{0.5}$, where $Q_h = 0.45H$ and H = total heat release in cal/sec

Fugitive (non-point source) Emissions

Emissions created within a structure that are not vented to a stack but are considered in aggregate in the permit should be included in the dispersion modeling analysis. Similarly, any outdoor source (e.g. tank or pond) that will be considered in the permit should be included in the analysis. The most representative AERMOD source type should be assumed.

Fugitive Dust

When fugitive dust emissions originating on the facility property are affected by the permit, those emissions should be included in the dispersion modeling analysis. The most representative AERMOD source type should be assumed.

If the impact of emissions from wind erosion is analyzed, the AERMOD emission factor can be used to allow concentration calculation for only the highest wind speed category (WSPEED 0 0 0 0 0 1). When fugitive dust from roadways will be analyzed, the provisions of the USEPA Haul Road Workgroup Final Report should be followed. The report is available at http://www.epa.gov/ttn/scram/reports/Haul_Road_Workgroup-Final_Report_Package-20120302.pdf

Intermittent Emissions

Emission units are considered intermittent when they do not have a set operating schedule, operate for short periods of time during the year (generally outside of the facilities' control) and do not contribute to the normal operation of the facility. An intermittent source is not defined by a specific number of yearly operating hours. Emergency generators as defined by Chapters NR 400, NR 406, and NR 436, *Wis. Adm. Code* and emergency fire pumps are considered intermittent. Operation of an emission unit that meets the definition of "essential service" in Section NR 445.02(6), *Wis. Adm. Code* is also considered intermittent. If a facility proposes permit conditions for a given emission unit consistent with intermittent operation, that emission unit does not have to be included in the dispersion modeling analysis.

Building Downwash

Aerodynamic building downwash effects can greatly affect dispersion modeling concentrations. Dispersion modeling analyses should include the geometry of the buildings by utilizing the Building Profile Input Program for PRIME (BPIP-PRIME). Building base elevations should be determined from the facility plot plan (required as part of complete permit application) or construction plan and should match the associated source base elevations.

Structures that are four feet or less above ground level should not be entered into BPIP-PRIME. All other structures that present a solid face from the ground to the top of the structure and that have angled corners should be included. Average roof heights should be used for peaked or sloped tiers. Structures off the ground (e.g. on stilts) should not be included. Single, individual silos that are taller than they are wide should also not be included. But groupings of silos should be included in addition to large, wide circular grain bins using the eave height as the structure height.

Stacks of any shape or size should not be considered. Any enclosure built to enhance the appearance of the stack should also not be entered into BPIP-PRIME.

Structures with several roof heights should be entered into BPIP-PRIME as a single building with multiple tiers. The lowest tier should completely encompass the foot print of the structure, with higher tiers assumed to be stacked on top of the lower tiers, similar to a wedding cake. Do not enter each roof height as a single building (similar to books on a bookshelf).

RECEPTOR INFORMATION

Receptors should be placed where the modeled impact to ambient air is greatest, taking into account topography, residences, building downwash, and meteorology. Cartesian receptor grids should be used, with additional receptors near the ambient air boundary and sensitive locations. Polar coordinate grids should not be used.

Ambient Air (Fence) Boundary

Ambient air is the portion of the atmosphere to which the general public has access. Ambient air is not the atmosphere over buildings or the air over land owned by the source to which public access is precluded by a fence or other physical barrier. Active work areas of a facility (e.g. conveyors, piles, trailers, etc.) are generally not considered ambient air, but parking lots, public roadways, and public waterways are ambient air.

Any installed fence must be permanent and meet the dictionary definition of a fence. Ambient air boundaries must enclose an area (other than driveway or pedestrian access) for receptors to be eliminated within that area.

Note that analysis of compounds regulated under Chapter NR 445, *Wis. Adm. Code* considers modeled impact off the facility property. Applicants can use the property line receptor grid only for NR 445 analysis.

Receptor Spacing

With limited exception, receptors should be placed as follows:

- along the ambient air boundary every 25 meters
- on a Cartesian grid with 25-meter spacing extending from the ambient air boundary to 500 meters from the sources
- on a 50-meter spaced grid from 500 meters to 1000 meters from the sources
- on a 100-meter spaced grid from 1000 meters to 2000 meters from the sources
- on a 250-meter spaced grid from 2000 meters to 5000 meters from the sources
- on a 500-meter spaced grid from 5 kilometers to 10 kilometers from the sources

If the location of the maximum impact is not within 1000 meters of the sources, additional 50-meter spaced grids should be used in the area of maximum impact.

Terrain Considerations

Receptor elevations and hill scaling heights should be determined using AERMAP, the AERMOD terrain processor. A recent tile of 1/3 arc second National Elevation Dataset (NED) information should be obtained from the U.S. Geologic Survey (USGS) and used in AERMAP. The data can be downloaded from the National Map Viewer at http://nationalmap.gov/viewer.html. The extent of the terrain information and the AERMAP domain should encompass a minimum of 10 kilometers beyond the furthest extent of the receptor grid. For receptors extending 10 km from the source in all directions, the terrain information and the AERMAP domain should have lateral dimensions of 40 km by 40 km.

Receptors placed above the terrain (i.e. set on a flag pole) are not used in regulatory dispersion modeling. Ambient air is represented by ground level concentrations and the default mode in AERMOD assumes a receptor height of zero meters above ground level.

METEOROLOGICAL DATA

Pre-processed meteorological data for use in AERMOD is provided on the WDNR Dispersion Modeling web page at http://dnr.wi.gov/topic/AirPermits/Modeling.html. AERMOD implementation guidance stresses the importance of using a meteorological data set that is representative of both the meteorological characteristics and the surface roughness characteristics of the application location. To aid in meteorological data selection, aerial photos centered on the anemometer are available for each station on the web page. WDNR modeling staff can be consulted with any selection questions.

AIR QUALITY IMPACT RESULTS

Significant Impact Analysis – Class II

The impact of the emissions from the proposed project can be analyzed relative to the Significant Impact Levels (SILs). The level of each SIL is established by federal guidance and not by rule, except in the case of $PM_{2.5}$. If the project involves the permanent shut down of existing, permitted emission units, credit (other than for NO_x) can be taken in the SIL analysis and those units modeled with a negative emission rate. Where credit is taken for permanent shut down emissions, it should be shown that the credited emissions would not have solely caused modeled exceedance of any ambient air standard.

PSD Class II Significant Impact Levels

POLLUTANT	SIL	AVERAGING TIME	STATISTIC/METRIC
Carbon Monoxide	2,000 µg/m^3 500 µg/m^3	1-hour 8-hour	1st Highest 1st Highest
Nitrogen Dioxide	7.4 µg/m^3 1.0 µg/m^3	1-hour Annual	5-Yr Avg 1st High HrDay 1st Highest
Particulate Matter Less than 10 Microns (PM_{10})	5 µg/m^3 1.0 µg/m^3	24-hour Annual	1st Highest 1st Highest
Particulate Matter Less than 2.5 Microns ($PM_{2.5}$)*	1.2 µg/m^3 0.3 µg/m^3	24-hour Annual	5-Yr Avg 1st High Day 5-yr Avg Year
Sulfur Dioxide	7.8 µg/m^3 25 µg/m^3 5 µg/m^3 1.0 µg/m^3	1-hour 3-hour 24-hour Annual	5-Yr Avg 1st High HrDay 1st Highest 1st Highest 1st Highest

** Refer to discussion under "January 22, 2013 D.C. Circuit Court Decision (SIL)"*

If the impact of the proposed project is less than the SIL, no further modeling for that pollutant and time period is required; the project has been shown to not cause or exacerbate a violation of an ambient air quality standard or ambient air increment for that pollutant and time period.

January 22, 2013 D.C. Circuit Court Decision (SIL)

On January 22, 2013 a decision was issued by the Washington D.C. Circuit Court that vacated and remanded the federal $PM_{2.5}$ SIL. The court took issue with USEPA's existing SIL regulations, which allows no discretion for requiring a more extensive modeling analysis in certain circumstances. As a result, applicants should assess the $PM_{2.5}$ air quality around their facility to establish the viability of using the SIL. If ambient air design value concentrations of $PM_{2.5}$ (24-hour or annual) are within the SIL concentration of the standard, a full PSD impact analysis for $PM_{2.5}$ should be performed, including background emission sources and background concentrations. Applicants will generally be able to rely on existing WDNR monitoring data to determine if the full PSD impact analysis for $PM_{2.5}$ will be required.

PSD Increment Analysis

If the impact of the emissions from the proposed project is above the SIL, a PSD increment analysis should be performed for those pollutants and time periods. The impact of the proposed project's allowable emission rate plus increment-consuming sources in the immediate area must be below the Class II increment concentrations.

PSD Class II Increment Concentrations

POLLUTANT	CLASS II INCREMENT	AVERAGING TIME	STATISTIC/METRIC
Carbon Monoxide	None	N/A	N/A
Nitrogen Dioxide	25 µg/m^3	Annual	1st Highest
Particulate Matter Less than 10 Microns (PM_{10})	30 µg/m^3	24-hour	High 2nd Highest
	17 µg/m^3	Annual	1st Highest
Particulate Matter Less than 2.5 Microns ($PM_{2.5}$)	9.0 µg/m^3	24-hour	High 2nd Highest
	4.0 µg/m^3	Annual	1st Highest
Sulfur Dioxide	512 µg/m^3	3-hour	High 2nd Highest
	91 µg/m^3	24-hour	High 2nd Highest
	20 µg/m^3	Annual	1st Highest

The first complete (as determined by WDNR permit staff) PSD application in a county will establish the minor source baseline date, otherwise known as the baseline date, for that county and pollutant. The baseline is set for the entire county once the PSD application is complete, regardless of the level of impact.

Where the baseline has been previously set (refer to the WDNR Dispersion Modeling web page at http://dnr.wi.gov/topic/AirPermits/Modeling.html), additional increment consuming sources may exist near the facility. Additional increment consuming sources will be identified by WDNR during the protocol process.

As with SIL analysis, credit (other than for NO_x) can be taken for permanent removal of certain emission units. If the unit existed prior to the baseline date and will be permanently shut down, those emissions are considered to expand the available increment and can be modeled with a negative emission rate. If credit is taken for permanent shut down emissions, it should be shown that the credited emissions would not have solely caused modeled exceedance of any ambient air standard.

NAAQS Analysis

If the impact of the emissions from the proposed project is above the SIL, an analysis should be performed of the impact relative to the NAAQS for those pollutants and time periods (in addition to the increment analysis). The impact of the allowable emissions from the facility and the allowable emissions from nearby sources plus the background concentration must be below the NAAQS.

National Ambient Air Quality Standards

POLLUTANT	NAAQS	AVERAGING TIME	STATISTIC/METRIC
Lead	0.15 µg/m^3	3-month	1st Highest
Carbon Monoxide	40,000 µg/m^3 10,000 µg/m^3	1-hour 8-hour	High 2nd Highest High 2nd Highest
Nitrogen Dioxide	188 µg/m^3 100 µg/m^3	1-hour Annual	5-Yr Avg 8th High HrDay 1st Highest
Particulate Matter Less than 10 Microns (PM_{10})	150 µg/m^3	24-hour	6th Highest in 5 Years
Particulate Matter Less than 2.5 Microns ($PM_{2.5}$)	35 µg/m^3 12.0 µg/m^3	24-hour Annual	5-Yr Avg 8th High Day 5-yr Avg Year
Sulfur Dioxide	196 µg/m^3 1,300 µg/m^3 365 µg/m^3 80 µg/m^3	1-hour 3-hour 24-hour Annual	5-Yr Avg 4th High HrDay High 2nd Highest High 2nd Highest 1st Highest

Every NAAQS analysis for PSD applications should include both the discrete impact of nearby sources and the regional background concentration. Additional sources to be included in the NAAQS analysis will be identified by WDNR during the protocol process.

Background Concentration

Background concentrations are added to modeled concentrations to estimate the total air quality impact relative to the NAAQS. Regional background values include the impact of both distant emissions as well as those of mobile sources and fugitive releases. Please refer to the WDNR Dispersion Modeling web page (http://dnr.wi.gov/topic/AirPermits/Modeling.html) for regional background concentrations.

Secondary Formation Analysis

In January 2012, USEPA agreed to initiate rulemaking to incorporate new analytical techniques for modeling the secondary formation of ozone and $PM_{2.5}$. Until that rule is finalized, permits that will go through the PSD process for NO_x, SO_2, or VOC should submit an analysis of the impact of secondary formation of ozone (NO_x and VOC) and $PM_{2.5}$ (NO_x and SO_2). Consistent with USEPA guidance first released in March 2013, most analyses of secondary formation will use a qualitative, or weight-of-evidence, approach. Examples of these types of analyses are available from prior PSD permit applications in Wisconsin as well as USEPA (http://www.epa.gov/scram001/).

NO_x-to-NO_2 Conversion

Emissions of NO_x react in the presence of sunlight and ozone to become NO_2. NO_2 is also reactive and can convert into other compounds. To account for these reactions, USEPA provides for three tiers of conversion. Tier 1 assumes all NO_x becomes and remains NO_2. Tier 2 currently assumes that over the course of a year, 75 percent of the NO_x is NO_2 on average. Tier 2 also assumes that 80 percent of the NO_x is NO_2 in any given hour. This ambient ratio method (ARM) provides that modeled impacts of NO_x emissions can be multiplied by 0.75 on an annual basis and 0.8 on the hourly basis to convert to NO_2 impact.

Tier 3 conversion uses one of the two algorithms within AERMOD that incorporates hourly ozone concentrations to convert NO_x emissions into NO_2 for each modeled hour. These methods are considered alternate model techniques under the Guideline on Air Quality Models and require USEPA concurrence on their use. WDNR dispersion modeling staff should be contacted prior to proposing either Tier 3 conversion algorithm.

All three tiers of NO_x-to-NO_2 conversion are classified as screening techniques, and negative emission rates (credit rates) cannot be used to account for emission reductions when analyzing net impacts relative to the NO_2 SIL increment. WDNR dispersion modeling staff should be contacted if applicants propose alternative methods for addressing negative emissions.

ADDITIONAL IMPACT ANALYSIS

PSD permit applicants must prepare an additional impact analysis for each pollutant subject to PSD (i.e. each pollutant with emissions greater than the respective PSD Significant Emission Rate threshold). This analysis assesses the impacts of the proposed or modified facility on industrial growth, soils and vegetation, and visibility in the vicinity of the facility. The depth of the analysis generally will depend on existing air quality, the quantity of emissions, and the sensitivity of local soils, vegetation, and visibility in the source impact area. Data from the additional impacts analysis should be presented so that it is logical and understandable to the interested public.

Growth Analysis

The growth analysis is an estimate of the projected residential, commercial, and industrial growth that may occur as a result of the project and an estimate of the emissions associated with the growth as well as from any construction-related activities.

Soils & Vegetation Analysis

The soils and vegetation analysis should be based on an inventory of the soil and vegetation types found in the impact area. This inventory should include all vegetation with any commercial or recreational value. For most types of soil and vegetation, ambient concentrations of criteria pollutants below the NAAQS will not result in harmful effects.

Local Visibility Analysis

The local visibility analysis is concerned with impacts that occur within the area affected by the PSD-applicable emissions. This analysis is separate and distinct from the Class I area visibility requirement. The suggested components of the local visibility analysis include a determination of the visual quality of the area and initial screening of emission sources to assess the possibility of visibility impairment. Under certain meteorological conditions the stacks will emit a visible steam plume that, after traveling a relatively short distance, will dissipate by dispersion and evaporation. A visible steam plume may occur when ambient air temperatures are relatively low with respect to plume temperature and ambient humidity levels are relatively high. The persistence of the plume is dependent upon wind speed and the time required for evaporation. If a more in-depth analysis is warranted, please refer to the 1988 USEPA document, "Workbook for Plume Visual Impact Screening and Analysis", available from USEPA at http://www.epa.gov/ttn/scram/userg/screen/WB4PlumeVisualOCR.pdf.

PSD CLASS I ANALYSIS

Under the PSD program, areas of special national or regional natural, scenic, recreational, or historic value are provided special protection. As of 2016, Wisconsin has two PSD Class I areas: Rainbow Lake Wilderness Area and certain lands of the Forest County Potawatomi Community.

WDNR must provide notification to the Land Manager of a Class I area if a proposed new major source or major modification may affect a Class I area. Generally, the Land Manager will be notified of applications at facilities within 100 km (62 miles) of a Class I area. In addition, WDNR will notify the Land Manager of PSD applications from sources located within 300 km of a Class I area for purposes of an Air Quality Related Value (AQRV) analysis. Refer to the WDNR Dispersion Modeling web page (http://dnr.wi.gov/topic/AirPermits/Modeling.html) for maps and details on the PSD Class I areas in Wisconsin.

Class I Significant Impact & Increment

PSD applications at facilities located within 100 km of a Class I area should assess their impact on the Class I area. The analysis follows the same methods as for Class II areas (i.e. SIL, then increment and NAAQS) but the specific concentrations thresholds are lower in the Class I area.

PSD Class I Threshold Concentrations

POLLUTANT	**CLASS I SIL**	**AVERAGING TIME**	**STATISTIC/METRIC**
Nitrogen Dioxide	0.1 µg/m^3	Annual	1st Highest
Particulate Matter Less than 10 Microns (PM_{10})	0.3 µg/m^3 0.2 µg/m^3	24-hour Annual	1st Highest 1st Highest
Particulate Matter Less than 2.5 Microns ($PM_{2.5}$)	0.07 µg/m^3 0.06 µg/m^3	24-hour Annual	5-Yr Avg 1st High Day 5-yr Avg Year
Sulfur Dioxide	1.0 µg/m^3 0.2 µg/m^3 0.1 µg/m^3	3-hour 24-hour Annual	1st Highest 1st Highest 1st Highest

POLLUTANT	**CLASS I INCREMENT**	**AVERAGING TIME**	**STATISTIC/METRIC**
Nitrogen Dioxide	2.5 µg/m^3	Annual	1st Highest
Particulate Matter Less than 10 Microns (PM_{10})	8 µg/m^3 4 µg/m^3	24-hour Annual	High 2nd Highest 1st Highest
Particulate Matter Less than 2.5 Microns ($PM_{2.5}$)	2.0 µg/m^3 1.0 µg/m^3	24-hour Annual	High 2nd Highest 1st Highest
Sulfur Dioxide	25 µg/m^3 5 µg/m^3 2 µg/m^3	3-hour 24-hour Annual	High 2nd Highest High 2nd Highest 1st Highest

The latest version of AERMOD is the recommended dispersion model for the near-field analysis, i.e. within 50 km of the source. To examine impacts to Class I areas when the source is located further away, a receptor can be placed 50 km from the source in the direction of the Class I area at a comparable ground elevation, and the resulting AERMOD calculated impact compared to the values. If this modeled concentration is above the threshold, long-range transport models should be used to refine the estimated impact to the Class I area.

