Cumulative Impacts Analysis

Assessment of Potential Visibility Cumulative Impacts in Federal Class I Areas in Minnesota

NorthMet Project

Prepared for
PolyMet Mining Inc.

January 2012
Version 3

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Table of Contents

List of Tables

List of Figures

Technical Summary

PolyMet plans to construct and operate a mine area near the town of Babbit, MN, to reactivate portions of the LTV Steel Mining Company (LTVSMC) Taconite Processing Plant and Tailing Basin near Hoyt Lakes, MN and to build an ore processing facility at the former LTVSMC site. The proposed project is referred to as the NorthMet Project. The project description is provided in the March, 2011 Draft Alternative Summary for the NorthMet Project environmental impact statement (reference(1)) and the NorthMet Project Description Version 3 Submitted September 13, 2011. The impact statement co-lead agencies, Minnesota Department of Natural Resources (MDNR), US Army Corps of Engineers, and US Forrest Service have concluded the proposed project requires a Supplemental Draft Environmental Impact Statement (SDEIS).

The Final Air Impact Assessment Planning Summary Memo for the Supplemental DEIS requires an updated assessment of the cumulative potential effects on visibility in Northeastern Minnesota (reference(2)). This assessment is to address not only the impacts of the proposed project, but also that of other past and "reasonably foreseeable" proposed projects on the Iron Range (see Table 1 and Figure 1). In addition, the project's potential cumulative air quality impacts are to be evaluated within the context of increasingly strict state and federal regulations to be implemented over the next decade. In this report, the project's potential cumulative impacts on visibility in the Boundary Waters Canoe Area Wilderness (BWCAW) and Voyageurs National Park (VNP) were evaluated.

This document is being provided as a stand-alone document for review and it will be integrated into the NorthMet Project Air Data Package after approval. Any discrepancy between this document and the NorthMet Project Air Data Package will be resolved in favor of this document.

Causes of Haze and Visibility Impairment

Persistent, widespread visibility problems in areas like national parks are primarily caused by fine particles less than 2.5 microns in diameter ($PM_{2.5}$). Most of the visibility impairment in the BWCAW and VNP is due to secondary sulfate, nitrate, and organic aerosols. These aerosols are not typically emitted directly, but are formed in the atmosphere through chemical reactions. Sulfur dioxide and nitrogen oxides react with ammonia to form sulfates and nitrates respectively. Volatile organic compounds (VOCs) react to form larger low-volatility compounds, which condense into fine particulate matter known as secondary organic aerosols (SOA). In Minnesota's Class I areas, the organic compounds leading to SOA were shown through modeling to be of mostly of biogenic origin (reference(3)).

Regional haze, a term used to describe visibility degradation over a broad area, is caused by both local as well as long-range transport emissions, and does not depend on stagnant meteorological conditions. In the absence of precipitation, fine aerosol particles (and their gaseous precursors) can exist in the atmosphere for many days and can be carried great distances by winds. Sources in Minnesota contribute approximately 30 percent of visibility degradation in the Class I areas, but the majority of regional haze is often caused by conversion and transport of gaseous precursor emissions from sources outside of Minnesota (reference(3)). In addition, organic particles are produced as primary emissions from natural sources such as wildfire smoke, plant waxes, and pollen and as a result of conversion of volatile organic compound emissions such as terpenes and other hydrocarbons from trees and other natural sources.

Regulatory Background

In July 1999, the U.S. Environmental Protection Agency (EPA) published regulations intended to improve visibility in our nation's largest national parks and wilderness ("Class I") areas. On June 15, 2005, EPA issued final amendments to its July 1999 rule. This rule and amendments are referred to as the Regional Haze Rule. Minnesota has two Class I areas – the BWCAW and VNP. The rule sets the goal of no man-made degradation of visibility by 2064 in Class I areas and also requires emission controls known as Best Available Retrofit Technology, or BART, for certain industrial facilities emitting air pollutants that reduce visibility. The Minnesota Pollution Control Agency (MPCA) submitted to EPA a State Implementation Plan (SIP) in December 2009 that sets forth a visibility goal for 2018 that shows reasonable progress towards the ultimate 2064 goal. Progress reports on the reasonable progress goals are to be submitted every five years and revisions to SIPs every ten years.

Pollutant Air Concentrations

SO_2, NO_x and particulate air concentrations, coarse and fine, are monitored by the Interagency Monitoring of Protected Visual Environments (IMPROVE) monitoring network. An IMPROVE site is located in the BWCAW (BOWA1) just north and east of Ely and in VNP (VOYA2) just east of International Falls. See Figure 2 and Figure 3. The particulate air concentrations are estimated from filter samples collected by standard equipment and are reported as PM_{10}, coarse particle ($PM_{2.5}$ – PM_{10}) or fine particle ($PM_{2.5}$ or less) air concentrations.

Visibility Metric

In this report, visibility is usually described by the haze index measured in "deciviews" which is calculated from the "light extinction coefficient". Deciviews are a logarithmic conversion of light extinction coefficient that more accurately reflects how humans perceive visibility impairment. Visibility

is not generally measured directly, but is usually indirectly estimated from monitored ambient particulate concentrations. The light extinction coefficient is calculated by multiplying the six major particulate components by component-specific light extinction efficiencies. Finally, visibility impairment often varies significantly from week to week and season to season. Therefore, visibility data is routinely reported not as an annual average but as that measured on "20% worst," "median," and "20% best" days.

Summary Findings and Conclusions

1. **Class I Area Visibility Gradually Improving or Showing No Trend.** Between 1992 and 2009, visibility in the BWCAW on the 20% worst days improved from 21.4 deciviews to 19.8 deciviews, based on a rolling five-year average. This 1.6 deciview reduction is equivalent to about an 8% improvement in visibility. Most of this visibility improvement took place in the first half of the time period. For VNP, the National Park Service (NPS) has concluded that through 2007 there was not a trend of either improving visibility or declining visibility for this park (reference(4)). Monitoring data at VNP from 2000-2008 confirm the NPS finding.

2. **Sulfate and Nitrate Particles Are Largest Contributor to Visibility Impairment**. Ammonium sulfate, ammonium nitrate and organic carbon matter particulates are the largest contributors to visibility impairment in both Class I areas. The ammonium sulfate and nitrate are due to emissions of SO_2 and NO_x, respectively. The organic carbon matter in Minnesota has been shown to be attributable to mostly biogenic sources. Elemental carbon, soil, coarse particulate matter and gaseous species are minor contributors.

3. **Overall Emissions of Pollutants that are Precursors to Sulfate and Nitrate Particulates will Decrease.** When the emissions from the proposed projects in northeast Minnesota are viewed together with the concurrent emission reductions of SO_2 and NO_x from the power and mining facilities in northeast Minnesota, there is a net decrease in emissions of both pollutants in the six-county area of northeast Minnesota. Minnesota's Regional Haze SIP requires additional reductions in SO_2 and NO_x emissions from existing facilities in the six-county project area. Additional reductions in emissions may be required in the future to meet longer-term regulatory goals (e.g., Regional Haze). The foreseeable regulatory requirements indicate that SO_2 and NO_x emissions from Minnesota sources will likely decline in the future.

4. **Percentage Increase in Pollutants Small Compared to Statewide Emissions that Affect Visibility and Fine Particulate Air Concentrations.** The percentage increase in pollutants from the proposed projects, not including the concurrent reductions, in northeast Minnesota is small in comparison to

current total statewide emissions. Worst-case total potential emissions from the proposed Iron Range projects represent a comparatively small increase compared to the 2009 statewide emissions: less than 1% of PM_{10}, about 2% of SO_2, and about 2% of NO_x emissions.

5. **Fine Particulate Concentrations and Visibility Impairment Mostly Due to Out of State Emissions.** Long-range transport modeling done in support of the Minnesota Regional Haze SIP shows that approximately 14 to 15% of the visibility impairment on the 20% worst days is due to emissions from northeast Minnesota. Three projects were included in this modeling; Mesabi Nugget, the NorthMet Project and Minnesota Steel (now Essar Steel). Based on the modeling results, the remainder of the visibility impairment is estimated to be due to sources in other parts of Minnesota (12 to 17%), other states and Canada (reference (3)). Overall, Minnesota sources are estimated to be responsible for about 30% of the current visibility impairment, with about 70% of the visibility impairment due to all other out-of-state sources, including global sources.

6. **National Emission Reductions Likely to Drive Further Improvement.** Over the next decade, voluntary and mandatory reductions in SO_2, NO_x and direct particulate emissions from existing sources in Minnesota and nationwide (including transportation sources) are likely to more than offset emissions from the proposed projects. In addition, the proposed projects will be controlling emissions of these pollutants in accordance with applicable regulations and permits, including the 2010 SO_2 and NO_x NAAQS. More importantly, continued nationwide emission reductions over the next decade in visibility impairing pollutants will likely allow for both industrial growth on the Iron Range and continued improvement in visibility in the nearby Class I areas.

1.0 Introduction

To support the analyses in the SDEIS, this cumulative visibility evaluation is provided. The scope of the SDEIS requires a series of cumulative impact assessments covering a range of environmental issues. These assessments are to address not only the impacts of the proposed project, but also those of other past and "reasonably foreseeable" proposed projects. In addition, the project's potential cumulative air quality impacts for visibility are to be evaluated within the context of increasingly strict state and federal regulations to be implemented over the next decade.

As required by the Final Air Impact Assessment Planning Summary Memo for the Supplemental DEIS (reference(2)), a semi-quantitative analysis was conducted to determine whether the project has the potential to contribute to visibility impairment in the Federal Class I areas in Minnesota (VNP and the BWCAW). Particulate emissions are included in this assessment, along with SO_2 and NO_x emissions, because fine particles are an important contributor to visibility impairment and fine particles can be made up of sulfate and nitrate aerosols. In addition, particle emissions are typically evaluated for their potential impacts in Federal Class I Areas, individually and in conjunction with SO_2 and NO_x emissions, for Prevention of Significant Deterioration (PSD) air permitting analyses. Because of the relationship of particle emissions with visibility impairment and the specific assessments of potential impacts related to particulate emissions that are required to be conducted for PSD air permitting, particulate emissions are evaluated along with SO_2 and NO_x emissions in this cumulative impact analysis.

1.1 What Are "Cumulative Impacts"?

The Council on Environmental Quality's (CEQ) regulations, which implement the National Environmental Policy Act (NEPA), define "cumulative effects" as: "… The impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-federal) or person undertakes such other actions. …" (40 CFR 1508.7). The Minnesota Environmental Quality Board environmental review rules use a similar definition for "cumulative impacts" instead of "cumulative effects" (see Minnesota Rules, part 4410.0200, Subp. 11).

Some regulatory programs, in effect, require a form of quantitative cumulative impact assessment as part of a permit review. For example, air quality modeling of all significant nearby emission sources is required for "New Source Review" air permits. Likewise, water discharge permits often require the applicant to account for the impact of other discharges that affect the same water body as the proposed

project. But for most cumulative impact issues, such as those to be addressed for the NorthMet Project, there are only general guidelines. Therefore, the specific approach used to assess cumulative impacts must be developed case by case (reference(5)).

1.2 Visibility Impairment "Cumulative Impact" Approach

In addition to national and statewide emissions, this analysis summarizes stationary source emission trends in the six-county area encompassed by Itasca, St. Louis, Lake, Carlton, Koochiching and Cook counties. This six-county area was chosen to be consistent with the MPCA's Regional Haze SIP analysis area for northeastern Minnesota.

The assessment of potential cumulative impacts on visibility from the proposed project is completed in four parts:

1. Assess the IMPROVE data for VNP and the BWCAW to provide the current haze index (an indicator for visibility) and concentrations of other pollutants that may degrade visibility, including a trends analysis where there is sufficient data (improvement, no change, or degradation).

2. Assess available information from the Regional Haze SIP (see Section 1.4) that identifies emission sources and/or emission source regions as significant contributors to ambient air concentrations in the Class I areas located in Minnesota.

3. Evaluate local, statewide and national SO_2, NO_x, and PM_{10} emissions and trends using existing emission inventory data.

4. Evaluate the cumulative impacts from the proposed projects based on the potential increases in SO_2, NO_x, and PM_{10} emissions and concurrent reductions from current and reasonably foreseeable projects and the expected decrease in state and national emissions in the future.

1.3 Proposed Projects and Summary of Potential Emissions

Table 1 shows the estimated potential emissions of SO_2, NO_x, and PM_{10} from each of the proposed projects and reductions included in this analysis. Concurrent emission reductions are provided for comparison to the emissions estimated for the proposed projects. Additional details regarding each of the emission reduction projects and their status are provided in Section 4.0. Proposed projects were included only if they were not yet fully operating as of January 1, 2010 and reductions were only included if they were fully implemented after January 1, 2010. This cutoff date was chosen because the monitoring data used to assess the past or existing conditions includes information through December 31, 2009. Any projects that began operating after January 1, 2010 were not included in the analysis of the existing

conditions and therefore needs to be considered in the assessment of future cumulative impacts. Similarly, any reductions that occurred or will occur after January 1, 2010 are not reflected in the monitoring data and are considered in this assessment of cumulative impacts.

The two major contributors to visibility impairment for both Federal Class I areas in Minnesota are ammonium sulfate and ammonium nitrate, secondary aerosols formed from emissions of SO_2 and NO_x, respectively. Even though there is a net increase in PM_{10} for all the proposed projects combined, direct PM_{10} emissions are not considered to be a concern for visibility impairment in the BWCAW or VNP (reference(3)).

As can be seen from Table 1, emissions of both NO_x and SO_2 will be reduced significantly in northeast Minnesota due to large reductions from Minnesota Power's facilities and BART reductions. The emission increases from the proposed projects (mainly mining) will be more than compensated for by the reductions from the power plants and other BART reductions. However, as noted later in this report, additional reductions may need to be made to meet the Regional Haze goals for visibility.

The PM_{10} emissions for the proposed projects include both stack and fugitive emissions and show a net increase for all the proposed projects. Stack emissions are generally fine particulate while fugitive emissions are typically larger particles. Fugitive emissions are often ground-level emissions, especially in the case of mining sources, having the potential for local air quality impacts near the facility, but likely not associated with impacts at a distance from a facility (reference(6)). Table 1 includes both fugitive and stack emissions in order to show a complete picture of the emissions.

Figure 1 shows the general locations of the proposed projects in northeast Minnesota in relation to the federal Class I areas included in this analysis, the BWCAW and VNP.

Table 1 Maximum potential sulfur dioxide, nitrogen oxide, and particulate emissions from proposed projects in the six-county project area in comparison to emission reductions.

(Six-county project area is Carlton, Koochiching, Itasca, St. Louis, Lake, Cook counties)

Project	Location In Minnesota	SO_2 (tpy)	NO_x (tpy)	PM_{10} [16] (tpy)	BACT/ MACT [18]
Increases					
Excelsior Energy, Mesaba Energy Project [1]	Taconite, Itasca County	1,390	2,872	532	Yes
Mesabi Nugget Phase I LSDP [2]	Hoyt Lakes, St. Louis County	417	955	587	Yes
Mesabi Nugget Phase II [3]	Hoyt Lakes, St. Louis County	7	298	1260	Yes
Essar Steel Minnesota LLC (formerly Minnesota Steel) [4]	Nashwauk, Itasca County	421	1,505	1,354	Yes
Essar Steel Minnesota LLC – Project modifications [5]	Nashwauk, Itasca County	146	-69	-90	Yes
Northshore Mining Company: Furnace 5 Reactivation [6]	Silver Bay, Lake County	56	200	149	Yes
PolyMet Mining, NorthMet Project [7]	Hoyt Lakes, St. Louis County	40	473	1186	No
SAPPI Cloquet [12]	Cloquet, Carlton County	1	162	29	Yes
UPM/Blandin Paper Mill Expansion: Project Thunderhawk [8]	Grand Rapids, Itasca County	213	169	-7	Yes
US Steel Keewatin, Keetac Expansion [9]	Keewatin, Itasca and St. Louis Counties	81	35	1284	Yes
United Taconite Green Production Project [13]	Forbes, St. Louis County	35	35	-10	No [13]
Total Increases		2,807	6,635	6,274	
Anticipated Reductions from 2009 Emissions					
Minnesota Power – Taconite Harbor Energy Center Unit 2, emission control modifications for SO2, NO_x and mercury [11]	Schroeder, Cook County	-1549	-423		
Minnesota Power – Laskin Energy Center Unit 2 NO_x reductions [10][11]	Hoyt Lakes, St. Louis County	0	0		
Minnesota Power – Boswell Energy Center Unit 3 [11]	Cohasset, Itasca County	-4,224	-6,372		
US Steel Minntac [15]	Mtn. Iron, St. Louis County		-1,973		
Hill Wood Products [14]	Cook, St. Louis County	0	0	-14	
Northshore Mining Company: BART Reductions [11][17]	Silver Bay, Lake County	-583	-1,159		
United Taconite BART Reductions [11][17]	Forbes, St. Louis County	-1,954			
Total Reductions		-8,310	-9,927	-14	
Net Reduction/Increase		-5,503	-3,292	+6,260	

[1] Emission estimates (Phase I and Phase II) based on emissions used in the air quality analysis in the final EIS, website: http://energy.gov/nepa/downloads/eis-0382-final-environmental-impact-statement-0. Accessed on May 5, 2011.

[2] Mesabi Nugget's Proposed Large Scale Demonstration Plant (LSDP): No crushing/grinding at the site; receive concentrate from off-site. Technical Support Document for MPCA permit 13700318-003. Included in Northeast Minnesota Plan Project Tracking for MPCA SIP, version 1-20-2011.

[3] Preliminary emission estimates, Barr Engineering, as of 1/29/2011.

[4] Baseline emissions from Potential to emit from Technical Support Document for Minnesota Steel (MPCA permit #06100067-002).

[5] Project modifications preliminary emission estimates Barr Engineering, emission estimate from EI spreadsheet submitted to MPCA on 4/5/2011.

[6] Northshore Mining's Furnace 5 Project: reactivating 2 crushing lines, 9 concentrating lines, one pellet furnace (Furnace 5); new sources emissions only (MPCA permit #07500003-003). Although construction for the project was completed prior to the January 1, 2009 cutoff date for this analysis, due to plant turnaround and current demand, the furnace has not yet operated at a capacity reflecting the expected increase and is therefore included in this evaluation.

[7] PolyMet Mining's Proposed Facility: crushing/grinding of ore, reagent and materials handling, flotation, hydrometallurgical processing, mobile emissions. Emission estimates from Barr Engineering report dated November 2008 *Stationary and Mobile Source Emission Calculations for the NorthMet Project –Combined Report (RS57)*, submitted to MDNR and updated 4/1/2009. An updated emission inventory is being prepared to reflect the project as currently proposed. All portions of the inventory are expected to be submitted for review within a few weeks of submittal of this report. The expectation is that emission will tend to be lower than those reported previously.

[8] Net Emission Increase from Blandin Project Thunderhawk MPCA permit #06100001-009 No change in emissions for -010 or -011.

[9] U. S. Steel Keewatin, Keetac mine expansion and restart of taconite processing line – preliminary emission calculations, Barr Engineering. Submitted to MPCA in May 2011 permit application. NO_x emission increase is from the baseline actual emissions used to determine PSD applicability. Although there will be a small increase in actual emissions, there will be a decrease in the allowable emissions.

[10] Minnesota Power completed installation of the Low NOx burner system project in Spring 2010. Although actual 2009 emissions already show reductions in excess of the anticipated reductions from 2002 levels, additional reductions are expected to result from the use of the low NOx burners in 2010 and future years. A reduction of zero is used in this analysis because the actual future reductions are unknown.

[11] Emission estimates provided by the MPCA from the "Northeast Minnesota Plan Emission Tracking Spreadsheet" 1-20-2011. Reductions are the estimated reduction from 2002 emissions minus any reduction in actual emissions that has occurred between 2002 and 2009.

[12] Net emission change estimates from final EAW dated 5/1/2009. Plant expansion, new paper machine, new boiler.

[13] United Taconite's Green Production Project involves fuel changes and improvements to the concentrator and the Line 1 pellet plant to increase pellet production and was a Prevention of Significant Deterioration (PSD) minor project. Because it was a PSD minor project, specific considerations for BACT/MACT were not required. However, the Line 1 pellet plant has an existing wet scrubber to control particulate and SO2 emissions. Emission estimates are taken from the Technical Support Document of Permit Number 13700113-005 authorizing the project on August 19, 2010.

[14] Net emissions increase from TSD of Air Emission Permit No. 13700030-003.

[15] Reductions calculated based on data in "US Steel Minntac Line 7 Low NOx Main Burner Final Testing Report", May 13, 2011of 3,990 ton per year goal for NOx emissions and the 2009 actual emissions provided in the MPCA "Northeast Minnesota Plan Emissions Tracking Spreadsheet" 1-20-2011.

[16] PM_{10} emission estimates include stationary and fugitive emissions for all sources at a facility.

[17] The MPCA RH SIP is still being reviewed by the EPA for approval including the recommended BART determinations for affected facilities. Under a court imposed consent decree the EPA must approve the MN SIP by May 15, 2012. Actual BART requirements are pending discussions with the MPCA and have not yet been implemented.

[18] Abbreviations:
tpy = tons per year;
BACT = Best Available Control Technology
MACT = Maximum Achievable Control Technology
SO_2 = sulfur dioxide
PM_{10} = particulate matter less than 10 micrometers in size
NO_x = nitrogen oxides
N/A = not applicable

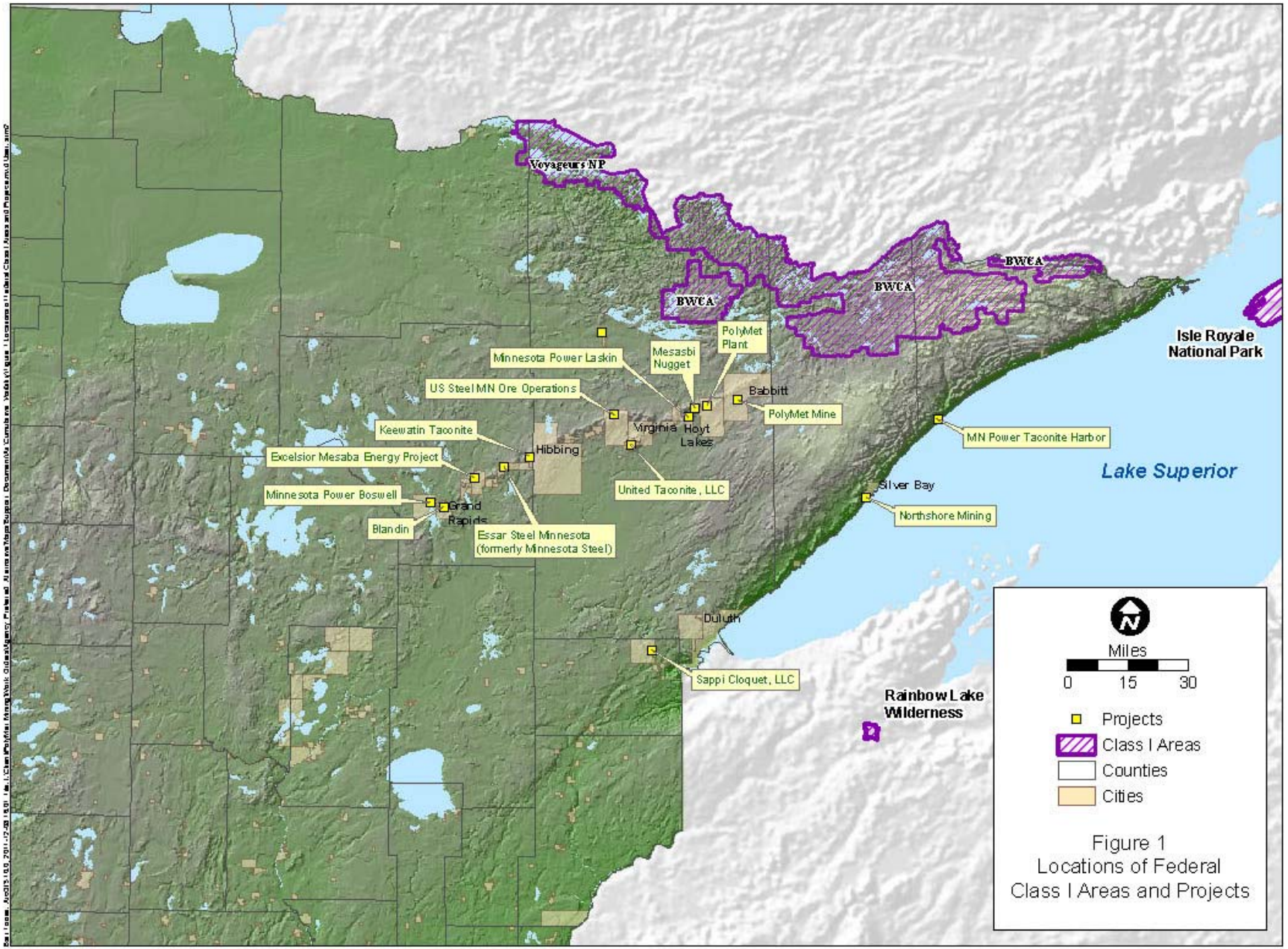


Figure 1 Location of Federal Class I Areas and Projects

1.4 Background on Regional Haze and Visibility Impairment

In order to better understand regional haze and visibility impairment and the methods used to describe it, this section summarizes the sources and types of visibility impairing particulate matter, visibility measurement methods and the applicable federal regional haze regulations.

1.4.1 What are Regional Haze and Visibility Impairment?

As defined by the U.S. EPA (reference (7)) "regional haze" is visibility impairment caused by the cumulative air pollutant emissions from numerous sources over a wide geographic area. Visibility impairment can be defined as the "introduction of particulate matter and certain gases into the atmosphere [that] interferes with the ability of an observer to see landscape features" and is primarily caused by very small particles, usually less than 2.5 microns in diameter ($PM_{2.5}$), including solid particles and liquid or aqueous aerosols (reference (8)).

PM_{10} can be divided into coarse (between 2.5 and 10 microns) and fine (less than 2.5 microns, $PM_{2.5}$) particulate fractions. The primary cause of regional haze in Minnesota's class I areas is light scattering resulting from fine particles in the atmosphere, specifically ammonium sulfate, ammonium nitrate and organic carbon matter (references (3)(8)). Coarse particles between 2.5 and 10 microns in diameter do contribute to light extinction. However, these particles tend to settle out from the air more rapidly than fine particles and usually will be found relatively close to their emission sources (references (6)(9)).

Visibility impairing particulates can also be categorized based on whether the particulate matter is emitted directly into the atmosphere or is indirectly formed when gaseous air pollutants react in the atmosphere (reference (6)). These two major categories of particulate matter are called "primary particulate matter" and "secondary particulate matter."

- **Primary PM** consists of mainly carbon emitted from many sources including smokestacks, cars, trucks, heavy equipment, forest fires, burning waste, crustal material from unpaved roads, stone crushing, construction sites, and metallurgical operations.
- **Secondary PM** forms due to chemical reactions of gases in the atmosphere. Some of these reactions require sunlight and/or water vapor in order to occur. Secondary PM includes sulfates formed from sulfur dioxide emissions, nitrates formed from nitrogen oxide emissions, and carbon formed from reactive organic gas emissions. Sulfur dioxide and nitrogen oxides are emitted from power plants, industrial facilities, cars and trucks. Organic gas emissions are emitted from these sources as well as from forest fires and biogenic sources such as trees. In Minnesota, the organic carbon matter found to be contributing to visibility impairment was found through modeling to be biogenic (reference (3)).

The fine particulate fraction ($PM_{2.5}$), which usually consists of secondary particulates, can be transported long distances by wind and weather and can be found in the air thousands of miles from where they were formed and can contribute to visibility problems at remote locations, such as national parks (references(6)(10)). The coarse fraction (particles with a diameter between 2.5 and 10 microns) is usually made up of primary particulates (references (6)(7)).

1.4.2 Fine Particulate Emission Sources

The air emissions most often responsible for regional haze are sulfur dioxide (SO_2, precursors of sulfate particles), nitrogen oxides (NO_x, precursors of nitrate aerosols and NO_2), primary volatile organic particles, gaseous VOCs (precursor of secondary organic particles), elemental carbon, soil-material, and ammonia (NH_3) (a precursor of ammonium nitrate). Each of these components can be naturally occurring or the result of human activity. The natural levels of these species result in some level of visibility impairment in the absence of any human influences, and will vary with season, daily meteorology, and geography (reference (11)).

The major anthropogenic sources of atmospheric fine particles (less than 2.5 microns) and their major mission sources are summarized Table 2.

Table 2 Atmospheric Fine Particles (PM2.5) and Their Major Emission Sources.

Atmospheric Pollutant	Primary Sources		Secondary Sources	
	Natural	Man Made	Natural	Man Made
Sulfate (SO_4)	Sea spray	Fossil Fuel combustion	SO_2 from volcanoes, oceans, wetlands	SO_2 from fossil fuel combustion
Nitrate (NO_3)	N/A	Motor vehicle exhaust, fossil fuel combustion	NO_x from soils, forest fires, lightning	NO_x from fossil fuel combustion, vehicle exhaust, prescribed burning
Organic Carbon	Wildfires	Open burning, wood burning, prescribed burning, motor vehicles, incineration, tire wear	Oxidation of Hydrocarbons (terpenes and waxes) emitted by vegetation and wildfires	Oxidation of hydrocarbons by vehicles, open burning, wood burning, fuel storage, solvent use
Ammonia (NH_3)	N/A	Motor vehicle exhaust		Animal agriculture, sewage, fertilizer

Reference: USEPA, 1997

1.4.3 How is Visibility Impairment Measured?

For the purposes of this report, visibility is characterized by the light extinction coefficient and the haze index. The light extinction coefficient is calculated using air concentrations of various fine particulate species and other factors. Haze index is a way of measuring visibility that better reflects how humans perceive changes in visibility. A description of and the relationship between these two measures of visibility is described below.

Light Extinction Coefficient

Because of the complications involved in direct measurements of visibility, most scientists use an indirect method which involves calculating the light extinction coefficient. The extinction coefficient is the sum of the atmospheric concentration of each species of interest multiplied by a corresponding coefficient. The light extinction coefficient is referred to as b_{ext} and has units of 10^{-6} m^{-1} or $(10^6$ $m)^{-1}$, or as typically labeled, inverse megameters (Mm^{-1}).

The IMPROVE program monitors air concentrations of visibility impairing constituents throughout the United States and uses these measured concentrations to calculate light extinction coefficients. The detailed IMPROVE light extinction coefficient calculations and assumptions can be found in the MPCA Regional Haze SIP (reference (3)).

Haze Index (Deciview)

Light extinction coefficient measurements are not linear with respect to the human perception of visual scene changes caused by uniform haze. For example, a given change in light extinction coefficient can result in a scene change that is either unnoticeably small or very apparent depending on the baseline visibility conditions. Presentation of visibility measurement data or model results in terms of extinction coefficient can lead to misinterpretation by those who are not aware of the nonlinear relationship.

Therefore, using the relationship of a constant fractional change in extinction coefficient to perceived visual change, a new visibility index called deciview (dv) was developed. The deciview is a unit of measurement of haze, implemented in a haze index (HI), which is derived from calculated light extinction, and is designed such that uniform changes in HI correspond approximately to uniform incremental changes in perception, across the entire range of conditions, from pristine to highly impaired (reference (7)).

The scale of the visibility index, expressed in deciview (dv), is linear with respect to perceived visual changes over its entire range, analogous to the decibel scale for sound. A one deciview change represents

a change in scenic quality that would be noticed by most people regardless of the initial visibility conditions. A deciview of zero equals clear air, while deciviews greater than zero depict proportionally increased visibility impairment (reference (12)). For example, a value of 29 dv represents more visibility impairment than does a value of 11 dv.

The haze index (*HI)* is defined by the following equation:

$$HI = 10\ln\left(\frac{b_{TOTAL}}{10}\right)$$

where b_{TOTAL} is the light extinction and is expressed in inverse megameters, or Mm^{-1}. One dv change is approximately a 10% change in extinction coefficient, which is a small, but perceptible scenic change under many circumstances. The deciview scale is near zero (0) for a pristine atmosphere (dv = 0 for a Rayleigh condition at about 1.5 km elevation) and increases as visibility is degraded. Like the decibel scale for sound, equal changes in deciview are equally perceptible. Because the deciview metric expresses visual scene changes that are linear with respect to human perception, EPA supports the use of the deciview metric in characterizing visibility changes for regulatory purposes.

1.4.4 Federal Regional Haze Rule

Section 169A of the 1977 Clean Air Act Amendments (CAAA) established a national visibility goal to remedy existing impairment and prevent future impairment in 156 National Parks and wilderness areas across the country designated as mandatory Federal Class I areas. The EPA issued initial visibility regulations in 1980 (reference(13)) that addressed visibility impairment in a mandatory Federal Class I area that is "reasonably attributable" to a single source or small group of sources (reference(7)).

Then, to address widespread regional haze problems, the EPA published regulations to address visibility impairment in federal Class I areas in July 1999. This rule is commonly known as the "Regional Haze Rule" (reference(14)) and is found in 40 CFR part 51, in §§ 51.300 through 51.309. On June 15, 2005, EPA issued final amendments to its July 1999 rule, including Appendix Y to 40 CFR part 51 "Guidelines for BART Determination Under the Regional Haze Rule." The MPCA subsequently prepared a BART strategy for Minnesota sources and is in the process of moving forward with that strategy (reference(15)).

As required under these rules, Minnesota submitted to EPA a Regional Haze State Implementation Plan (SIP) that identifies sources that cause or contribute to visibility impairment in these areas in December of 2009. EPA is currently reviewing the SIP to verify that the plan complies with all of the rule requirements. Under a court imposed consent decree, the EPA must approve of the MN SIP by May 15,

2012. The Regional Haze SIP includes a long term strategy that contains a 2018 visibility goal that demonstrates reasonable progress toward reaching the 2064 goal of no man-made visibility impairment for each of the federal Class I areas in Minnesota. The Federal Regional Haze Rule also requires states to submit progress reports every five years and SIP revisions every ten years. The first SIP revision for Minnesota is planned for 2018. The first progress report evaluating reasonable progress goals is due 2014.

In addition, the federal new source review (NSR) program generally requires air permit applicants to conduct a source impact analysis. For the NSR program, the impact analysis must demonstrate that the new or modified source will not cause or contribute to a violation of state or national ambient air quality standards (NAAQS) or cause an adverse impact to visibility in any federal class I area. Included in this impact analysis is the protection of federal lands (national parks, wilderness areas, etc.) which have been designated as federal Class I areas for PSD purposes. The EPA also administers several other programs designed to protect visibility including the secondary NAAQS for PM_{10} and $PM_{2.5}$, and section 401 under the provisions for acid deposition control. EPA has also promulgated a series of related regulations likely to reduce regional haze. See http://www.epa.gov/oar/visibility/actions.html.

Affected Federal Class I Areas

Minnesota has two federal Class I areas – the BWCAW and VNP. These Class I areas in Minnesota are the current focus of this analysis due to their proximity to the proposed projects.

There are also two federal Class I areas nearby, Rainbow Lakes Wilderness Area in Wisconsin and Isle Royale National Park in Lake Superior and part of the state of Michigan. Both Rainbow Lakes Wilderness and Isle Royale are out of scope for this analysis. Visibility is not an Air Quality Related Values for Rainbow Lakes Wilderness, so this area is not included in the visibility analysis. For both areas, PSD modeling results that have been reviewed by the Federal Land Managers (FLMs) for several of the proposed projects indicate that potential air quality impacts in the wilderness area and the park, including PM_{10} increment, are below the respective "significant impact levels" (SILs). If each proposed project has modeled potential impacts below the respective SILs, there is a level of confidence that air quality is protected against potential cumulative impacts (reference(16)). In addition, modeling performed for the Minnesota Regional Haze SIP for the year 2018 estimates that stationary sources in northeastern Minnesota contribute approximately three percent to the visibility impairment at Isle Royale for the 20 percent worst days. The SIP identifies any contributions less than 5 percent as insignificant. Because the estimated contributions from northeast Minnesota sources to modeled visibility impairment at Isle Royale are considered to be insignificant, Isle Royale is not included in the visibility analysis.

Rule Requirements

The federal Regional Haze Rule includes the following key requirements:

- Certain emission sources "that may reasonably be anticipated to cause or contribute" to visibility impairment in downwind Class I areas are required to install Best Available Retrofit Technology (BART).

- Control strategy State Implementation Plans (SIPs) must be submitted to EPA with individual states adopting progress goals for improving visibility from baseline conditions (represented by 2000 – 2004) to 2018 (represented by 2014 – 2018) for each Class I area in the state.
    - A state without any Class I areas will also need to adopt emission reduction strategies to address its contribution to visibility impairment problems in Class I areas located in other states.

- Specifically, a state is required to set reasonable progress goals for each Class I area in the state that:
    - Provide for an improvement in visibility for the most impaired (i.e., 20% worst) days over the period of the implementation plan; and
    - Ensure no degradation in visibility for the least impaired (i.e., 20% best) days over the same period.

- Reasonable progress goals are established by taking into account "reasonable progress factors", which include the costs of compliance, the time needed for compliance, the energy and non-air quality environmental impacts of compliance, and the remaining useful life of any existing source subject to such requirements

- States will determine whether they are meeting their goals by comparing visibility conditions from one five-year rolling average to another (e.g., 2000-2004 to 2014-2018).

IMPROVE Monitoring Network and Regional Planning Organizations

The IMPROVE program was established in 1985 to assist states and the federal government with SIPs for improving visibility in Class I areas and visibility data is gathered throughout the United States. It has been operating in Minnesota since 1988. After publication of the regional haze rule in 1999, the first step in the implementation process was the upgrade and expansion of the IMPROVE visibility monitoring network to 110 sites nationally. These sites were selected to represent all mandatory federal Class I areas (reference(7)). Representative data from this network has been used to establish baseline conditions (for the 2000 – 2004 time period) for each Class I area and to track progress toward the goals to be established in each State's SIP.

Five regional planning organizations (RPOs) were formed to assist in implementing the regional haze rule. Minnesota belongs to the Central Regional Air Planning Association (CENRAP), but also worked

extensively with the Midwest RPO. These RPOs are intended to respond to the transport of visibility-reducing pollutants within and across state and international boundaries. Over the last few years, RPOs have assisted states with assessing current haze conditions, establishing baseline levels, and specifying and coordinating emissions reduction strategies. The goal is to achieve "natural" visibility conditions by 2064.

1.5 Pollutant Emissions in Class I Areas and Potential Cumulative Impacts

Air quality in Federal Class I areas is protected under PSD air quality regulations and permitting. A Class I area assessment for potential air quality impacts is conducted for those projects that exceed specific emission thresholds. The NPS and US Forest Service, FLMs for the respective Class I areas, have specific requirements for the Class I area assessments. For example, for routine air permitting purposes, particulate emissions are calculated as primary particulate emissions (total particulate, PM_{10}, and $PM_{2.5}$). However, when assessing and evaluating potential air quality impacts in Federal Class I areas, the FLMs require an assessment of primary particulate as well as speciated particulate matter. The following size and speciation fractions of particulate matter have potential implications on visibility:

- Coarse ($PM_{2.5}$ < particles < PM_{10})
- Fine ($PM_{2.5}$ or smaller)
- Elemental Carbon (EC)
- Organic Carbon (OC)
- Sulfate aerosol
- Nitrate aerosol

This cumulative impact analysis evaluates the particulate fractions (coarse, fine) and species (primarily sulfate and nitrate aerosols) identified above. Sulfate and nitrate aerosols are formed from SO_2 and NO_x in the atmosphere. Therefore an evaluation of SO_2 and NO_x emissions is also included.

2.0 Analysis Boundaries

The analysis boundaries for the visibility cumulative impact analysis are:

- The timeframe for the analysis
- Other "reasonably foreseeable" actions to be assessed in addition to the proposed project
- The geographic area that may be affected (the "zone of impact")

2.1 Timeframe

The timeframe for this analysis extends to the expected duration of the NorthMet mine plan, 20 years. For emission rate data, this report describes historical emission rates back to 1990 for sources in northeastern Minnesota and uses information from the MPCA's Regional Haze SIP to show expected future emission rates based on likely emission caps or other regulatory emission limits. Emission inventory data is available through 2008. Monitoring data for key species affecting visibility and visibility information from the IMPROVE network are available for full calendar years from 1992 to 2009, depending on the (see section 3.0 and Table 3 for more information). Projections of future emission changes are compared to the 2008 baseline, the date of the most recent emissions data, for future emission projections and to a 2009 baseline when discussed in the context of future visibility.

2.2 Other Actions to be Assessed

Other "reasonably foreseeable" actions to be assessed include activities occurring in two different geographic areas:

- Other projects proceeding concurrently with the NorthMet Project, including projects that will both increase and decrease emissions, within the six-county area of northeastern Minnesota (Lake, Cook, St. Louis, Carlton, Itasca and Koochiching)
- Regulatory and other major actions to be undertaken in geographic areas that could potentially impact visibility in the BWCAW or VNP based on the Minnesota Regional Haze SIP

Figure 1 shows the general locations of the "reasonably foreseeable" projects to be assessed for cumulative impacts, as well as the locations of federally protected Class I areas. The projects selected as "reasonably foreseeable" are defined as those that are already underway and are actively moving through the environmental review process. It includes those that have completed their environmental review and received permits but were not yet constructed or operating in 2009, and therefore are not included in the IMPROVE monitoring data, or for which a completed data portion of an environmental review document

has been submitted to the MDNR or the MPCA. "Reasonably foreseeable actions" in regard to potential emission reductions include those regulatory actions that have been placed on public notice by a government agency (e.g., draft rules or regulations) or there has been a submittal to a regulatory agency that provides details on a planned action being considered.

The following projects and actions are considered to be underway or "reasonably foreseeable":

- Proposed projects:
    - Excelsior Energy, Mesaba Energy Project, Coal Gasification Power Plant
    - Mesabi Nugget Company, Phase I Large Scale Demonstration Plant
    - Mesabi Nugget Company, Phase II Project
    - Essar Steel Minnesota LLC, Mining/Taconite/DRI/Steel Plant
    - Essar Steel Minnesota LLC, Project modifications
    - Northshore Mining Company, Furnace 5 Reactivation Project
    - PolyMet Mining, NorthMet Project
    - SAPPI Cloquet Plant Expansion
    - UPM/Blandin Paper Mill Expansion, Project Thunderhawk
    - U. S. Steel Keetac, Expansion Project
    - United Taconite Green Production Project
- Emission Reductions
    - Minnesota Power Taconite Harbor Energy Center Unit 2, Emission Control Modifications
    - Minnesota Power Laskin Energy Center Unit 2, NO_x Reductions
    - Minnesota Power Boswell Energy Center Unit 3,
    - U. S. Steel Minntac BACT Reductions
    - Hill Wood Products major modification amendment.
    - Northshore Mining Company: BART Reductions
    - United Taconite BART Reductions
- Regulatory and other actions:
    - Implementation of the Regional Haze Rule and Best Available Retrofit Technology (BART) Rule;
    - Implementation of the Cross State Air Pollution Rule (CAIR Replacement Rule)
    - Implementation of other MACT standards, especially for boilers and process heater
    - State acid rain rule and statewide SO_2 emissions cap
    - Title IV of the 1990 Clean Air Act Amendments.
    - On-road mobile source programs
        - Fuel blending standards
        - Tier II/Low sulfur gasoline
    - Non-road mobile source programs
        - Non-road diesel rule
        - Control of emissions from unregulated non-road engines

- Locomotive/Marine engine reductions
- RACT requirements under the Wisconsin and Michigan $PM_{2.5}$ and ozone SIPs
- Updates and additions to the NAAQS for SO_2, NO_x, $PM/PM_{2.5}$ and ozone, including 1-hr NO_x and SO_2 standards
- Xcel Energy's Riverside plant re-powering project

2.3 Zone of Impact

The "zone of impact" is defined as the area of concern to be evaluated for potential cumulative impacts due to the above listed actions. The selected zone of impact is defined as VNP and the BWCAW, based on guidance from the Air Impact Assessment Planning Group (reference(2)). VNP is primarily located in St. Louis County, while the BWCAW encompasses parts of St. Louis, Lake, and Cook Counties.

The federal Class I areas in Minnesota are the current focus of this analysis due to their proximity to the proposed projects. Other Class I areas within 250 kilometers of the proposed Iron Range projects are Isle Royale National Park located to the northeast of the Iron Range off the northeast tip of Minnesota in Lake Superior (in the state of Michigan) and Rainbow Lake Wilderness located to the southeast of the proposed projects in northwest Wisconsin (Figure 1). Neither Rainbow Lakes Wilderness nor Isle Royale are included in this analysis. See Section 1.4.4 of this report for details.

3.0 Assessment of Existing Visibility Impairment in Minnesota Class I Areas

The assessment of visibility impairment due to past actions in Minnesota Class I areas is based on monitoring data from the IMPROVE program. The monitoring data provides measurements of pollutants that contribute to visibility impairment including: coarse particulate matter ($PM_{2.5}$ to PM_{10}), fine particulate matter ($PM_{2.5}$ and less), sulfate, nitrate, elemental carbon, organic carbon and soil.

The assessment of visibility impairment involves four primary tasks:

- accessing data from the IMPROVE program
- using the data available from the IMPROVE program combined with Barr calculations to derive 5-year rolling averages for the specific pollutants
- presenting the results of the 5-year rolling average calculations
- interpreting those results.

3.1 IMPROVE Monitoring Data Availability

The IMPROVE monitoring program has been ongoing in Minnesota since March 1988. The initial monitoring site was in VNP near the Rainy Lake Visitor Center at the western end of the Park and is referred to as VOYA1. Data were only collected at this site until 1993. A new, more centrally located site near the Ash River Visitor Center, referred to as VOYA2, began collecting data in late 1999. Monitoring was initiated for the BWCAW at the Fernberg Lookout Tower (north and east of Ely along the Fernberg Road) in 1991 at a site referred to as BOWA1. See Figure 2 and Figure 3 for the approximate locations of these monitors. See Table 3 for operating dates of each monitoring site.

For this analysis, data for full calendar years from BOWA1 and VOYA2 will be assessed. Due to the lack of adequate continuous measurements and the change in monitor location within Voyageurs to the VOYA2 location, data from VOYA1 are not assessed for trends, but comparisons are made between data from the VOYA2 site and the VOYA1 site.

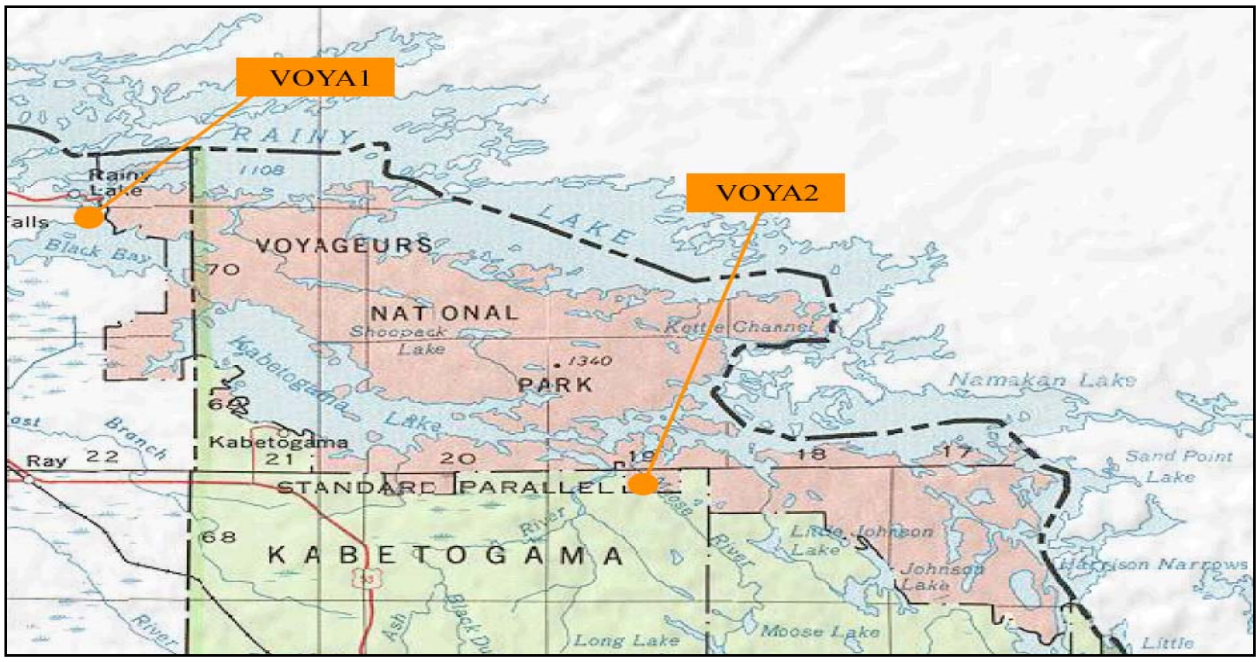


Figure 2 Approximate locations of the VOYA1 and VOYA2 IMPROVE monitoring sites within Voyageurs National Park in northern Minnesota.

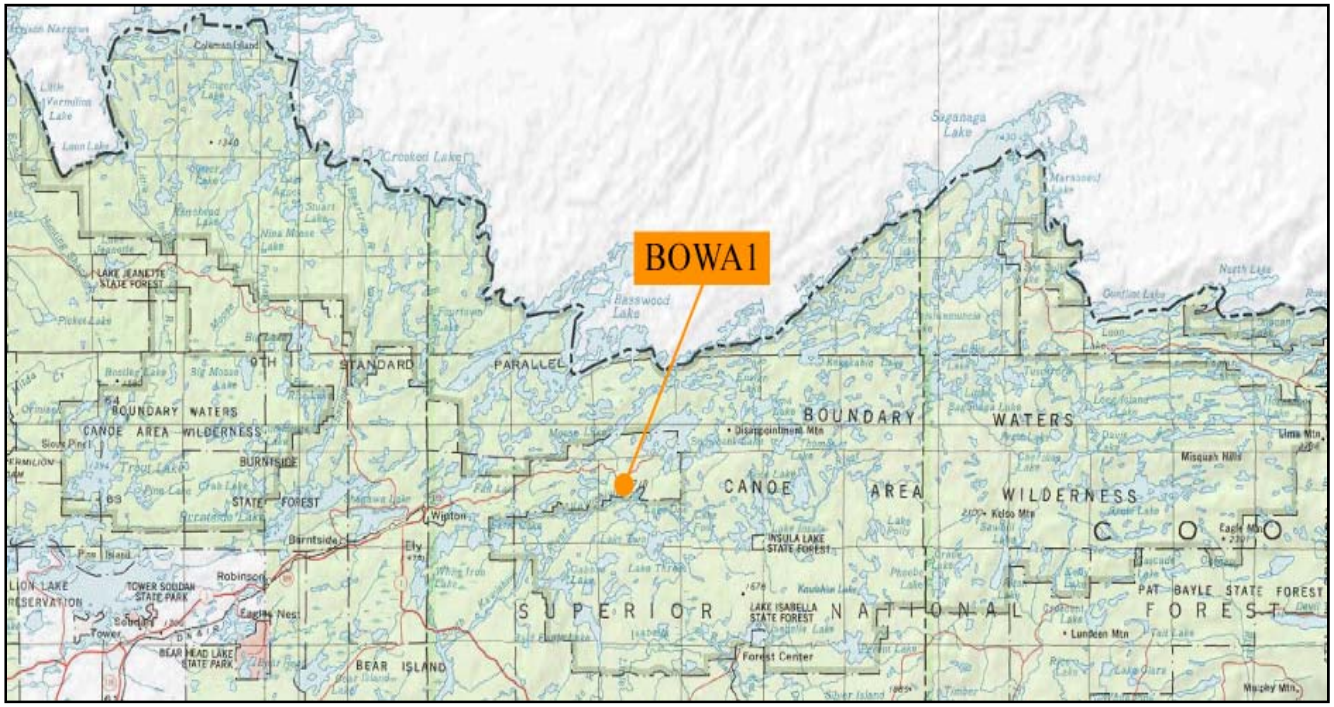


Figure 3 Approximate location of the BOWA1 IMPROVE monitoring site for the Boundary Waters Canoe Area Wilderness in northern Minnesota.

Table 3 IMPROVE monitoring sites in Minnesota Class I areas and start and end dates for available quality assured data. [1]

Monitoring Location	IMPROVE Monitoring Site Name	Starting Date	Ending Date (quality assured data)
Boundary Waters Canoe Area	BOWA1	AUG 1991	DEC 2009
Voyageurs National Park	VOYA1	MAR 1988	AUG 1993
	VOYA2	JAN 2000	DEC 2009

[1] VIEWS. 2011. "VIEWS Query Wizard." http://vista.cira.colostate.edu/views/Web/Data/DataWizard.aspx (accessed April 2011)

Data from the IMPROVE program, which is housed on the Visibility Information Exchange Web System (VIEWS) (reference (17)) website, includes ambient air concentrations for constituents that may affect visibility and relative humidity data. The VIEWS website also provides the calculated total light-extinction coefficient from aerosol measurements and relative humidity data using the IMPROVE algorithm. In December 2005, the IMPROVE Steering Committee adopted a new light-extinction coefficient calculation method because the older method tended to underestimate the highest extinction values and over-estimate the lowest extinction values (reference (18)). The new IMPROVE algorithm is used to calculate light extinction for data from both BOWA1 and VOYA2 for this report.

Ambient concentration data, extinction coefficient and haze index calculations are available from the VIEWS website for all monitoring sites. In addition, as of December 2011, IMPROVE had not made available on its website the recalculated 5-year rolling averages using the revised calculation methods. Using the available annual data, 5-year rolling averages were calculated by Barr Engineering staff and are presented in this report.

Although most monitoring data is available from the IMPROVE network, some data for the BOWA1 site was not available due to malfunctions of the monitors. The first dataset that was not available are concentrations of fine soil, elemental carbon, organic matter and coarse mass for some days in 2002 through 2004. The VIEWS website posted a surrogate dataset for this time period based on a seasonal regression analysis using data from VOYA2 site as a surrogate.[1] MPCA used this surrogate data set for the Regional Haze SIP and it is used in this analysis to remain consistent with the Regional Haze analyses.

In addition, the MPCA identified certain days for both the BOWA1 and the VOYA2 sites in the analyses conducted for the Regional Haze SIP where data for certain particulate constituents was missing (typically fine soil mass and coarse mass). This missing data would ordinarily exclude these days from

[1] Visibility Information Exchange Web System (VIEWS) http://vista.cira.colostate.edu/views/web/documents/substitutedata.aspx (RHR dataset)

inclusion in the dataset used for the Regional Haze program based on quality assurance criteria. However, these days fell within the worst 20% days even without considering the light extinction due to these missing components. Because these days were likely dominated by anthropogenic sources, the MPCA has chosen to consider these days for the Regional Haze program (reference(3)). To ensure that this analysis correlates with the Regional Haze program, these days have been included here. All other data comes directly from the IMPROVE monitoring data.

3.2 Characteristics and Composition of Particulate Air Concentrations

A summary of the average of the median PM_{10} and $PM_{2.5}$ concentrations and haze index observed in the BWCAW and VNP over the entire monitoring period is provided in Table 4. For comparison, the table includes the average values from the VOYA1 site.

Table 4 Average PM10 and PM2.5 median concentrations and haze index observed at IMPROVE monitoring sites in Class I areas in Minnesota.

IMPROVE Monitoring site	Time frame [1]	Average PM_{10} Median Concentration $\mu g/m^3$	Average $PM_{2.5}$ Median Concentration $\mu g/m^3$	Average Haze Index Median Concentration Deciviews
BOWA1	1/92 -12/ 09	5.7	3.6	11.5
VOYA1	3/88-8/93	11.7	5.6	13.7
VOYA2	1/00-12/ 09	5.2	3.2	11.3

[1] Concentration and Haze Index data available through 12/2009 for BOWA1 and VOYA2

(Source: VIEWS Data Wizard; http://vista.cira.colostate.edu/views/Web/Data/DataWizard.aspx)

The particulate matter that affects visibility is generally the fine fraction and is made up of mainly five constituents: sulfates, nitrates, organic matter, elemental (or light absorbing) carbon and fine soil. The sulfate and nitrate originate as SO_2 and NO_x from fuel combustion (e.g. electrical generation and transportation) and transform over time and distance to ammonium sulfate and nitrate, respectively. The source of the organic matter is less well understood, but some sources are fossil fuel burning, wood burning, and natural sources. Elemental carbon is believed to come from diesel exhaust and biomass burning (reference (8)(19)).

3.3 Monitored Changes in Visibility with Time

Monitoring data is available from the IMPROVE network to examine the trends in visibility and pollutant air concentrations over time for the BWCAW at the BOWA1 and VOYA2 sites which can help assess the cumulative impacts of past actions. The BOWA1 and VOYA2 IMPROVE data can be evaluated for trends for the 20% worst days, the median concentration days, and 20% best days. As of July 2011, the

IMPROVE website provided full calendar years of data for pollutant air concentrations and haze index from 1992 to 2009 for the BOWA1 site and from 2000 to 2009 for the VOYA2 site. Calendar year annual averages for the best and worst 20 percent days and the median concentrations were used to calculate the 5-year rolling averages presented below in Table 5 for the BOWA1 and VOYA2 sites, respectively. The changes were calculated by comparing the 5-year rolling averages and median for 1992 or 2000 to the 5-yr rolling averages and median for 2009, depending on data availability, and determining the percent change.

Table 5 Changes in 5 Five-year Rolling Average[6] and Median Particulate and Haze Index for BOWA1 and VOYA2.