Air Quality Related Values

An Air Quality Related Value (AQRV) is a features or property of the Class I area that could be adversely affected by air pollution, even if the pollutant concentrations are below the Class I increments. Land Managers are responsible for protecting AQRVs and will advise the applicant of the level of analysis needed to assess potential impacts on the resource. Refer to the WDNR Dispersion Modeling web page (http://dnr.wi.gov/topic/AirPermits/Modeling.html), for the appropriate Land Manager contact of the specified Class I area.

Forest County Potawatomi Class I Area

A portion of the Forest County Potawatomi Community (FCPC) Reservation was designated as a tribal (non-federal) Class I area in 2008. The State of Wisconsin negotiated an agreement with FCPC that provides the framework for implementation of Class I area provisions. Proposed PSD permit applications from facilities farther than 10 miles from the FCPC Class I area are subject to an increment analysis and consumption requirements using Class II standards, rather than Class I standards.

FCPC has identified three AQRVs: aquatic systems and water quality; visibility and night skies; and vegetation and has provided WDNR with threshold effect levels. Threshold effect levels for visibility and sulfur/nitrogen deposition were recognized on August 7, 2014. The current status of discussions with the FCPC on AQRV's and threshold levels can be found at the WDNR Dispersion Modeling web page (http://dnr.wi.gov/topic/AirPermits/Modeling.html) under the PSD Class I areas tab. Additional documentation and agreements relative to FCPC AQRV analysis are found at the same web location.

SUBMITTAL REQUIREMENTS

Prior to performing detailed dispersion modeling, WDNR recommends that a protocol document be submitted and approved. The agreed-upon protocol will establish the most recent federal and state guidance and policy to follow in the dispersion modeling analysis. However, at the time of submission of the draft permit to USEPA, the dispersion modeling will have to follow the guidance and policy in place at that time. Every effort will be made to notify applicants of notable changes to policy.

In addition to the standard permit application forms, a detailed report of the dispersion modeling should be submitted. This report (preferably in electronic form) should contain provisions from the dispersion modeling protocol plus details on source parameters, emission rates, and modeled scenarios. This report should also contain pertinent information on secondary formation analyses and should indicate if the Tier 3 NO_x-to-NO_2 conversion algorithms were used. While a facility plot plan (indicating true north, all peak and edge tier heights, and stack locations) is considered part of a complete permit application, the dispersion modeling report should also contain additional information on the specific geographic location of all stacks and structures with enough detail to accurately locate the facility in Wisconsin. The full set of dispersion modeling files should also be submitted, both input and output files from AERMOD and the building downwash analysis. If using commercial software, the full archive can be submitted – including any specific files. Electronic dispersion modeling files can be transmitted in a multitude of ways, including email (~15Mb limit per message), file transfer protocol (FTP), disc (CD or DVD), or any other accessible service.

Air Dispersion Modeling Guidelines for Minor NSR Projects

Contents

OVERVIEW

This document provides general information about the dispersion modeling performed in association with minor source (below Prevention of Significant Deterioration [PSD] threshold) construction permit applications. Dispersion modeling analyses are used to support the limitations contained in the air permit. Due to uncertainties in both the emission estimates and the compliance tests used to demonstrate emission limits are being met, dispersion modeling is used to set a theoretical limit on the emission rate rather than basing the emission rate on physical characteristics of the emission source.

Applicants are not required to submit an air quality analysis, but any analysis performed should be consistent with this document, Federal Guidance 40 CFR Part 51 Appendix W (Guideline on Air Quality Models), and information available from the U.S. Environmental Protection Agency (USEPA) Support Center for Regulatory Atmospheric Modeling (SCRAM) website at http://www.epa.gov/scram001.

The Wisconsin Department of Natural Resources (WDNR) is required to make a determination of impact to ambient air prior to permit issuance in order to show that a source will not cause or exacerbate a violation of an air quality standard. This determination can take the form of a dispersion modeling analysis, but dispersion modeling is not specifically a criterion of permit approvability.

When dispersion modeling is performed, the analysis should show that the impact of the emissions from the new or modified source, in conjunction with applicable emissions from other existing sources, will not cause or exacerbate a violation of any applicable National Ambient Air Quality Standards (NAAQS) or PSD increment. An initial analysis evaluates the potential increase of emission from the project or the net increase associated with the modification to determine if the emissions have a significant impact. If a full facility analysis is required, then existing emission units at the facility are included along with any applicable nearby facilities, as well as regional background concentrations.

Special Note Regarding $PM_{2.5}$

Pursuant to Section 285.63(1)(b), *Wisconsin Statutes*, WDNR has concluded that direct emissions of $PM_{2.5}$ from existing sources, minor new sources, and minor modifications of sources will not cause or exacerbate violations of any $PM_{2.5}$ standard or increment. The details of this determination are available in the Technical Support Document titled *Air Quality Review of Industrial $PM_{2.5}$ Emissions from Stationary Sources in Wisconsin*, dated February 2016 and attached as Appendix B.

SOURCE & MODEL INFORMATION

WDNR uses the latest version of the regulatory model AERMOD for dispersion modeling analyses. Source locations should be entered with Universal Transverse Mercator (UTM) coordinates in the 1983 North American Datum (NAD83). Ground elevations for sources entered into the model should be obtained from the facility; as-built ground elevations may be different from publicly available terrain information.

AERMOD can compute concentrations for point, area, or volume sources; emissions should be entered using the most representative source type. Each emission unit, or process listed in a permit, should be included in the analysis. If an emission unit vents out multiple locations, each release location should be included discretely as well. Analyzed emission rates should reflect the short-term maximum (hourly) permit limitation.

Based on USEPA dispersion modeling guidance, most locations in Wisconsin will use 'rural' dispersion coefficients. Only a portion of the Milwaukee metropolitan area is considered 'urban' under the Irwin/Auer land use technique. For facility locations within the 'urban' area, the analysis should use a population of 1,000,000 (based on Milwaukee County) and a roughness length of 1.0 meter in AERMOD. Refer to Appendix A for the location of the 'urban' area.

Source Parameters

The following information is necessary for each source that is entered into AERMOD.

Point Source:

- Stack height as measured from the ground or finished floor elevation
- Stack inside circular diameter at the release point
- Exit gas velocity (refer to Operational Loads for more information); stacks that do not allow vertical unobstructed release of gas while the process is operating should be analyzed with an exit gas velocity of 0.01 ms^{-1} (POINTCAP or POINTHOR cannot be used)
- Exit gas temperature (refer to Operational Loads for more information); stacks emitting at outdoor ambient temperature should be analyzed with a gas temperature of -0.1 K.

Area Source:

- Release height above ground
- Lateral dimensions of source, either square, rectangular, circular, or polygon
- Initial vertical mixed dimension, if applicable

Volume (or Line) Source:

- Center of initial volume above ground
- Initial estimate of lateral dispersion coefficient; volume sources are assumed small and square in the lateral dimension, so multiple volume sources may be needed for large and /or irregularly shaped emissions
- Initial estimate of vertical dispersion coefficient

Operational Loads or Scenarios

The emissions from certain stack vented emission units can have variable exhaust parameters (exit gas velocity and temperature) as emission rates vary. Other types of emission units may be either 'on' or 'off' with limited variation. The dispersion modeling analysis should capture all possible emission load scenarios for each unit.

For an emission unit, multiple load conditions can be analyzed separately and the resulting worst-case impact determined. One load scenario must reflect the stack conditions when emitting at the maximum permit emission rate. Alternatively, a single stack can be analyzed for an emission unit assuming the exit gas velocity and temperature expected to occur most often (normal conditions) along with the maximum permit limitation.

If all emission units at the facility cannot operate simultaneously, and the applicant will propose permit limitations to this effect, the dispersion modeling analysis can be adjusted to reflect this scenario. Similarly, if the facility proposes permit limitations on the hours of operation per day or per year, the dispersion modeling analysis can also be adjusted.

Flares

In accordance with USEPA Region V policy, external flares (those with a visible flame) are modeled using the following methodology:

- Stack height is the level above ground of gas release
- Exit gas temperature is set to 1273 K
- Exit gas velocity is set to 20 ms^{-1}
- Stack diameter = $9.88E\text{-}4(Q_h)^{0.5}$, where $Q_h = 0.45H$ and H = total heat release in cal/sec

Fugitive (non-point source) Emissions

Emissions created within a structure that are not vented to a stack but are considered in the permit in aggregate should be included in the dispersion modeling analysis. Similarly, any outdoor source (e.g. tank or pond) that will be considered in the permit should be included in the analysis. The most representative AERMOD source type should be assumed. Due to large uncertainties associated with establishing rates and the difficulties in modeling them, fugitive dust emissions (e.g. roadways, piles, dumping, crushing, etc.) are considered only for PSD applications.

Intermittent Emissions

Emission units are considered intermittent when they do not have a set operating schedule, operate for short periods of time during the year (generally outside of the facilities' control) and do not contribute to the normal operation of the facility. An intermittent source is not defined by a specific number of yearly operating hours. Emergency generators as defined by Chapters NR 400, NR 406, and NR 436, *Wis. Adm. Code* and emergency fire pumps are considered intermittent. Operation of an emission unit that meets the definition of "essential service" in Section NR 445.02(6), *Wis. Adm. Code* is also considered intermittent. If a facility proposes permit conditions for a given emission unit consistent with intermittent operation, that emission unit does not have to be included in the dispersion modeling analysis.

Building Downwash

Aerodynamic building downwash effects can greatly affect dispersion modeling concentrations. Dispersion modeling analyses should include the geometry of the buildings by using the Building Profile

Input Program for PRIME (BPIP-PRIME). Building base elevations should be determined from the facility plot plan (required as part of a complete permit application) or construction plan, and should match the associated source base elevations.

Structures that are four feet or less above ground level should not be entered into BPIP-PRIME. All other structures that present a solid face from the ground to the top of the structure and that have angled corners should be included. Average roof heights should be used for peaked or sloped tiers. Structures off the ground (e.g. on stilts) should not be included. Single, individual silos that are taller than they are wide should also not be included. But groupings of silos should be included in addition to large, wide circular grain bins using the eave height as the structure height.

Stacks of any shape or size should not be considered. Any enclosure built to enhance the appearance of the stack should also not be entered into BPIP-PRIME.

Structures with several roof heights should be entered into BPIP-PRIME as a single building with multiple tiers. The lowest tier should completely encompass the foot print of the structure, with higher tiers assumed to be stacked on top of the lower tiers, similar to a wedding cake. Do not enter each roof height as a single building (similar to books on a bookshelf).

RECEPTOR INFORMATION

Receptors should be placed where the modeled impact to ambient air is greatest, taking into account topography, residences, building downwash, and meteorology. Cartesian receptor grids should be used, with additional receptors near the ambient air boundary and sensitive locations. Polar coordinate grids should not be used.

Ambient Air (Fence) Boundary

Ambient air is the portion of the atmosphere to which the general public has access. Ambient air is not the atmosphere over buildings or the air over land owned by the source to which public access is precluded by a fence or other physical barrier. Active work areas of a facility (e.g. conveyors, piles, trailers, etc.) are generally not considered ambient air, but parking lots, public roadways, and public waterways are ambient air.

Any installed fence must be permanent and meet the dictionary definition of a fence. Ambient air boundaries must enclose an area (other than driveway or pedestrian access) for receptors to be eliminated within that area.

Note that analysis of compounds regulated under Chapter NR 445, *Wis. Adm. Code* considers modeled impact off the facility property. Applicants can use the property line receptor grid only for NR 445 analysis.

Receptor Spacing

With limited exception, receptors should be placed as follows:

- along the ambient air boundary every 25 meters
- on a Cartesian grid with 25-meter spacing extending from the ambient air boundary to 500 meters from the sources
- 50-meter spaced grid from 500 meters to 1000 meters from the sources

Additional receptors can be placed beyond 1000 meters to assess possible impacts.

If the location of the maximum impact is not within 1000 meters of the sources, additional 50-meter spaced grids should be used in the area of maximum impact.

Terrain Considerations

Receptor elevations and hill scaling heights should be determined using AERMAP, the AERMOD terrain processor. A recent tile of 1/3 arc second National Elevation Dataset (NED) information should be obtained from the U.S. Geologic Survey (USGS) and used in AERMAP. The data can be downloaded from the National Map Viewer at http://nationalmap.gov/viewer.html. The extent of the terrain information and the AERMAP domain should encompass a minimum of 10 kilometers beyond the furthest extent of the receptor grid. For receptors extending 1 km from the source in all directions, the terrain information and the AERMAP domain should have lateral dimensions of 22 km by 22 km.

Receptors placed above the terrain (i.e. set on a flag pole) are not used in regulatory dispersion modeling. Ambient air is represented by ground level concentrations and the default mode in AERMOD assumes a receptor height of zero meters above ground level.

METEOROLOGICAL DATA

Pre-processed meteorological data for use in AERMOD is provided on the WDNR Dispersion Modeling web page at http://dnr.wi.gov/topic/AirPermits/Modeling.html. AERMOD implementation guidance stresses the importance of using a meteorological data set that is representative of both the meteorological characteristics and the surface roughness characteristics of the application location. To aid in meteorological data selection, aerial photos centered on the anemometer are available for each station on the web page. WDNR modeling staff can be consulted with any selection questions.

AIR QUALITY IMPACT RESULTS

Significant Impact Analysis – Class II

The impact of the emissions from the proposed project can be analyzed relative to the Significant Impact Levels (SILs). The level of each SIL is established by federal guidance and not by rule. If the project involves the permanent shut down of existing, permitted emission units, credit (other than for NO_x) can be taken in the SIL analysis and those units modeled with a negative emission rate. Where credit is taken for permanent shut down emissions, it should be shown that the credited emissions would not have solely caused modeled exceedance of any ambient air standard.

PSD Class II Significant Impact Levels

POLLUTANT	SIL	AVERAGING TIME	STATISTIC/METRIC
Carbon Monoxide	2,000 μg/m^3	1-hour	1st Highest
	500 μg/m^3	8-hour	1st Highest
Nitrogen Dioxide	1.0 μg/m^3	Annual	1st Highest
Particulate Matter Less than 10 Microns (PM_{10})	5 μg/m^3	24-hour	1st Highest
	1.0 μg/m^3	Annual	1st Highest
Sulfur Dioxide	25 μg/m^3	3-hour	1st Highest
	5 μg/m^3	24-hour	1st Highest
	1.0 μg/m^3	Annual	1st Highest

If the impact of the proposed project is less than the SIL, no further modeling for that pollutant and time period is required; the project has been shown to not cause or exacerbate a violation of an ambient air quality standard or ambient air increment for that pollutant and time period.

PSD Increment Analysis

If the impact of the emissions from the proposed project is above the SIL, and the facility is located in a county where the minor source baseline has been set, a PSD increment analysis should be performed for those pollutants and time periods. Refer to the WDNR Dispersion Modeling web page (http://dnr.wi.gov/topic/AirPermits/Modeling.html) for baseline status. Additional increment consuming sources near the facility will be included in the analysis. The impact of the proposed project's allowable emission rate plus increment consuming sources in the immediate area must be below the Class II increment concentrations.

PSD Class II Increment Concentrations

POLLUTANT	CLASS II INCREMENT	AVERAGING TIME	STATISTIC/METRIC
Carbon Monoxide	None	N/A	N/A
Nitrogen Dioxide	25 μg/m^3	Annual	1st Highest
Particulate Matter Less than 10 Microns (PM_{10})	30 μg/m^3 17 μg/m^3	24-hour Annual	High 2nd Highest 1st Highest
Sulfur Dioxide	512 μg/m^3 91 μg/m^3 20 μg/m^3	3-hour 24-hour Annual	High 2nd Highest High 2nd Highest 1st Highest

The first complete (as determined by WDNR permit staff) PSD application in a county establishes the minor source baseline date, otherwise known as the baseline date, for that county and pollutant. The baseline is set for the entire county once the PSD application is complete, regardless of the level of impact.

As with SIL analysis, credit (other than for NO_x) can be taken for permanent removal of certain emission units. If the unit existed prior to the baseline date and will be permanently shut down, those emissions are considered to expand the available increment and can be modeled with a negative emission rate. If credit is taken for permanent shut down emissions, it should be shown that the credited emissions would not have solely caused a modeled exceedance of any ambient air standard.

NAAQS Analysis

If the impact of the emissions from the proposed project is above the SIL, an analysis should be performed of the impact relative to the NAAQS for those pollutants and time periods (in addition to the increment analysis, if applicable). The impact of the allowable emissions from the facility added to the background concentration must be below the NAAQS.

National Ambient Air Quality Standards

POLLUTANT	NAAQS	AVERAGING TIME	STATISTIC/METRIC
LEAD	0.15 µg/m^3	3-MONTH	1ST HIGHEST
CARBON MONOXIDE	40,000 µg/m^3 10,000 µg/m^3	1-HOUR 8-HOUR	HIGH 2ND HIGHEST HIGH 2ND HIGHEST
NITROGEN DIOXIDE	100 µg/m^3	ANNUAL	1ST HIGHEST
PARTICULATE MATTER LESS THAN 10 MICRONS (PM_{10})	150 µg/m^3	24-HOUR	6TH HIGHEST IN 5 YEARS
SULFUR DIOXIDE	1,300 µg/m^3 365 µg/m^3 80 µg/m^3	3-HOUR 24-HOUR ANNUAL	HIGH 2ND HIGHEST HIGH 2ND HIGHEST 1ST HIGHEST

Background Concentration

Background concentrations are added to modeled concentrations to estimate the total air quality impact relative to the NAAQS. Regional background values include the impact of both distant emissions as well as those of mobile sources and fugitive releases. Please refer to the WDNR Dispersion Modeling web page (http://dnr.wi.gov/topic/AirPermits/Modeling.html) for regional background concentrations.

NO_x-to-NO_2 Conversion

Emissions of NO_x react in the presence of sunlight and ozone to become NO_2. NO_2 is also reactive and can convert into other compounds. To account for these reactions, USEPA provides for three tiers of conversion. Tier 1 assumes all NO_x becomes and remains NO_2. Tier 2 currently assumes that over the course of a year, 75 percent of the NO_x is NO_2 on average. Tier 2 also assumes that 80 percent of the NO_x is NO_2 in any given hour. This ambient ratio method (ARM) provides that modeled impacts of NO_x emissions can be multiplied by 0.75 on an annual basis and 0.8 on the hourly basis to convert to NO_2 impact.

Tier 3 conversion uses one of the two algorithms within AERMOD that incorporates hourly ozone concentrations to convert NO_x emissions into NO_2 for each modeled hour. These methods are considered alternate model techniques under the Guideline on Air Quality Models and require USEPA

concurrence on their use. WDNR dispersion modeling staff should be contacted prior to proposing either Tier 3 conversion algorithm.

All three tiers of NO_x-to-NO_2 conversion are classified as screening techniques and negative emission rates (credit rates) cannot be used to account for emission reductions when analyzing net impacts relative to the NO_2 SIL or increment. WDNR dispersion modeling staff should be contacted if applicants propose alternative methods for addressing negative emissions.

SUBMITTAL INFORMATION

When applicants perform dispersion modeling a detailed report of the dispersion modeling should be submitted in addition to the standard permit application forms. This report (preferably in electronic form) should contain provisions from the dispersion modeling protocol plus details on source parameters, emission rates, and modeled scenarios. While a facility plot plan (indicating true north, all peak and edge tier heights, and stack locations) is considered part of a complete permit application, the dispersion modeling report should also contain additional information on the specific geographic location of all stacks and structures with enough detail to accurately locate the facility in Wisconsin. The full set of dispersion modeling files should also be submitted, both input and output files from AERMOD and the building downwash analysis. If using commercial software, the full archive can be submitted – including any specific files. Electronic dispersion modeling files can be transmitted in a multitude of ways, including email (~15Mb limit per message), file transfer protocol (FTP), disc (CD or DVD), or any other accessible service.

Air Dispersion Modeling Guidelines for Individual Operation Permit Actions

Contents

OVERVIEW

This document provides general information about the dispersion modeling performed in association with individual operation permit applications, including initial issuance, revisions, and renewals. Dispersion modeling analyses are used to support the limitations contained in the air permit. Due to uncertainties in both the emission estimates and the compliance tests used to demonstrate emission limits are being met, dispersion modeling is used to set a theoretical limit on the emission rate rather than basing the emission rate on physical characteristics of the emission source.

Applicants are not required to submit an air quality analysis for these permit actions, but any analysis performed should be consistent with this document, Federal Guidance 40 CFR Part 51 Appendix W (Guideline on Air Quality Models), and information available from the U.S. Environmental Protection Agency (USEPA) Support Center for Regulatory Atmospheric Modeling (SCRAM) website at http://www.epa.gov/scram001.

The Wisconsin Department of Natural Resources (WDNR) is required to make a determination of impact to ambient air prior to permit issuance in order to show that a source will not cause or exacerbate a violation of an air quality standard. This determination can take the form of a dispersion modeling analysis, but dispersion modeling is not a condition of permit approvability.

When dispersion modeling is performed, the analysis should show that the impact of the emissions from the entire facility, in conjunction with applicable emissions from other existing sources and regional background concentrations, will not cause or exacerbate a violation of any applicable National Ambient Air Quality Standard (NAAQS) or Prevention of Significant Deterioration (PSD) increment.

Special Note Regarding $PM_{2.5}$

Pursuant to Section 285.63(1)(b), *Wisconsin Statutes*, WDNR has concluded that direct emissions of $PM_{2.5}$ from existing sources, minor new sources, and minor modifications of sources will not cause or exacerbate violations of any $PM_{2.5}$ standard or increment. The details of this determination are available in the Technical Support Document titled *Air Quality Review of Industrial $PM_{2.5}$ Emissions from Stationary Sources in Wisconsin*, dated February 2016 and attached as Appendix B.

SOURCE & MODEL INFORMATION

WDNR uses the latest version of the regulatory model AERMOD for dispersion modeling analyses. Source locations should be entered with Universal Transverse Mercator (UTM) coordinates in the 1983 North American Datum (NAD83). Ground elevations for sources entered into the model should be obtained from the facility; as-built ground elevations may be different from publicly available terrain information.

AERMOD can compute concentrations for point, area, or volume sources; emissions should be entered using the most representative source type. Each emission unit, or process listed in a permit, should be included in the analysis. If an emission unit vents out multiple locations, each release location should be included discretely as well. Analyzed emission rates should reflect the short-term maximum (hourly) permit limitation.

Based on USEPA dispersion modeling guidance, most locations in Wisconsin will use 'rural' dispersion coefficients. Only a portion of the Milwaukee metropolitan area is considered 'urban' under the Irwin/Auer land use technique. For facility locations within the 'urban' area, the analysis should use a population of 1,000,000 (based on Milwaukee County) and a roughness length of 1.0 meter in AERMOD. Refer to Appendix A for the location of the 'urban' area.

Source Parameters

The following information is necessary for each source that is entered into AERMOD.

Point Source:

- Stack height as measured from the ground or finished floor elevation
- Stack inside circular diameter at the release point
- Exit gas velocity (refer to Operational Loads for more information); stacks that do not allow vertical unobstructed release of gas while the process is operating should be analyzed with an exit gas velocity of 0.01 ms^{-1} (POINTCAP or POINTHOR cannot be used)
- Exit gas temperature (refer to Operational Loads for more information); stacks emitting at outdoor ambient temperature should be analyzed with a gas temperature of -0.1 K.

Area Source:

- Release height above ground
- Lateral dimensions of source, either square, rectangular, circular, or polygon
- Initial vertical mixed dimension, if applicable

Volume (or Line) Source:

- Center of initial volume above ground
- Initial estimate of lateral dispersion coefficient; volume sources are assumed to be small and square in the lateral dimension, so multiple volume sources may be needed for large and /or irregularly shaped emissions
- Initial estimate of vertical dispersion coefficient

Operational Loads or Scenarios

The emissions from certain stack vented emission units can have variable exhaust parameters (exit gas velocity and temperature) as emission rates vary. Other types of emission units may be either 'on' or 'off' with limited variation. The dispersion modeling analysis can consider all possible emission load scenarios for each unit.

For an emission unit, multiple load conditions can be analyzed separately and the resulting worst-case impact determined. One load scenario must reflect the stack conditions when emitting at the maximum permit emission rate. Alternatively, a single stack can be analyzed for an emission unit assuming the exit gas velocity and temperature expected to occur most often (normal conditions) along with the maximum permit limitation.

If all emission units at the facility cannot operate simultaneously, and the applicant will propose permit limitations to this effect, the dispersion modeling analysis can be adjusted to reflect this scenario. Similarly, if the facility proposes permit limitations on the hours of operation per day or per year, the dispersion modeling analysis can also be adjusted.

Flares

In accordance with USEPA Region V policy, external flares (those with visible flame) are modeled using the following methodology:

- Stack height is the level above ground of gas release
- Exit gas temperature is set to 1273 K
- Exit gas velocity is set to 20 ms^{-1}
- Stack diameter = $9.88E\text{-}4(Q_h)^{0.5}$, where $Q_h = 0.45H$ and H = total heat release in cal/sec

Fugitive (non-point source) Emissions

Emissions created within a structure that are not vented to a stack but are considered in the permit in aggregate should be included in the dispersion modeling analysis. Similarly, any outdoor source (e.g. tank or pond) that will be considered in the permit should be included in the analysis. The most representative AERMOD source type should be assumed. Due to large uncertainties associated with establishing rates and the difficulties in modeling them, fugitive dust emissions (e.g. roadways, piles, dumping, crushing, etc.) are considered only for PSD applications.

Intermittent Emissions

Emission units are considered intermittent when they do not have a set operating schedule, operate for short periods of time during the year (generally outside of the facilities' control) and do not contribute to the normal operation of the facility. An intermittent source is not defined by a specific number of yearly operating hours. Emergency generators as defined by Chapters NR 400, NR 406, and NR 436, *Wis. Adm. Code* and emergency fire pumps are considered intermittent. Operation of an emission unit that meets the definition of "essential service" in Section NR 445.02(6), *Wis. Adm. Code* is also considered intermittent. If a facility proposes permit conditions for a given emission unit consistent with intermittent operation, that emission unit does not have to be included in the dispersion modeling analysis.

Building Downwash

Aerodynamic building downwash effects can greatly affect dispersion modeling concentrations. Dispersion modeling analyses should include the geometry of the buildings by using the Building Profile

Input Program for PRIME (BPIP-PRIME). Building base elevations should be determined from the facility plot plan (required as part of complete permit application) or construction plan and should match the associated source base elevations.

Structures that are four feet or less above ground level should not be entered into BPIP-PRIME. All other structures that present a solid face from the ground to the top of the structure and that have angled corners should be included. Average roof heights should be used for peaked or sloped tiers. Structures off the ground (e.g. on stilts) should not be included. Single, individual silos that are taller than they are wide should also not be included. But groupings of silos should be included in addition to large, wide circular grain bins using the eave height as the structure height.

Stacks of any shape or size should not be considered. Any enclosure built to enhance the appearance of the stack should also not be entered into BPIP-PRIME.

Structures with several roof heights should be entered into BPIP-PRIME as a single building with multiple tiers. The lowest tier should completely encompass the foot print of the structure, with higher tiers assumed to be stacked on top of the lower tiers, similar to a wedding cake. Do not enter each roof height as a single building (similar to books on a bookshelf).

RECEPTOR INFORMATION

Receptors should be placed where the modeled impact to ambient air is greatest, taking into account topography, residences, building downwash, and meteorology. Cartesian receptor grids should be used, with additional receptors near the ambient air boundary and sensitive locations. Polar coordinate grids should not be used.

Ambient Air (Fence) Boundary

Ambient air is the portion of the atmosphere to which the general public has access. Ambient air is not the atmosphere over buildings or the air over land owned by the source to which public access is precluded by a fence or other physical barrier. Active work areas of a facility (e.g. conveyors, piles, trailers, etc.) are generally not considered ambient air, but parking lots, public roadways, and public waterways are ambient air.

Any installed fence must be permanent and meet the dictionary definition of a fence. Ambient air boundaries must enclose an area (other than driveway or pedestrian access) for receptors to be eliminated within that area.

Note that analysis of compounds regulated under Chapter NR 445, *Wis. Adm. Code* considers modeled impact off the facility property. Applicants can use the property line receptor grid only for NR 445 analysis.

Receptor Spacing

With limited exception, receptors should be placed as follows:

- along the ambient air boundary every 25 meters
- on a Cartesian grid with 25-meter spacing extending from the ambient air boundary to 500 meters from the sources
- 50-meter spaced grid from 500 meters to 1000 meters from the sources

Additional receptors can be placed beyond 1000 meters to assess possible impacts.

If the location of the maximum impact is not within 1000 meters of the sources, additional 50-meter spaced grids should be used in the area of maximum impact.

Terrain Considerations

Receptor elevations and hill scaling heights should be determined using AERMAP, the AERMOD terrain processor. A recent tile of 1/3 arc second National Elevation Dataset (NED) information should be obtained from the U.S. Geologic Survey (USGS) and used in AERMAP. The data can be downloaded from the National Map Viewer at http://nationalmap.gov/viewer.html. The extent of the terrain information and the AERMAP domain should encompass a minimum of 10 kilometers beyond the furthest extent of the receptor grid. For receptors extending 1 km from the source in all directions, the terrain information and the AERMAP domain should have lateral dimensions of 22 km by 22 km.

Receptors placed above the terrain (i.e. set on a flag pole) are not used in regulatory dispersion modeling. Ambient air is represented by ground level concentrations and the default mode in AERMOD assumes a receptor height of zero meters above ground level.

METEOROLOGICAL DATA

Pre-processed meteorological data for use in AERMOD is provided on the WDNR Dispersion Modeling web page at http://dnr.wi.gov/topic/AirPermits/Modeling.html. AERMOD implementation guidance stresses the importance of using a meteorological data set that is representative of both the meteorological characteristics and the surface roughness characteristics of the application location. To aid in meteorological data selection, aerial photos centered on the anemometer are available for each station on the web page. WDNR modeling staff can be consulted with any selection questions.

AIR QUALITY IMPACT RESULTS

PSD Increment Analysis

Although dispersion modeling analyses for operation permit actions consider existing emissions PSD increment consumption should be considered for the applicable emissions if the facility is located in a county where the minor source baseline has been set. Refer WDNR Dispersion Modeling web page (http://dnr.wi.gov/topic/AirPermits/Modeling.html) for baseline status. Additional increment consuming sources near the facility will be included in the analysis. The impact of all the analyzed increment consuming sources must be below the Class II increment concentrations.

PSD Class II Increment Concentrations

POLLUTANT	CLASS II INCREMENT	AVERAGING TIME	STATISTIC/METRIC
Carbon Monoxide	None	N/A	N/A
Nitrogen Dioxide	25 µg/m^3	Annual	1st Highest
Particulate Matter Less than 10 Microns (PM_{10})	30 µg/m^3 17 µg/m^3	24-hour Annual	High 2nd Highest 1st Highest
Sulfur Dioxide	512 µg/m^3 91 µg/m^3 20 µg/m^3	3-hour 24-hour Annual	High 2nd Highest High 2nd Highest 1st Highest

The first complete (as determined by WDNR permit staff) PSD application in a county establishes the minor source baseline date (otherwise known as the baseline date) for that county and pollutant. The baseline is set for the entire county once the PSD application is complete, regardless of the level of impact.

Credit (other than for NO_x) can be taken for permanent removal of certain emission units. If the unit existed prior to the baseline date and was permanently shut down, those emissions are considered to expand the available increment and can be modeled with a negative emission rate. If credit is taken for permanent shut down emissions, it should be shown that the credited emissions would not have solely caused modeled exceedance of any ambient air standard.

NAAQS Analysis

In addition to any applicable increment analysis, an analysis should be performed of the impact relative to the NAAQS for applicable pollutants and time periods. The impact of the allowable emissions from the facility added to the background concentration must be below the NAAQS.

National Ambient Air Quality Standards

POLLUTANT	NAAQS	AVERAGING TIME	STATISTIC/METRIC
Lead	0.15 µg/m^3	3-month	1st Highest
Carbon Monoxide	40,000 µg/m^3 10,000 µg/m^3	1-hour 8-hour	High 2nd Highest High 2nd Highest
Nitrogen Dioxide	100 µg/m^3	Annual	1st Highest
Particulate Matter Less than 10 Microns (PM_{10})	150 µg/m^3	24-hour	6th Highest in 5 Years
Sulfur Dioxide	1,300 µg/m^3 365 µg/m^3 80 µg/m^3	3-hour 24-hour Annual	High 2nd Highest High 2nd Highest 1st Highest

Background Concentration

Background concentrations are added to modeled concentrations to estimate the total air quality impact relative to the NAAQS. Regional background values include the impact of both distant emissions as well as those of mobile sources and fugitive releases. Please refer to the WDNR Dispersion Modeling web page (http://dnr.wi.gov/topic/AirPermits/Modeling.html) for regional background concentrations.

NO_x-to-NO_2 Conversion

Emissions of NO_x react in the presence of sunlight and ozone to become NO_2. NO_2 is also reactive and can convert into other compounds. To account for these reactions, USEPA provides for three tiers of conversion. Tier 1 assumes all NO_x becomes and remains NO_2. Tier 2 currently assumes that over the course of a year, 75 percent of the NO_x is NO_2 on average. Tier 2 also assumes that 80 percent of the NO_x is NO_2 in any given hour. This ambient ratio method (ARM) provides that modeled impacts of NO_x emissions can be multiplied by 0.75 on an annual basis and 0.8 on the hourly basis to convert to NO_2 impact.

Tier 3 conversion uses one of the two algorithms within AERMOD that incorporates hourly ozone concentrations to convert NO_x emissions into NO_2 for each modeled hour. These methods are considered alternate model techniques under the Guideline on Air Quality Models and require USEPA

concurrence on their use. WDNR dispersion modeling staff should be contacted prior to proposing either Tier 3 conversion algorithm.

All three tiers of NO_x-to-NO_2 conversion are classified as screening techniques, and negative emission rates (credit rates) cannot be used to account for emission reductions when analyzing net impacts relative to the NO_2 increment. WDNR dispersion modeling staff should be contacted if applicants propose alternative methods for addressing negative emissions.

SUBMITTAL INFORMATION

When applicants perform dispersion modeling a detailed report of the dispersion modeling should be submitted in additions to the standard permit application forms. This report (preferably in electronic form) should contain provisions from the dispersion modeling protocol plus details on source parameters, emission rates, and modeled scenarios. While a facility plot plan (indicating true north, all peak and edge tier heights, and stack locations) is considered part of a complete permit application, the dispersion modeling report should also contain additional information on the specific geographic location of all stacks and structures with enough detail to accurately locate the facility in Wisconsin. The full set of dispersion modeling files should also be submitted, both input and output files from AERMOD and the building downwash analysis. If using commercial software, the full archive can be submitted – including any specific files. Electronic dispersion modeling files can be transmitted in a multitude of ways, including email (~15Mb limit per message), file transfer protocol (FTP), disc (CD or DVD), or any other accessible service.

Air Dispersion Modeling Guidelines for Registration Permits

Contents

OVERVIEW

This document provides general information about the dispersion modeling performed in association with registration permit actions, including granting of coverage for registration construction permit (RCPA, RCPB, RCPC) or registration operation permit (ROPA, ROPB, ROPC) actions. When all stacks at the facility do not vent vertically without obstruction, or the results of a dispersion modeling analysis are required because emissions exceed certain thresholds, the analysis should be consistent with this document, Federal Guidance 40 CFR Part 51 Appendix W (Guideline on Air Quality Models), and information available from the U.S. Environmental Protection Agency (USEPA) Support Center for Regulatory Atmospheric Modeling (SCRAM) website at http://www.epa.gov/scram001.

When dispersion modeling is performed, the analysis should show that the impact of the emissions from the facility and regional background concentrations will not cause or exacerbate a violation of any applicable National Ambient Air Quality Standards (NAAQS).

Special Note Regarding $PM_{2.5}$

Pursuant to Section 285.63(1)(b), *Wisconsin Statutes*, WDNR has concluded that direct emissions of $PM_{2.5}$ from existing sources, minor new sources, and minor modifications of sources will not cause or exacerbate violations of any $PM_{2.5}$ standard or increment. The details of this determination are available in the Technical Support Document titled *Air Quality Review of Industrial $PM_{2.5}$ Emissions from Stationary Sources in Wisconsin*, dated February 2016 and attached as Appendix B.

SOURCE & MODEL INFORMATION

WDNR uses the latest version of the regulatory model AERMOD for dispersion modeling analyses. Source locations should be input with Universal Transverse Mercator (UTM) coordinates in the 1983 North American Datum (NAD83). Ground elevations for sources entered into the model should be obtained from the facility; as-built ground elevations may be different from publicly available terrain information.

AERMOD can compute concentrations for point, area, or volume sources; emissions should be entered using the most representative source type. Each emission unit, or process listed in a permit, should be included in the analysis. If an emission unit vents out multiple locations, each release location should be included discretely as well. Analyzed emission rates should reflect the short-term maximum (hourly) permit limitation.

Based on USEPA dispersion modeling guidance, most locations in Wisconsin will use ‘rural’ dispersion coefficients. Only a portion of the Milwaukee metropolitan area is considered ‘urban’ under the Irwin/Auer land use technique. For facility locations within the ‘urban’ area, the analysis should use a population of 1,000,000 (based on Milwaukee County) and a roughness length of 1.0 meter in AERMOD. Refer to Appendix A for the location of the ‘urban’ area.