Site	Change in 20% Best Days			Change in Median Days			Change in 20% Worst Days		
	PM_{10}	$PM_{2.5}$	HI[2]	PM_{10}	$PM_{2.5}$	HI	PM_{10}	$PM_{2.5}$	HI
BOWA1 [1] [3] **1992-2009**	-45%	-35%	-27%	-39%	-33%	-20%	-23%	-22%	-7%
BOWA1 [1] [5] **2000-2009**	-21%	-30%	-23%	-25%	-27%	-17%	-20%	-14%	-3%
VOYA2 [3][4] 2000-2009	-13%	-12%	-14%	-23%	-10%	-9%	-9%	+3%	+1%

[1] Data for the BOWA1 site are for 1992 to 2009
[2] HI = Haze Index;
[3] Negative numbers indicate improving concentrations or haze index.
[4] Data for the VOYA2 site are for 2000 to 2009
[5] Although data for the BOWA1 site are available for 1992 to 2009, a portion of the entire dataset is shown because the regulatory timeframe of the Regional Haze Rule evaluates progress using the year 2000 as a benchmark.
[6] Rolling averages require at least 3 years of data and average the specified year, two years prior and two years succeeding the specified year.

Figure 4 through Figure 8 show the annual haze index, concentration for PM_{10}, $PM_{2.5,}$ ammonium sulfate, and ammonium nitrate at BOWA1. For BOWA1, the 5-yr rolling average data indicates a downward trend for four parameters (PM_{10}, $PM_{2.5,}$ haze index and ammonium sulfate) while ammonium nitrate does not appear to show a trend from 1992 to 2009 for the 20% best days, and the median days and a slight increasing trend for the 20% worst days. Within the Regional Haze Rule regulatory timeframe (2000-present) the haze index trend is relatively flat for the 20% worst days and a downward trend for the median and 20% best days. The use of rolling averages to determine trends is used for many data types and allows the smoothing of the data to more clearly show underlying trends over time (references(20)(21)). The decline in $PM_{2.5}$ air concentrations primarily reflects a reduction in sulfate air concentration.

Figure 9 through Figure 13 show the 5-yr rolling average for the VOYA2 site for the ten years from 2000 to 2009. As shown in Table 5, the changes vary from a 23% decrease to a 3% increase. Overall, no trend is evident. The NPS reviews trends in visibility for all the National Parks, including VNP. The most recent report published by the NPS includes data from 1998 through 2007 and concludes based on a statistical analysis that visibility for the 20 percent haziest and the 20 percent clearest days at VNP is not showing a trend either improving or degrading (reference (4)).

Compared to national averages, the 39% decline in median PM_{10} concentration for BWCAW since 1992 is in line with the national decline in average PM_{10} air concentration of 38% from 1990 to 2009. The 33% decrease in median $PM_{2.5}$ concentrations for BWCAW is above the national average of 27% from 2000 to 2009 (reference (22)).

Nationally, the long term trend for concentrations of visibility impairing pollutants is decreasing in federal Class I areas in both the eastern US and western US from 1989-2008 with a few exceptions in the western US where concentrations of total carbon, soil and fine particulate are increasing in a few areas (reference(23)). National short term trends from 2000 to 2008 are less significant but show general decreasing trends for most visibility impairing pollutants, with a few exceptions in the western US. Soil and coarse particulate show a mix of short term increasing and decreasing trends across the US (reference(23)). The level of visibility impairment is much higher in the eastern US, where the visual range on the best visibility days is similar to that on the worst visibility days in the western US (reference(24)).

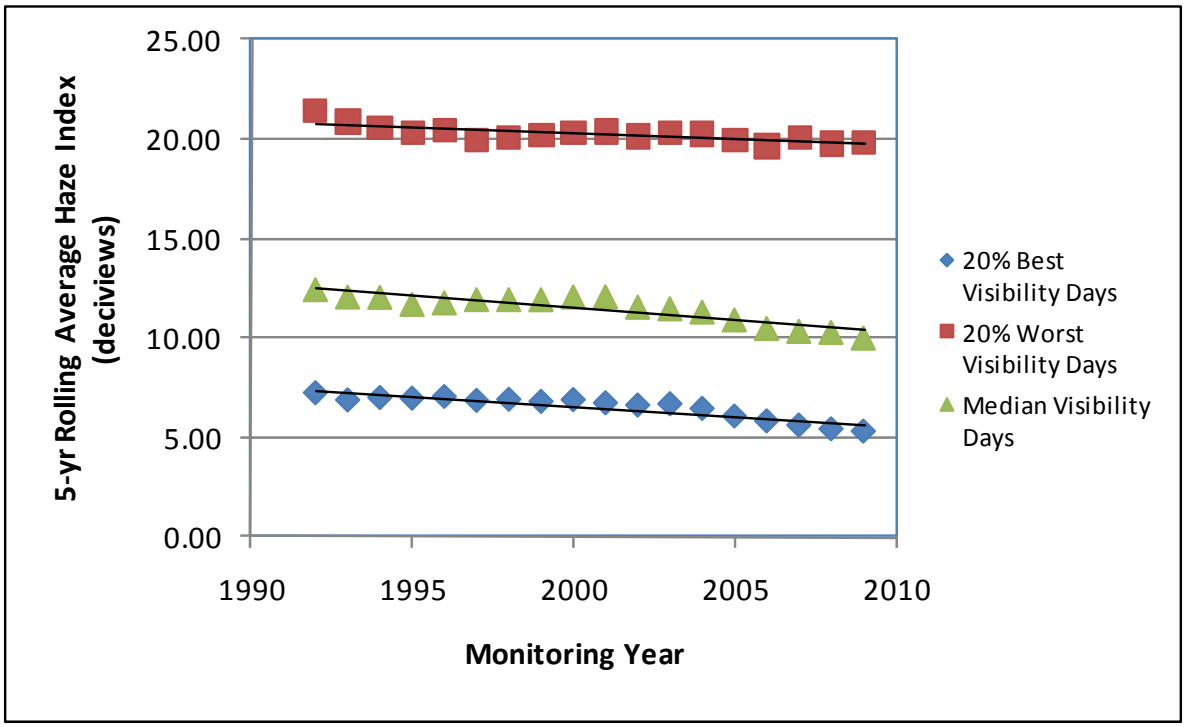


Figure 4 **Five-year rolling averages of the haze index (deciviews) and linear trend lines for the BOWA1 IMPROVE monitoring site in northeast Minnesota, based on data for January 1992 through December 2009.**

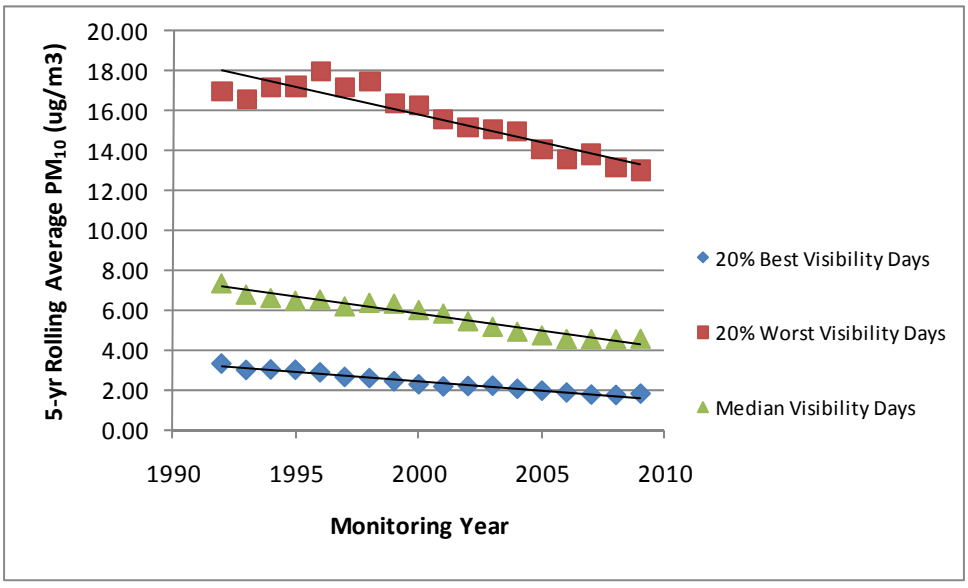


Figure 5 **Five-year rolling average PM10 concentrations (µg/m3) and linear trend lines for the BOWA1 IMPROVE monitoring site in northeast Minnesota, based on data for January 1992 through December 2009.**

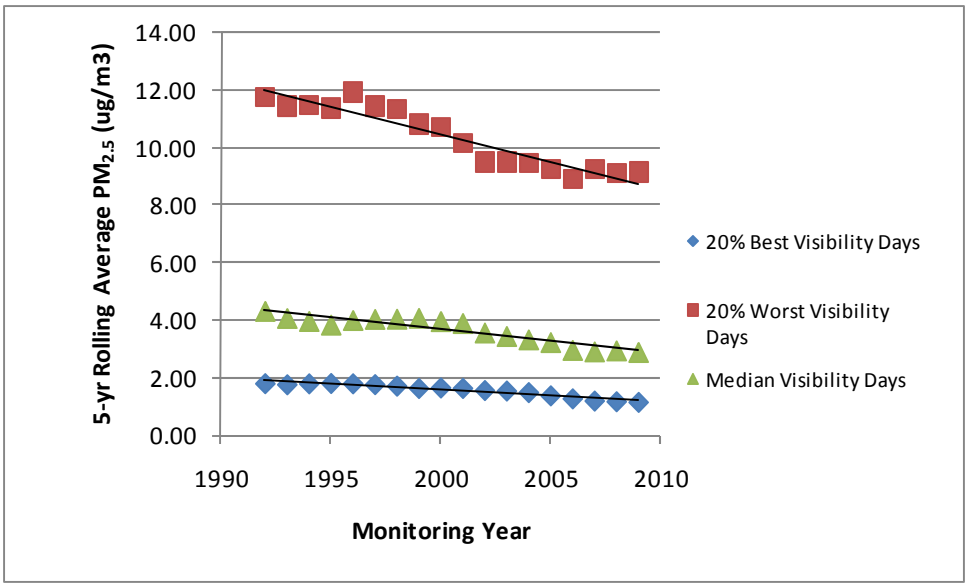


Figure 6 **Five-year rolling average PM2.5 concentrations (µg/m3) and linear trend lines for the BOWA1 IMPROVE monitoring site in northeast Minnesota, based on data for January 1992 through December 2009.**

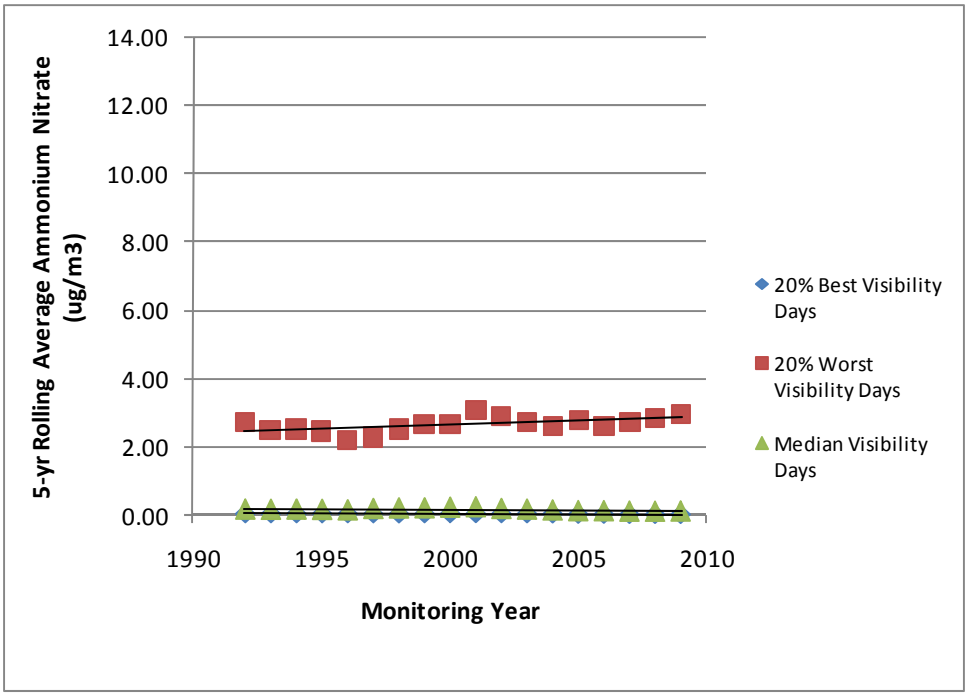


Figure 7 **Five-year rolling average ammonium nitrate concentrations (µg/m3) and linear trend lines for the BOWA1 IMPROVE monitoring site in northeast Minnesota, based on data for January 1992 through December 2009.**

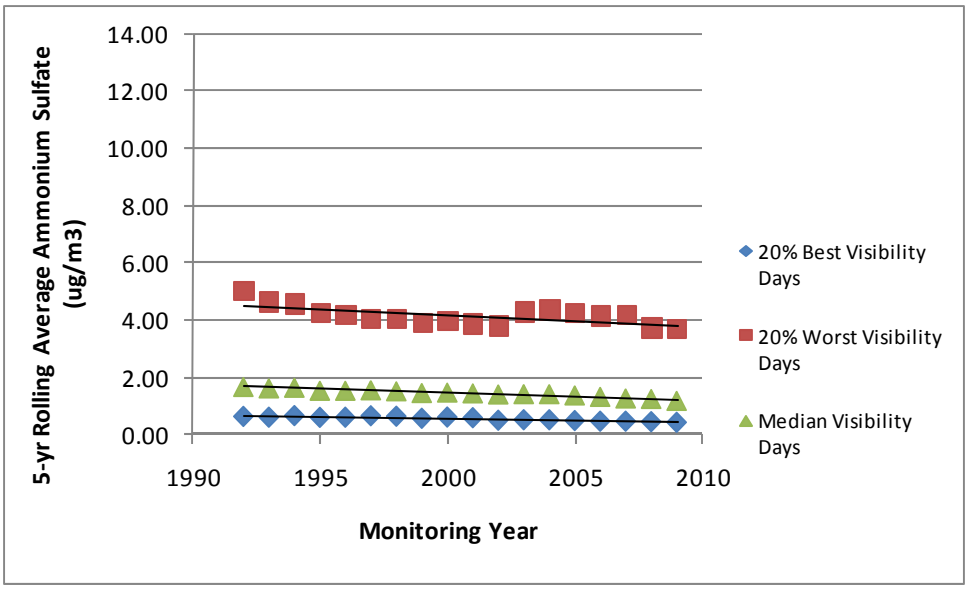


Figure 8 **Five-year rolling average ammonium sulfate concentrations (µg/m3) and linear trend lines for the BOWA1 IMPROVE monitoring site in northeast Minnesota, based on data for January 1992 through December 2009.**

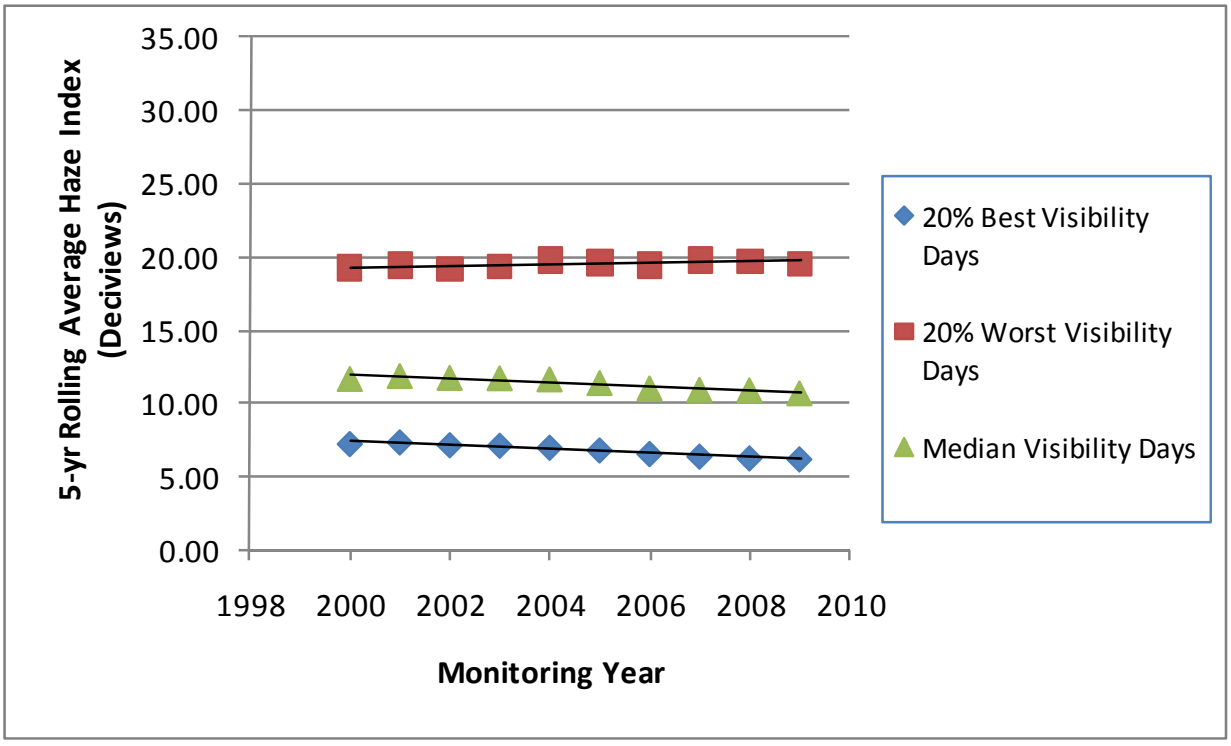


Figure 9 **Five-year rolling average of the haze index (deciviews) and linear trend lines for the VOYA2 IMPROVE monitoring site in northeast Minnesota, based on data for January 2000 through December 2009.**

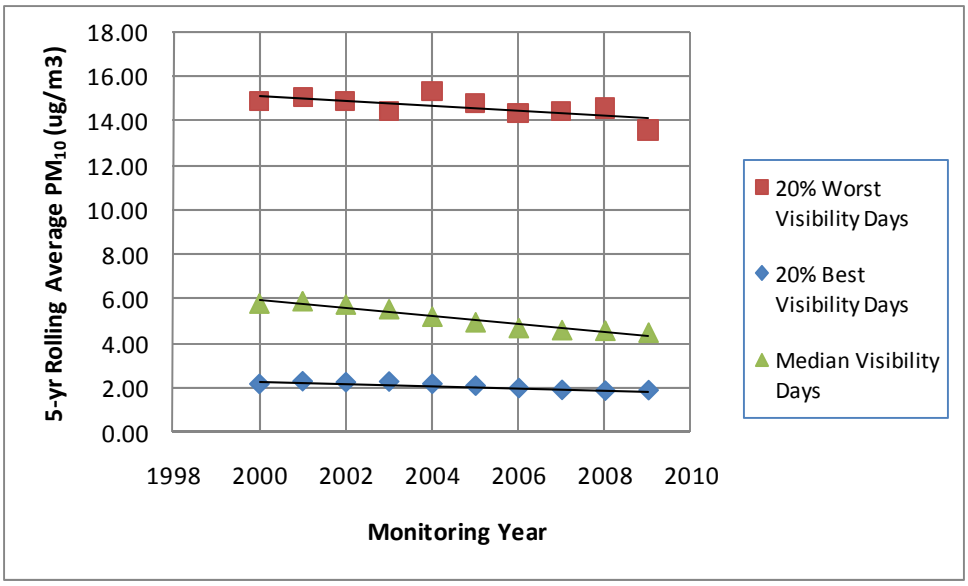


Figure 10 **Five-year rolling average PM10 concentrations (µg/m3) and linear trend lines for the VOYA2 IMPROVE monitoring site in northeast Minnesota, based on data for January 2000 through December 2009.**

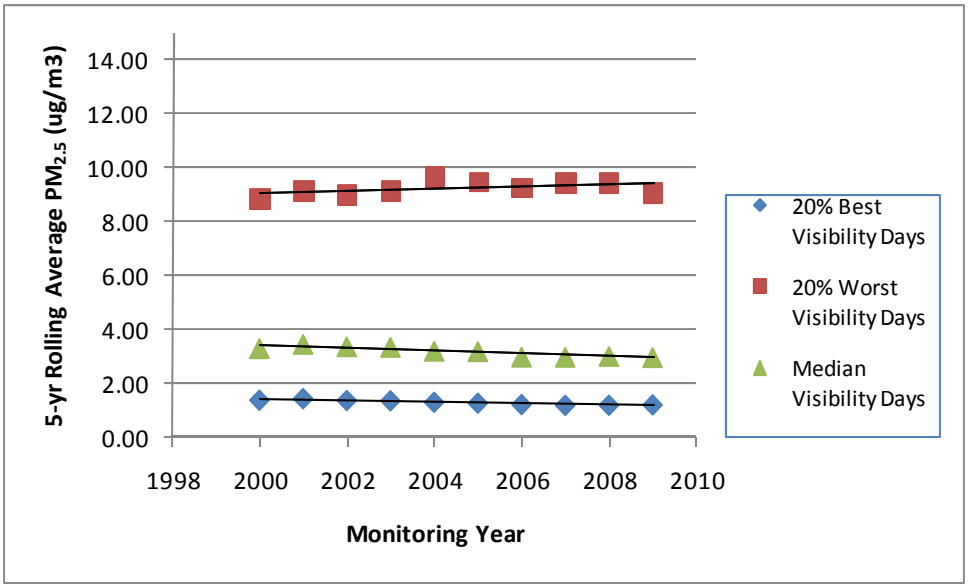


Figure 11 **Five-year rolling average PM2.5 concentrations (µg/m3) and linear trend lines for the VOYA2 IMPROVE monitoring site in northeast Minnesota, based on data for January 2000 through December 2009.**

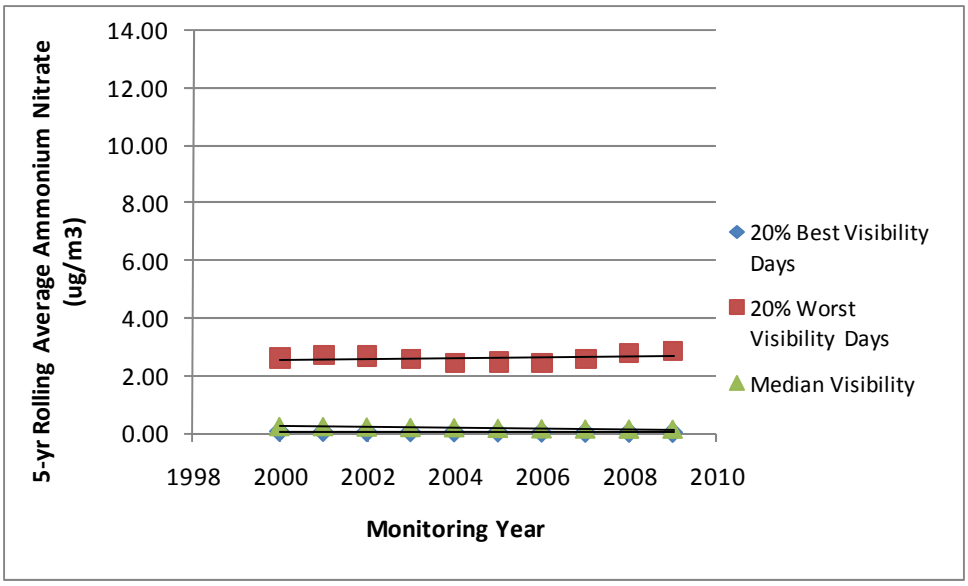


Figure 12 **Five-year rolling average ammonium nitrate concentrations (µg/m3) and linear trend lines for the VOYA2 IMPROVE monitoring site in northeast Minnesota, based on data for January 2000 through December 2009.**

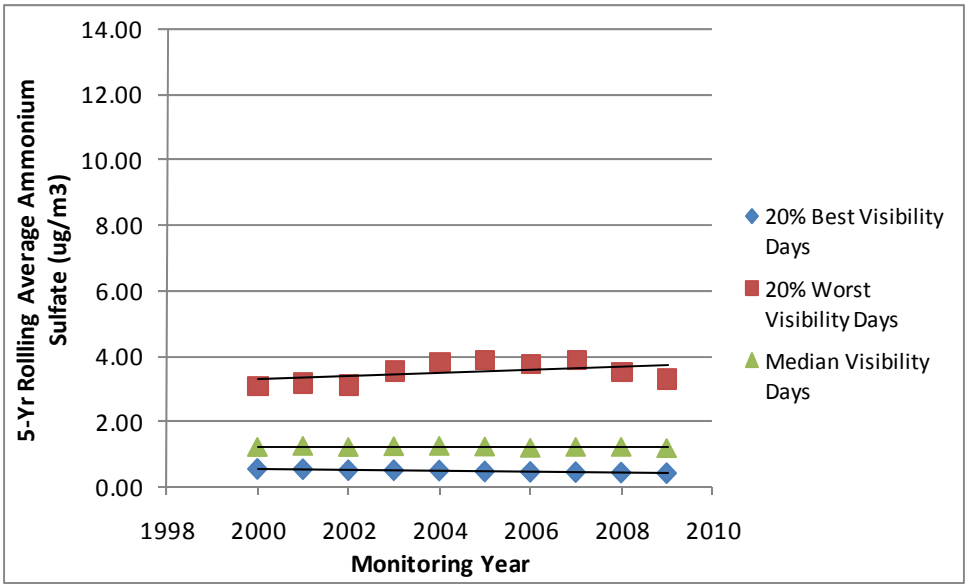


Figure 13 **Five-year rolling average ammonium sulfate concentrations (µg/m3) and linear trend lines for the VOYA2 IMPROVE monitoring site in northeast Minnesota, based on data for January 2000 through December 2009.**

3.4 Emission Source Contributions to Haze

Various emission sources are estimated to contribute to visibility impairment in the Federal Class I areas located in Minnesota. These sources include natural, local, state, national and global contributions that all factor in to the overall visibility impairment in VNP and BWCAW.

3.4.1 Natural and Global Contributions

Natural concentrations are those that would be present in the absence of *any* anthropogenic emissions. Globally, the long-range transport of fine particles, including soil dust from Asian sources, contributing to relatively high particulate air concentrations at the international boundaries has been known for some time (references(24)(25)). The MPCA Regional Haze SIP (reference(3)) indicates that boundary conditions (BC), or sources outside of the modeling domain, account for 11% and 15% of the visibility impairment for BWCAW and VNP respectively. The modeling domains used in developing the Minnesota Regional Haze SIP are shown below in Figure 14. Sources outside of the modeling domain are considered part of the BC.

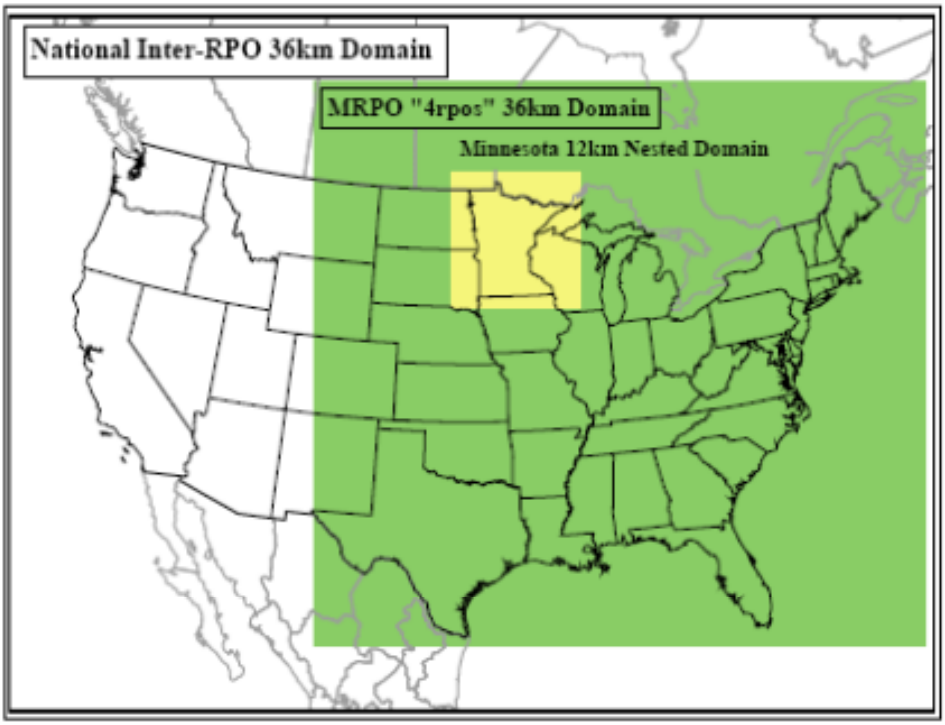
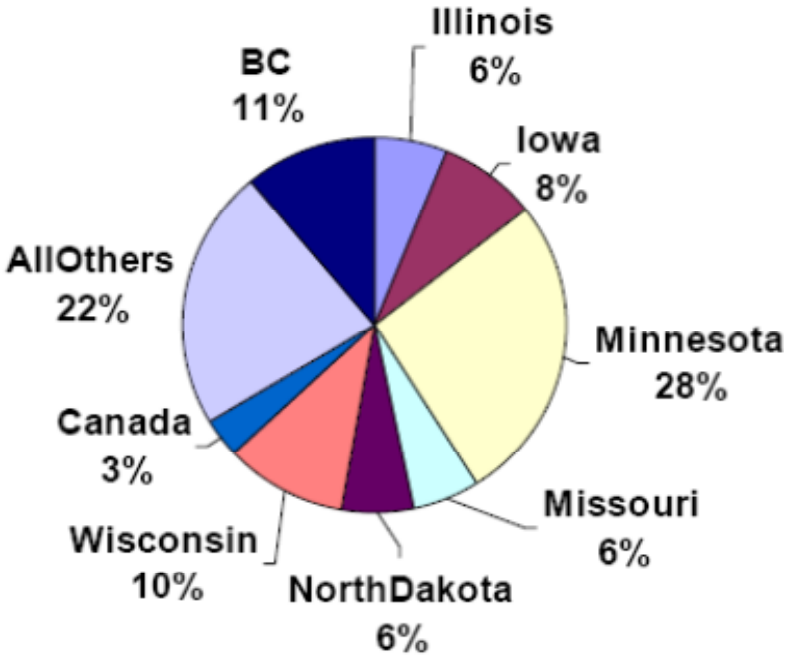


Figure 14 Modeling Domains used for MN Regional Haze SIP Evaluations (figure from reference (3))

3.4.2 Regional and Local (Minnesota) Contributions

Although it has been generally known that fine aerosol particulate that impairs visibility travels long distances and requires time in the atmosphere to react, the modeling done for the Minnesota Regional Haze SIP has provided a great deal of specific information regarding the geographic sources of these particulates. Presented here are some of the highlights from the Minnesota Regional Haze SIP.