WDNR also uses the latest version of AERSCREEN, the screening version of AERMOD. Either model can be used to determine the impact of emissions on ambient air quality. Some degree of familiarity with dispersion modeling is recommended when using either model. The table on page 51 provides default values for entry to AERSCREEN.

Source Parameters

The following information is necessary for each source that is entered into AERMOD.

Point Source:

- Stack height as measured from the ground or finished floor elevation
- Stack inside circular diameter at the release point
- Exit gas velocity (refer to Operational Loads for more information); stacks that do not allow vertical unobstructed release of gas while the process is operating should be analyzed with an exit gas velocity of 0.01 ms^{-1} (POINTCAP or POINTHOR cannot be used)
- Exit gas temperature (refer to Operational Loads for more information); stacks emitting at outdoor ambient temperature should be analyzed with a gas temperature of -0.1 K.

Area Source:

- Release height above ground
- Lateral dimensions of source, either square, rectangular, circular, or polygon
- Initial vertical mixed dimension, if applicable

Volume (or Line) Source:

- Center of initial volume above ground
- Initial estimate of lateral dispersion coefficient; volume sources are assumed to be small and square in the lateral dimension, so multiple volume sources may be needed for large and /or irregularly shaped emissions
- Initial estimate of vertical dispersion coefficient

Operational Loads or Scenarios

The emissions from certain stack vented emission units can have variable exhaust parameters (exit gas velocity and temperature) as emission rates vary. Other types of emission units may be either ‘on’ or ‘off’ with limited variation. The dispersion modeling analysis should capture all possible emission load scenarios for each unit.

For an emission unit, multiple load conditions can be analyzed separately and the resulting worst-case impact determined. One load scenario must reflect the stack conditions when emitting at the maximum permit emission rate. Alternatively, a single stack can be analyzed for an emission unit assuming the exit gas velocity and temperature expected to occur most often (normal conditions) along with the maximum permit limitation.

If all emission units at the facility cannot physically operate simultaneously, the dispersion modeling analysis can be adjusted to reflect this scenario. If the facility has legal restrictions on the hours of operation due to local ordinances, state, or federal regulations, the dispersion modeling analysis can be adjusted to reflect the restrictions.

Flares

In accordance with USEPA Region V policy, external flares (those with visible flame) are modeled using the following methodology:

- Stack height is the level above ground of gas release
- Exit gas temperature is set to 1273 K
- Exit gas velocity is set to 20 ms^{-1}
- Stack diameter = $9.88E\text{-}4(Q_h)^{0.5}$, where $Q_h = 0.45H$ and H = total heat release in cal/sec

Fugitive (non-point source) Emissions

Emissions created within a structure that are not vented to a stack but are considered in the permit in aggregate should be included in the dispersion modeling analysis. Similarly, any outdoor source (e.g. tank or pond) that will be considered in the permit should be included in the analysis. The most representative AERMOD source type should be assumed. Due to large uncertainties associated with establishing rates and the difficulties in modeling them, fugitive dust emissions (e.g. roadways, piles, dumping, crushing, etc.) are considered only for PSD applications.

Intermittent Emissions

Emission units are considered intermittent when they do not have a set operating schedule, operate for short periods of time during the year (generally outside of the facilities' control) and do not contribute to the normal operation of the facility. An intermittent source is not defined by a specific number of yearly operating hours. Emergency generators as defined by Chapters NR 400, NR 406, and NR 436, *Wis. Adm. Code* and emergency fire pumps are considered intermittent. Operation of an emission unit that meets the definition of "essential service" in Section NR 445.02(6), *Wis. Adm. Code* is also considered intermittent. If a facility proposes permit conditions for a given emission unit consistent with intermittent operation, that emission unit does not have to be included in the dispersion modeling analysis.

Building Downwash

Aerodynamic building downwash effects can greatly affect dispersion modeling concentrations. Dispersion modeling analyses should include the geometry of the buildings by using the Building Profile Input Program for PRIME (BPIP-PRIME). Building base elevations should be determined from the facility plot plan or construction plan and should match the associated source base elevations.

Structures that are four feet or less above ground level should not be entered into BPIP-PRIME. All other structures that present a solid face from the ground to the top of the structure and that have angled corners should be included. Average roof heights should be used for peaked or sloped tiers.

Structures off the ground (e.g. on stilts) should not be included. Single, individual silos that are taller than they are wide should also not be included. But groupings of silos should be included in addition to large, wide circular grain bins using the eave height as the structure height.

Stacks of any shape or size should not be considered. Any enclosure built to enhance the appearance of the stack should also not be entered into BPIP-PRIME.

Structures with several roof heights should be entered into BPIP-PRIME as a single building with multiple tiers. The lowest tier should completely encompass the foot print of the structure, with higher tiers assumed to be stacked on top of the lower tiers, similar to a wedding cake. Do not enter each roof height as a single building (similar to books on a bookshelf).

RECEPTOR INFORMATION

Receptors should be placed where the modeled impact to ambient air is greatest, taking into account topography, residences, building downwash, and meteorology. Cartesian receptor grids should be used, with additional receptors near the ambient air boundary and sensitive locations. Polar coordinate grids should not be used.

Ambient Air (Fence) Boundary

Ambient air is the portion of the atmosphere to which the general public has access. Ambient air is not the atmosphere over buildings or the air over land owned by the source to which public access is precluded by a fence or other physical barrier. Active work areas of a facility (e.g. conveyors, piles, trailers, etc.) are generally not considered ambient air, but parking lots, public roadways, and public waterways are ambient air.

Any installed fence must be permanent and meet the dictionary definition of a fence. Ambient air boundaries must enclose an area (other than driveway or pedestrian access) for receptors to be eliminated within that area.

Note that analysis of compounds regulated under Chapter NR 445, *Wis. Adm. Code* considers modeled impact off the facility property. Applicants can use the property line receptor grid only for NR 445 analysis.

Receptor Spacing

With limited exception, receptors should be placed as follows:

- along the ambient air boundary every 25 meters
- on a Cartesian grid with 25-meter spacing extending from the ambient air boundary to 500 meters from the sources
- 50-meter spaced grid from 500 meters to 1000 meters from the sources

Additional receptors can be placed beyond 1000 meters to assess possible impacts.

If the location of the maximum impact is not within 1000 meters of the sources, additional 50-meter spaced grids should be used in the area of maximum impact.

Terrain Considerations

Receptor elevations and hill scaling heights should be determined using AERMAP, the AERMOD terrain processor. A recent tile of 1/3 arc second National Elevation Dataset (NED) information should be obtained from the U.S. Geologic Survey (USGS) and used in AERMAP. The data can be downloaded from the National Map Viewer at http://nationalmap.gov/viewer.html. The extent of the terrain information and the AERMAP domain should encompass a minimum of 10 kilometers beyond the furthest extent of the receptor grid. For receptors extending 1 km from the source in all directions, the terrain information and the AERMAP domain should have lateral dimensions of 22 km by 22 km.

Receptors placed above the terrain (i.e. set on a flag pole) are not used in regulatory dispersion modeling. Ambient air is represented by ground level concentrations and the default mode in AERMOD assumes a receptor height of zero meters above ground level.

METEOROLOGICAL DATA

Pre-processed meteorological data for use in AERMOD is provided on the WDNR Dispersion Modeling web page at http://dnr.wi.gov/topic/AirPermits/Modeling.html. AERMOD implementation guidance stresses the importance of using a meteorological data set that is representative of both the meteorological characteristics and the surface roughness characteristics of the application location. To aid in meteorological data selection, aerial photos centered on the anemometer are available for each station on the web page. WDNR modeling staff can be consulted with any selection questions.

AIR QUALITY IMPACT RESULTS

NAAQS Analysis

An analysis should be performed of the impact relative to the NAAQS for applicable pollutants and time periods. The impact of the allowable emissions from the facility added to the background concentration must be below the NAAQS.

National Ambient Air Quality Standards

POLLUTANT	NAAQS	AVERAGING TIME	STATISTIC/METRIC
Lead	0.15 µg/m^3	3-month	1st Highest
Carbon Monoxide	40,000 µg/m^3 10,000 µg/m^3	1-hour 8-hour	High 2nd Highest High 2nd Highest
Nitrogen Dioxide	100 µg/m^3	Annual	1st Highest
Particulate Matter Less than 10 Microns (PM_{10})	150 µg/m^3	24-hour	6th Highest in 5 Years
Sulfur Dioxide	1,300 µg/m^3 365 µg/m^3 80 µg/m^3	3-hour 24-hour Annual	High 2nd Highest High 2nd Highest 1st Highest

Background Concentration

Background concentrations are added to modeled concentrations to estimate the total air quality impact relative to the NAAQS. Regional background values include the impact of both distant emissions as well as those of mobile sources and fugitive releases. Please refer to the WDNR Dispersion Modeling web page (http://dnr.wi.gov/topic/AirPermits/Modeling.html) for regional background concentrations.

NO_x-to-NO_2 Conversion

Emissions of NO_x react in the presence of sunlight and ozone to become NO_2. NO_2 is also reactive and can convert into other compounds. To account for these reactions, USEPA provides for three tiers of conversion. Tier 1 assumes all NO_x becomes and remains NO_2. Tier 2 currently assumes that over the course of a year, 75 percent of the NO_x is NO_2 on average. Tier 2 also assumes that 80 percent of the NO_x is NO_2 in any given hour. This ambient ratio method (ARM) provides that modeled impacts of NO_x emissions can be multiplied by 0.75 on an annual basis and 0.8 on the hourly basis to convert to NO_2 impact.

Tier 3 conversion uses one of the two algorithms within AERMOD that incorporates hourly ozone concentrations to convert NO_x emissions into NO_2 for each modeled hour. These methods are considered alternate model techniques under the Guideline on Air Quality Models and require USEPA

concurrence on their use. WDNR dispersion modeling staff should be contacted prior to proposing either Tier 3 conversion algorithm.

SUBMITTAL INFORMATION

When applicants perform dispersion modeling, the results are supplied to the WDNR as part of the Registration Permit application. Applicants are required to maintain records from the analysis for the duration of the permit coverage. It is recommended that facilities prepare a detailed modeling report for their records at the time of the analysis. This report should contain details on source parameters, emission rates, and modeled scenarios. The facility plot plan (indicating true north and all peak and edge tier heights as well as stack locations) is considered part of the dispersion modeling analysis and should be retained as well.

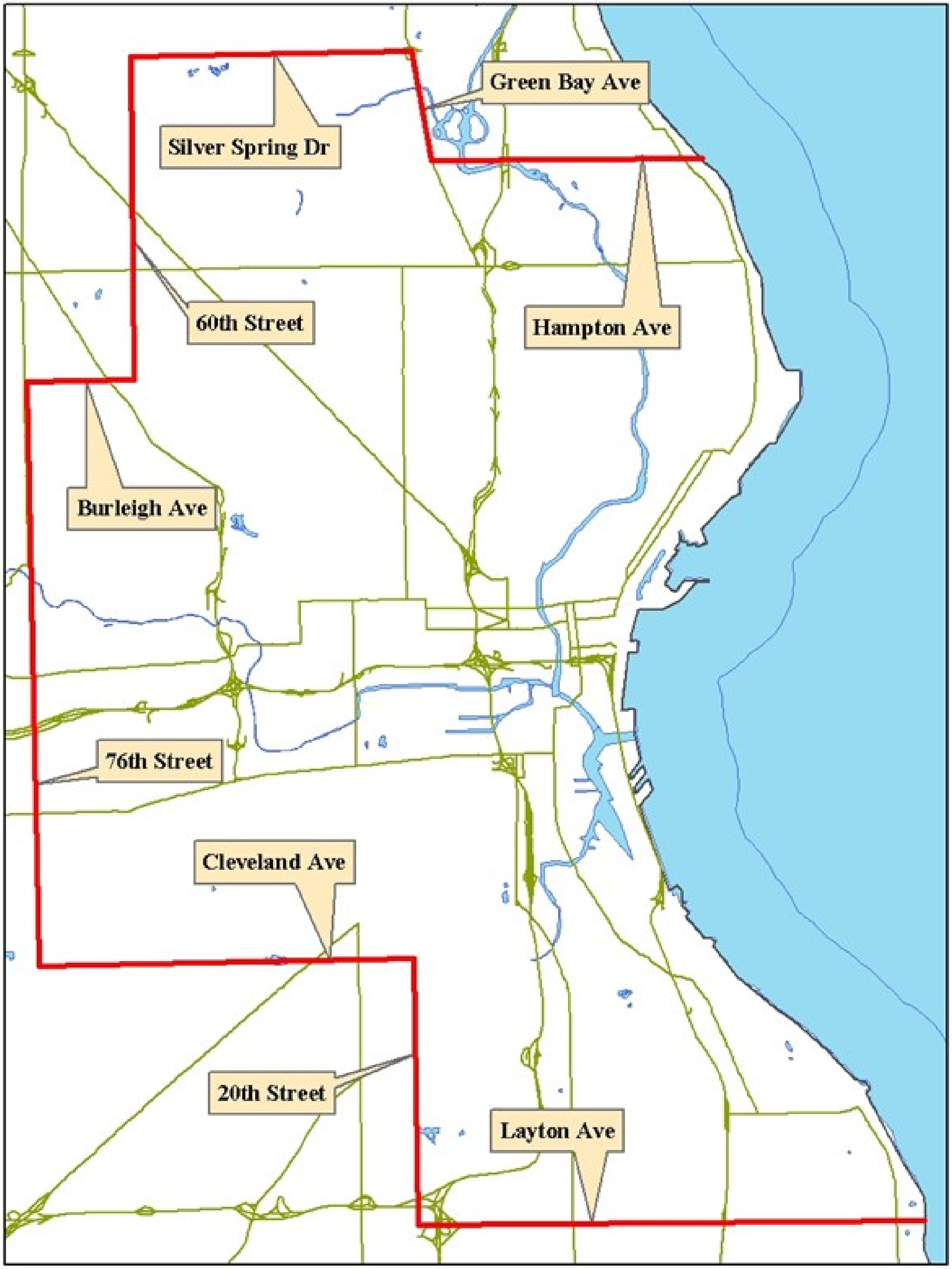
AERSCREEN Default Prompts

ON-SCREEN PROMPT	USER ACTION
Enter Title or Use Restart File	Enter Title or Restart file name
Enter English or Metric Units	Enter ‘E’ for English or ‘M’ for Metric
Source Type	Enter ‘P’ for point
Emission Rate	Enter maximum hourly emission rate
Stack Height	Enter stack height above ground
Stack Diameter	Enter diameter at exit of stack
Stack Temperature	Enter gas temp at exit of stack
Exit Velocity or Flow Rate	Enter appropriate parameter NOTE: If stack is not vertical and unobstructed, enter 0.01 m/s for exit velocity
Rural or Urban	If within the urban portion of Milwaukee (refer to USEPA/WDNR guidance) enter ‘U’, then use 1000000 as population – otherwise enter ‘R’
Minimum Distance to Ambient Air	Enter distance to closest fence line if fence completely encloses property, or use the provided default value
NO_2 Chemistry	Enter Option #1 – No Chemistry
Building Downwash	Most cases will include downwash, but will not have a pre-existing BPIP-PRIME input file

ON-SCREEN PROMPT	USER ACTION
Building Height	Enter height of controlling building
Maximum Horizontal Dimension	Enter length of longest side
Minimum Horizontal Dimension	Enter length of shortest side
Angle of Building to True North	Enter 45 degrees *Note: This angle has been shown to consistently provide conservative results*
Angle of Stack to True North Relative to Building	Enter zero (0) *Note: This places stack in center of building*
Distance Between Stack and Building	Enter zero (0) *Note: Even if stack is not on top of controlling building, the conservative assumption will be made*
Terrain Height	Enter 'N' – No terrain considered
Maximum Probe Distance	Enter default value
Discrete Receptors	User discretion
Flagpole Receptors	Enter 'N' – No flagpole receptor height
Source Elevation	Enter default value
Max and Min Ambient Temp	Enter default values

ON-SCREEN PROMPT	**USER ACTION**
Minimum Wind Speed	Enter default value
Anemometer Height	Enter default value
Surface Characteristics	Enter Option #2 – AERMET seasonal tables, then Option #7 – urban, followed by climate profile Option #1 – average moisture *Note: This designation of urban indicates that other structures exist around the modeled stack, not that USEPA urban dispersion coefficients are needed.*
Output File Name	User discretion
Confirmation Screen	Following final <enter>, AERSCREEN executes

APPENDIX A - Urban Dispersion Coefficient Map



APPENDIX B - $PM_{2.5}$ Technical Support Document

Air Quality Review of Industrial $PM_{2.5}$ Emissions from Stationary Sources In Wisconsin

February 2016

Wisconsin Department of Natural Resources
Air Management Program
P.O. Box 7921
Madison, WI 53707

Publication Number: AM-527 2015

This document is intended solely as guidance and does not include any mandatory requirements except where requirements found in statute or administrative rule are referenced. This guidance does not establish or affect legal rights or obligations and is not finally determinative of any of the issues addressed. This guidance does not create any rights enforceable by any party in litigation with the State of Wisconsin or the Department of Natural Resources. Any regulatory decisions made by the Department of Natural Resources in any manner addressed by this guidance will be made by applying the governing statutes and administrative rules to the relevant facts.

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This publication is available in alternate format (large print, Braille, audio tape, etc) upon request. Please call the Air Dispersion Modeling Team (608 267-0805) for more information.

EXECUTIVE SUMMARY

The Wisconsin Department of Natural Resources (WDNR) under the authority of the Wisconsin State Statutes (Statutes) and the Wisconsin Administrative Code (Code), issues air pollution control permits to industrial, direct stationary sources of air pollution[1]. An air permit application may be approved if WDNR finds, "The source will not cause or exacerbate a violation of any ambient air quality standard or ambient air increment;" [s. 285.63(1)(b), Wis. Stats.]

National Ambient Air Quality Standards (NAAQS) were established by the United States Environmental Protection Agency (USEPA) for particulate matter with aerodynamic diameter of 2.5 micrometers or less ($PM_{2.5}$) in 1997 and were revised in 2006 and again in 2012. Initially, Federal guidance supported a surrogate approach for determining when a source will not cause or exacerbate violation of the $PM_{2.5}$ standards. Under the surrogate approach, if it was determined that emissions of PM_{10} (particulate matter with aerodynamic diameter of 10 micrometers or less) did not cause or exacerbate violation of the PM_{10} standards, then compliance with $PM_{2.5}$ standards was assumed. This policy was deemed necessary considering the various technical issues associated with $PM_{2.5}$ air quality analysis.