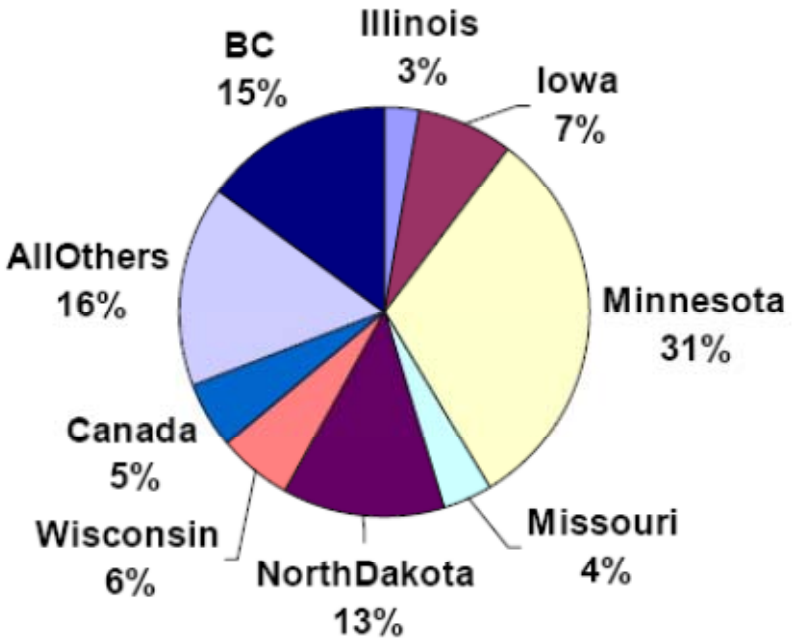
Figure 15 shows the contributions to visibility impairment from ammonium sulfate and ammonium nitrate on the 20% worst days for the BWCAW based on the Minnesota Regional Haze SIP modeling. Although Minnesota sources contribute the largest amount of any single state, 72% of the contribution is from out of state. The states contributing more than 5% are Illinois, Iowa, Missouri, North Dakota and Wisconsin.



Source: MN Regional Haze SIP, December 2009, available at: http://www.pca.state.mn.us/index.php/air/air-quality-and-pollutants/general-air-quality/minnesota-regional-haze-plan.html?menuid=&missing=0&redirect=1

Figure 15 State/Regional Contributions to Light Extinction for ammonium sulfate and ammonium nitrate on the 20% Worst Days in Boundary Waters Canoe Area Wilderness in Northern Minnesota.

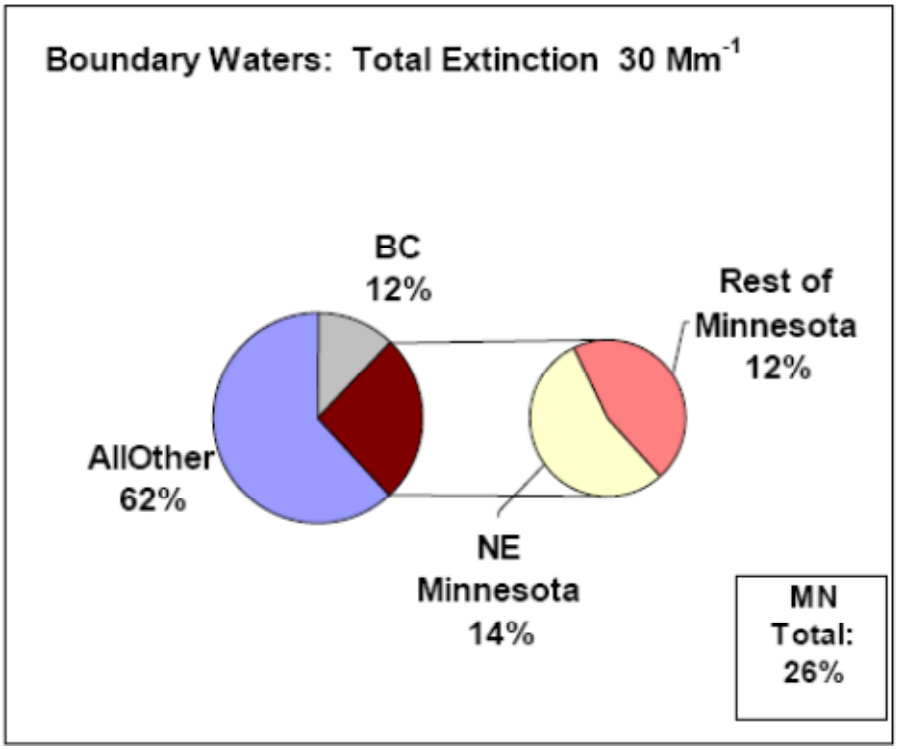
See Figure 16 for a similar view for contributions to visibility impairment in VNP for the 20% worst days due to ammonium nitrate and ammonium sulfate. Similar to the BWCAW, the majority of the impairment is due to out of state sources at 69%. The distribution of the remaining impairment is slightly different for VNP than was estimated for the BWCAW. States contributing more than 5% are Iowa, Wisconsin and North Dakota.



Source: MN Regional Haze SIP, December 2009, available at: http://www.pca.state.mn.us/index.php/air/air-quality-and-pollutants/general-air-quality/minnesota-regional-haze-plan.html?menuid=&missing=0&redirect=1

Figure 16 State/Regional Contributions to Light Extinction for ammonium sulfate and ammonium nitrate on the 20% Worst Days in Voyageurs National Park in Northern Minnesota.

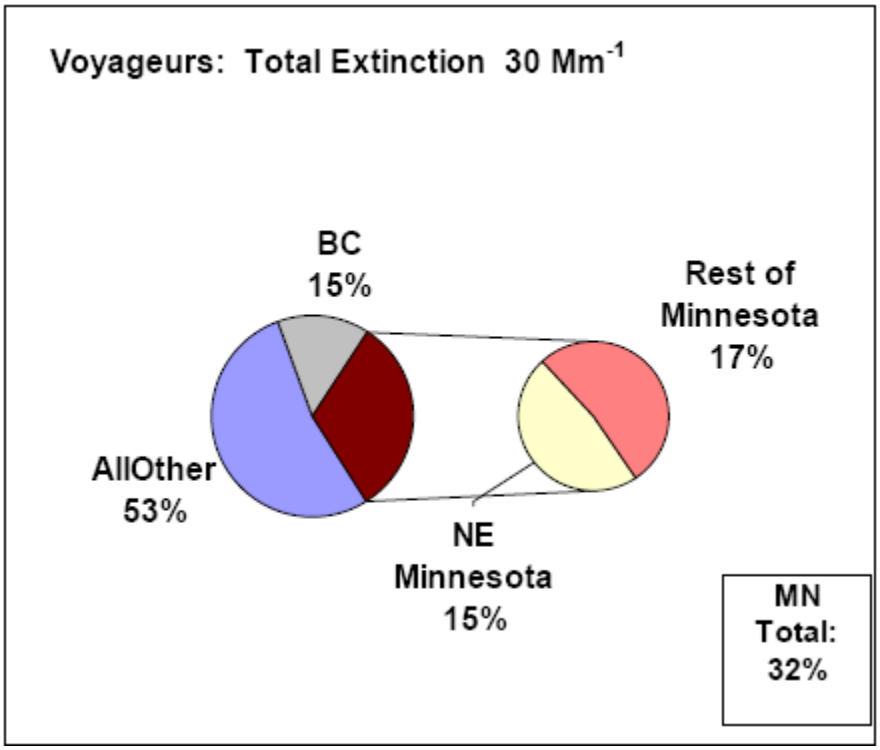
Figure 17 shows the contributions to total light extinction in the BWCAW for the 20% worst days, but breaks out the estimated contribution from sources in northeastern Minnesota. The contribution from Minnesota sources to total light extinction is 26% and the specific contribution from northeastern Minnesota sources is 14%. The remaining 12% of the contribution from Minnesota comes from elsewhere in the state.



Source: MN Regional Haze SIP, December 2009, available at: http://www.pca.state.mn.us/index.php/air/air-quality-and-pollutants/general-air-quality/minnesota-regional-haze-plan.html?menuid=&missing=0&redirect=1

Figure 17 Estimated Percentage Contribution of Sources in Northeast Minnesota to Light Extinction for the 20% Worst Days in the Boundary Waters Canoe Area Wilderness Compared to the Estimated Contribution from Sources in the Rest of Minnesota.

For VNP, the contribution from Minnesota sources to total light extinction is estimated to be about 32% for the 20% worst days. Northeast Minnesota sources are estimated to be responsible for approximately 15% of the light extinction. This is illustrated in Figure 18.



Source: MN Regional Haze SIP, December 2009, available at: http://www.pca.state.mn.us/index.php/air/air-quality-and-pollutants/general-air-quality/minnesota-regional-haze-plan.html?menuid=&missing=0&redirect=1

Figure 18 Estimated Percentage Contribution of Northeast Minnesota Sources to Light Extinction on the 20% Worst Days in Voyageurs National Park Compared to the Estimated Contribution from Sources in the Rest of Minnesota.

Overall, out-of-state sources contribute the most to visibility impairment in both VNP and BWCAW, approximately 70%, while Minnesota sources are estimated to contribute about 30% (26% for BWCAW; 32% for VNP). The estimated contributions from northeast Minnesota sources to light extinction in both VNP and BWCAW is relatively small compared to the total, about 14 – 15%. Northeast Minnesota sources account for about half of the total contribution from Minnesota sources.

4.0 Summary of State and National Emission Trends

The primary air pollutants from the proposed projects in northeast Minnesota (see Table 1) being assessed for potential cumulative effects that may affect visibility and particulate matter air concentrations in the federal Class I areas are SO_2, NO_x ,PM_{10} and $PM_{2.5}$. As was shown in the previous section, air quality in remote federal Class I areas such as the BWCAW and VNP, including air concentrations of pollutants responsible for visibility degradation, is affected not only by the emission increases and decreases in the area nearest the federal Class I areas, but also regional and national emission increases and decreases. To give perspective on these emissions, this section includes a summary of local, state and national emission trends.

Data from the MPCA Criteria Pollutant Emission inventory is complete and available for stationary sources through 2008. State-wide emission estimates, including, stationary, non-stationary and mobile sources, is available through 2009. National emission data from the EPA's NEI are estimated through 2008.

4.1 Local (Six-County Zone of Interest) Emissions and Trends

In this section, we compare the potential new emissions (potential to emit basis) of SO_2, NO_x and PM_{10} from the proposed projects to actual emissions from existing facilities in the zone of interest (six county area that includes Carlton, Koochiching, Itasca, St. Louis, Lake, and Cook Counties). Data for $PM_{2.5}$ emissions are currently not available.

Table 1 in Section 1.0 of this report, provides estimated emissions of PM_{10}, SO_2 and NO_X from the proposed projects on a "potential to emit" basis. In addition, new major sources will incorporate the best available control technology into their design which will minimize both their potential and actual emissions. Actual emissions from the proposed projects may be lower than these potential emissions. Because the regulatory permitting programs require that emissions for new sources be based on potential to emit or maximum controlled emissions, actual emissions for the proposed projects are not available at this time. Therefore, potential emissions from the proposed projects will be compared to the estimates of actual emissions from existing facilities for previous and future years.

The emission estimates for the proposed projects and the existing facilities include both stack and fugitive emissions. This is a very important consideration for PM_{10} emissions. For certain types of operations/facilities such as mining, fugitive emissions can account for a significant amount of the total facility PM_{10} emissions. For example, for the NorthMet Project, over 70% of the PM_{10} emissions are

from fugitive sources. At this time, no attempts have been made to separate the stack emission from the fugitive emissions. As discussed in Section 1.1, the larger particles typically associated with ground-level fugitive emissions ($PM_{2.5}$ to PM_{10}) tend to settle out near an emission source (references(6)(26)). The inclusion of PM_{10} fugitive emissions in this analysis overestimates the potential cumulative impacts from the proposed projects on PM_{10} air concentrations in the federal Class I areas in Minnesota.

4.1.1 Sulfur Dioxide (SO_2)

Table 6 compares the estimated cumulative potential SO_2 emissions from the proposed projects to the existing facility emissions in the six-county area since 1990. The year 2015 is selected as the comparison year due to the assumption that the proposed projects and reductions are likely to be in full operation by that time. The estimated 2015 emissions for existing facilities do not take into consideration reductions due to foreseeable regulatory actions, except for reductions from Hill Wood Products, Minnesota Power's Boswell, Laskin Energy Center and Taconite Harbor facilities along with reductions required under BART for United Taconite and Northshore Mining.

Table 6 indicates that the cumulative potential emissions from the proposed projects will potentially increase the local emissions in the six-county area by a relatively small amount (2,807 tons per year – see Table 1). This represents an approximate 7% increase above 2008 SO_2 emissions of 40,115 tons in the six-county area if all projects reach their potential to emit. However, when decreases in SO_2 from the proposed projects are included (see Table 1, "Reductions"), the emissions will decrease by 34% compared to the 2008 levels. Proposed and in-progress concurrent voluntary emission reductions in the six-county area are summarized below in Section 4.1.4. Additional local emission reductions due to ongoing regulatory requirements are likely, as summarized in Section 4.4.

Table 6 Annual and projected sulfur dioxide (SO_2) emissions for existing major emission sources in the six-county "zone of interest" in northeast Minnesota.
(Six-county project area: Carlton, Koochiching, Itasca, St. Louis, Lake, and Cook).

Actual and Projected SO_2 Emissions (tons per year) [1]							
Year	Itasca County	St. Louis County	Cook County	Lake County	Koochiching County	Carlton County	Total 6-County Area
1990	21,612	6,443	0	689	604	1,315	30,663
1991	14,275	4,949	337	1,082	199	931	21,772
1992	12,622	5,131	3,899	705	118	1,426	23,902
1993	15,479	5,153	2,210	1,441	81	1,158	25,522
1994	20,228	6,028	2,685	1,881	86	1,447	32,355
1995	19,129	4,887	1,865	1,071	81	1,413	28,446
1996	15,054	8,782	1,184	1,466	68	1,520	28,074
1997	14,409	8,836	1,992	1,294	71	1,871	28,472
1998	16,327	7,835	3,278	1,516	93	1,767	30,815
1999	17,374	8,910	2,961	1,872	99	1,536	32,752
2000	15,212	10,860	3,255	2,062	60	1,324	32,773
2001	18,740	9,250	91	1,857	72	446	30,457
2002	21,215	9,646	3,113	2,292	68	214	36,549
2003	20,027	7,598	5,503	2,371	80	222	35,800
2004	19,843	9,338	5,575	2,881	71	475	38,184
2005	20,036	9,493	5,237	2,673	83	393	37,914
2006	20,477	8,921	5,388	2,781	51	218	37,836
2007	21,722	10,293	5,064	2,936	97	274	40,386
2008	21,643	11,164	4,722	2,312	86	188	40,115
2015[2]	11,902	9,464	3,173	1,785	86	189	26,598

[1] Historical data obtained from http://www.pca.state.mn.us/data/edaAir/index.cfm; downloaded in June 2010, and http://www.pca.state.mn.us/index.php/air/air-monitoring-and-reporting/air-emissions-and-monitoring/criteria-air-pollutant-emission-inventory/facility-actual-emissions-data.html; downloaded in May 2011.
[2] 2015 emission estimates for existing facilities is 2008 emissions summed with reductions and increases for the proposed projects for each county in NE Minnesota as described in Table 1 using 2008 instead of 2009 as a baseline year to estimate reductions because countywide emission data is only available through 2008. This estimate does not account for potential emission reductions due to foreseeable regulatory actions, except for those noted in Table 1. Emissions from projects located in two counties were split evenly between the two counties.

4.1.2 Nitrogen Oxides (NO_x)

Table 7 provides historical emissions from existing major emission sources in the six-county project area (Carlton, Koochiching, Itasca, St. Louis, Lake, and Cook counties). The cumulative potential NO_x emissions from the proposed projects are compared to the existing facility emissions in this six-county "zone of interest". The year 2015 is selected as the comparison year due to the assumption that the proposed projects and reductions are likely to be in full operation by that time. The estimated 2015 emissions for existing facilities do not take into consideration reductions due to foreseeable regulatory

actions except for reductions from Minnesota Power's Laskin, Boswell and Taconite Harbor facilities, US Steel Minntac, Hill Wood Products and Northshore Mining.

Table 7 indicates that the cumulative potential emissions from the proposed projects will be an increase in the local emissions in the six-county area of Itasca, St. Louis, Lake, and Cook by a relatively small amount (6,635 tons). This represents a maximum potential increase of about 12% compared to 2008 local NO_x emissions of 54,350 tons. However, when decreases in NO_x from the proposed projects are included (see Table 1, "Reductions"), the emissions will decrease by about 25% compared to the 2008 levels. Proposed and in-progress concurrent voluntary emission reductions in the six-county area are summarized below in Section 4.1.4. Additional local emission reductions due to ongoing regulatory requirements are likely, as summarized in Section 4.4.

Table 7 Annual and projected nitrogen oxide (NO_x) emissions trends for existing major emission sources in the six-county area of interest in northeast Minnesota.
(Six counties of interest: Carlton, Koochiching, Itasca, St. Louis, Lake, Cook)

Actual and Projected NO_x Emissions (tons per year) [1]							
Year	Itasca County	St. Louis County	Cook County	Lake County	Koochichin g County	Carlton County	Total 6-County Area
1990	20,061	25,601	0	6,037	1,416	1,860	54,974
1991	17,816	24,588	540	1,350	1,333	1,801	47,429
1992	15,845	21,377	4,318	2,086	943	1,634	46,203
1993	16,967	22,470	2,106	6,313	900	1,652	50,408
1994	13,977	14,597	2,717	6,912	1,141	1,412	40,756
1995	14,650	16,020	1,709	5,717	956	1,370	40,421
1996	13,563	34,016	984	3,695	1,012	1,645	54,914
1997	13,587	40,723	1,498	3,848	952	1,361	61,968
1998	13,857	37,618	1,925	3,029	904	1,065	58,399
1999	12,411	33,824	2,670	3,294	842	1,264	54,307
2000	13,167	34,232	2,796	3,869	683	1,616	56,362
2001	14,190	28,651	104	3,175	699	1,520	48,337
2002	15,049	35,850	2,321	3,950	880	1,563	59,613
2003	15,443	27,912	3,381	4,092	971	1,471	53,270
2004	13,210	34,116	3,388	4,120	925	1,652	57,411
2005	14,851	14,851	3,242	4,242	894	1,356	39,437
2006	13,996	28,469	3,241	3,767	964	1,414	51,851
2007	15,031	28,685	3,017	3,931	900	1,526	53,090
2008	16,034	29,838	2,374	3,681	911	1,512	54,350
2015 [2]	10,846	23,244	1,264	2,722	911	1,674	40660

[1] Historical data obtained from http://www.pca.state.mn.us/data/edaAir/index.cfm; downloaded in June 2010, and http://www.pca.state.mn.us/index.php/air/air-monitoring-and-reporting/air-emissions-and-monitoring/criteria-air-pollutant-emission-inventory/facility-actual-emissions-data.html; downloaded in May 2011.

[2] 2015 emission estimates for existing facilities is 2008 emissions summed with reductions and increases for the proposed projects for each county in NE Minnesota as described in Table 1 using 2008 instead of 2009 as a base year to estimate reductions because countywide emission data is only available through 2008. This estimate does not account for potential emission reductions due to foreseeable regulatory actions except for those noted in Table 1. Emissions from projects located in two counties were split evenly between the two counties.

4.1.3 Particulate Matter (PM_{10})

Table 8 provides historical PM_{10} emissions from existing major facilities in the six-county area since 1990. The cumulative potential PM_{10} emissions from the proposed projects are compared to the existing facility emissions in the six-county "zone of interest". The year 2015 is selected as the comparison year due to the assumption that the proposed projects are likely to be in full operation by that time. Table 8 indicates that the cumulative potential emissions from the proposed projects will increase the local emissions in the six-county area of Itasca, St. Louis, Lake, and Cook by about 6,274 tons (potential to emit basis including fugitive emissions). This represents a maximum potential increase of about 42% over 2008 actual PM_{10} emissions of 15,045 tons in the six-county area if all projects reach their potential to emit. Likely concurrent voluntary emission reductions in the six-county area are summarized below in Section 4.1.4. Additional local emission reductions due to ongoing regulatory requirements are likely, as summarized in Section 4.4.

Table 8 Annual and Projected PM10 emissions trends for existing major emission sources in the six- county area of interest in northeast Minnesota.
(Six counties of interest: Carlton, Koochiching, Itasca, St. Louis, Lake, Cook)

Actual and Projected PM_{10} Emissions (tons per year) [1]							
Year	Itasca County	St. Louis County	Cook County	Lake County	Koochiching County	Carlton County	Total 6-County Area
1990	1,995	35,929	0	616	838	321	39,700
1991	1,931	28,461	56	1,960	604	483	33,495
1992	1,350	20,747	166	1,683	270	361	24,576
1993	1,259	22,854	214	2,371	735	480	27,913
1994	1,198	23,120	235	2,126	216	699	27,594
1995	1,379	26,457	401	2,076	219	913	31,445
1996	1,109	9,691	294	424	136	683	12,337
1997	2,189	10,657	350	409	145	987	14,738
1998	2,383	13,704	451	599	215	1,743	19,095
1999	2,180	15,678	416	567	333	988	20,162
2000	2,453	18,624	388	943	270	884	23,563
2001	2,394	10,822	48	543	170	801	14,778
2002	3,113	11,963	202	592	142	517	16,529
2003	3,101	12,748	324	630	152	507	17,461
2004	2,601	13,909	323	749	152	726	18,459
2005	2,894	9,829	1,000	1,067	141	583	15,514
2006	2,701	8,867	1,021	1,114	138	549	14,392
2007	3,409	8,969	1,076	978	127	404	14,963
2008	3,616	9,056	788	1,050	116	419	15,045
2015 [2]	6,047	12,707	788	1,199	116	448	21305

[1] Historical data obtained from http://www.pca.state.mn.us/data/edaAir/index.cfm; downloaded in June 2010, and http://www.pca.state.mn.us/index.php/air/air-monitoring-and-reporting/air-emissions-and-monitoring/criteria-air-pollutant-emission-inventory/facility-actual-emissions-data.html; downloaded in May 2011.
[2] 2015 emission estimates for existing facilities is the 2008 emissions summed with reductions and increases for the proposed projects for each county in NE Minnesota as described in Table 1 using 2008 instead of 2009 as a base year to estimate reductions because countywide emission data is only available through 2008. This estimate does not account for potential emission reductions due to foreseeable regulatory actions except for those noted in Table 1. Emissions from projects located in two counties were split evenly between the two counties.

4.1.4 Emission Reductions in Northeastern Minnesota

There are several emission reductions occurring in northeastern Minnesota that will significantly reduce emissions of visibility impairing pollutants, SO_2, NO_X, PM_{10}, and $PM_{2.5}$. These emission reductions are included in Table 1. Two projects are part of the Minnesota Power Arrowhead Regional Emission Abatement Plan, one at the Laskin Energy Center in Hoyt Lakes and one at the Taconite Harbor Energy Center. Minnesota Power is also reducing emissions at the Boswell Energy Center in Cohasset. U. S. Steel Minntac and Hill Wood Products are also proposing projects that will reduce emissions. In addition, BART emission reductions are expected from Northshore Mining Company and United Taconite.

Work began on the Minnesota Power Laskin Energy Center in Hoyt Lakes in October and November 2006. The project entails replacing existing coal burners with low NO_x burners and overfire air systems on both Laskin coal-fired generating units. Overfire air systems feature additional air ports as well as software that tracks combustion conditions and automatically modifies fuel/air input to more completely burn fuel. These improvements reduce NO_x emissions from coal-burning. Work was completed in 2010, and the expected emission reductions will be 1,381 tons per year of NO_x from 2002 levels (reference(3)). Because actual emissions at Laskin Energy Center through 2009 have been reduced the amount of any possible further reduction from the installation from the low NO_x burners in future years is unknown.

Work is currently in progress at the Taconite Harbor Energy Center in Schroeder and includes installing and optimizing Mobotec multi-pollutant control technology on each of the three 75 MW coal-fired units. The company will install equipment within the combustion chamber of each boiler to modify combustion conditions and inject reagents to reduce NO_x, SO_2, and mercury emissions. Expected emission reductions from 2009 actual emissions will be 423 tons per year NO_x and 1,549 tons per year SO_2 (reference (3)).

Minnesota Power also broke ground on an emission reduction project at the Boswell Energy Center in May 2007 and completed installation by the end of 2009. The project will decrease emissions of NO_x and SO_2 by replacing an existing wet scrubber on Unit 3 with a selective catalytic reduction system, activated carbon injection, a fabric filter and a wet flue gas desulfurization scrubber (reference (27)). The project was fully operational in April 2010. Emission reductions through 2009 have been 3,311 tons per year NO_x

and 7,729 tons per year SO_2 and expected additional emission reductions starting in 2010 are 6,372 tons per year of NO_x and 4,224 tons per year of SO_2 (reference (3)(28)).

In addition to these projects at power plants, two taconite facilities are proposing emission reductions, United Taconite and U. S. Steel Minntac. The United Taconite reductions are related to BART requirements and will be implemented at the Fairlane plant in Forbes. Emission reductions from 2009 levels are expected to be 1,954 tons per year of SO_2 (reference (3)).

The U. S. Steel project at Minntac is a reduction in NO_x emissions due to a backwards looking PSD analysis that resulted in permit conditions to conduct pilot testing to prove a NO_x control technology. As a result of this testing, one low NO_x burner was installed in May 2010 to meet the new permit limit and another low NO_x burner was installed in April 2011. The goal is a NO_x reduction of 9,310 tons per year from the backward looking permit limit (reference (3)(29)). The expected NO_x reductions from 2009 levels are 1,973 tons per year (reference (29)(30)).

Reductions from a proposed project at Hill Wood Products for the replacement of several old units with newer units is expect to result in a 14 tons per year reduction in PM_{10} emissions. Finally, BART requirements for Northshore Mining's facility in Silver Bay, Lake County are expected to result in reductions of 583 tons per year and 1,159 tons per year of SO_2 and NO_x respectively.

4.1.5 Summary of Local (Six-county Project Area) Emissions

As shown above, if all proposed projects included in this analysis move forward to construction as planned, they would potentially increase stationary source emissions from 2008 levels in the six-county area of interest by approximately 7% for SO_2, 12% for NO_x, and 42% for PM_{10}. These potential increases do not take into account the proposed reductions associated with the voluntary actions described for some of the projects in Section 4.1.4 or the additional likely reductions required by foreseeable future regulatory and other actions summarized in Section 4.4. When reductions from various projects including Minnesota Power facilities and BART requirements are included, the emissions of SO_2 in the six-county area will be reduced from 2008 levels by 13,517 tons per year or 34% and the emissions of NO_x by 13,690 tons per year or 25%. Particulate emissions from the Minnesota Power facilities are not being reduced from their 2008 levels.

Table 9 Summary of Local Emissions and Proposed Changes in Emissions.

	2008 Six-County Emissions TPY	Proposed Project Emissions TPY	Proposed Net Emission Change, Increases Plus Reductions, TPY[1]	Proposed Net Emission Change, Increases Plus Reductions, %[1]
SO_2	40,115	2,807	-13,517	-34
NO_x	54,350	6,635	-13,690	-25
PM_{10} (Includes Fugitives)	15,045	6,274	6,260	42

[1] Reductions included are those by Minnesota Power facilities in the six-county area, US Steel Minntac, Hill Wood Products and the required BART reductions.

When comparing the potential emissions from the proposed projects and reductions with historical and existing emissions in the six-county project area the following can be concluded:

- SO_2: projected emissions for 2015, calculated using the 2008 actual emission data and including existing sources with reductions from Minnesota Power's Boswell, Laskin Energy Center and Taconite Harbor facilities along with reductions required under BART for United Taconite and Northshore Mining and the potential change in emissions from the proposed projects, are lower than historical emissions. See Figure 19.
- NO_x: projected emissions for 2015, which include existing sources with reductions from Minnesota Power's Laskin, Boswell and Taconite Harbor facilities, US Steel Minntac, and Northshore Mining, the potential change in emissions from the proposed projects are lower than historical emissions. See Figure 20.
- PM_{10}: projected emissions for 2015, which include existing sources with reductions from Hill Wood Products and the potential change in emissions from the proposed projects, are within the range of historical emissions (see Figure 21).

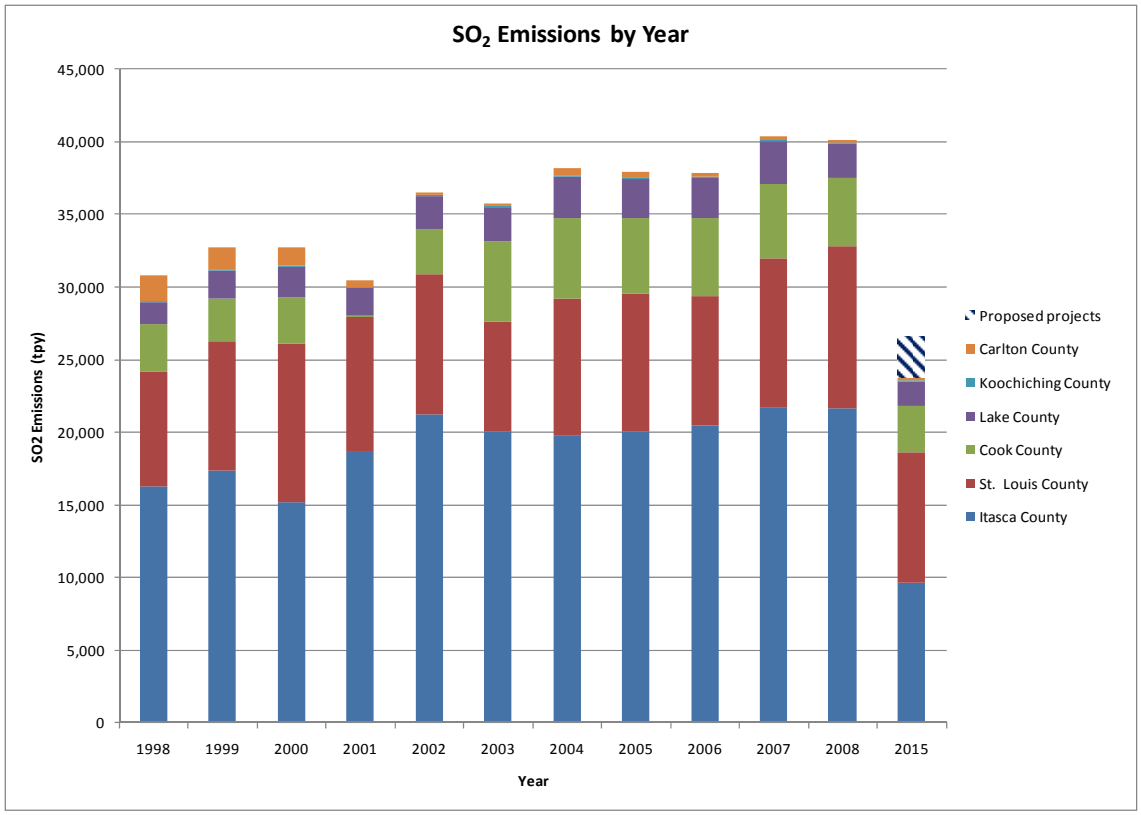


Figure 19 Sulfur Dioxide (SO_2) Emissions in Northeast Minnesota.

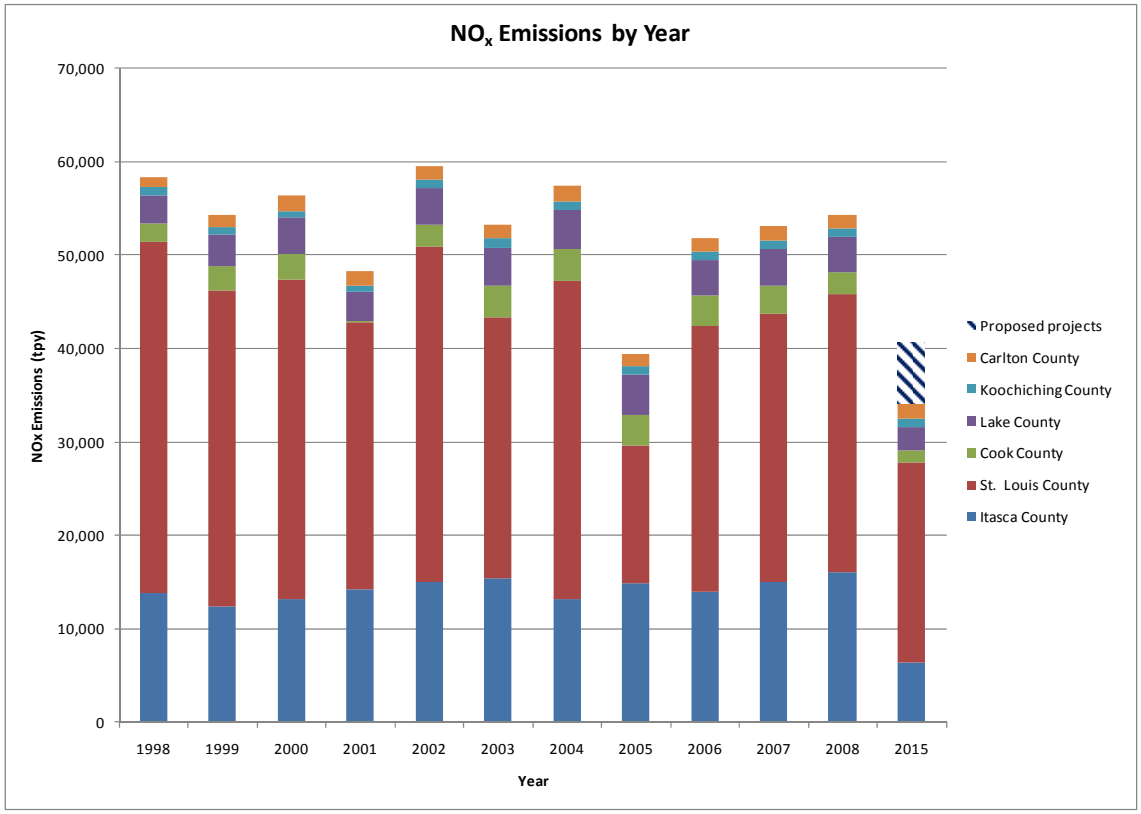


Figure 20 Nitrogen Oxides (NO_x) Emissions in Northeast Minnesota.

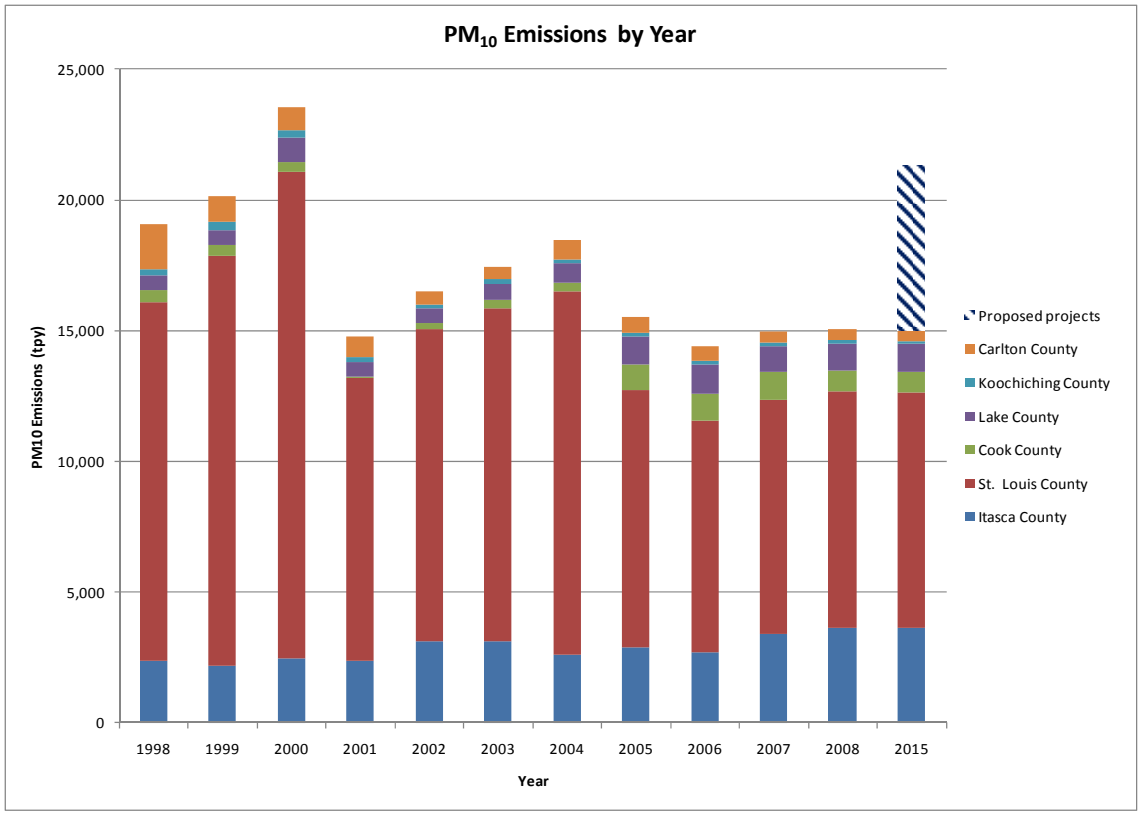


Figure 21 Particulate Matter less than 10 microns (PM_{10}) Emissions in Northeast Minnesota.

4.2 Statewide Emissions and Trends

This section first summarizes statewide emission trends for SO_2, NO_x, and PM_{10}. In addition, the statewide emission inventory data for the most recent year available (2009) is further broken down between northeastern Minnesota and the rest of the state. Note that due to the economic downturn, much of the taconite industry was idle in 2009. Therefore, changes between 2008 and 2009 emissions for the mining industry may be more representative of the economic climate and not long term emission trends in the mining sector in Minnesota.

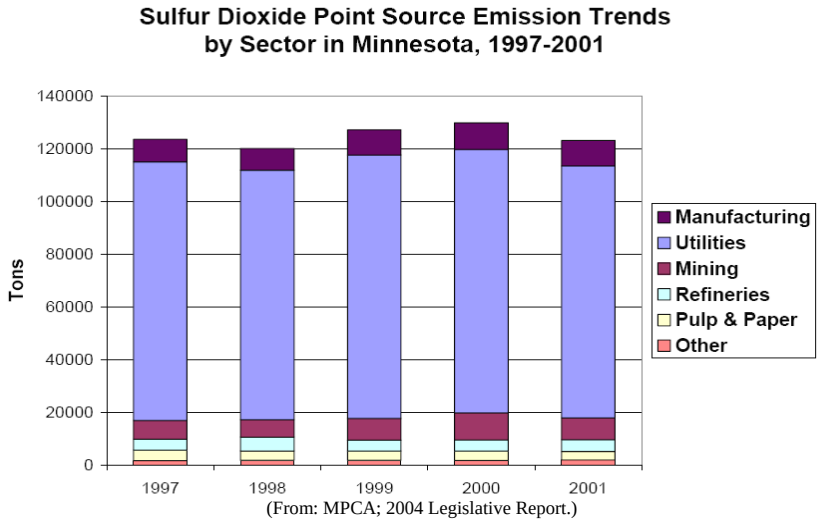
4.2.1 Sulfur Dioxide (SO_2)

Following large reductions in SO_2 emissions from the electric utility sector between 1980 and 1985 (reference (31))and more modest reductions through the mid-90's, by 1994, total statewide emissions were slightly more than 140,000 tons/yr.

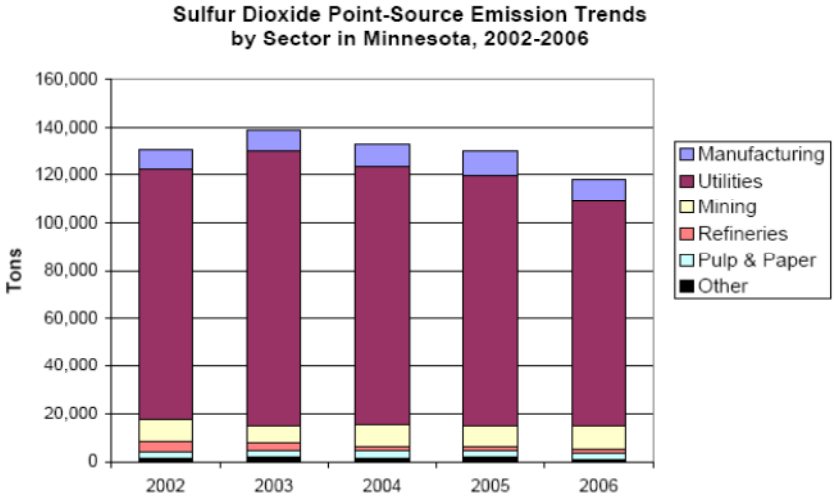
Since 1994, statewide SO_2 emissions have decreased to about 101,000 tons/yr in 2009 (reference (32)). Currently, stationary source emissions make up approximately 71% of the statewide SO_2 emissions (reference (32)) and are estimated to be approximately 72,000 tons/year in 2009. The potential SO_2

emissions from the proposed projects (2,807 tons), compared to total statewide actual emissions of approximately 101,000 tons/yr, represent an approximate increase of about 2.8% on a statewide basis. When the potential SO_2 emissions from the projects are compared to stationary source SO_2 emissions only (~72,000 tpy), the potential increase is approximately 4%. As can be seen from Figure 22, the potential SO_2 emissions added by the proposed projects are within the annual variability of statewide stationary source emissions from 1997 to 2009. This comparison indicates that on a statewide level the potential increase in SO_2 emissions from the proposed projects will be small.

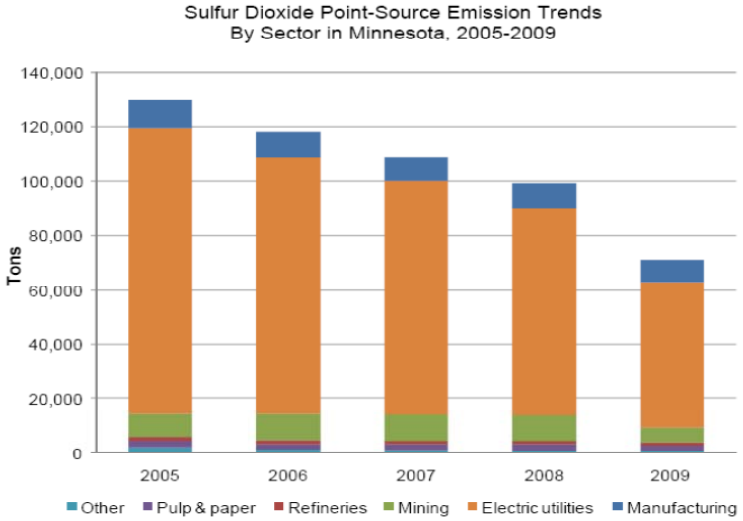
The SO_2 emissions from the proposed projects (2,807 tpy) do not take into account the expected emission reductions from Minnesota Power's Boswell, Laskin Energy Center and Taconite Harbor facilities, United Taconite and Northshore Mining. See Section 4.4 for details of these reductions. When emission reductions are included, the emission change will be a reduction of 13,517 tons per year, which is a reduction of 19% in stationary source emissions compared to 2009.



(From: MPCA; 2004 Legislative Report.)



From: MPCA Annual Pollution Report to the Legislature. April 2008.

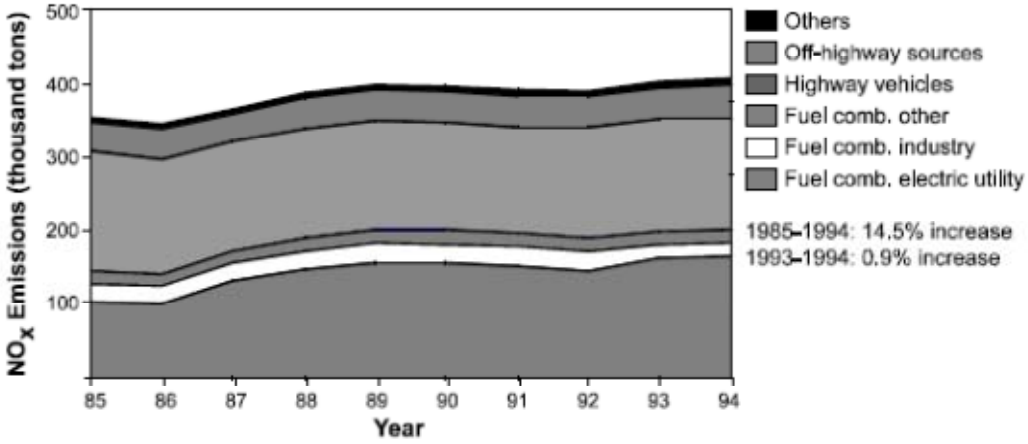


From: MPCA Annual Pollution Report to the Legislature. April 2011.

Figure 22 Statewide stationary source sulfur dioxide (SO_2) emission trends, 1997 – 2009.

4.2.2 Nitrogen Oxides (NO_x)

Figure 23 summarizes Minnesota NO_x emission trends between 1985 and 1994, which is the last detailed analysis that is publicly available from the MPCA (1997). These data show that statewide NO_x emissions increased gradually from 1985 to 1994, reaching about 416,000 tons/yr in 1994 (reference (33)).



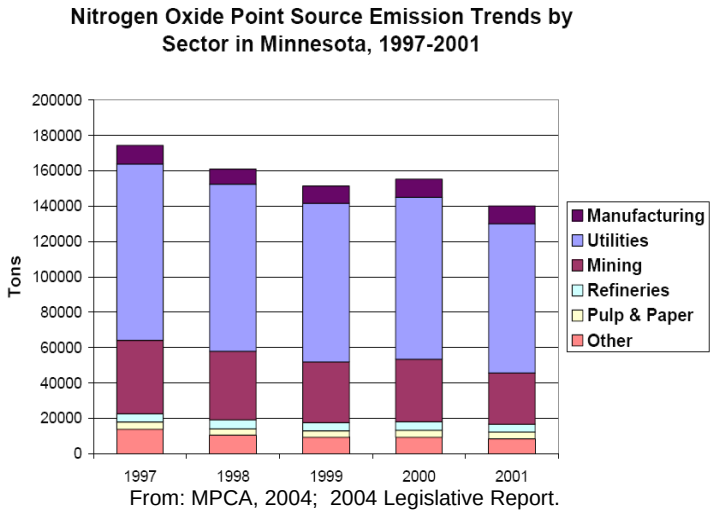
From: MPCA, 1997.

Figure 23 Sources of nitrogen oxide emissions in Minnesota, 1985 – 1994.

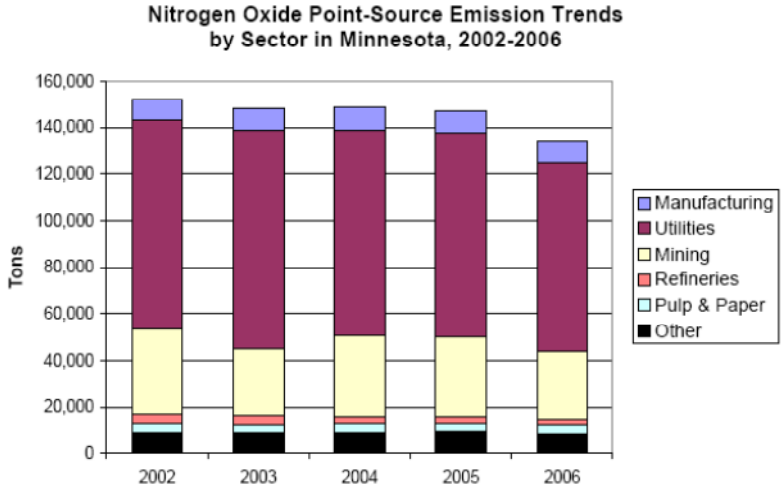
MPCA has recently estimated that since 1994, NO_x emissions have decreased to about 353,000 tons by 2009 (reference (32)). As identified by the MPCA, stationary source emissions account for approximately 22% of the statewide NO_x emissions while gasoline and diesel sources account for approximately 40% of NO_x emissions and non-road sources, including off-road transportation, contribute approximately 29% of NO_x emissions. Figure 24 provides stationary-source emissions of NO_x in Minnesota for the 1997 to 2009 time period, broken down by industrial sector (references (34)(32)). Figure 24 indicates that NO_x emissions gradually declined from stationary sources in Minnesota from 1997 to 2001, but have remained relatively steady from 2002 to 2005 with a decrease in 2006 through 2009. These reductions were mainly due to the mining and utility sectors (references (35)(32)).

In comparison to statewide NO_x emissions of 353,000 tons/year in 2009, the potential increase in NO_x emissions from the proposed projects is small (6,635 tons/year), an approximately 2% increase. When the potential emissions increase from the proposed projects is compared to stationary source emissions only (78,000 tpy), the potential increase is approximately 8.5%. Based on the relatively small amount of NO_x estimated to be emitted from the proposed projects, it is concluded that the NO_x emissions from the proposed projects is within the variability exhibited by statewide NO_x emissions since 1997 (Figure 24). Additionally, stationary sources, or point sources do not account for the majority of NO_x emissions in Minnesota; approximately 78% of statewide NO_x emissions are from on and off road sources.

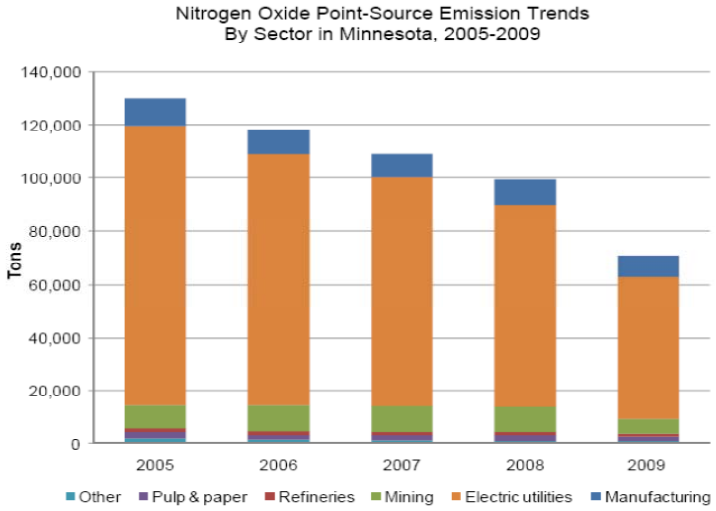
The NO_x emissions from the proposed projects (6,635 tpy) do not take into account the expected emission reductions from Minnesota Power's Laskin, Boswell and Taconite Harbor facilities, US Steel Minntac, and Northshore Mining. See Section 4.4 for details of these reductions. When emission reductions are included, the emission change will be a reduction of 13,690 tons per year, which is a reduction of approximately 18 percent in stationary source emissions compared to 2009.



From: MPCA, 2004; 2004 Legislative Report.



From: MPCA Annual Pollution Report to the Legislature. April 2008



From: MPCA Annual Pollution Report to the Legislature. April 2011

Figure 24 Nitrogen oxide stationary source emission trends in Minnesota by sector, 1997-2009.

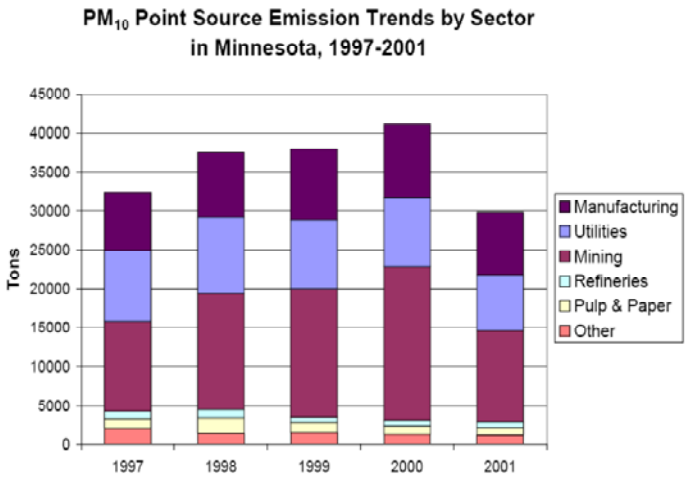
4.2.3 Particulate Matter (PM_{10})

Coarse particles are generally emitted from sources such as vehicles traveling on unpaved roads, materials handling, crushing and grinding operations, and windblown dust (reference (35)). It is estimated that PM_{10} emissions were approximately 786,930 tons/year in 2009 (reference (32)). As identified by the MPCA, stationary source emissions account for approximately 3% of the statewide PM_{10} emissions, while transportation related activities including unpaved roads account for approximately 59% of PM_{10} emissions.

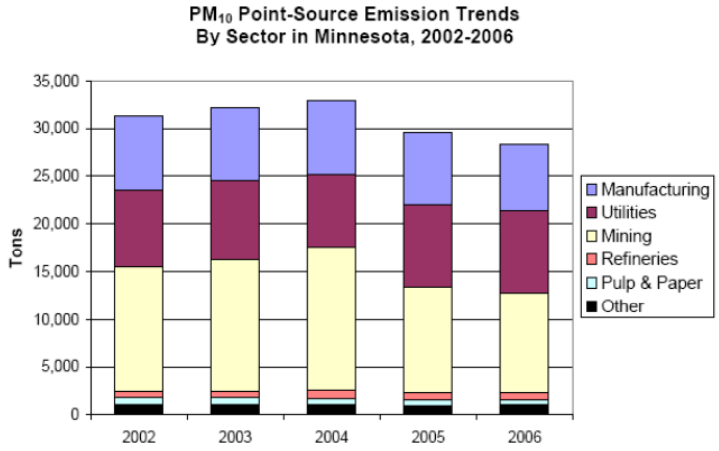
Figure 25 below summarizes PM_{10} stationary source emission trends between 1997 and 2009 (references(32)(34)). These data show that statewide PM_{10} emissions increased gradually from 1997 to 2000. In 2001, emissions decreased markedly in part due to the closing of LTV Steel Mining Company and a general decline in taconite processing. Since 2002, PM_{10} emissions have increased slowly up to 2004, but are well within historic levels (Figure 25). In 2005 there was a decrease mainly due to mining sources. In 2006 emissions dropped due to decreases in all source sectors except refining (reference (35)). PM_{10} emissions remained relatively constant from 2006 through 2008 and decreased in 2009 due to production decreases in mining (reference (32)).

In comparison to statewide PM_{10} emissions of 768,930 tons/year in 2009, the potential increase in PM_{10} emissions from the proposed projects is small (6,274 tons/year), an approximately 1% increase. When the potential emissions increase from the proposed projects is compared to stationary source emissions only (~23,000 tons/year), the potential increase is approximately 27%. Based on the emissions data from 1997 to 2009 (Figure 25), the potential increase in PM_{10} emissions associated with the proposed projects is within the variability exhibited by statewide PM_{10} point source emissions. Additionally, point sources only contribute 3% of the statewide PM_{10} emissions, with agriculture and road dust contributing the bulk of the statewide emissions.