After the surrogate approach was eliminated in 2011, WDNR turned to air quality dispersion modeling to determine whether emissions from direct sources of $PM_{2.5}$ meet the obligations for permit approval. Dispersion modeling is used to assess the impact of direct emissions of several other compounds (e.g. sulfur dioxide) and it was presumed that modeling of $PM_{2.5}$ would be effective. However, examination of the science behind $PM_{2.5}$ has raised questions about treating $PM_{2.5}$ solely as a directly emitted compound.

Dispersion modeling of direct $PM_{2.5}$ emissions is ineffective as a means for meeting the obligations of the Statutes and Code. This analysis shows that air quality dispersion modeling of an industrial source of direct emission of $PM_{2.5}$ does not provide information useful to understanding of the impact of the source on ambient air quality. The WDNR approach to determine whether a direct $PM_{2.5}$ source causes or exacerbates violation of an air standard or increment, and thus can be issued an air permit, will be consistent with the determination used for other regional pollutants such as ozone. This conclusion serves as the WDNR determination pursuant to s. 285.63(1)(b), Wis. Stats.

[1] For purposes of this document, when using the term "direct source" or "direct industrial source", the Department is referring to stationary industrial sources such as power plants, foundries, paper mills, etc. Direct sources do not include emissions from cars, trucks, locomotives, or other mobile sources.

Wisconsin is committed to regulating $PM_{2.5}$ and its precursors consistent with federal requirements, even though there are currently no specific federal requirements for direct emissions of $PM_{2.5}$. The regulation of industrial, direct stationary sources of nitrogen oxides (NO_x) and sulfur dioxide (SO_2) through the hourly standards is expected to further decrease ambient concentrations of $PM_{2.5}$ precursors. If ambient concentrations of $PM_{2.5}$ increase in the future, WDNR will consider regulatory requirements to address reductions of emissions of $PM_{2.5}$ precursors via advances in technology. Wisconsin will continue to regulate emissions of NO_x and SO_2 and will follow USEPA guidance on assessing the impact of secondarily formed $PM_{2.5}$ under the Prevention of Significant Deterioration permit program.

BACKGROUND[2]

Particulate matter is not a single pollutant but rather a mixture of solid particles and liquid droplets distributed among numerous gases that interact with solid and liquid phases. Particle diameters span more than four orders of magnitude, ranging from a few nanometers to one hundred micrometers. A typical strand of human hair is 70 micrometers thick, and particles less than 20 micrometers generally are not detectable by the human eye. Fine particles like $PM_{2.5}$ are classified based on their diameter, but fine particles are not simply a subset of total particulate matter. Fine particles have different emission sources than coarse particles and behave like gases in the atmosphere.

A fundamental division of atmospheric particles into a fine mode and a coarse mode exists, as shown in Figure 1 (USEPA, 1996). Fine particles have long atmospheric lifetimes and are able to penetrate deep into the lungs. Fine particles also come from different sources than coarse particles, and have different chemical, physical, and biological properties. Fine and coarse particles have different formation mechanisms. Coarse particles are generated by mechanical processes such as crushing, grinding, abrasion of surfaces, evaporation of sprays, or suspension of dusts. Common sources of direct emissions of coarse particulates are silicates and oxides found in soil dust; fugitive dust from roads, industry, agriculture, construction and demolition activities; fly ash; and additional contributions from plant and animal material. Fine particles contain primary particles from combustion sources but also secondary particles that result from condensation, coagulation, or nucleation of low-volatility vapors formed in chemical reactions.

[2] Information in this section is taken from "*Guidance for PM2.5 Permit Modeling Appendix A", EPA-454/B-14-001, May 2014* and *"Air Quality Criteria for Particulate Matter Chapters 3 & 5", EPA/600/P-95/001aF, April 1996*.

Figure 1 – Size Distribution of Fine Mode and Coarse Mode Particles

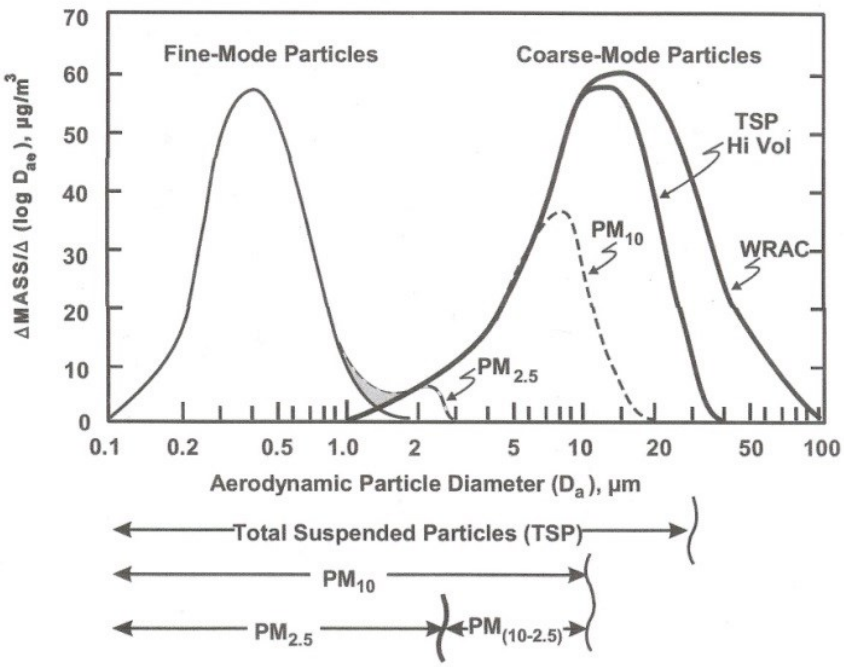


Figure 3-3. An idealized distribution of ambient particulate matter showing fine-mode particles and coarse-mode particles and the fractions collected by size-selective samplers.

Source: Adapted from Wilson and Suh (1996).

Common sources of direct emissions of fine particulates are fossil fuel combustion, vegetation burning, and the smelting or other processing of metals. The formation of secondary $PM_{2.5}$ in the atmosphere depends on reactions involving the hydroxyl radical (OH), ozone (O_3), and peroxide (H_2O_2) that are present in the atmosphere and which are generated during the photochemical smog formation process. Sulfur dioxide (SO_2), nitrogen oxides (NO_x), and certain organic compounds are also major precursors of fine secondary $PM_{2.5}$. Sulfuric and nitric acid, produced from emissions of SO_2 and NO_x, react with ammonia to form ammonium sulfate and ammonium nitrate, major components of ambient $PM_{2.5}$. Certain types of organic compounds react with OH and O_3 to form oxygenated compounds that condense onto existing particles. Fine particles in the atmosphere consist mainly of sulfate, nitrate, ammonium ions, water, organic aerosols, and metallic components.

Fine and coarse particulates also have different atmospheric transport and fates once they become airborne. Fine particles have long lifetimes in the atmosphere (days to weeks), travel long distances (hundreds to thousands of kilometers), and are uniformly distributed over larger regions i.e. thousands of square kilometers. As a result, they are not easily traced back to an individual source. Fine particles are removed from the atmosphere primarily by forming cloud droplets and falling out in raindrops. Coarse particles normally have short lifetimes (minutes to hours), only travel short distances (tens of kilometers), and tend to be unevenly distributed with localized effects and impacts. Coarse particles are removed mainly by gravitational settling.

Due to these fundamental differences between fine and coarse particulates, it is not appropriate to treat them as the same pollutant for permitting and modeling purposes. Coarse particles from industrial stationary sources are appropriately modeled for permitting purposes because they are directly emitted. Fine particles are not appropriately modeled for permitting purposes using the current tools because they are secondarily formed in the atmosphere.

Figure 2 (USEPA, 1996) summarizes the differences between fine and coarse particles.

Figure 2 – Comparison of Ambient Fine and Coarse Particles

TABLE 3-15. COMPARISON OF AMBIENT FINE AND COARSE MODE PARTICLES

	Fine	Coarse
Formed from:	Gases	Large solids/droplets
Formed by:	Chemical reaction Nucleation Condensation Coagulation Evaporation of fog and cloud droplets in which gases have dissolved and reacted	Mechanical disruption (crushing, grinding, abrasion of surfaces, etc.) Evaporation of sprays Suspension of dusts
Composed of:	Sulfate, $SO_4^=$ Nitrate, NO_3^- Ammonium, NH_4^+ Hydrogen ion, H^+ Elemental carbon, Organic compounds (e.g., PAHs, PNAs) Metals, (e.g., Pb, Cd, V, Ni, Cu, Zn, Mn, Fe) Particle-bound water	Resuspended dust (Soil dust, street dust) Coal and oil fly ash Oxides of crustal elements, (Si, Al, Ti, Fe) $CaCO_3$, NaCl, sea salt Pollen, mold, fungal spores Plant/animal fragments Tire wear debris
Solubility:	Largely soluble, hygroscopic and deliquescent	Largely insoluble and non-hygroscopic
Sources:	Combustion of coal, oil, gasoline, diesel fuel, wood Atmospheric transformation products of NO_x, SO_2, and organic compounds including biogenic organic species, e.g., terpenes High temperature processes, smelters, steel mills, etc.	Resuspension of industrial dust and soil tracked onto roads and streets Suspension from disturbed soil, e.g., farming, mining, unpaved roads Biological sources Construction and demolition, coal and oil combustion, ocean spray
Atmospheric half-life:	Days to weeks	Minutes to hours
Travel distance:	100s to 1000s of km	<1 to 10s of km

Source: Adapted from Wilson and Suh (1996).

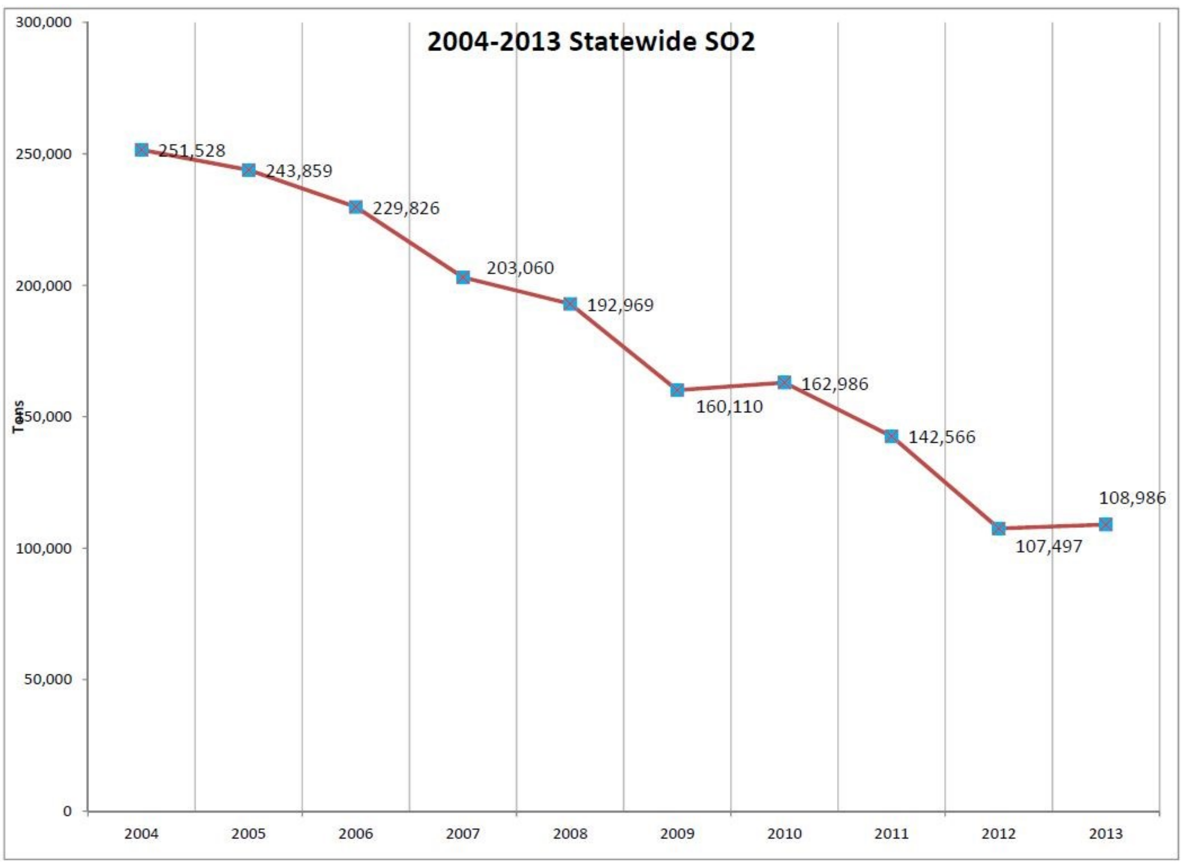
$PM_{2.5}$, SO_2, & NO_x EMISSION TRENDS

According to the USEPA National Emissions Inventory (NEI), total emissions of directly emitted $PM_{2.5}$ (primary $PM_{2.5}$) in the United States have remained steady at around 5 million tons per year, excluding emissions from wildfires. Total emissions include industrial sources as well as mobile sources (e.g. cars, trucks, trains) and area sources (e.g. home heating). Less than 20% of total directly emitted $PM_{2.5}$ is assumed to come from fossil fuel combustion, and less than 10% of directly emitted $PM_{2.5}$ is from on-road and off-road tailpipe emissions[3].

From the NEI, emissions of SO_2 in the U.S. have dropped from approximately 9 million tons per year in 2009 to around 5 million tons per year in 2013, the most recent reported year. Emissions of NO_x in the U.S. have dropped from about 16 million tons per year in 2009 to 13 million tons in 2013.

The trend in SO_2 and NO_x emissions is also seen from Wisconsin industrial stationary sources[4]. Emissions of SO_2 in Wisconsin have dropped from 160,000 tons in 2009 to 109,000 tons in 2013, while emissions of NO_x have dropped from 68,000 tons in 2009 to 56,000 tons in 2013. {Wisconsin collects estimates of total particulate matter industrial emissions for billing purposes and not direct $PM_{2.5}$}

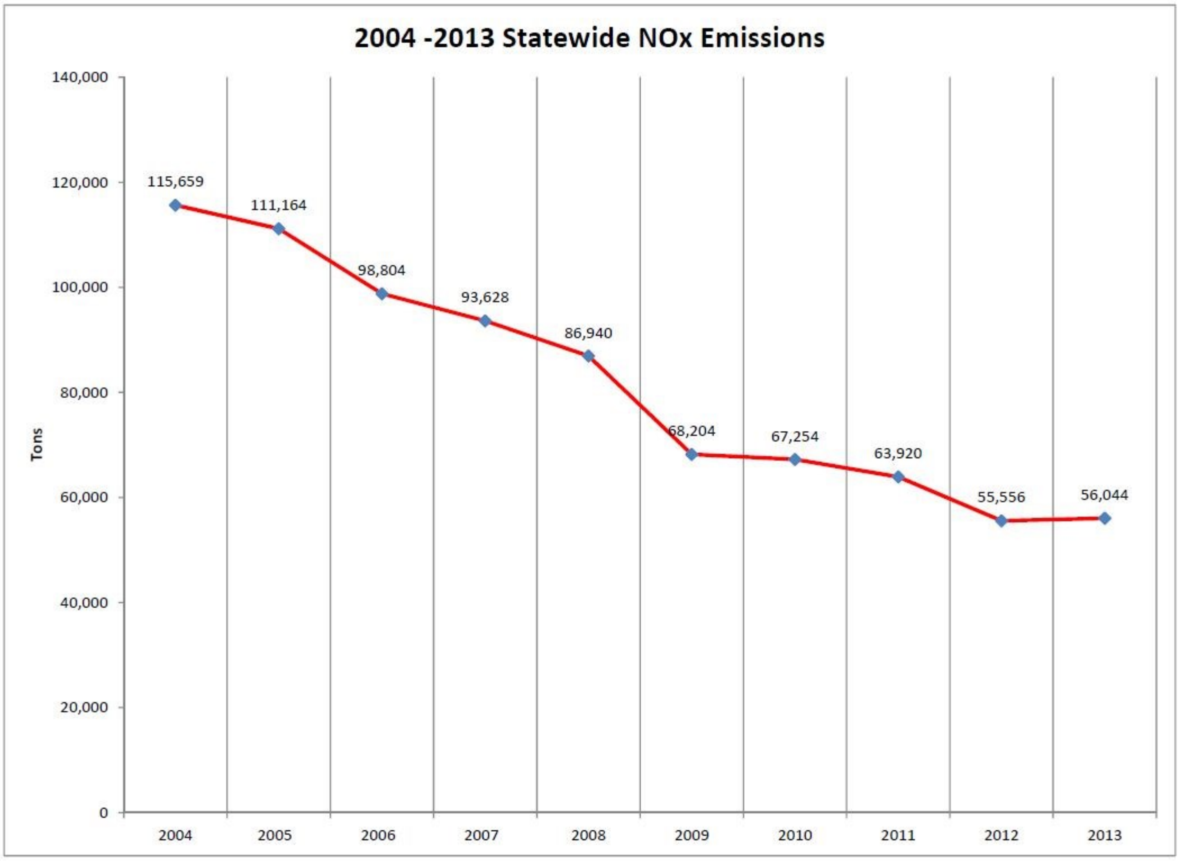
Figure 3 – Wisconsin Reported Annual SO_2 Emissions from Industrial Sources



[3] http://www.epa.gov/ttn/chief/trends (accessed Jan 7, 2015)

[4] http://dnr.wi.gov/topic/AirEmissions/Historical.html (accessed Jan 7, 2015)

Figure 4 – Wisconsin Reported Annual NO_x Emissions from Industrial Sources



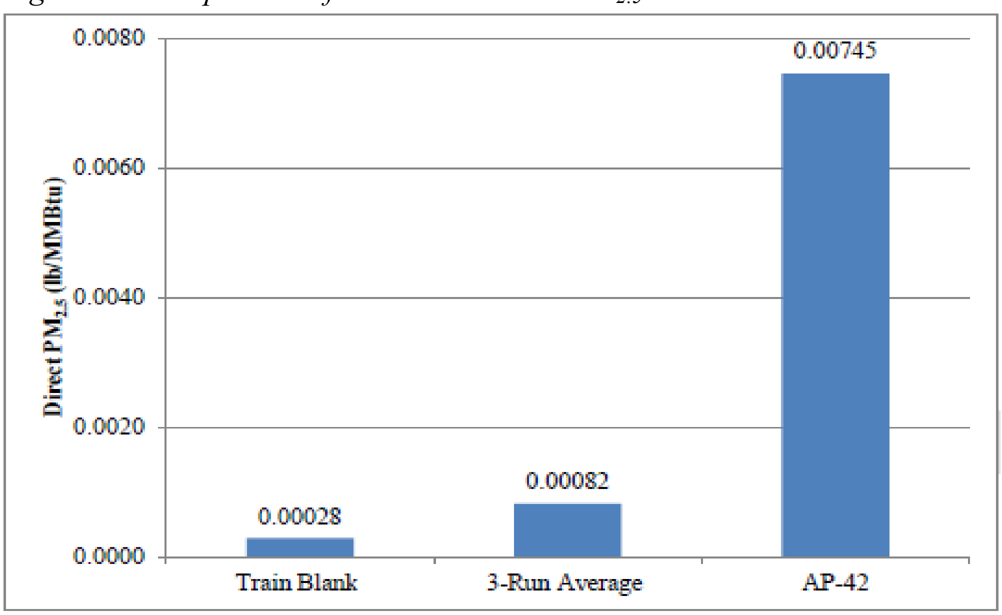
DIRECT SOURCE EMISSIONS OF $PM_{2.5}$

Wisconsin DNR stack testing staff reviewed and concurs with recently published data that suggests estimates of direct industrial emissions of $PM_{2.5}$ may be overestimated by as much as nine times[5]. This indicates that the contribution of direct sources of $PM_{2.5}$ to ambient air historically has been overstated. Using these incorrect emission estimates in dispersion modeling results in overestimates of facility impact.