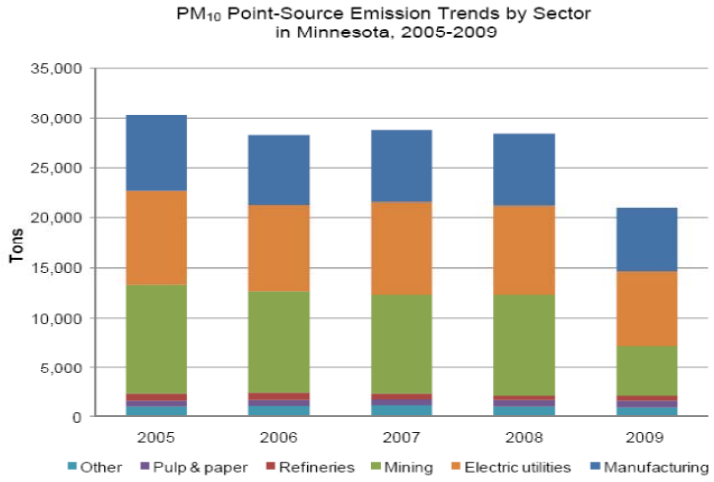
The PM_{10} emissions from the proposed projects (6,274 tpy) do not take into account the expected PM_{10} emission reductions from Hill Wood Products. See Section 4.4 for details of these reductions.



From: MPCA 2004. Annual Pollution Report to the Legislature.



From: MPCA 2008. Annual Pollution Report to the Legislature



From: MPCA Annual Pollution Report to the Legislature. April 2011

Figure 25 Trend in stationary source emissions of particulate matter (PM10) in Minnesota, 1997 - 2009.

4.2.4 Northeast Minnesota and Statewide Stationary Source Emissions

Stationary source emissions of SO_2, NO_x, and PM_{10} are not distributed evenly in the state. When 2008 statewide stationary source emissions of SO_2, NO_x, and PM_{10} are compared to the 2008 emissions from the major stationary sources in the northeast region of the state (Carlton, Koochiching, Itasca, Lake, Cook and St. Louis counties), the northeast sources contribute about 39% of the stationary source SO_2 emissions, about 42% of the stationary source NO_x emissions, and approximately 49% of the stationary source PM_{10} emissions.

While the northeast region of the state has a notable percentage of total statewide stationary source emissions of SO_2 (39%), NO_x (42%), and PM_{10} (49%) these emissions do not seem to have a correlation with ammonium sulfate, ammonium nitrate or haze index monitored values in VNP and the BWCAW. Figure 26 shows the annual SO_2 emissions from northeast Minnesota stationary sources compared to the annual median ammonium sulfate value for the BOWA1 monitoring site. The trend of the SO_2 emissions is increasing while the median ammonium sulfate air concentrations are trending down at the BOWA1 monitor, indicating that local emissions are not necessarily the driving force for the particulate sulfate in Minnesota Class I areas. A similar lack of apparent correlation is seen between the 6-county SO_2 emissions and ammonium sulfate monitored at the VOYA2 monitoring site. Figure 27 shows the annual NO_x emissions from northeast Minnesota stationary sources compared to the annual median ammonium nitrate value for the BOWA1 monitoring site. Although the data shows more variability in the trends, increases or decreases in local emissions are not reflected with a corresponding increase or decrease in monitored ammonium nitrate concentrations and often show the opposite, indicating that local point source NO_x emissions are not necessarily the driving force for the particulate nitrate in Minnesota Class I areas. The monitoring data at VOYA2 also shows a similar apparent lack of direct correlation with point source NO_x emissions from northeast Minnesota. Visibility impairment is a complex system that involves multiple pollutants, sources, and atmospheric reactions. In addition to the point source emissions discussed in this report, seasonality, humidity, the availability of ammonia and other emission source categories, such as mobile and area sources, are all factors that may contribute to the level of visibility impairment in any region.

The proposed projects combined with the Minnesota Power, US Steel Minntac, Hill Wood Products and BART reductions will decrease the northeast region emissions by about 19% overall (SO_2, NO_x and PM_{10} combined) compared to 2008 emissions.

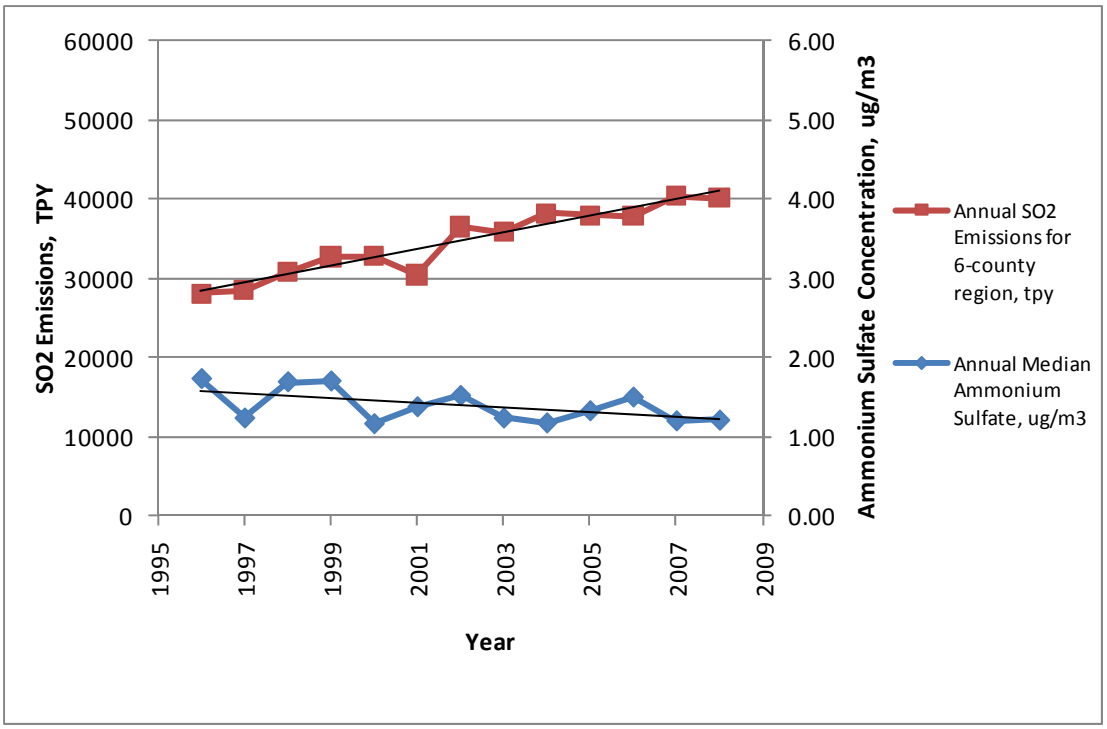


Figure 26 Historical emissions of SO_2 (1996 – 2008) in six-county area from MPCA inventory data compared to historical annual median ammonium sulfate values in the BWCAW.

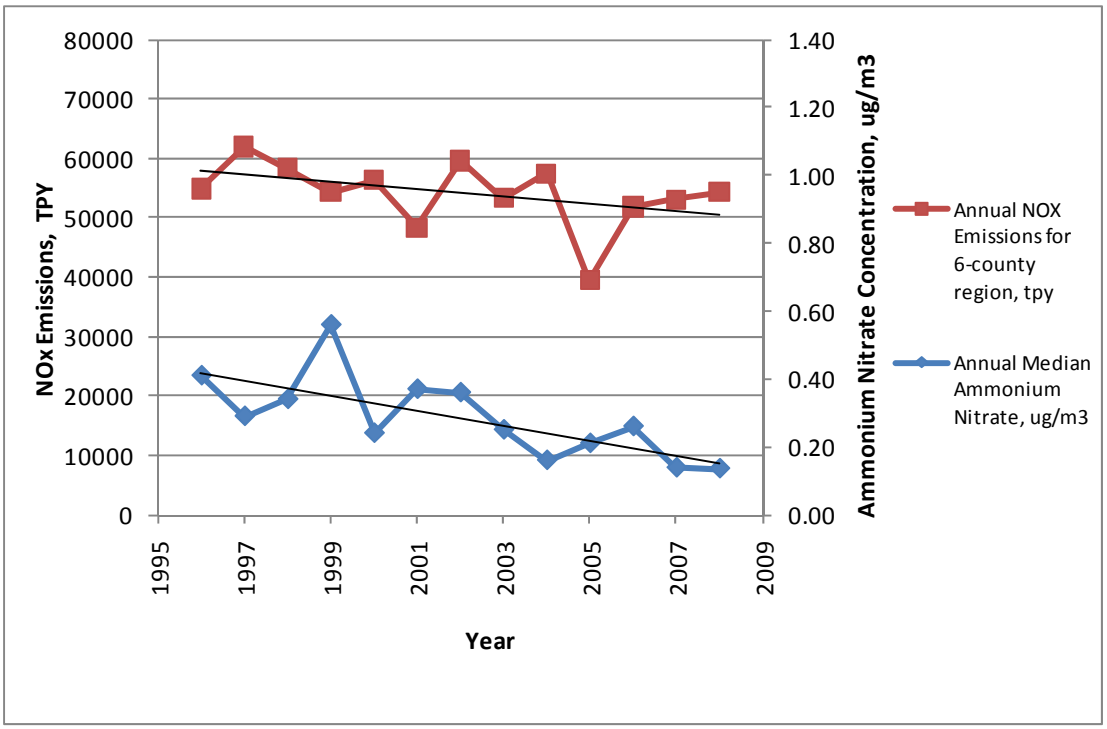


Figure 27 Historical emissions of NO_x (1996 – 2008) in six-county area from MPCA inventory data compared to historical annual median ammonium nitrate values in the BWCAW.

4.2.5 Statewide Emission Trend Summary

As shown above, if all proposed projects included in this analysis move forward to construction as planned, when combined with reductions from Minnesota Power's Laskin, Boswell and Taconite Harbor facilities, US Steel Minntac, Hill Wood Products and United Taconite and Northshore Mining, they would potentially change stationary source emissions in the state by approximately -19% for SO_2, -18% for NO_x, and +27% for PM_{10} compared to 2009 emissions. These potential increases and decreases do not take into account the likely reductions required by foreseeable regulatory and other actions besides the anticipated BART reductions shown in Table 1 (see Section 4.4).

When comparing the potential emissions from the proposed projects with statewide emissions, the following can be concluded:

- For SO_2: the potential change in emissions from the proposed projects combined with the reductions from Minnesota Power's Boswell, Laskin Energy Center and Taconite Harbor facilities, United Taconite and Northshore Mining will be an 8% reduction in stationary source emissions from 2009, or approximately 5,500 tons per year. Total stationary source annual emission including these changes would be approximately 66,000 tons per year which is less than historical emissions which have ranged from approximately 120,000 to 140,000 tons per year (Figure 22).
- For NO_x: the potential change in emissions from the proposed projects combined with the reductions from Minnesota Power's Laskin, Boswell and Taconite Harbor facilities, US Steel Minntac, and Northshore Mining will be a 4% reduction in stationary source emissions from 2009, or approximately 3,300 tons per year. Total stationary source annual emission including these changes would be approximately 74,000 tons per year which is less than historical emissions which have ranged from approximately 130,000 to 170,000 tons per year (Figure 24).
- For PM_{10}: the potential change in emissions from the proposed projects combined with the reduction from Hill Wood Products, is a 27% increase in stationary source emissions from 2009, or approximately 6,260 tons per year. Total stationary source annual emission including these changes would be approximately 30,000 tons per year which is within the range of historical emissions which have varied from approximately 28,000 to 41,000 tons per year (Figure 25). (Note that much of the increase in PM_{10} emissions is in coarse, fugitive emissions, which are unlikely to impact regional haze in the National Parks, even when emitted in northeast Minnesota.)

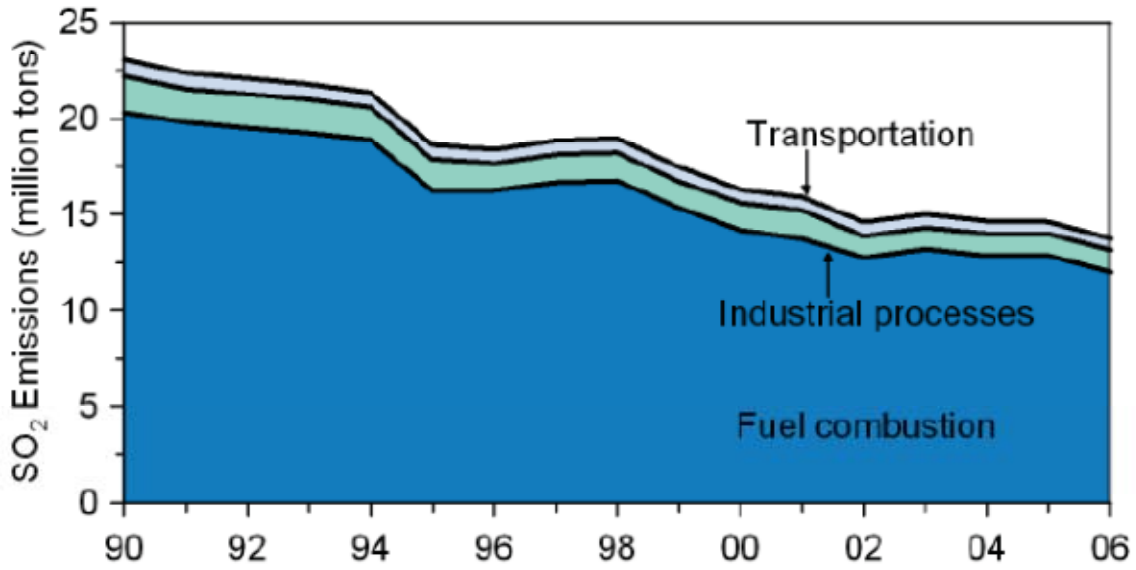
4.3 National Emission and Trends

National emission trends are also important to the visibility in federal Class I areas in Minnesota. As described in Section 3.4, out-of-state emissions contribute a major portion of the $PM_{2.5}$ to VNP and the BWCAW. Therefore, the trends in national emissions are expected to be reflected in the air concentration trends in VNP and the BWCAW. Due to the long-range transport of pollutants and their importance in federal Class I area air concentrations, national emissions of SO_2, NO_x, and PM_{10} are discussed below.

4.3.1 Sulfur Dioxide (SO_2)

Nationally, total SO_2 emissions (including mobile sources) have decreased by about 50% from 1990 to 2008 (reference (36)). Total SO_2 emissions in the U.S. in 2008 were about 11.4 million tons/yr. EPA data on historic SO_2 emission trends through 2006 is summarized below in Figure 28. More detailed historical criteria pollutant emission trends are available through EPA's web site:

- http://www.epa.gov/ttnchie1/trends/
- http://www.epa.gov/airtrends/sulfur.html.



From http://www.epa.gov/airtrends/sulfur.html

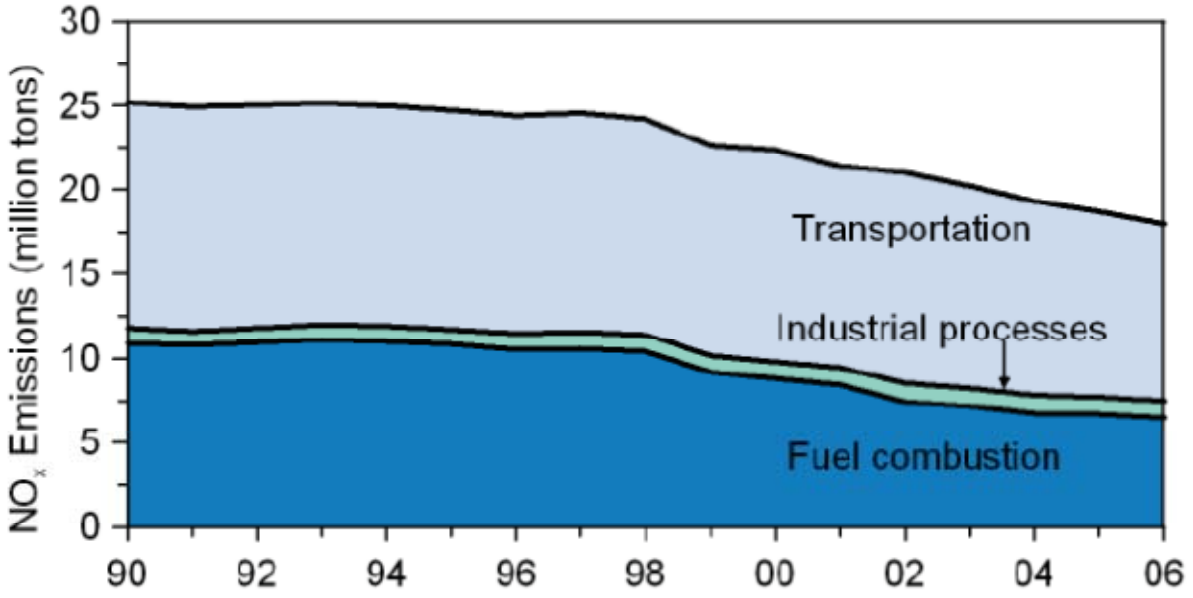
Figure 28 National sulfur dioxide emission trends from 1990 to 2006.

National SO_2 emissions from electric generation units were anticipated to level off at 8.7 million tons annually by 2010. Data is not yet available for 2010, however, actual emissions were almost at this level in 2007. The Cross State Air Pollution Rule (CSAPR), which was finalized in July 2011 and replaces CAIR, places additional caps on SO_2 emissions of electric generating units in covered states. The anticipated reduction in SO_2 emissions in these states is 6.4 million tons per year by 2014 compared to base case 2005 emissions (reference (37))

4.3.2 Nitrogen Oxides (NO_x)

Nationally, total NO_x emissions (mobile plus stationary sources) have declined about 36% since 1990(36), with the biggest decline starting in about 1999 (Figure 29). Stationary source NO_x emissions have declined about 43% from 1990 to 2008 and are currently approximately 6.9 million tons/year. The decline in national NO_x emissions is expected to continue due to regulatory actions. The Cross State Air

Pollution Rule, which was fianlized in July 2011 anticipates reducing NO_x emissions by 1.4 million tons per year within the covered 27 state area compared to base case 2005 emissions (reference(37)).



From http://www.epa.gov/airtrends/nitrogen.html

Figure 29 National nitrogen oxide emission trends from 1990 to 2006.

4.3.3 Particulate Matter (PM_{10} and $PM_{2.5}$)

Nationally, total PM_{10} emissions (including condensibles for both mobile and stationary sources and including miscellaneous sources) have declined since 1990 by 47%. Stationary source PM_{10} emissions (including condensibles and miscellaneous sources) have declined since 1990 by about 47% and were at about 14.3 million tons/year in 2008. Estimated total emissions of $PM_{2.5}$ have declined about 5% over the same period. Stationary source emissions of $PM_{2.5}$ have declined about 35% and in 2008 were 4.5 million tons/year (reference (36)).

PM_{10} and $PM_{2.5}$ emission reductions are expected to occur over the next decade, from a number of regulatory actions including the implementation of the revised National Ambient Air Quality Standard for $PM_{2.5}$. Models predicting the effect of the emission reductions due to the regulatory actions show that all areas in the eastern U.S. will have lower $PM_{2.5}$ concentrations in 2015 relative to present-day concentrations (reference (6)).

4.3.4 Summary of National Emissions and Trends

Nationally, there is a declining trend in NO_x, SO_2 and PM_{10} emissions over the time period from approximately 1990-2008 (reference (36)). Specifically:

- SO_2: Between 1990 and 2008, total SO_2 emissions have declined approximately 50%
- NO_x: Between 1990 and 2008, total emissions have declined approximately 35%
- PM_{10}: From 1990 to 2008, direct emissions of PM_{10} have decreased approximately 47%
- $PM_{2.5}$: From 1990 to 2008, direct emissions of $PM_{2.5}$ have decreased approximately 35%

EPA and the states have put in place a number of control programs that will continue to reduce particle-forming emissions that impair visibility. These future declines in emissions are expected to result in a continued downward trend in emissions nationally and a decrease in visibility impairment in VNP and the BWCAW.

4.4 Foreseeable Regulatory and Other Actions and Expected Emission Reductions

Predicting the exact schedule or scale that existing sources in Minnesota will reduce SO_2, NO_x, and PM_{10} emissions over the next ten to fifteen years is outside the scope of this report. However, there are several "on the books" or "on the way" regulatory programs that are likely to reduce or constrain emissions from both existing taconite facilities and existing coal-fired power plants. These include at least the following initiatives that will be implemented in Minnesota or throughout the country:

- Minnesota's Acid Rain Rule (Minn. Rule parts 7021.0010-7021.0050) (will serve to constrain emissions);
- EPA Acid Rain Program (Title IV of the 1999 Clean Air Act Amendments); Phase II began implementation in 2000. (will serve to constrain emissions);
- Boiler Maximum Achievable Control Technology (MACT) Standards, 40 CFR Part 63
- The Clean Air Interstate Rule (CAIR) replacement called the Cross State Air Pollution Rule (CSAPR), modifying 40 CFR Parts 51, 52, 72, 78, 97
- Regional Haze Rule, including Best Available Retrofit Technologies (BART) requirements for certain sources. On July 6, 2005, the U.S.EPA published final amendments to its 1999 regional haze rule in the Federal Register, including Appendix Y, the final guidance for Best Available Retrofit Technology (BART) determinations (70 FR39104-39172).
- National Ambient Air Quality Standards: 1-hr standards for NO_x and SO_2, reconsiderations of the 2008 Ozone standards, and additional changes to the standards for $PM_{2.5}$.
- Mobile source reductions
- SIPs from nearby states for upcoming ozone and $PM_{2.5}$ NAAQS standards

How these programs will work together, which units will be affected, and on what schedule are yet to be determined. Therefore, a detailed assessment of the potential emission reductions due to these regulations is outside the scope of this report. Nevertheless, while the timing of each of these regulatory initiatives is different, each could affect emissions of pollutants that impair visibility from existing sources in northeastern Minnesota and throughout the state.

4.4.1 Minnesota's Acid Rain Rule

Minnesota's Acid Rain Rule was established in July 1986 and includes the following provisions:

- A deposition standard that allows no more than 11 kilograms per hectare of wet sulfate to be deposited within the designated sensitive resource areas of Minnesota during any 52-week period (reference (33)).
- An emissions control plan that caps statewide SO_2 emissions at 194,000 tons/year.
- System-wide SO_2 emission limit of 93,500 tons/year for Northern States Power Company (now known as Xcel Energy).
- System-wide SO_2 emission limit of 40,390 tons/year for Minnesota Power.

As of 2009, statewide SO_2 emissions are estimated at 101,000 tons/year (reference (32)). Under Minnesota's Acid Rain Rule, SO_2 emissions would be allowed to increase and as such will not require any further reductions. However, current federal regulatory actions (e.g., the EPA acid rain program), foreseeable future actions, and voluntary actions (Minnesota Power's AREA Project; Xcel Energy's MERP) will continue to keep the statewide emissions below the 194,000 tons/year emissions cap.

4.4.2 EPA's Acid Rain Program

The goal of EPA's Acid Rain Program is to improve public health and the environment by reducing emissions of SO_2 and NO_x. The program was implemented in two phases: Phase I for SO_2 began in 1995 and targeted the largest and highest emitting coal-fired power plants. Phase I for NO_x began in 1996. Phase II for both pollutants began in 2000 and sets restrictions on Phase I plants as well as smaller coal-, gas-, and oil-fired plants. Approximately 3000 emission units are now affected by the Acid Rain Program (see http://www.epa.gov/airtrends/ acidrain.html and http://www.epa.gov/airmarkets/progsregs/arp/).

By 2010, the Acid Rain Program has reduced annual SO_2 emissions from electric utilities to about half that emitted in 1980. The program sets a permanent cap of 8.95 million tons on the total amount of SO_2 that may be emitted by power plants nationwide. It employs an emissions trading program to achieve emission reductions more efficiently and cost-effectively. Sources are allocated allowances each year (one allowance equals 1 ton of SO_2 emissions), which can be bought or sold or banked for future use. This approach gives sources the flexibility and incentive to reduce emissions at the lowest cost and the cap ensures that emission reductions are maintained over time.

The NO_x component of the Acid Rain Program limits the emission rate for all affected utilities, resulting in a 2 million ton NO_x reduction from 1990 levels by 2001. There is no cap on total NO_x emissions, but under this program a source can choose to over-control at units where it is technically easier to control emissions, average these emissions with those at their other units, and thereby achieve overall emissions reductions at lower cost.

Minnesota's electric utilities are subject to EPA's Acid Rain Program. As discussed below, additional emission reductions for SO_2 and NO_x may not be expected from Minnesota's sources.

4.4.3 Maximum Achievable Control Technology (MACT) Standards

The Industrial, Commercial, and Institutional Boilers and Process Heaters (Boiler) MACT (Subpart DDDDD) has been re-proposed and was finalized February, 2011. Affected emission units under the Boiler MACT are boilers and indirect-fired process heaters, characterized by 11 sub-categories of units. These MACT rules set requirements that will reduce precursors to $PM_{2.5}$ and visibility impairing pollutants.

On March 16, 2011, the EPA also issued a new proposed rule that would reduce emissions of toxic air pollutants from power plants (utility boilers). Specifically, the proposal would reduce emissions from new and existing coal- and oil-fired electric utility steam generating units (EGUs). Under a court-imposed consent decree, the EPA must issue the final rule by November 16, 2011. A 30 day extension period has extended this deadline to December 16, 2011. Although this proposed rule is directed primarily at reducing emissions of mercury and other metallic pollutants from electric power plants, it could drive additional reductions in SO_2, NO_x, PM_{10}, and $PM_{2.5}$ emissions at some plants. See http://www.epa.gov/airquality/powerplanttoxics/actions.html.

4.4.4 Cross State Air Pollution Rule (CSAPR)

The Cross State Air Pollution Rule (CSAPR) was developed to replace CAIR, which was vacated by the D.C. Circuit Court of Appeals in July of 2008 and remanded in December 2008 to the EPA for rewriting to address the flaws identified in the court's July findings. CSAPR takes effect January 1, 2012.

CSAPR requires 27 states to reduce emissions that contribute to ozone and fine particle pollution in other states. The reductions in this rule were developed to assist states in meeting the 1997 ozone and 2006 $PM_{2.5}$ standards. An additional supplemental notice of proposed rulemaking related to CSPAR would require summertime NO_x reductions under the CSPAR ozone season control program and bring the number of states covered by CSAPR to 28. CSAPR sets an emissions budget for each state and allows limited interstate trading among power plants, within the emission ceiling of each state. CSAPR sets emissions budgets that are expected to reduce NO_x emissions by 1.4 million tons per year and SO_2 emissions by 6.4 million tons per year by 2014 compared to 2005 base levels (reference (37)).

Minnesota is included in CSPAR and will have annual budgets of 29,572 tons of NO_x and 41,981 tons SO_2 starting in 2012 for facilities generating electrical power for sale. Voluntary reductions by Minnesota sources may meet or exceed the emission reductions that will be required under CSAPR. For example, Minnesota Power has completed or is proceeding with voluntary projects to reduce emissions at the Laskin Energy Center in Hoyt Lakes, the Taconite Harbor facility on Lake Superior (Lake County) and the Boswell station in Cohasset.

Various bills regarding the implementation of CSAPR have been introduced in the US House of Representatives that would either delay or negate this rule. However, it is uncertain if any of these bills will be passed into law. At the current time there is no change to the timing of the implementation CSAPR. EPA has proposed technical adjustments to CSAPR that include increasing certain state budgets. The Minnesota state budgets are not changed in these adjustments. The total increases to all state budgets will increase the overall CSAPR budgets by approximately 1% (reference (38)).

4.4.5 Best Available Retrofit Technology (BART) and Regional Haze

BART requirements are part of the EPA effort to improve visibility in federal Class I areas, such as VNP and the BWCAW. The MPCA Regional Haze SIP includes a summary of sources with units subject to BART in Minnesota, which includes six taconite facilities and five electric generating units in Minnesota. BART will require SO_2 and NO_x reductions from three generating plants in the area: Minnesota Power's Boswell Energy Center Unit 3 and Taconite Harbor Unit 3 and Northshore Power Unit 2. In addition, electric generating units in other parts of the state will also be required to implement BART including Rochester Public Utilities Silver Lake Units 3 and 4 and Xcel Energy's Sherco plant.

In late 2009, Minnesota submitted its Regional Haze State Implementation Plan to EPA and it is currently under review to verify that the plan complies with all of the rule requirements. Under a court imposed consent decree, the EPA must approve the MN SIP by May 15, 2012. The plan, as submitted, proposes a goal of a 30% reduction in the six-county northeastern Minnesota region by 2018. Additional SO_2 and NO_x reductions may be required in Minnesota as part of the Regional Haze SIP requirements to meet federal visibility goals.