Emission estimates for $PM_{2.5}$ typically come from EPA emission factors based on stack test data from select facilities. USEPA emission factors vary in quality from a rating of "A", meaning excellent data with minimal variability, to a rating of "E", meaning poor data with strong evidence of variability. Most USEPA $PM_{2.5}$ emissions factors are ranked either "D" or "E" in quality[6].

The National Council for Air and Stream Improvement (NCASI) has evaluated stack testing methods for estimating emissions and found evidence of incorrect and overly conservative $PM_{2.5}$ emission rates. In comments submitted to USEPA dated May 31, 2013, NCASI attached a report titled, "Evaluation of the Performance of EPA Methods 201A and 202 on a Natural Gas-Fired Package Boiler". Figure 5, taken from the NCASI report, illustrates the anomalously high emission estimates that result from factors derived from the aforementioned EPA tests. The EPA emission factor could result in an emission estimate as much as nine times higher than actual measured values for these types of sources. Therefore the actual emissions of direct, primary $PM_{2.5}$ that are used in permit review are likely far lower than what is currently used. As facilities utilize the correct stack testing methods, both the national emission estimates and the permit allowable direct $PM_{2.5}$ emissions will be greatly reduced.

Figure 5 – Comparison of Measured Direct $PM_{2.5}$ to USEPA Emission Factor



5 NCASI report titled, "Evaluation of the Performance of EPA Methods 201A and 202 on a Natural Gas-Fired Package Boiler"

6 http://cfpup.epa.gov/webfire/index.cfm?action=fire.detailedSearch (accessed Dec 30, 2014)

AMBIENT MONITOR DATA

While the trend of emissions of direct $PM_{2.5}$ has remained steady, the measured ambient concentrations of $PM_{2.5}$ have decreased in Wisconsin[7]. Referring to Figure 6, both daily and annual concentrations throughout Wisconsin decreased between 2009 and 2013. The trend of decreasing $PM_{2.5}$ ambient air quality values, in light of steady trend of direct emissions of $PM_{2.5}$, can be explained by a decrease in the precursor pollutants SO_2 and NO_x. The overall concentrations in the Milwaukee area decreased enough that in April 2014 USEPA redesignated the counties of Milwaukee, Waukesha, and Racine to attainment for the 24-hour $PM_{2.5}$ standard. These were the only counties designated nonattainment for $PM_{2.5}$ in Wisconsin. In addition, a December 18, 2014 letter from USEPA to Wisconsin indicated the entire state of Wisconsin is designated as attainment for both the 24-hour and the revised annual $PM_{2.5}$ standard.

Figure 6 – Daily and Annual Wisconsin $PM_{2.5}$ Concentration[8]

Site Name	County	24-Hour Design Value (ug/m^3)			Annual Design Value (ug/m^3)		
		2009-11	2010-12	2011-13	2009-11	2010-12	2011-13
Bad River	Ashland	17	17	17	5.5	5.3	5.1
GRB East	Brown	33	29	24	10.4	9.6	8.8
MSN Well	Dane	29	28	25	10.6	9.9	9.7
Horicon	Dodge	29	27	23	9.5	9.3	8.7
FCPC	Forest	19	21	19	6.0	5.6	5.1
Potosi	Grant	29	25	21	10.7	10.0	9.5
Chiwaukee	Kenosha	28	25	24	9.7	9.5	9.1
La Crosse	La Crosse	29	25	21	9.6	9.0	8.5
Health Ctr	Milwaukee	32	29	27	11.1	10.9	10.5
DNR SER	Milwaukee	31	26	22	10.8	10.2	9.6
College Ave	Milwaukee	29	29	24	11.6	11.2	9.9
Appleton	Outagamie	31	28	23	9.8	9.2	8.6
Harrington	Ozaukee	27	23	21	9.5	9.1	8.4
Devils Lake	Sauk	29	24	21	9.0	8.6	8.2
Perkinstown	Taylor	26	26	20	7.9	7.8	7.2
Trout Lake	Vilas	21	17	15	6.1	5.8	5.4
Cleveland Ave	Waukesha	31	27	24	11.7	11.3	10.8

[7] AM-526-2054 “Wisconsin Air Quality Trends 2015”

[8] http://www.epa.gov/airquality/airdata (accessed Jan 7, 2015)

Figure 7 shows the 24-hour $PM_{2.5}$ design value from 2000 through 2013. These plots show the downward trend in $PM_{2.5}$ concentrations throughout Wisconsin.

Figure 7a – Daily Wisconsin $PM_{2.5}$ Design Value Concentration

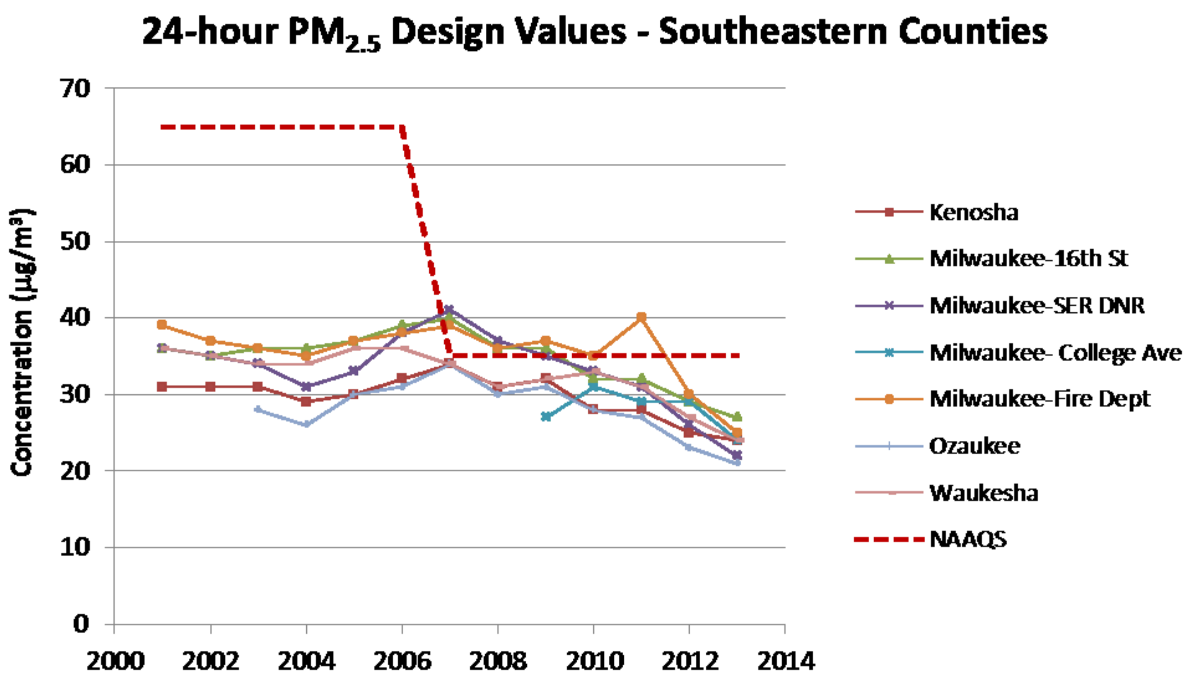
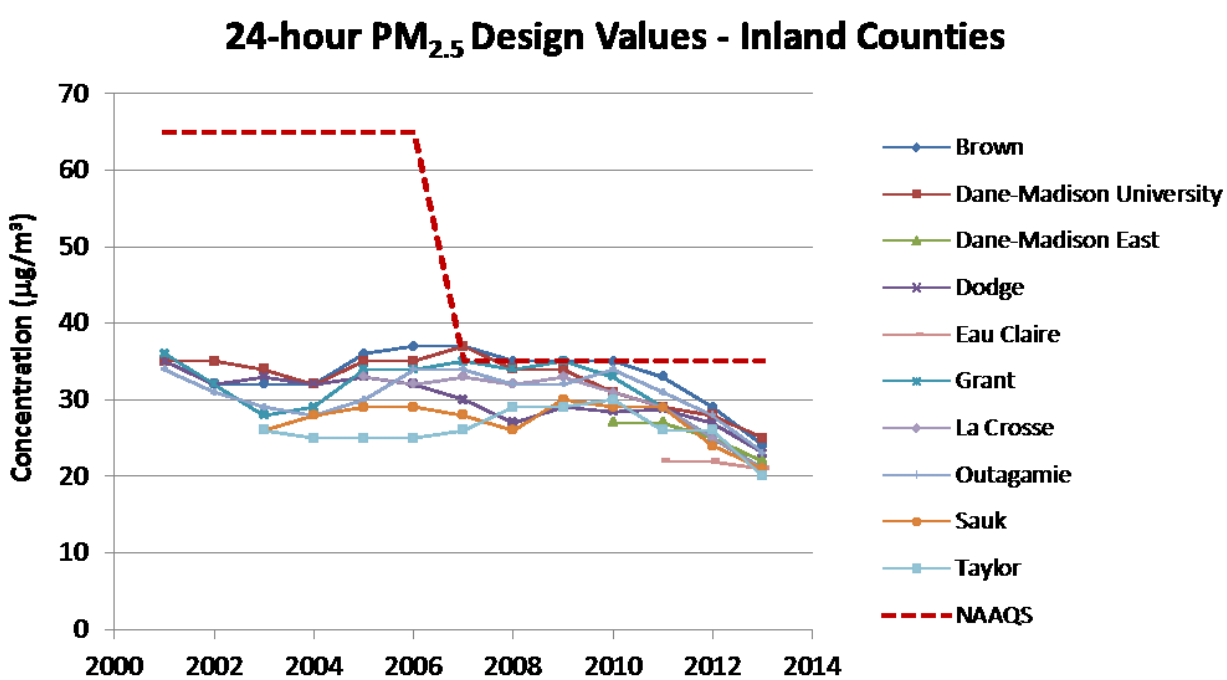


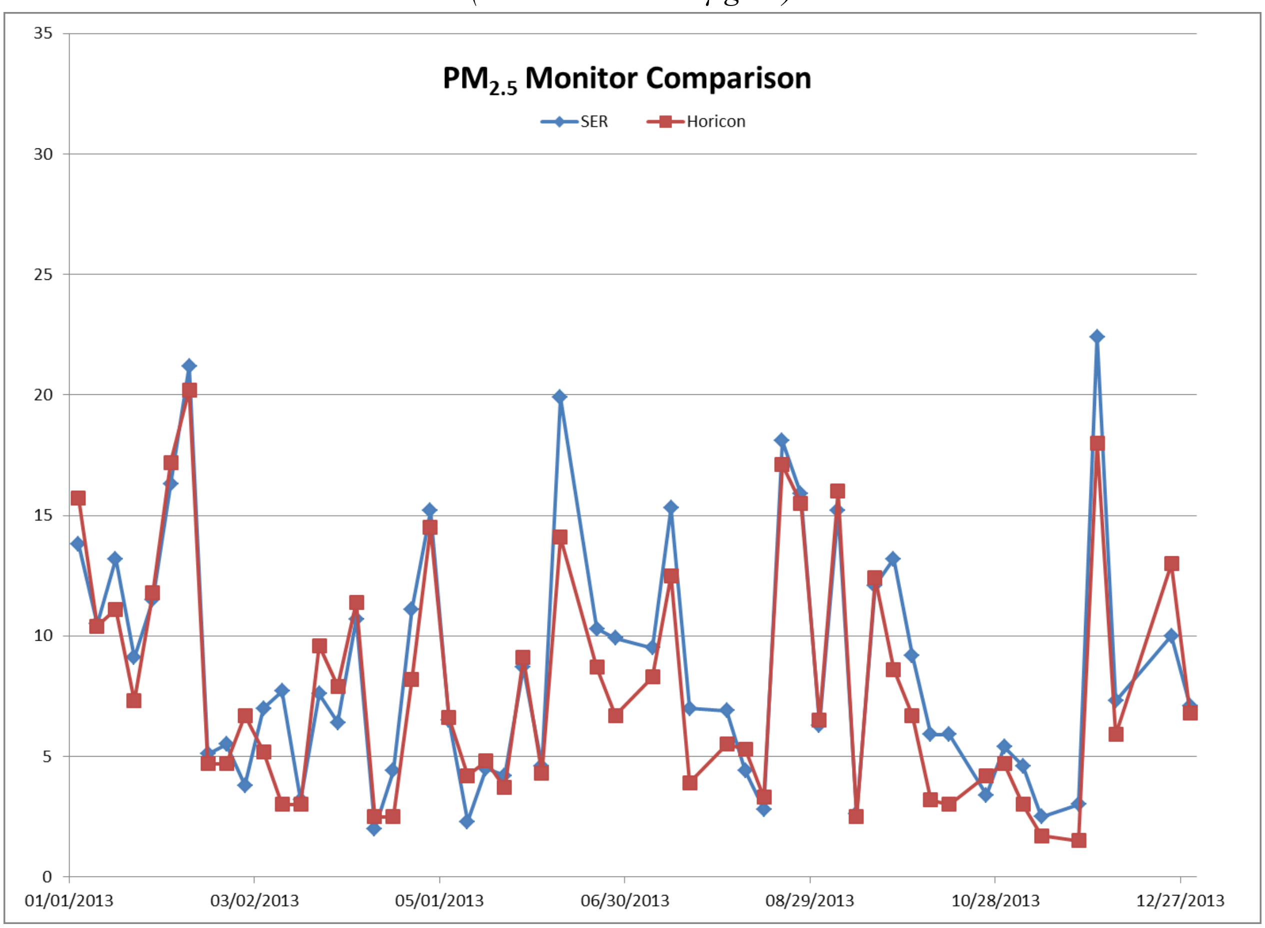
Figure 7b – Daily Wisconsin $PM_{2.5}$ Design Value Concentration



$PM_{2.5}$ concentrations are decreasing at all monitoring locations in Wisconsin, regardless of whether the site is rural and distant from large sources or urban and near major electric utilities. This trend indicates $PM_{2.5}$ from sources other than direct emissions have a profound effect on ambient concentrations.

This conclusion is confirmed by comparing the values between pairs of monitors. The filter based $PM_{2.5}$ federal reference method monitors at an urban location (SER – DNR Milwaukee Office) and a rural location (Horicon) were compared for days during 2013 where both sites were simultaneously measuring concentration. As shown in Figure 8, at neither site were concentrations near the 24-hour $PM_{2.5}$ standard of 35 micrograms per cubic meter. In addition, for the 54 common days, the correlation coefficient was 0.93, indicating strong correlation. When concentrations at Horicon increased, so did concentrations at SER Milwaukee, even though the monitors are ~73 kilometers apart. Since there are more sources of emission in a major city than outside the city, this indicates that larger scale regional factors such as long-range transport of emissions influence both monitors.

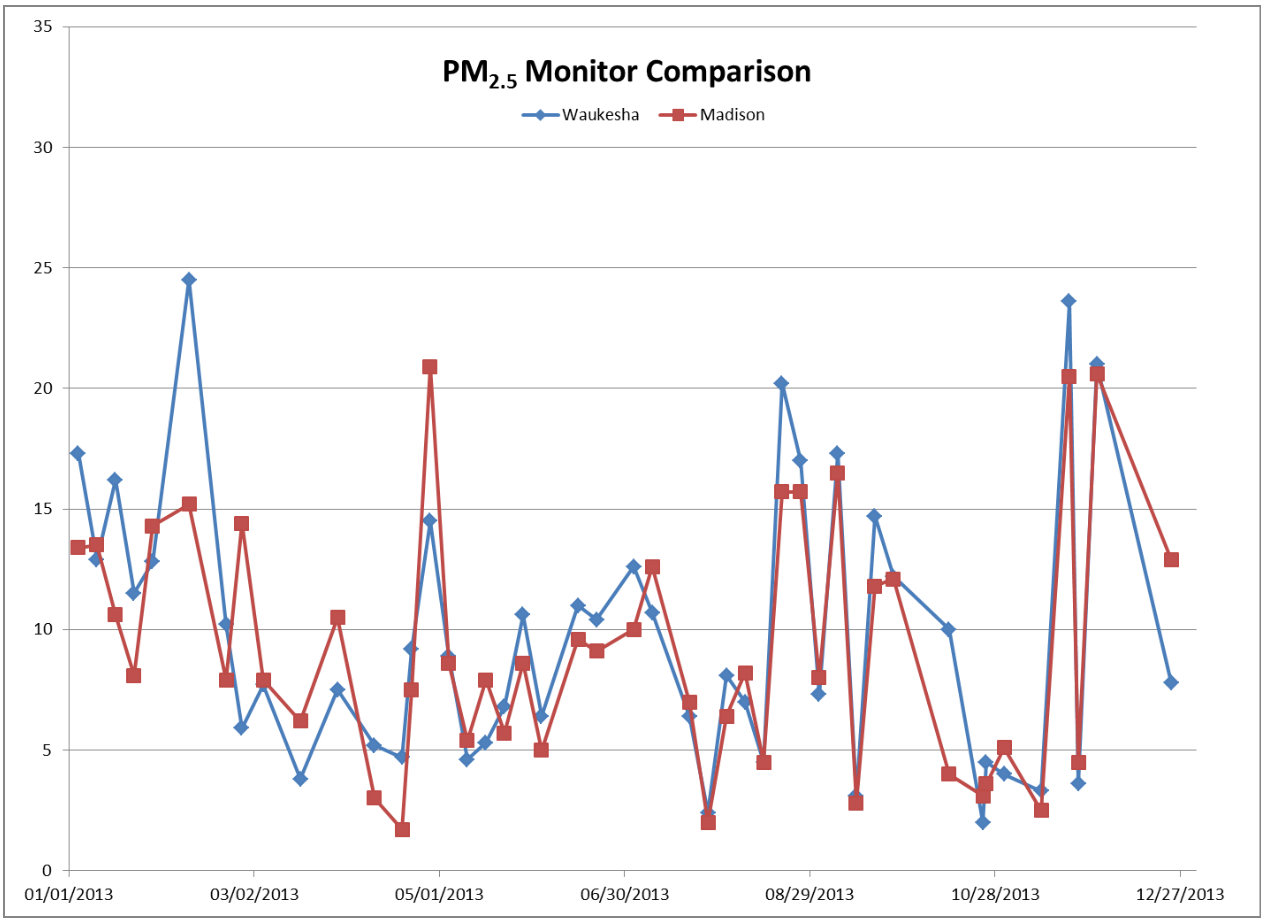
Figure 8 – $PM_{2.5}$ Monitor Comparison – Urban (SER) & Rural (Horicon)[9]
(Concentration in $\mu g/m^3$)



[9] http://www.epa.gov/airquality/airdata (accessed Jun 25, 2014)

Monitors even further apart also show the same temporal correlation. For example, the filter-based $PM_{2.5}$ monitors at Cleveland Avenue in Waukesha and University Avenue in Madison (~95 km apart) were compared for days during 2013 where both were simultaneously taking samples. Note that concentrations at both locations were never close to the 24-hour $PM_{2.5}$ standard of 35 micrograms per cubic meter. Also, for the 47 common days between these pairs, the correlation coefficient was 0.84, indicating strong correlation. As shown in Figure 9, values at both monitors increased and decreased in a similar fashion, even though they are far apart. Since the concentration trend is very similar between the monitoring sites this indicates that larger scale regional factors such as long-range transport of emissions influence both monitors.