4.4.6 Other Actions

There are several other actions that will help to reduce PM_{10}, $PM_{2.5}$ and other visibility impairing pollutants. These have been implemented since 2009 or will be implemented in the next several years and include:

- Heavy Duty engine standards

- Low sulfur fuel standards
- Federal control programs for nonroad mobile emissions
- Control of emissions from unregulated non-road engines
- $PM_{2.5}$ and Ozone SIPs for Wisconsin and Michigan
- 2008 Ozone NAAQS Reconsideration
- Ozone NAAQS Review
- Primary NAAQS Standards for SO_2 and NO_x
- PM NAAQS Review
- Inclusion of $PM_{2.5}$ in the PSD rule, including increments, Significant Impact Levels and Significant Monitoring Concentrations

5.0 Cumulative Impacts on Visibility and the Minnesota Regional Haze Long Term Strategy

As has been described in previous sections of this report, the Regional Haze Rule requires visibility improvements in Minnesota's Class I areas on the 20% worst days and no degradation on the 20% best days. To achieve this goal, the rule requires that Minnesota develop a long term strategy with initial implementation through 2018 and reassessment and revision every 10 years. The ultimate goal is to reach natural visibility conditions in both Class I areas by 2064.

Under the current Regional Haze Plan for Minnesota, the MPCA has set a reasonable progress goal (RPG) that they believe can be met under the long term strategy. The goal is to achieve a haze index of 18.6 deciviews for the 20% worst days at BWCAW and 18.9 deciviews at VNP by 2018. The current 20% worst visibility, based on 2008 5-yr rolling averages of IMPROVE data, are 19.6 for BWCAW and 19.5 for VNP.

To reach the reasonable progress goal, further reductions in emissions will be required not only in northeast Minnesota, but the rest of Minnesota and in other states. Control strategies that will ensure reductions are made and the goal is met include regulations already on the books, voluntary reductions and additional control measures. Voluntary control measures that were not quantified in earlier sections of this report, but that will decrease impairment in the BWCAW and VNP include large reductions in SO_2 and NO_x from electric utilities not located in the 6-county area. These include reductions being implemented by Xcel Energy at four of their plants, and reductions at the Otter Tail Power Hoot Lake facility. The MPCA expects to exceed the reasonable progress goal due to factors that were not included in the assessment, but which are expected to help reduce impacts on visibility. These include the Minnesota Renewable Energy Standard requiring 25% of the state's energy to be from renewable sources by 2025, reductions made in response to climate change issues and reductions from other states required by SIPs for $PM_{2.5}$ and ozone.

To develop the long term strategy, the MPCA modeled the visibility impacts of all sources affecting the Class I areas with the 2002 emissions and the 2018 expected emissions. The modeling for 2018 included all sources existing in 2002 plus several anticipated new sources. The new sources included Mesabi Nugget, NorthMet, Essar Steel, Northshore Mining Silver Bay Furnace 5, and the restart of a production line at United Taconite. In essence, the 2018 modeling is a cumulative assessment of the impact on visibility from these sources, including reductions and control measures.

The modeling clearly showed that the largest contributors to visibility degradation in both the BWCAW and VNP are ammonium sulfate, ammonium nitrate and organic carbon. The ammonium sulfate and ammonium nitrate are the result of emissions of SO_2 and NO_x. The organic carbon is believed to be of natural or biogenic origin. The largest contributors to impairment on the 20% worst days vary by season with ammonium sulfate and organic carbon dominating in the summer and ammonium nitrate and sulfate dominating in the winter. The largest stationary source contributors are electric generating units. The majority of the impairment is not from sources within the 6-county area of interest, nor from sources within the state of Minnesota. Emissions from Minnesota sources represent the single largest contribution of any state, however, the total from sources in other states and Canada make up the majority of the impairment.

As part of the long term strategy to meet the visibility goals, the MPCA, in conjunction with the FFLMs for the Class I areas, developed the Northeast Minnesota Plan. This plan is expected to ensure that emissions in the northeastern 6 counties in the state are reduced over time to facilitate meeting the RPG. The plan includes the following provisions:

- Includes sources over 100 tpy of either SO_2 or NO_x based on 2002 emissions.
- Targets a 20% reduction in combined SO_2 and NO_x by 2012 and 30% reduction by 2018 compared to 2002 levels. Estimates of emissions in 2015 show an overall reduction of SO_2 and NO_x of approximately 25 percent when compared to 2002, including the proposed projects and reductions.
- MPCA will review emissions and progress towards the visibility goals when any new major source applies for a permit or an existing source gets a PSD permit and will share the information with the FLMs.
- Taconite sources (Northshore, Keetac, Minntac, Hibbing Taconite, United Taconite, Mittal; all in the 6-county area) will be required to monitor starting in 2008.
- If the EGU and taconite reductions aren't adequate, the MPCA will require other sources to reduce through a "state retrofit" requirement.

6.0 Findings and Conclusions

Visibility Trends

Visibility in the BWCAW is gradually improving on the 20% worst visibility days, based on the 5-year rolling average haze index. Figure 30 compares the 5-year rolling average haze index to the reasonable progress goals (RPGs) set in the Regional Haze Plan (reference (3)). The 2018 RPG appears to be roughly consistent with the trend seen in the 5- year rolling averages. An obvious trend in visibility in VNP is not evident based on the NPS statistical assessment of the monitoring data.

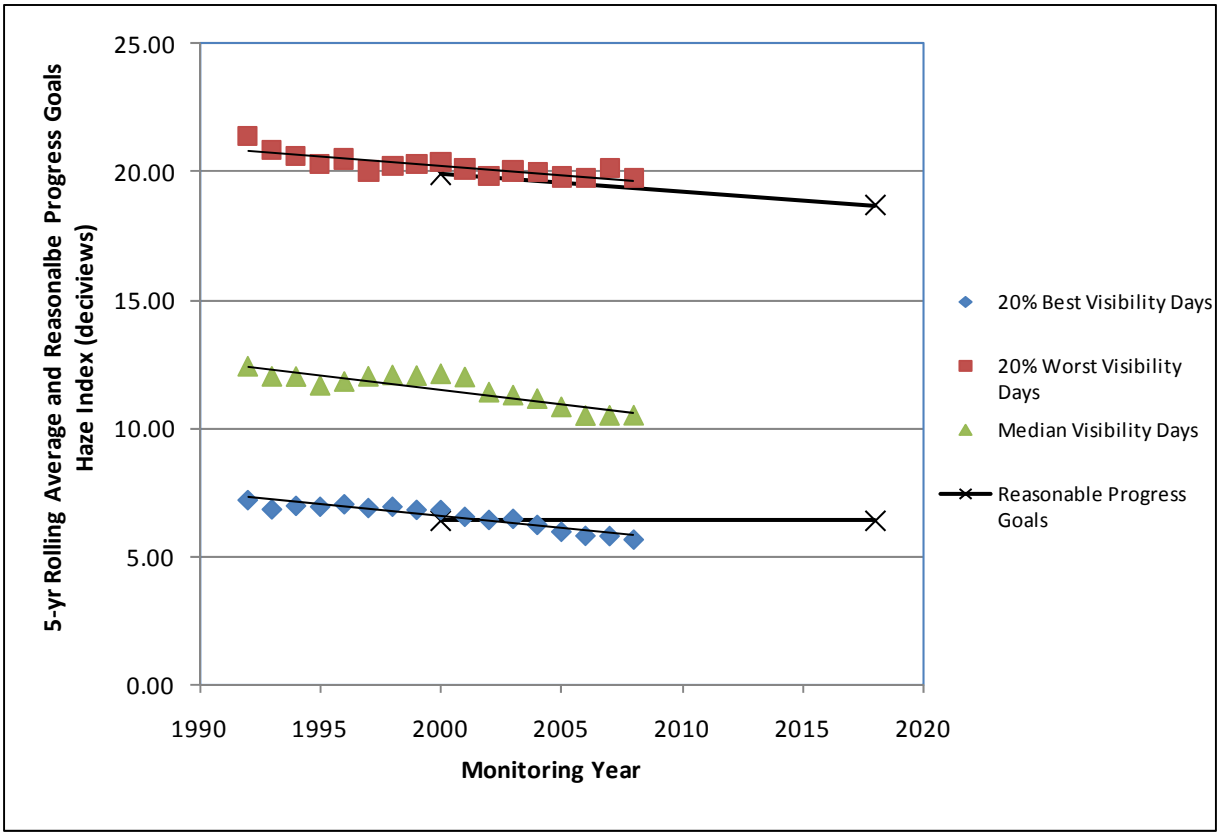


Figure 30 Minnesota Regional Haze Plan Reasonable Progress Goals for the BWCAW and five-year rolling averages of the haze index (deciviews) and linear trend lines for the BOWA1 IMPROVE monitoring site based on data for Jan 1992 through Dec 2008.

Source Contribution

1. Source apportionment of fine particulate indicates that northeast Minnesota sources contribute approximately 14 – 15% of visibility impairment to the Class I areas on the 20% worst days.

2. Minnesota emission sources contribute about 32% and 26% of fine particles to VNP and the BWCAW, respectively. The majority of impairment (approximately 70%) is caused by emissions from out-of-state sources.

3. The major contributors to visibility impairment are ammonium sulfate and ammonium nitrate, secondary aerosols formed from SO_2 and NO_x emissions. The proposed projects combined with the concurrent voluntary reductions result in a net decrease of both SO_2 and NO_x. Although PM_{10} emissions will increase from the projects, direct particulate emissions are not a significant contributor to visibility impairment in either of Minnesota's Class I areas.

Emission Trends

1. The potential PM_{10}, SO_2 and NO_x cumulative emissions increase from the proposed projects are relatively small in comparison to statewide emissions. To the extent local emissions affect visibility in the BWCAW and VNP, the potential increases in SO_2, NO_x and PM_{10} stationary source emissions from the proposed projects are within historical emission variability for the six-county project area and the state as a whole.

Emission Category	PM_{10} (tons/yr)	SO_2 (tons/yr)	NO_x (tons/yr)
Proposed Projects:	6,274	2,807	6,635
Statewide Emissions (all sources, 2009):	768,930	101,000	353,000
2008 Six-County Area Emissions (stationary sources only)	15,045	40,115	54,350
Maximum Increase From Projects from 2009 Statewide (approximate):	1%	3%	2%

2. The potential emission increases from the proposed project will be offset by reductions from other northeast Minnesota sources due to voluntary actions and current and foreseeable federal regulations such as mobile source reductions and Regional Haze/BART. In northeast Minnesota, Minnesota Power, US Steel Minntac, Hill Wood Products and BART requirements will reduce SO_2 and NO_x emissions by 16,467 tons/year and 20,996 tons/year, respectively, resulting in a net decrease in these pollutants. In other parts of the state, Xcel Energy, Otter Tail Power and Rochester Public Utilities will reduce both NO_x and SO_2 significantly.

3. Although there is a net increase in PM_{10} emissions from the proposed projects, a large percentage are fugitive emissions that will likely deposit nearby the source based on air dispersion/deposition modeling results in Class II areas and contribute little, if any, to visibility impairment in the more distant Class I areas. Direct particulate emissions are not a significant contributor to visibility

impairment in either of Minnesota's Class I areas and these potential emission increases are not expected to change this.

4. It is likely that the national emission reductions in SO_2, NO_x, and $PM_{10/2.5}$ from the foreseeable regulatory actions and the implementation of the Regional Haze Plan Long Term Strategy, which may require additional future reductions, will lead to declining $PM_{10/2.5}$ air concentrations and decreased visibility impairment in VNP and the BWCAW (references (3)(39)).

Conclusion

The net effect from the proposed projects, the voluntary reductions of Minnesota Power, the mining companies and the foreseeable regulatory actions will be to reduce emissions of SO_2 and NO_x in Minnesota. Within the context of anticipated regulatory changes, and expected emission reductions the current trend in visibility improvement is not likely to be changed by the proposed projects in northeast Minnesota. Although direct emissions of PM_{10} will increase, a large percentage is fugitive emissions that will deposit nearby the source. Subsequently, foreseeable emission reductions in Minnesota should continue to improve the visibility in VNP and the BWCAW, although it is uncertain as to the degree of visibility improvement that will be obtained from the emission reductions in Minnesota alone. Additional improvement in the air quality of VNP and the BWCAW is expected due to national, statewide and regional reductions of SO_2, NO_x, and $PM_{10/2.5}$ emissions. Therefore, gradual visibility improvement in VNP and the BWCAW is expected in the future.

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8.0 Abbreviations / Acronyms / Selected Definitions

[Visibility related abbreviations and definitions adapted from EPA 2003; Guidance for Tracking Progress Under the Regional Haze Rule; EPA-454/B-03-004.]

BART	Best Available Retrofit Technology
BWCAW	Boundary Waters Canoe Area (Wilderness); located in northeast Minnesota
CAA / CAAA	Clean Air Act / Clean Air Act Amendments
CAIR / CAMR	Clean Air Interstate Rule / Clean Air Mercury Rule
CENRAP	Central States Regional Air Partnership: one of five regional planning organizations for Implementing the Regional Haze Rule. Member states include Minnesota, Iowa, Nebraska, Missouri, Arkansas, Kansas, Oklahoma, Texas, Louisiana
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CIRA	Cooperative Institute for Research in the Atmosphere, Colorado State University
COHA	Causes of Haze website; sponsored by the WRAP and CENRAP (http://coha.dri.edu/)
CM	Coarse particle mass (same as PMC)
DRI	Direct Reduced Iron
DMS	dimethyl sulfide (from Park et al. 2005)
Dv or dv	Deciview, unit of the haze index
EC	Elemental carbon
EIS	Environmental Impact Statement
EPA, USEPA	United States Environmental Protection Agency
IMPROVE	Interagency Monitoring of Protected Visual Environments
km	kilometer
LAC	Light absorbing carbon
MACT	Maximum Achievable Control Technology
MERP	Xcel Energy's Metropolitan Emission Reduction Project
MDNR	Minnesota Department of Natural Resources
MPCA	Minnesota Pollution Control Agency
Mm^{-1}	Inverse megameter (10^{-6} m^{-1})
NO_X	Oxides of nitrogen
NPS	National Park Service
LAC	Light absorbing carbon

OC	Organic carbon
OMC	Organic carbon mass
PIXE	Proton induced x-ray emission spectroscopy
PM	Particulate matter
PMC	Particulate matter, coarse (aerodynamic size fraction between 10 and 2.5 microns) (same as CM)
PMF	Particulate matter, fine (typically referred to as $PM_{2.5}$)
$PM_{2.5}$	Particulate matter with an aerodynamic diameter less than 2.5 microns
PM_{10}	particulate matter with an aerodynamic diameter less than 10 microns
PSD	Prevention of Significant Deterioration
PTE	Potential-to-emit as defined at 40 CFR 52.21(b)(4)
RH	Relative humidity
RPO	Regional Planning Organization
SIP	State Implementation Plan
SO_2	Sulfur dioxide
SO_x	Sulfur oxides – including all of the oxides of sulfur
ton	Short ton = 2,000 pounds
ton, long	Long ton = 2240 pounds
ton, metric	Metric ton = 2204.6 pounds
$\mu g/m^3$	micrograms per cubic meter
µm	micrometer or micron; one-millionth of a meter.
U.S.	United States
VNP	Voyageurs National Park; located in northeast Minnesota
WRAP	Western Region Air Partnership. One of five regional planning organizations formed to implement the Regional Haze Rule. Member states include: Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, Wyoming
Yr or yr	year

Selected Definitions

Aerosols – suspensions of tiny liquid and/or solids particles in air.

Class I Area – Under the Clean Air Act, a Class I area is one in which air quality is protected more stringently than under the national ambient air quality standards; Federal Class I areas include national parks, wilderness areas, monuments, and other areas of special national and cultural significance. Mandatory Federal Class I areas include certain national parks (over 6,000 acres), wilderness areas (over 5,000 acres), national memorial parks (over 5,000 acres), and international parks that were in existence as of August 1977.

Federal Class I Areas in Minnesota – Boundary Waters Canoe Area Wilderness and Voyageurs National Park.

Coarse mass – mass of particulate matter with an aerodynamic diameter greater than 2.5 microns but less than 10 microns.

Deciview (dv) – the unit of measurement of haze, as in the haze index (HI) defined below.

Fine soil – particulate matter composed of pollutants from the Earth's soil, with an aerodynamic diameter less than 2.5 microns. The soil mass is calculated from chemical mass measurements of fine aluminum, fine silicon, fine calcium, fine iron, and fine titanium as well as their associated oxides.

Haze Index – a measure of visibility derived from calculated light extinction measurements that is designed so that uniform changes in the haze index correspond to uniform incremental changes in visual perceptions, across the entire range of conditions from pristine to highly impaired. The haze index [in units of deciviews (dv)] is calculated directly from the total light extinction [b_{ext} expressed in inverse megameters (Mm^{-1})] as follows:

$$HI = 10 \ln(b_{ext}/10)$$

Light absorbing carbon – carbon particles in the atmosphere that absorb light; also reported as elemental carbon.

Least-impaired days – data representing a subset of the annual measurements that correspond to the clearest, or least hazy, days of the year.

Light extinction – a measure of how much light is absorbed or scattered as it passes through a medium, such as the atmosphere. The aerosol light extinction refers to the absorption and scattering by aerosols, and the total light extinction refers to the sum of the aerosol light extinction, the absorption of gases (such as NO2), and the atmospheric light extinction (Rayleigh scattering).

Most impaired days – data representing a subset of the annual measurements that correspond to the dirtiest, or haziest, days of the year.

Nitrate – solid or liquid particulate matter containing ammonium nitrate [NH_4NO_3] or other nitrate salts. Atmospheric nitrate aerosols are often formed from the atmospheric oxidation of oxides of nitrogen (NO_X).

Organic carbon – aerosols composed of organic compounds, which may result from emissions from incomplete combustion processes, solvent evaporation followed by atmospheric condensation, or the oxidation of some vegetative emissions.

Particulate matter – material that is carried by liquid or solid aerosol particles with aerodynamic diameters less than 10 microns. The term is used for both the in situ atmospheric suspension and the sample collected by filtration or other means.

Particulate matter, coarse (PMC) – particulate matter with an aerodynamic diameter less than 10 microns but greater than 2.5 microns.

Particulate matter, fine (PMF) – particulate matter with an aerodynamic diameter less than 2.5 microns ($PM_{2.5}$).

Rayleigh scattering ($b_{RAYLEIGH}$) – light scattering of the natural gases in the atmosphere. At an elevation of 1.8 kilometers, the light extinction from Rayleigh scattering is approximately 10 inverse megameters (Mm^{-1}). This is the standard value used in visibility calculations regardless of site elevation in keeping with the practice of rounding each constant in the aerosol extinction coefficient to one significant digit and to simplify comparisons of values among sites at a variety of elevations.

Relative humidity – partial pressure of water vapor at the atmospheric temperature divided by the vapor pressure of water at that temperature, expressed as a percentage.

Sulfate – solid or liquid particulate matter composed of sulfuric acid [H_2SO_4], ammonium bisulfate [NH_4HSO_4], or ammonium sulfate [$(NH4)_2SO_4$]. Atmospheric sulfate aerosols are often formed form the atmospheric oxidation of sulfur dioxide.

Taconite – low-grade iron ore processed by crushing and concentrating to yield a pellet for use in iron smelters. Taconite has low mercury concentrations but large volumes of the material are heated during processing, which releases mercury into the atmosphere.

Total carbon – sum of the light absorbing carbon and organic carbon.

Visibility impairment – any humanly perceptible change in visibility (light extinction, visual range, contrast, coloration) from that which would have existed under natural conditions. This change in atmospheric transparency results from added particulate matter or trace gases.

9.0 Attachment A: Comments and Responses Related to Cumulative Visibility Report

Report Name: Cumulative Impacts Analysis Assessment of Potential Visibility Cumulative Impacts in Federal Class I Areas in Minnesota NorthMet Project dated May 2011
Date: 6/21/2011
Compiled by: Suzanne Baumann
Team: Catherine Neuschler, MPCA; Trent Wickman, USFS; Joy Wiecks, FdL

Comment ID	Initials	Chapter	Page	Para/ Sentence	Comment	PolyMet/Barr Response	Commenter Review of Response	PolyMet/Barr Response
00001	CN	Tech Summ	1		Line 3 typo	This will be corrected in the revised report.	OK	No response necessary.
00002	CN	Tech Summ	1	3	Feel like the chemistry needs a little more clariy. SO2 and NOx react with ammonia to form sulfate and nitrates. Also, we generally refer to secondary organic aerosols rather than compounds.	Chemistry will be elaborated in the text of the revised report.	OK	No response necessary.
00003	CN	Tech Summ	2	2	The rule sets a **goal** of no man-made visibility impairment by 2064.	Difference between requirement and goal noted and text will be changed appropriately.	OK	No response necessary.
00004	CN	Tech Summ	3	1	2009 data is available for both parks.	As of May 2011 only the concentration data was available for 2009 through the VIEWS website. Calculated visibility data (haze index and deciview contribution of components) was not available. Currently, calculated data (haze index) is also available for 2009 and will be added to the report.	OK	No response necessary.
00005	CN	1.0 Intro	5	2	Seems like a repetitive paragraph. Could probably be shortened.	Noted. The scope of the cumulative assessment is quite important (see comments 00032, 00034, 00038, 44, 48, 58, 61, 66), so the origin of the scope is included in detail in this section to define what the report intends to address. We recommend keeping this section in the report.	OK	No response necessary.
00006	CN	1.3	7	3	Mentions that Table 1 shows that emissions will be reduced due to large reductions from Minnesota Power's facilities. Some part of these reduction projects were likely already in place and operating as of the 1/1/2010 date and so could be impacting the 2009 visibility data.	Many of the power emissions reduction projects were partially underway by 1/10/2010, however, none were complete. It is reasonable to expect, therefore that emissions in the "future" (post 1/1/2010) would be reduced compared to historical emissions. Because some projects may have relalized some reduction prior to full project completion, the expected reductions from 2002 base emissions have been adjusted to account for any reductions that have already taken place up through 2009, based on actual 2002 and 2009 emissions. The reductions cited in Table 1, will be adjusted to account for any reductions that have taken place prior to 1/1/2010. The following methodology will be used for calculating anticipated future reductions from all projects. Future reduction = anticipated reduction from 2002 baseline - (2002 actual emissions - 2009 actual emissions)		It will be assumed that the absence of a comment in Column H indicates that the original comment has been adequately addressed unless the commenter indicates otherwise.
						Note1: Negative reductions will be considered to be zero (it is possible that reductions beyond the anticipated reduction have already occured). Note2: If actual emissions have increased since 2002, the projected decrease will be set equal to the decrease from 2002 (decrease is capped). Note3: When reductions are compared to 2008 data (i.e. NE MN emission inventory) the 2008 actual emissions will be used to account for any reduction already achieved.		
00007	CN	Table 1	8		Taconite Harbor Unit 2 is shown with a footnote that says "facility shutdown" - I'm not aware that MP plans to shut down this unit. Also, we will need to pay close attention to what is listed on the table as occurring since 2010. The emission estimates on the NE MN tracking spreadsheet are all estimated reductions from 2002 emissions, so this raises the same issue as identified above: all the emission reductions may be portrayed as occurring since 2010 when part might have already been completed.	The footnote regarding the Taconite Harbor Unit 2 shutdown was in error and will be removed. See response to comment 00006.	OK	No response necessary.
00008	CN	1.4.3	13	2	Typo - kept subscript too long	Will be corrected in text	OK	No response necessary.

Comment ID	Initials	Chapter	Page	Para/ Sentence	Comment	PolyMet/Barr Response	Commenter Review of Response	PolyMet/Barr Response
00009	CN	1.4.4	15		The plural of FLM is "FLMs" not "FLM's"	Will be corrected in text	OK	No response necessary.
00010	CN	1.4.4	16	Rule Reqs	The bullets are inconsistent - one has 2014 - 2018 and one 2013 - 2017	Will be corrected in text	OK	No response necessary.
00011	CN	1.5	17	Bulleted List	Aren't speciationation and size fraction two different things, so the FLMs request an assessment of PM, differentiated both into size fractions and species? The sentence after the bulleted list seems to say this, but the sentence before seems to conflate the two.	The categories will be de-conflated in the text.	OK	No response necessary.
00012	CN	2.1	18	2	This sentence is very confusing. "For monitoring data, visibility information from the IMPROVE network are available for full calendar years from 1992 to 2008, depending on the site and concentration data for key species affecting visibility are available for full calendar years from 1992 to 2009, depending on the site (see section 3.0 for more information)." I believe all data is available through 2009. Even if not, the sentence needs a semi-colon or something in the middle.	See comment 00004.	OK	No response necessary.
00013	CN	2.2	19	Bulleted List	Good that this emission reductions piece seems to parse out and include only those projects that are not yet completed (I think, based on the fact that it says things like "Tac Harbor 2" rather than just the whole facility).	Noted.	OK - the baseline issue is going to have to be looked at carefully as we go through this process	Noted
00014	CN	3.1	23	Table 3	Footnote 2 here seems to address my earlier comment about the available data through 2009. The footnote is very clear should perhaps be used in place of the sentence mentioned in comment 12.	See comment 00004.	OK, but will the language in the text be clarified?	Language will be more clear in revised report now that all data through 2009 is available.
00015	CN	3.3	25	Table 5	Not sure why this part went all the way back to 1992; nothing else goes back that far. Also, the sentence should mention that for VOYA it was 2000 (which is in the table title but not in the text). Maybe also mention the baseline used in the Regional Haze SIP.	The full range of data available for each monitoring site is represented in the table. The general public may not be aware of the improvements in air quality or the trend of improving visibility in the BWCAW. The report is meant to provide information on what data has been collected and what it means (e.g., trends in data). The trend in improving visibility is an important factor for the public to understand and to consider in assessing the potential for significant impact from the cumulative emissions from the proposed projects. The timeframe of the VOYA2 site will be added to the text. It is understood that in addition to overall trends the regulatory timeframe of the regional haze rule is also important and it will be addressed in the revised report where appropriate, including Table 5.	Trent: The report needs to note that the direction of a trend in visibility is completely dependant on the base year selected. As such the public should also know that there is a decrease in visibility across all northern CIAs since 2000 (http://vista.cira.colostate.edu/improve/Publications/Reports/2011/2011.htm)	The visibility decrease referred to in section 9.4.1 of the IMPROVE V report is not a trend analysis but a comparison of the average of 2000-2004 data and 2005-2009 data for the BWCAW. In this case there is one particularly high visibility year in the first time period and one particularly low visibility year in the second period. When the two time periods are compared and presented as a trend in this way it does appear that visibility has decreased over the entire decade. However, a trend analysis using 5-year rolling averages does not highlight the effects of these two particular years in the same way and shows fairly consistent visibility, if not a slight improvement in visibility over the decade. The revised cumulative visibility assessment report will note that the trend improving visibility is greater in the 1990's and relatively flat in the past decade in the BWCAW.
00016	CN	3.3	26 - 31	Figures	It would be nice if there was some way to emphasize the deciviews/haze index figures, as these seem to me to be the most important.	The haze index figures are first the the series for each park. The size of these figures relative to the others will be increased in the revised report.	OK	No response necessary.
00017	CN	3.4.1	32		If you talk about sources outside of the modeling domain, might be good to briefly mention what the modeling domain covered.	Figure of modeling domains will be added to the report.	OK	No response necessary.
00018	CN	.1.1 and 4.1.	39 -40		I think these tables are quite useful.	OK		No response necessary.
00019	CN	4.1.4	42		I like the description of the projects; is there some way here to try to sort out pre and post-2010? Also, there seem to be footnotes here that I'm not sure where they go? If they are references, then I'm not sure the MN Haze SIP really gives enough info to discuss the pre and post 2010 stuff.	To our knowledge, none of these projects were complete prior to 2010. See response to comment 00006 regarding emissions reductions compared to 2009 emissions.	OK	No response necessary.