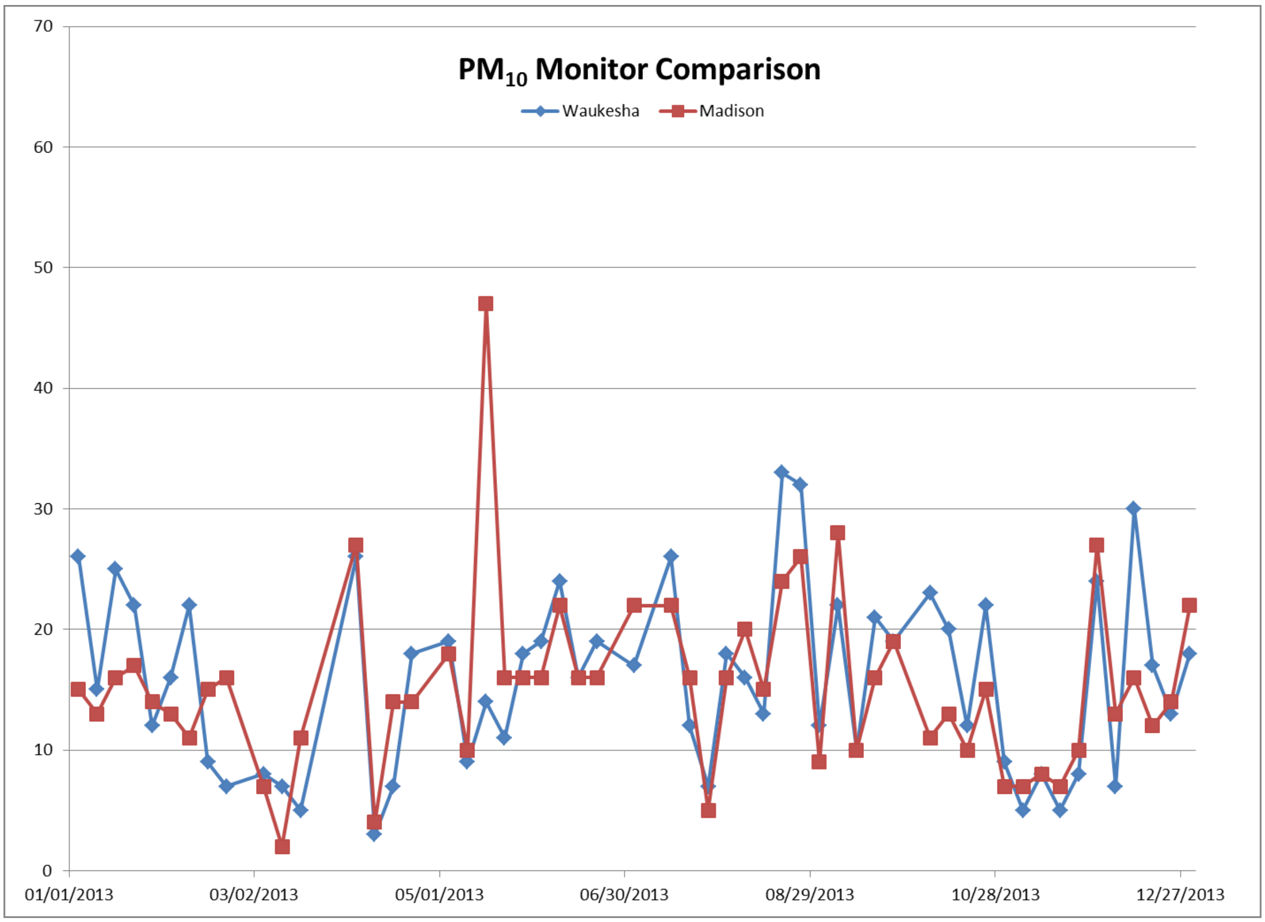
Figure 9 – $PM_{2.5}$ Monitor Comparison – Waukesha and Madison (University Ave)[10]
(Concentration in $\mu g/m^3$)



10 http://www.epa.gov/airquality/airdata (accessed Jun 25, 2014)

The difference between fine and coarse particulate is revealed by examining the correlation between pairs of PM_{10} monitors. For PM_{10} concentrations at Waukesha and University Avenue in Madison (54 days) the correlation coefficient was 0.56 or one-third lower than the $PM_{2.5}$ correlation. In comparison to the $PM_{2.5}$ graph in Figure 9, PM_{10} concentrations at Waukesha did not always increase similarly to concentrations in Madison, although in both cases the values were well below the 24-hr PM_{10} standard (150 micrograms per cubic meter). Therefore, ambient PM_{10} concentrations act differently than ambient $PM_{2.5}$ concentrations and are influenced by different factors.

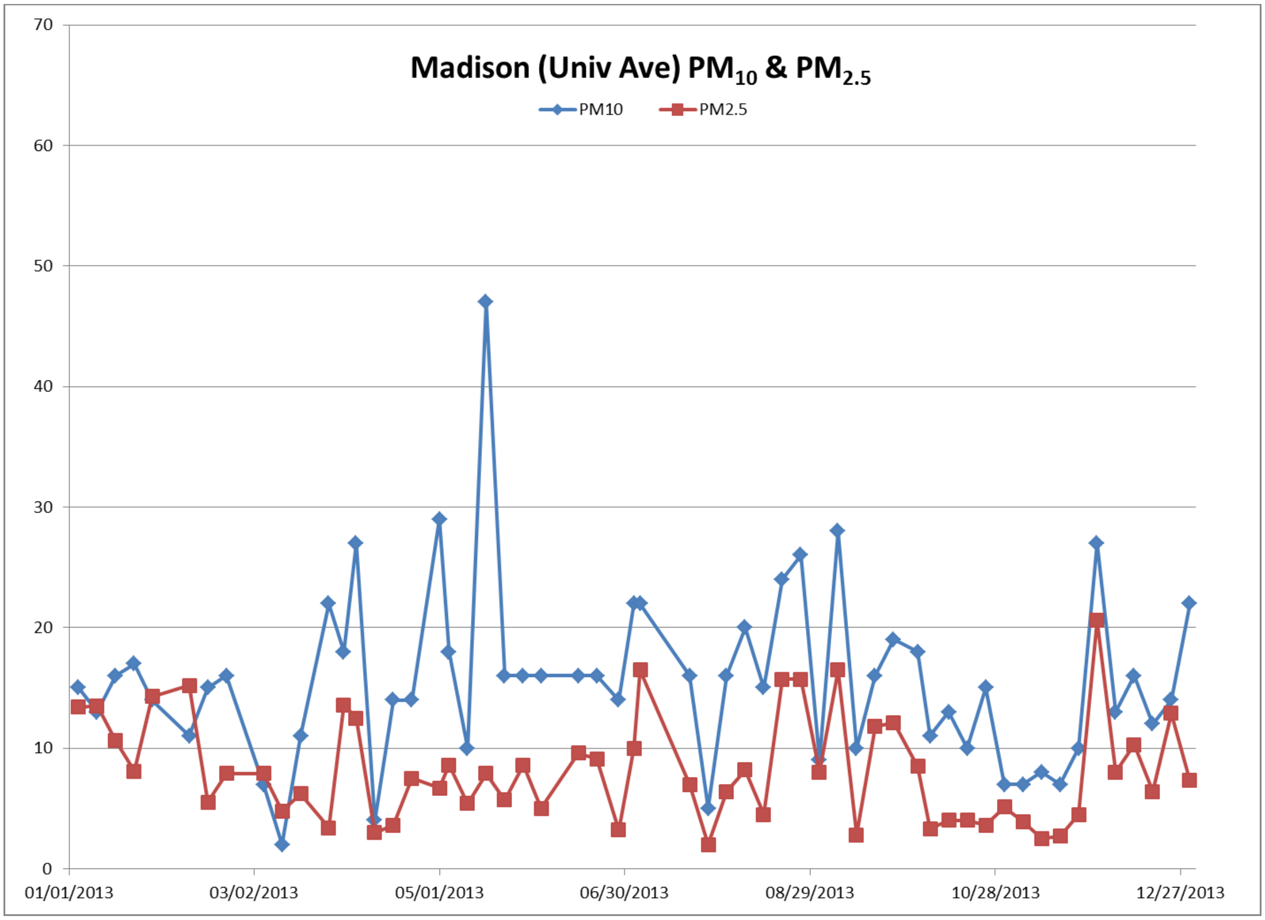
Figure 10 – PM_{10} Monitor Comparison – Waukesha & Madison (University Ave)[11]
(Concentration in $\mu g/m^3$)



11 http://www.epa.gov/airquality/airdata (accessed Jun 25, 2014)

The difference between fine and coarse particulate is further revealed by examining the correlation between PM_{10} and $PM_{2.5}$ at the same monitor. For concentrations at the University Avenue monitor in Madison (57 days) the correlation coefficient between PM_{10} and $PM_{2.5}$ was 0.49, lower than the correlation of PM_{10} between Madison and Waukesha, and lower than the correlation of $PM_{2.5}$ between Madison and Waukesha. Although there are some days where PM_{10} increases along with $PM_{2.5}$, the values of PM_{10} can change more measurably and more quickly than values of $PM_{2.5}$.

Figure 11 – PM_{10} to $PM_{2.5}$ Comparison – Madison (University Ave)[12]
(Concentration in $\mu g/m^3$)

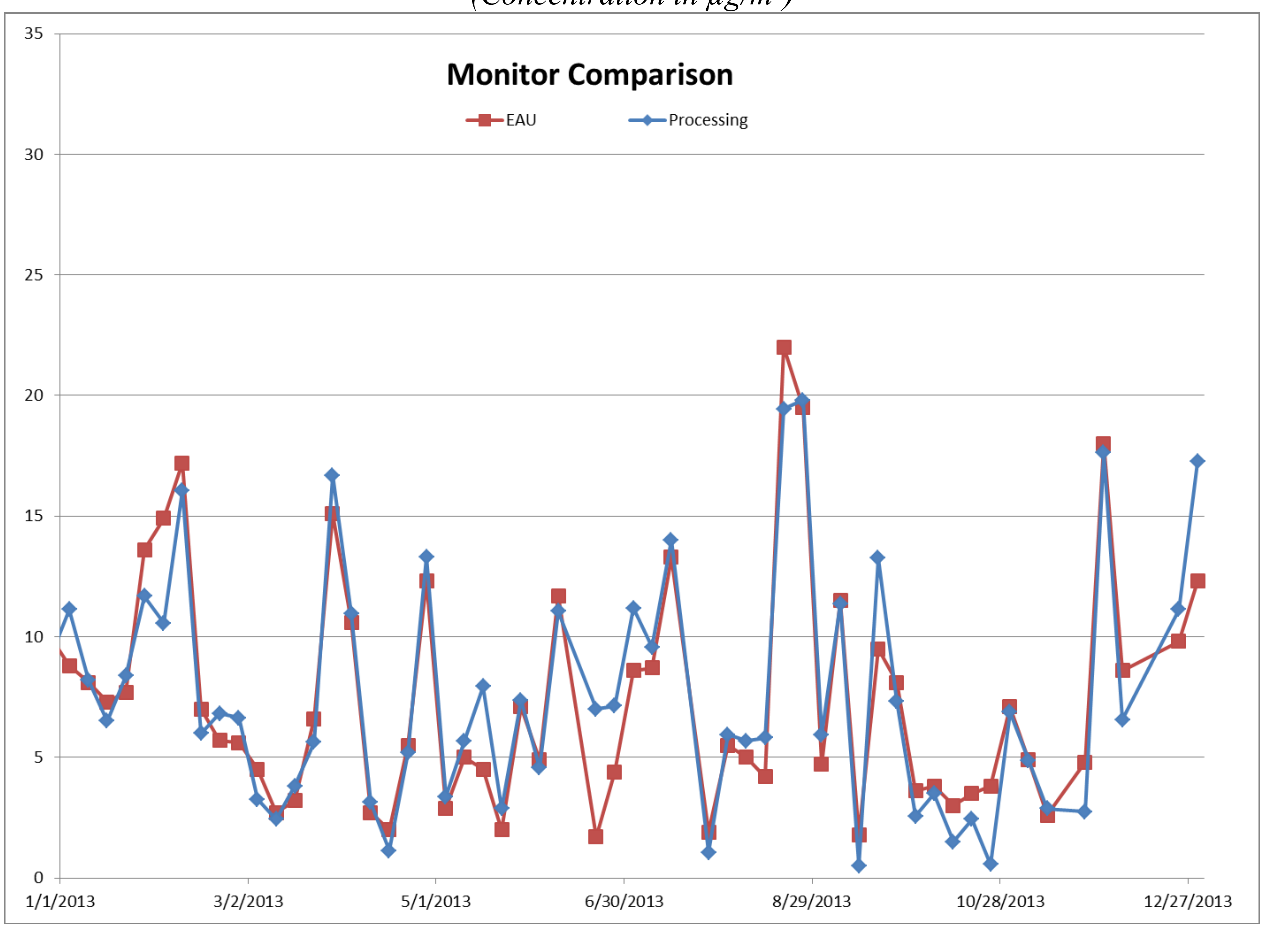


12 http://www.epa.gov/airquality/airdata (accessed Jun 25, 2014)

As further evidence, ambient monitoring was performed adjacent to a sand processing plant and affiliated sand mine in western Wisconsin (refer to *Assessment of Community Exposure to Ambient Respriable Crystalline Silica near Frac Sand Processing Facilities, Richards, J. and Brozell, T., Atmosphere 2015, 6, 960-982*). The monitors were located in the area expected to have the highest ambient concentrations from a directly emitted pollutant – within the property of the facilities. The filter-based data collected was fine particles with aerodynamic diameter of 4 micrometers (PM_4). By definition, this data will contain all the $PM_{2.5}$, including secondarily formed $PM_{2.5}$, and particles between 2.5 micrometers and 4 micrometers in diameter, so the PM_4 data should have higher concentrations than ambient $PM_{2.5}$ data.

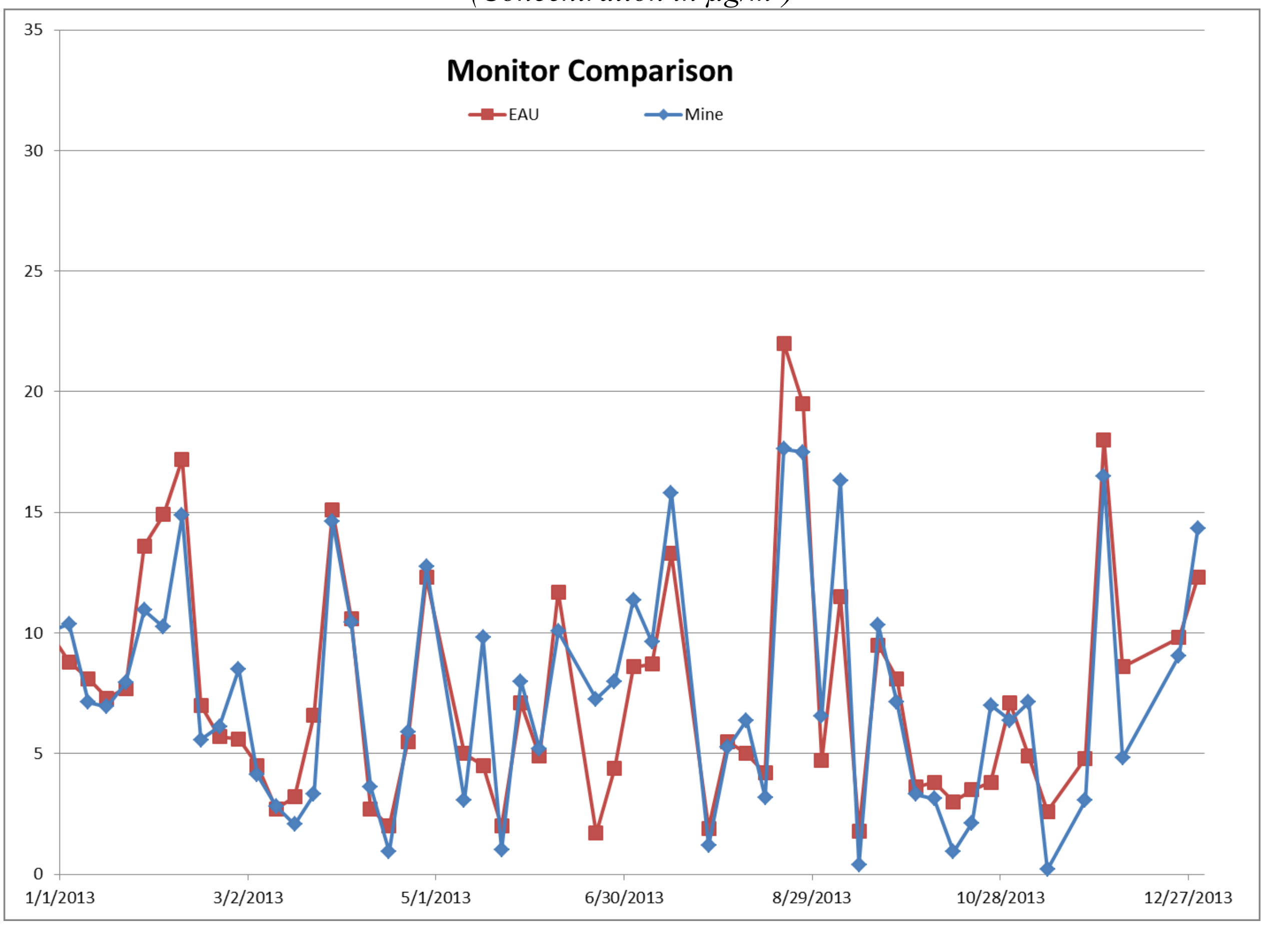
Comparing the facility-adjacent PM_4 monitoring data with Wisconsin $PM_{2.5}$ monitoring data confirms that sources other than direct emissions have a profound effect on ambient concentrations. The filter based $PM_{2.5}$ federal reference method monitored concentrations at Eau Claire (EAU) are compared to filter based PM_4 concentrations measured at the processing plant. As shown in Figure 12 no concentrations were near the 24-hour $PM_{2.5}$ standard of 35 micrograms per cubic meter. In addition, the correlation coefficient between the PM_4 data collected at the processing plant and the Eau Claire $PM_{2.5}$ data is 0.93, indicating strong correlation. When concentrations at the processing plant monitor increased, so did concentrations in Eau Claire even though the monitors are 23 kilometers apart.

Figure 12 – Monitor Comparison – Eau Claire & Sand Processing Plant (Concentration in $\mu g/m^3$)



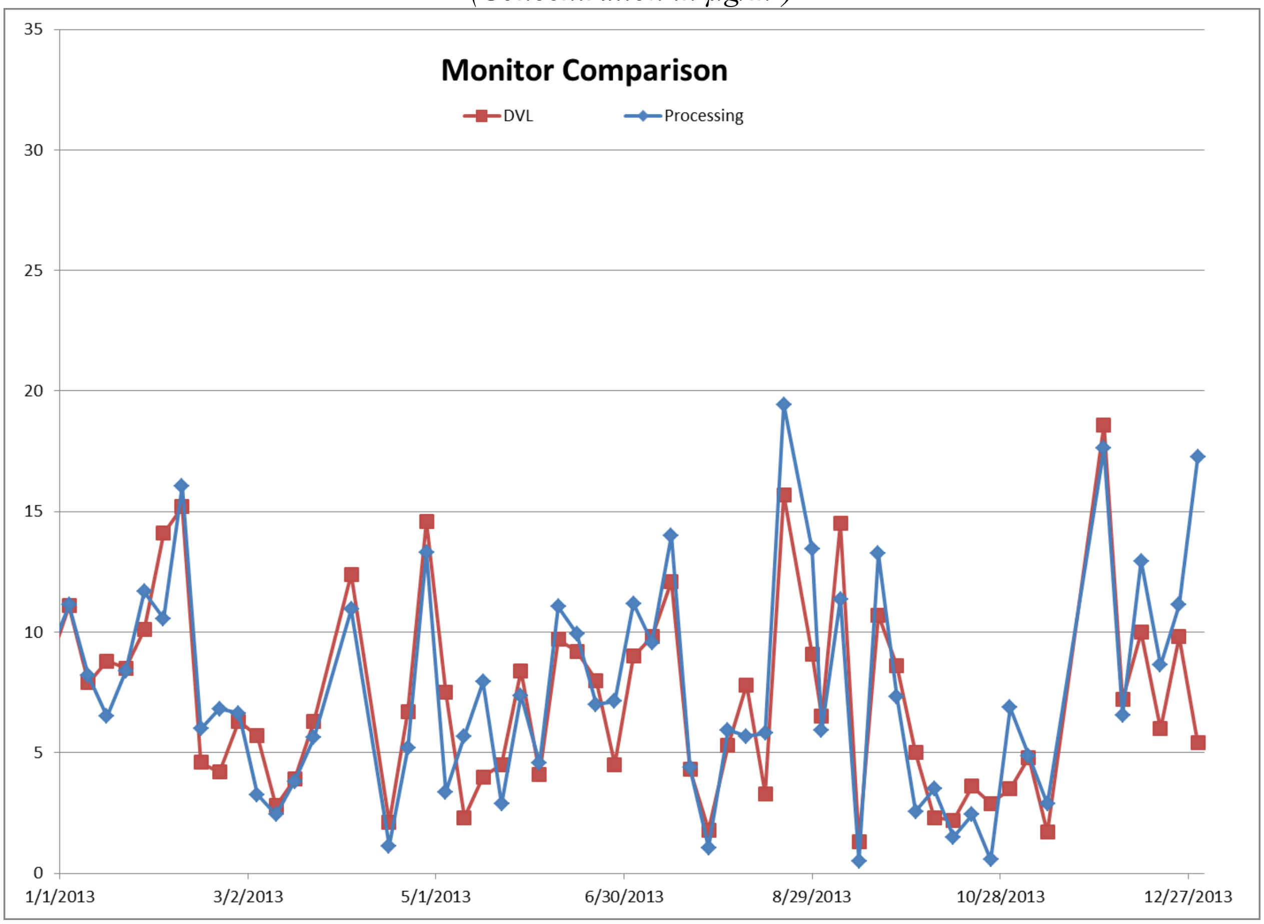
The filter based $PM_{2.5}$ federal reference method monitor at Eau Claire (EAU) was also compared to filter based PM_4 concentrations measured at the sand mine. As shown in Figure 13 no concentrations were near the 24-hour $PM_{2.5}$ standard of 35 micrograms per cubic meter. The correlation coefficient between the PM_4 data collected at the sand mine and the Eau Claire $PM_{2.5}$ data is 0.89, indicating strong correlation. When concentrations at the mine increased, so did concentrations in Eau Claire even though the monitors are 37 kilometers apart.

Figure 13 – Monitor Comparison – Eau Claire & Sand Mine (Concentration in $\mu g/m^3$)



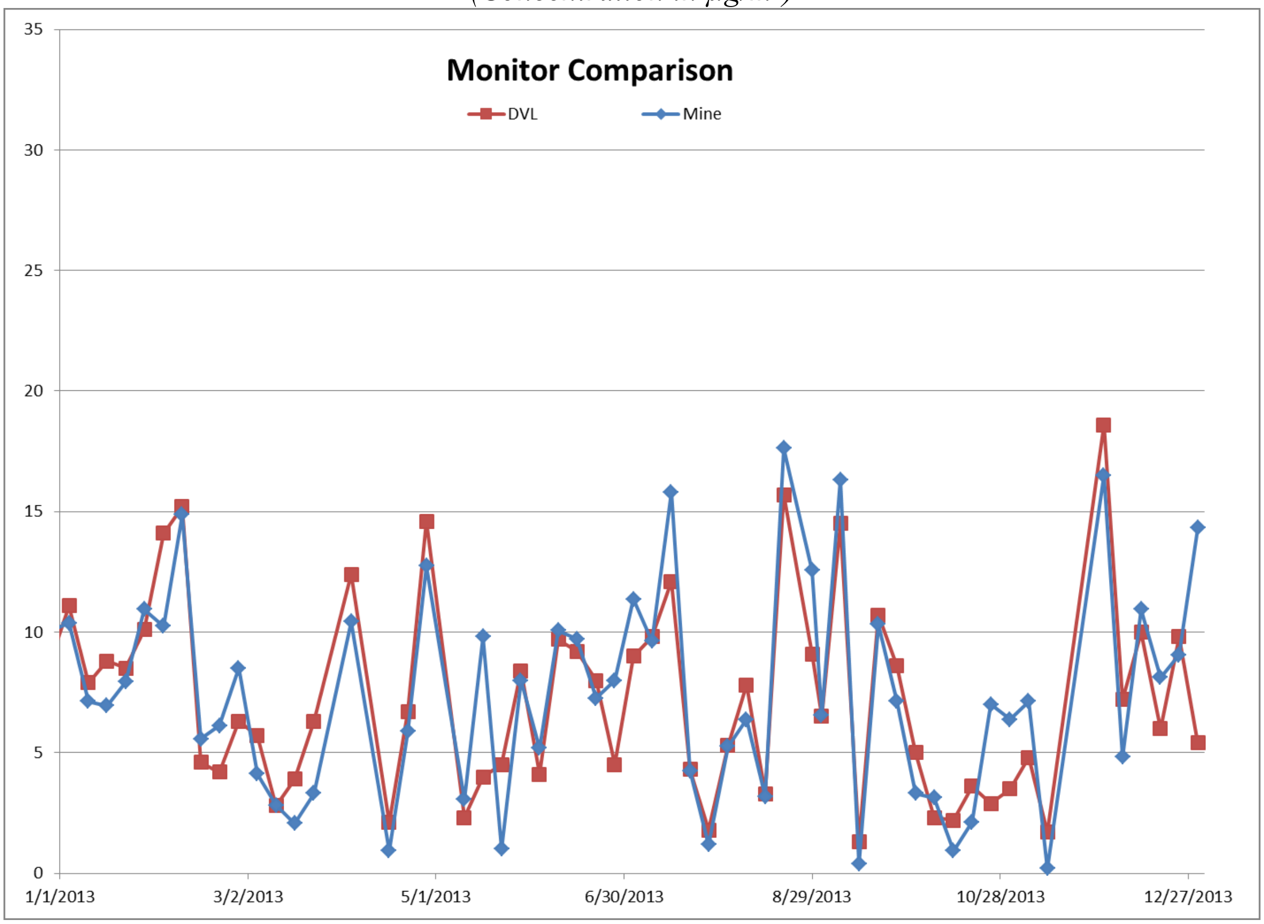
Monitors even further apart show the same temporal correlation. The filter based $PM_{2.5}$ federal reference monitor at Devils Lake (DVL) were compared to the filter based PM_4 concentrations at the processing plant. As shown in Figure 14, no concentrations were near the 24-hour PM2.5 standard, and the correlation coefficient is 0.84, even though the monitors are about 130 kilometers apart.

Figure 14 – Monitor Comparison – Devils Lake & Sand Processing Plant (Concentration in μg/m³)



The filter based $PM_{2.5}$ federal reference monitor at Devils Lake (DVL) were also compared to the filter based PM_4 concentrations at the sand mine. As shown in Figure 15, no concentrations were near the 24-hour PM2.5 standard, and the correlation coefficient is 0.86, even though the monitors are about 145 kilometers apart.

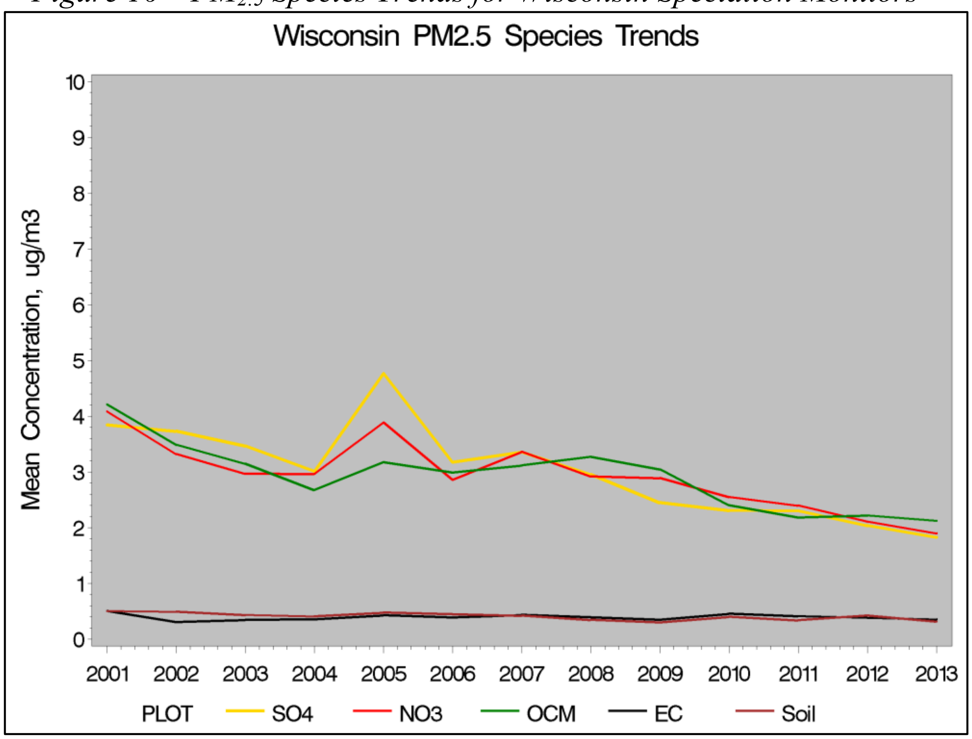
Figure 15 – Monitor Comparison – Devils Lake & Sand Mine
(Concentration in $\mu g/m^3$)



Detailed examination of fine particles captured using speciation monitors reveals that the mean concentrations of the sulfate, nitrate, and organic carbon components of $PM_{2.5}$ have decreased. Sulfates, nitrates, and organic carbon are all formed secondarily in the atmosphere from precursor pollutants. Of the reported components, elemental carbon is correlated to directly emitted $PM_{2.5}$ from fuel combustion. Concentrations of elemental carbon have essentially held steady at very low levels and this trend does not correspond to the decrease in ambient $PM_{2.5}$. The distribution of component contributions demonstrates that emissions of primary, direct $PM_{2.5}$ have minimal impact upon ambient air concentrations.

Figure 16 obtained from the Lake Michigan Air Directors Consortium (LADCO) provides detail on the species with the largest contribution to ambient concentrations. As approximated from the plot, in 2009, measured average nitrate concentrations were ~2.9 ug/m^3 as compared to ~1.9 ug/m^3 in 2013. Average measured sulfates dropped from ~2.4 ug/m^3 in 2009 to ~1.8 ug/m^3 in 2013; average organic carbon went from ~3.1 ug/m^3 in 2009 to ~2.2 ug/m^3 in 2013.

Figure 16 – $PM_{2.5}$ Species Trends for Wisconsin Speciation Monitors[13]



13 May 9, 2014 email from Donna Kenski – LADCO to John Roth - WDNR

The reduction in sulfate, nitrate, and organic carbon correspond to reductions in NO_x and SO_2 emissions from improvements in engine efficiency and reductions in sulfur content of fuels (Tier 2 Emission Standards for Vehicles and Gasoline Sulfur Standards; Heavy-Duty Diesel Engine Rule; & Nonroad Large Spark Ignition Engine and Recreational Engine Standards). The reduction in ambient concentration is also consistent with regression analysis performed by the Lake Michigan Air Directors Consortium (LADCO). The 2010 update *Summary of CART Analysis for PM2.5 Meteorologically Adjusted Trends* states, "Trends in all eight urban areas were consistently downward; these results appear to show that nationwide emission reductions of SO_2 and NO_x in recent years have had a measurable impact on $PM_{2.5}$."

SUMMARY

- This analysis demonstrates that direct emissions of $PM_{2.5}$ from any individual stack or source have little influence on ambient concentrations of $PM_{2.5}$ and therefore $PM_{2.5}$ emissions from any individual stack or source do not cause or exacerbate violation of any $PM_{2.5}$ increment or standard. In summary:

- Emissions of $PM_{2.5}$ derive from different sources than those of PM_{10} and therefore $PM_{2.5}$ emissions cannot be characterized simply as a subset of total particulate matter.

- Emissions of $PM_{2.5}$ have long lifetimes in the atmosphere and travel long distances from the emission source thus becoming well-mixed in ambient air.

- National emissions estimates of $PM_{2.5}$ from direct sources have remained steady from year-to-year, yet monitored concentrations have steadily decreased at both rural and urban locations bolstering the conclusion that directly emitted $PM_{2.5}$ is not affecting monitored concentrations of the pollutant.

- Both national and Wisconsin emission estimates of the $PM_{2.5}$ precursors SO_2 and NO_x from direct sources have decreased year-to-year, similar to $PM_{2.5}$ monitored concentrations.

- The true level of direct, primary $PM_{2.5}$ emissions may be at least nine times lower than previously reported due to errors in stack testing methods that were used to develop emission factors.

- Concentrations of ambient $PM_{2.5}$, as measured by monitors in Wisconsin, are below the NAAQS and continue to steadily decrease with time.

- All of Wisconsin is considered in attainment for both the 24-hour and annual NAAQS for $PM_{2.5}$ due to the steady decrease of ambient levels of $PM_{2.5}$ as monitored by DNR's air monitoring network.

- Comparison of ambient $PM_{2.5}$ concentrations from monitors both in close proximity of each other and far apart show strong correlations, indicating that broad regional factors, such as weather patterns and long-range transport from distant sources, have a greater effect on ambient air than direct emissions from stationary sources.

- Comparison of concentrations from monitors within sand facilities to either nearby or distant Wisconsin ambient monitors also show strong correlations, further indicating that broad regional factors have a greater effect on ambient air than direct emissions from stationary sources.

- Examination of component substances captured by $PM_{2.5}$ speciation monitors illustrates that concentration of elemental carbon (corresponding to directly emitted $PM_{2.5}$ from fuel combustion) are not a major contributor to ambient $PM_{2.5}$ concentrations and are not increasing.

- Sulfate, nitrate, and organic carbon, produced by secondary reactions in the atmosphere, comprise most of the ambient $PM_{2.5}$ in Wisconsin.

- Decreased concentrations of ambient $PM_{2.5}$ correlate to national technology improvements such as fuel efficiency and reductions in sulfur content of fuels for both industry and mobile sources.

CONCLUSION

Use of dispersion modeling in order to approve air permit applications for direct sources of fine particulate ($PM_{2.5}$) is not appropriate for demonstrating that the emissions from the source do not cause or exacerbate an exceedance of the air quality standards for $PM_{2.5}$. Reductions in ambient air concentrations of pollutants such as ozone and $PM_{2.5}$ are influenced by regional factors such as weather patterns, long-range transport from distant sources, and secondary formation.

Ambient concentrations of $PM_{2.5}$ have decreased over time due to reductions in concentrations of sulfate, nitrate, and organic carbon. Reductions in concentrations of sulfate, nitrate, and organic carbon are due to national technology improvements, increases in mobile source fuel efficiency, and reductions in the sulfur content of fuels, leading to reductions in emission of SO_2 and NO_x. The trend in ambient concentrations of $PM_{2.5}$ does not correlate to trends in concentrations of elemental carbon, and so do not correlate to direct, industrial $PM_{2.5}$ emissions.

Therefore, the WDNR concludes that direct emissions of $PM_{2.5}$ from a single, direct stationary source will not cause or exacerbate violation of any $PM_{2.5}$ air quality standard or increment. For existing sources, minor new sources, and minor modifications of sources dispersion modeling of $PM_{2.5}$ is not necessary to demonstrate whether the emissions from the source cause or exacerbate an exceedance of the air quality standard for $PM_{2.5}$ and will no longer be performed for this purpose. Wisconsin will continue to regulate emissions of NO_x and SO_2 and will follow USEPA guidance on assessing the impact of direct $PM_{2.5}$ and secondarily formed $PM_{2.5}$ under the Prevention of Significant Deterioration permit program.

This report serves as the WDNR determination pursuant to s. 285.63(1)(b), Wis. Stats and is consistent with the determination made for other pollutants, such as ozone.