Comment ID	Initials	Chapter	Page	Para/ Sentence	Comment	PolyMet/Barr Response	Commenter Review of Response	PolyMet/Barr Response
00020	CN	4.1.5	43		Says that the actions in section 4.1.4 are voluntary, but they are not all - many of them are BART and therefore not voluntary.	It will be clarified in the text that not all are voluntary.	OK	No response necessary.
00021	CN	.2.1 and 4.2.	46		It doesn't really seem necessary to take this much of a historical look. Going back to 1990 or 1995 or so would be enough.	The historical look at SO2 emissions will be scaled back.	OK	No response necessary.
00022	CN	4.2.1	46		Typo, second to last line (stationary)	this will be corrected in text	OK	No response necessary.
00023	CN	4.2.2	48, 51, 53	Figures 22, 24, 25	Using three separate graphs here is confusing, especially as the colors change. Could you recreate the graphs and make the colors consistent, or only include the most recent one? The most recent years are probably the most critical.	The figures are from MPCA reports. As identified for each figure, the respective figure was taken directly from the MPCA legislative reports for 2004, 2008 and 2011 respectively, which dictated the year ranges and colors. Data is not readily and publically available to recreate the graphs in a more aesthetically pleasing format.	OK	No response necessary.
00024	CN	4.3.1	57		Seems odd to say that emissions will level off in 2010. Either they were expected to, or did. Also, this seems to treat the issue of banked allowances as completely separate from CAIR or TR, when in fact the application of the TR may prevent sources from using too many banked allowances.	Wording will be clarified in text.	OK	No response necessary.
00025	CN	4.3.3	58		Might want to mention that the PM2.5 NAAQS revision is also likely to include a revision of the PM10 NAAQS.	Point will be noted in text.	OK	No response necessary.
00026	CN	4.4	59		I would prefer it if we could separate "on the books/way" programs that will reduce emissions from programs that serve to constrain emissions. The Minnesota and Federal Acid Rain programs really aren't serving to further reduce emissions, though they do likely provide some constraint on emissions growth. (This is elaborated well later, but it's not very clear in the first bulleted list.)	will be noted in text.	OK	No response necessary.
00027	CN	4.4	59		We keep putting "Wisconsin and Michigan ozone and PM2.5 SIPs" in this category, and I'm not aware that anything is really going to come from those. I believe both states are pursuing redesignation requests rather than developing full SIPs, at least for PM2.5, and the 2008 ozone standard isn't being implemented. Maybe this should be changed to more broadly say "SIPs from nearby states for upcoming ozone and PM2.5 NAAQS standards"	Change will be made in text.	OK	No response necessary.
00028	CN	4.4.4	62		The ozone standard is expected to be final in July 2011 - it has already been proposed.	It will be noted in the text of the revised report that the rule is finalized and the text will be updated to reflect the Cross-State Air Pollution Rule instead of the Transport Rule.	Trent: The ozone standard is no longer a rule to c	The revised report will reflect the most recent status of rules and standards at the time of submission.
00029	CN	5	64		I do not belive the SIP referenced the renewable energy standard as a reason that we expected to have more visibility improvement than the RPGs.	The renewable energy standard is included in the 2010 SIP under the section titled "Potential Future Projects and Impacts" that discusses likely actions that were not included in the RPGs. (p.106)	OK	No response necessary.
00030	CN	5	64		Two facilities were added as proposed “east mine” (Polymet) and “west mine” (Essar). The emissions projections also reflect lines at UTAC line 1 and Northshore Mining Silver Bay Furnace 5, that did not operate during 2002. Emissions for the Mesabi Nugget taconite plant were also added to the future year inventory.	Noted. Northshore Mining Furnace 5 will be added to the existing list.	OK	No response necessary.

Comment ID	Initials	Chapter	Page	Para/ Sentence	Comment	PolyMet/Barr Response	Commenter Review of Response	PolyMet/Barr Response
00031	tw-1		3		Summary finding #1 is sensitive to the baseline chosen. Recent analysis for the upcoming IMPROVE report shows that since 2000 the BWCA and Voyagers monitors (along with the 2 other "northern" class I areas) are the only ones in the eastern US where visibility has degraded. Map will be provided. Please include this data and change summary finding #1 to reflect the fact that using a more recent baseline date of 2000 a decrease is seen.	The scope of the Cummulative Impact Analysis for Visibility assesment for the SDEIS differs from the Minnesota Regional Haze SIP. The Cumulative Impact Analysis for Visibility is provided to determine whether or not the proposed project will result in degredation of the visibility resource when considered "cumulatively" with exisiting and other known future projects. Therefore, is is appropriate to use the entire dataset available regarding the visibility resource for determining trends regarding visibility and emissions.	Please include a statement in the report that the direction of a trend in the dataset is dependent on the baseline date selected and that trends since 2000 show a worsening of visibility.	The revised cumulative visibility assessment will note that the trend of improving visibility is greater in the 1990's and relatively flat in the past decade in the BWCAW. See response to Comment 00015 for additional supporting information.
00031 cont.						The 2011 IMPROVE report, published in June 2011, does have a case study for the BWCAW, however, it only compares the average of two regulatory five year periods, not trends in the BWCAW. The case study also indicates that several high bext episodes in 2005 seem to be driving most of the apparent difference between the two time periods. The Visibility Cumulative Impacts Analysis is addressing trends in visibility, not the regulatory 5 year period comparisons used in the case study. The speciation trend analysis that is presented in the 2011 IMPROVE report shows either decreasing trends or no significant trend for the concentration of all visibility impairing constituents for short term trends at both BOWA1 and VOYA2 and long term trends at BOWA1. However, the regulatory timeframe associated with the Regional Haze Rule is acknowledged and a discussion of trends since 2000 for BWCAW will be added to the text where appropriate.		
00032	tw-2		3		after summary finding # 3 please add a finding that discusses whether or not NE MN will make the 20% by 2012 and 30% by 2018 goals in the regional haze SIP. Emissions must go down to meet the goals of the regional haze SIP so it is not a significant finding that emissions in the future may go down. The significant question is whether it will go down enough. Please use the tracking spreadsheet maintained by MPCA and discuss the impact of including excelsior energy in this spreadsheet on whether the goals will be met.	Whether or not the goals set in the regional haze SIP are met is beyond the scope of this report. See response to comment 00031.	disagree. As a cooperating agency the Forest Service has a say in determining what is, or is not, within the scope of the report	Our understanding is that the regulatory agencies will work directly with ERM on developing the discussion of the Regional Haze SIP for the SDEIS. Therefore, further revision to the report to address this topic is not necessary.
00033	tw-3		3		how the emission reductions are calculated that supports finding #3 in some cases leads to the double counting of emission reductions - as will be discussed in later comments	To be addressed as pertains to later comments.		Please see responses to other comments.
00034	tw-4		4		Finding #6 "Over the next decade, voluntary and mandatory reductions in SO2, NOx and direct particulate emissions from existing sources in Minnesota and nationwide (including transportation sources) are likely to more than offset emissions from the proposed projects." again the significance of this conclusion is not clear. emissions must go down (more than an offset) to meet the regional haze SIP and the significant question is whether they will go down enough	The "findings and conclusions" in the July 2011 Cumulative Visibility Report, that "net decrease" or "offsets" lead to visibility improvement, are the same conclusions reached by the MPCA in their modeling for the Regional Haze SIP. In that modeling, five projects were included as emission increases (Mesabi Nugget Phase I, NorthMet, Essar, UTac Line 1, Northshore Silver Bay Furnace 5) (MPCA 2009). However, even with the three proposed new mining projects (Mesabi Nuggest Phase I, Essar, PolyMet), the SO2 and NOx emissions for the 2018 modeled year showed a net decrease from the 2002 modeled year (MPCA 2009). Therefore, the Cumulative Visibility Report is consistent with the findings from the Regional Haze SIP modeling results that visibility improves even with the addition of proposed projects. Whether the improvement is enough to meet reasonable progress goals or natural visibility by 2064 is beyond the scope of this Cumulative Visibility Analysis.	disagree. As a cooperating agency the Forest Service has a say in determining what is, or is not, within the scope of the report	Our understanding is that the regulatory agencies will work directly with ERM on developing the discussion of the Regional Haze SIP for the SDEIS. Therefore, further revision to the report to address this topic is not necessary.
00035	tw-5		6		The statement that emission changes will only be included if they occurred after 1/1/10 (because the monitoring data available goes through 12/31/09) is a key statement establishing the baseline and one that is not followed throughout the document	Only emissions reductions that will be fully implemented after 12/31/09 are included and only future projects that have yet to be fully implemented by 12/31/09 are included. See response to comment 00006.		It will be assumed that the absence of a comment in Column H indicates that the original comment has been adequately addressed unless the commenter indicates otherwise.

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00036	tw-6		8		there is a problem with some of the emission reduction values in Table 1. For example Minntac's reduction of 7624 tons of NOx is based on the difference between its current permit limit and its emissions in 2002. Unless Minntac is currently in noncompliance with its permit, that reduction has already taken place. See the 2009 NOx emissions for Minntac.	Please see response to comment 00006 with regards to how antipicated future reductions are calculated. The low NOx burners were installed at Minntac in 2010 and 2011 so any reductions from the low NOx burner installation is considered a future reduction.	regardless of whether the burners were installed or not, the NOx emissions from Minntac in 2009 were 5963 tons according to the MPCA tracking spreadsheet. Further reductions from 5963 tons are unlikely.	Communications between US Steel and the Minnesota Pollution Control Agency have stated a goal of 3,990 tons per year NOx emissions at Minntac. Recent pilot test results indicates that progress is being made toward this goal and there are no indications at this time that this target has been changed. The revised report will reflect and cite this information as appropriate.
00037	tw-7		18		section 2.1 Timeframe - historical emission rates back to 1990 are irrelevant. As stated on page 6 the baseline should be determined based on the date of available monitoring data. Also see discussion regarding "reasonably foreseeable" where 2009 is determined to be baseline based on availablility of IMPROVE data	Within the context of cumulative impacts and long term trends in visibility, long term trends in emissions are relevant. IMPROVE monitoring data and visibility calculations are available for the BOWA1 site starting in 1992, so the emissions from the corresponding time period is relevant.	disagree. As a cooperating agency the Forest Service has a say in determining what is, or is not, relevant	Ultimately the lead agencies (MDNR, USACE, USFS) determine what information will be included in the SDEIS. It is not unreasonable to provide all potentially informative data in the cumulative visibility report for consideration.
00038	tw-8		26		please include a section (#3.4) that discusses where the improve data is in relation to the reasonable progress goals set for BOWA snd VOYA in the regional haze SIP	This discussion is already included in section 6.0 (see figure).		It will be assumed that the absence of a comment in Column H indicates that the original comment has been adequately addressed unless the commenter indicates otherwise.
00039	tw-9		25		why is there no discussion regarding the increase in NH3NO3?	The difference between 20% best and median days and 20% worst days will be added to the text.		It will be assumed that the absence of a comment in Column H indicates that the original comment has been adequately addressed unless the commenter indicates otherwise.
00040	tw-10		38		"The estimated 2015 emissions for existing facilities do not take into consideration any reductions due to foreseeable regulatory actions, but do include reductions from Hill Wood Products, Minnesota Power's Boswell, Laskin Energy Center and Taconite Harbor facilities along with reductions required under BART for United Taconite and Northshore Mining." This statement is inaccurate, many of the reductions listed are related to meeting BART and/or the Transport Rule which are listed under section 4.4	As stated, the reductions related to meeting BART and certain Power Industry reductions are included. Wording will be changed to make this point more clear.		It will be assumed that the absence of a comment in Column H indicates that the original comment has been adequately addressed unless the commenter indicates otherwise.
41	tw-11		39		same comment as above - many of the reductions listed are related to meeting BART and/or the Transport Rule which are listed under section 4.4	The footnote to the table will be edited to indicate which reductions are included.		It will be assumed that the absence of a comment in Column H indicates that the original comment has been adequately addressed unless the commenter indicates otherwise.
42	tw-12		40		"This represents a maximum potential increase of about 12% compared to 2008 local NOx emissions of 54,350 tons. However, when decreases in NOx from the proposed projects are included (see Table 1, "Reductions"), the emissions will decrease by about 26% compared to the 2008 levels." This needs to be reconsidered in light of comment 6. Comparisons here with reductions calculated in table 1 are problematic because it assumes the baseline for the reduction calculations are 2009 which is not the case and can lead to paper reductions - i.e. Minntac	Please see response to comment 00006 with regards to how anticipated future reductions are calculated. Also note that all emissions increases from projects are to a certain extent "paper increases" because they are based on forseeable potential to emit. Actual future emission cannot be known, but using the potential does overstate what the actual increases will be.		It will be assumed that the absence of a comment in Column H indicates that the original comment has been adequately addressed unless the commenter indicates otherwise.
43	tw-13		46		2009 is an anomalous year due to the economic downturn and shuttering of most of taconite industry. This should be noted or another year used to represent current emissions	A statement will be added to clarify that mining sector emission changes from 2008 to 2009 may be driven more by economics than long term emission trends.		It will be assumed that the absence of a comment in Column H indicates that the original comment has been adequately addressed unless the commenter indicates otherwise.
44	tw-14		47		"emissions added by the proposed projects are within the annual variability of statewide stationary source" Being within the range of natural variablility is not a goal. To achieve the goals in the RH SIP emissions must go down enough to meet the RPG.	This statement is meant to put the emissions from the proposed projects in perspective of historical emissions, not to imply that that the emissions will meet the RH SIP goal. Assessing whether or not the RPG will be met is beyond the scope of the cummulative impacts analysis. Section 4.4 outlines actions that either reduce or constrain emissions and does imply that the overall trend in the regulatory framework is toward reducing emissions.	disagree. As a cooperating agency the Forest Service has a say in determining what is, or is not, within the scope of the report	Our understanding is that the regulatory agencies will work directly with ERM on developing the discussion of the Regional Haze SIP for the SDEIS. Therefore, further revision to the report to address this topic is not necessary.

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45	tw-15		47 and 49		Comparisons here with reductions calculated in table 1 are problematic because they assume the baseline for the reduction calculations are 2009 which is not the case and can lead to paper reductions - i.e. Minntac comment 6. Predictions of reductions for 2015 for SO2 and NOx in Tables 6 and 7 are greater than the 2012 or 2018 predictions in MPCA tracking spreadsheet. Just use the MPCA tracking spreadsheet to show future emissions.	Please see the response to comments 00006 and 42.		It will be assumed that the absence of a comment in Column H indicates that the original comment has been adequately addressed unless the commenter indicates otherwise.
46	tw-16		54		Section 4.2.4 should be removed. To understand the impact of the sources in NE MN finer scale work using back trajectories and dispersion modeling should be employed. For example the results of subject to BART modeling done by MPCA should be discussed. Another example is work done by LADCO showing most of the sources in NE MN included in the top 30 impairing sources list. The lack of a correlation between the NE MN EI and the annual average IMPROVE monitoring data does not prove a lack of impact. There are many other reasons to explain the data.	Section 4.2.4 is essential for providing the public with information regarding how sensitive the visibility in Class I areas is to emissions from NE MN. While it is intuitive that closer sources have a greater impact, it is misleading to imply that reducing emissions in NE MN will be a driver in improving visibility. This section does not imply that emissions from NE MN have no impact on visiblity, but that they cannot be assumed to be the driving factor. The complexity of the systems that are involved in visibility impairment will be acknowledged in the text. Figures 17 and 18 in section 3.4.2 demonstrate the relative importance of NE MN emission to visibility impairment.	disagree. As a cooperating agency the Forest Service has a say in determining what is, or is not, a driving factor or what is helpful or essential information for the public to know. Please include a reference for (or a copy of) the LADCO report referenced.	We understand that there may be differing opinions on what data is relevant and how the data should be interpreted. The purpose of this report is to provide information to the Lead Agencies and the EIS contractor and other interested parties. The lead agencies (MDNR, USACE, USFS) will determine what information is presented in the SDEIS.
						The data (Fig. 26 and 27) presented in Section 4.2.4 indicate that monitored concentrations of ammonium sulfate and ammonium nitrate do not parallel or track with emissions from northeast MN sources. This is confirmed by the CAMx modeling conducted for the Regional Haze SIP, that was calibrated for estimating baseline and future visibility impairment, and that modeling showed about 70% of the visibility impairment is due to out of state sources. The BART modeling with CALPUFF was not calibrated to any baseline conditions. The CALPUFF model is known to overestimate potential visibility impairment and the relationship of CALPUFF modeling results to actual visibility impairment and/or visibility related monitoring data is highly uncertain. Therefore, presenting CALPUFF modeling results that may have no real relationship to visibility impairment does not seem helpful at this time. The most recent LADCO summary indicates that impairment on 20% worst days is predominantly from southern MN and discusses source apportionment, but not source sensitivity.		LADCO report is available here: http://www.ladco.org/reports/rpo/consultation/products/regional_haze_in_the_upper_midwest_summary_of_technical_information_v2.2_feb_22_2008.pdf
47	tw-17		56		"These potential increases and decreases do not take into account the likely reductions required by foreseeable regulatory and other actions" as stated previously many of these address BART and the transport rule (see comment 10)	Text will be updated to clarify that anticipated reductions from BART are included.		It will be assumed that the absence of a comment in Column H indicates that the original comment has been adequately addressed unless the commenter indicates otherwise.
48	tw-18		56		Somewhere in 4.1.5 local emissions section a discussion needs to take place concerning whether these emissions will go down enough to meet the 20 and 30% targets in the MN Regional Haze plan. Again, emissions MUST go down to acieve the goals of the regional haze plan - so showing that they are going down doesn't address the key question of whether they will go down enough to meet the goals (RPGs) in the regional haze plan	Whether the improvement is enough to meet reasonable progress goals or or the 2012 or 2018 emission goals is beyond the scope of this Cumulative Visibility Analysis. Please see response to comment 00031.	disagree. As a cooperating agency the Forest Service has a say in determining what is, or is not, within the scope of the report	Our understanding is that the regulatory agencies will work directly with ERM on developing the discussion of the Regional Haze SIP for the SDEIS. Therefore, further revision to the report to address this topic is not necessary.
49	tw-19		57		In 2010 acid rain sources emitted 5.1 MM tons of SO2. The affect of allowances leveling off at 8.7 MM tons or the CAIR rule bringing emissions down 5 MM tons from 2005 (2005 emissions were 10.2 MM ton so that would mean down to 5.2 MM ton) are both nil. Current emissions are already below these levels.	The text already acknowledges that the function of the Acid Rain rule is to constrain and not reduce emissions. It is included in the report to emphasize the number of current rules already in place that at a minimum constrain emissions on a broad scale. The text will be updated to reflect the recently promulgated Cross State Air Pollution Rule, which replaced CAIR.		It will be assumed that the absence of a comment in Column H indicates that the original comment has been adequately addressed unless the commenter indicates otherwise.
50	tw-20		59		What is the relevance of trends with a baseline in 1990? that is 21 years ago	Please see response to comment 00015	see previous comments	see previous responses

Comment ID	Initials	Chapter	Page	Para/ Sentence	Comment	PolyMet/Barr Response	Commenter Review of Response	PolyMet/Barr Response
51	tw-21		59		The following programs have already been implemented, the specific reductions at NE MN facilities included, or, for the CAIR/Transport rule, the current emissions are already below the cap. Please remove them from this section. . Minnesota's Acid Rain Rule (Minn. Rule parts 7021.0010-7021.0050); • EPA Acid Rain Program (Title IV of the 1999 Clean Air Act Amendments); Phase II began implementation in 2000. • The Clean Air Interstate Rule (CAIR) replacement called the Transport Rule, modifying 40 CFR Parts 51, 52, 72, 78, 97 • Regional Haze Rule, including Best Available Retrofit Technologies (BART) requirements for certain sources. On July 6, 2005, the U.S.EPA published final amendments to its 1999 regional haze rule in the Federal Register, including Appendix Y, the final guidance for Best Available Retrofit Technology (BART) determinations (70 FR39104-39172).	The emission constraint function of the EPA and MN acid rain programs is explained in Section 4.4 The Cross-State Air Pollution Rule (replacement to Transport Rule, which is replacement to CAIR) does call for emissions reductions with goals for 2012 and 2014 and was recently promulgated. Certain aspects of BART for some facilities is still being determined and has yet to be implemented (e.g. UTac) The discussion of these rules is relevant to the discussion of programs intended to reduce or restrict emissions and to illustrate that current programs either constrain or reduce emissions at both the State and National levels. The discussion of regulations anticipated to improve visibility will be updated to reflect recent poltical developments (e.g. recent statements by the President).		It will be assumed that the absence of a comment in Column H indicates that the original comment has been adequately addressed unless the commenter indicates otherwise.
52	tw-22		62		"The plan, as submitted,proposes a goal of a 30% reduction in the six-county northeastern Minnesota region by 2018. Additional SO2 and NOx reductions may be required in Minnesota as part of the Regional Haze SIP requirements to meet federal visibility goals." this is one of the most important conclusions in the document and it is buried in the back. please add this to the summary findings	The summary and conclusion sections contain summary points that are related specifically to the cummulative analysis of visibility as pertains to known future projects in NE MN. A statement pertaining to possible additional future reductions will be added to finding #4 under "Emission Trends"		It will be assumed that the absence of a comment in Column H indicates that the original comment has been adequately addressed unless the commenter indicates otherwise.
53	tw-23		64		"These include reductions being implemented by Xcel Energy at four of their plants..." Is this refering to MERP? Aren't these already done?	Please see response to comment 00006.		It will be assumed that the absence of a comment in Column H indicates that the original comment has been adequately addressed unless the commenter indicates otherwise.
54	tw-24		64		The discussion on future O3 and PM2.5 SIPs is extremely speculative. It is not clear what the future NAAQS will be or the distribution of future nonattainment areas. It is not clear that WI or MI would ask for any reductions from MN. In addition the purpose of the Transport Rule is to address these interstate transport issues related to O3 and PM2.5 and the affect of this rule is potentially minimal as illustrated in comment 19.	The text acknowledges that future responses are uncertain, but that future actions may be necessary to meet the SIP requirements in other areas and these actions will have emission reductions as a goal. It is not relevant whether or not WI or MI will require MN to make additional reductions to meet their SIP requirements. Because visibility in MN Class I areas is impacted by emissions in other states, any reduction in WI or MI will also lead to improvement in visibility in MN. All discussion of the Transport rule will be updated to reflect the recently promulgated Cross State Air Pollution Rule.	Has MN ever been asked by another state to make reductions?	The issue of pollution transport between states is addressed in the Cross State Air Pollution Rule. The response to the original comment may not have been clear. The intent was that if WI or MI reduce emission to address issues in other states (not MN), the reductions would also potentially have a positive effect in MN.
55	tw-25		64		The following is another key point that deserves to be a summary finding "Under the current Regional Haze Plan for Minnesota, the MPCA has set a reasonable progress goal (RPG) that they believe can be met under the long term strategy. The goal is to achieve a haze index of 18.6 deciviews for the 20% worst days at BWCAW and 18.9 deciviews at VNP by 2018. The current 20% worst visibility, based on 2008 5-yr rolling averages of IMPROVE data, are 19.6 for BWCAW and 19.5 for VNP." Also since the baseline year for the rule (2000) the 20% worst days have gotten worse, so achieveing the RPG is getting harder all the time.	The resonable progress goals are addressed in Section 6.0: Visibility Trends.		It will be assumed that the absence of a comment in Column H indicates that the original comment has been adequately addressed unless the commenter indicates otherwise.
56	tw-26		65		The FLMs have been told this will not be implemented so please remove "and investigate control technologies and pollution prevention practices for indurating furnaces through pilot tests or other mechanisms during 2011-2012 and report cost and feasibility to the MPCA."	Statement will be removed from text.		It will be assumed that the absence of a comment in Column H indicates that the original comment has been adequately addressed unless the commenter indicates otherwise.
57	tw-27		66		"Visibility in the BWCAW is gradually improving on the 20% worst visibility days," again this is sensitive to the baseline year selected. The opposite is true if you choose the RH Rule baseline year of 2000. Please note this fact	Please see response to comments 00015 and 00031.	see previous responses	see previous responses

Comment ID	Initials	Chapter	Page	Para/ Sentence	Comment	PolyMet/Barr Response	Commenter Review of Response	PolyMet/Barr Response
58	tw-28		67		"are within historical emission variability for" and" increases from the proposed project will be offset by reductions" these are not criteria specified in the regional haze rule. Visibility is currently impaired and therefore emissions must go down. Reduction goals are set in the MN regional haze rule: ambient air stds (reasonable progress goals as measured by IMPROVE) and emission goals for NE MN sources (20% and 30% by 2012 and 2018).	New projects within the state will result in new emissions, just as the retirement of exisitng sources will result in the retirement of their emissions. This statement puts the potential emissions increase from all proposed projects within the context of statewide and historical emissions. The "net emissions" based on the increases from known new projects and reductions from existing facilities is also discussed in this section.	disagree. As a cooperating agency the Forest Service has a say in determining what is, or is not, an appropriate context within which to describe the emissions.	Our understanding is that the regulatory agencies will work directly with ERM on developing the discussion of the Regional Haze SIP for the SDEIS. Therefore, further revision to the report to address this topic is not necessary.
59	tw-29		68		"gradual visibility improvement in VNP and the BWCAW is expected in the future." see comment 29	As stated in the text, based on the long term trends in visibility in MN Class I areas and the regulatory programs that are either in place or expected in the future, visibility is expected to improve.	disagree. Recent trends show a decline in visibility. Listed regulatory porgrams are for the most part implemented or are so far in the future so as to make their mention extremely speculative and uncertain (note the recent Ozone NAAQS withdrawl and movements in Congress to delay implementation of other EPA regulations)	See comments 00015 and 00028
60	JW1	1	2	1	While it is true that the majority of haze-causing pollutants come from out of state, MN is the largest contributor to its own regional haze problems, with 28-31% of haze-causing pollutants coming from within the state (Fig. 8.3, RH SIP). The next largest contributors emit only 6-10% of the total. The current text gives a false sense of the issue.	The report highlights that ~70% of the emissions come from outisde of Minnesota, while Minnesota is the single largest contributor. Both statements are correct. The introductory statements in the Technical Summary provide some scale to the contribution of Minnesota sources to visibility conditions at MN Class I areas. The contibution of other states (next largest contributors) is covered in more detail in section 3.4.		It will be assumed that the absence of a comment in Column H indicates that the original comment has been adequately addressed unless the commenter indicates otherwise.
61	JW2	1	3	Item #3	FdL agrees that the emissions of haze-causing pollutants emitted in MN are projected to decrease overall, it is still true that the state is not projected to meet its regional haze goals even when upcoming regulations are included in the projections.	The scope of the Cummulative Impact Analysis for Visibility assesment for the SDEIS does not include assesing the projected SIP goals.		It will be assumed that the absence of a comment in Column H indicates that the original comment has been adequately addressed unless the commenter indicates otherwise.
62	JW3	1	3	Item #4	Same as for #1 above. From Fig. 8.5 in the RH SIP, NE MN contributes about 15% whereas the rest of the state contributes from 12-17%. Fig. 8.6 (BWCA) shows NE MN's contribution ranging from 3-19%. Shows that there is a real contribution from the NE MN area, especially when you consider that only roughly 5% of the state's population lives there. Also, sources in NE MN have been described as "traditionally undercontrolled". The report itself admits that half of the effects on RH from the state of MN come from the Arrowhead Region, consisting of maybe 15-20 facilities.	The full details and all topics are not covered in the Technical Summary. Item #4 is a summary statement regarding the emissions of the proposed projects in relation to existing emissions within MN. The details on project and state emissions are found in sections 1.3 and 4.	Mining sources are still traditionally under-controlled compared with, say, utilities. This is a reason why the NE MN Plan exists and is a reason why agencies are expecting more from this sector in the long term. What is missing from this discussion is a sense of what long-term visibility improvement can be expected when several new sources are being/may be constructed.	The visibility cumulative assessment report does not predict future actual levels of visibility, but does compare current and historical trends in visibility and presents information on the relative contributions of different areas to visibility impairment and the emissions of different regions (local, state, national). The conclusions drawn from these comparisons is that anticipated projects in NE MN, most of which are subject to BACT, are not expected to change current trends in visibility. (see section 6.0)
63	JW4		4	Item #6	Proximity to a Class 1 area has a large impact, so we can't rely heavily on national emissions reductions for RH improvement in MN.	Close proximity is not necessarily an indicator of contribution to impairment. We acknowledge that Minnesota is the single largest contributor, but only contributes 30% of the total impact with 70 percent coming from outside MN. National programs aimed at reducing emissions will impact sources both in and outside of Minnesota, in theory reducing all emissions. Because 70% of haze causing pollutants are from out of state, reduction of emissions nationwide will be necessary to affect visibility in Minnesota. Even if the emissions in MN were reduced to zero, 70% of the haze causing pollutants would still be available. Reductions in national emissions are essential to continuing visibility improvements in MN Class I areas.	JOY: Again, the NE MN Visibility Plan was developed to address sources in this area. As the author of the Plan, the MPCA feels the contribution of local sources is important, as do the tribes. TRENT: both national and state reductions are necessary - as recognized by the Hg TMDL for which MN as a lesser contribution than for visibility.	It seems that the commenter's concern has been addressed in the response to other comments and/or will be addressed by the planned coordination between the Agencies and ERM on preparing the discussion of the regional haze SIP for the SDIES. If this is not the case, additional follow-up can be provided.
64	JW5		19		Isn't there a Utac fuel-switching project, too, that should be considered?	See the United Taconite Green Production Project in Table 1.		It will be assumed that the absence of a comment in Column H indicates that the original comment has been adequately addressed unless the commenter indicates otherwise.

Comment ID	Initials	Chapter	Page	Para/ Sentence	Comment	PolyMet/Barr Response	Commenter Review of Response	PolyMet/Barr Response
65	JW6		36		Proximity to a Class 1 area has a large impact.	As noted at the end of section 3.4.2 "Northeast Minnesota sources account for about half of the total contribution from Minnesota sources."		It will be assumed that the absence of a comment in Column H indicates that the original comment has been adequately addressed unless the commenter indicates otherwise.
66	JW7		42		Even with reductions, MN is not expected to meet the glide path for the RH SIP.	Whether Minnesota meet its reasonable progress goals is beyond the scope of this Cumulative Visibility Analysis. This issue is better suited to be addressed within the context of a SIP reassessment.	This issue needs to be addressed. If beyond the scope of this document, then the MPCA needs to address.	Our understanding is that the regulatory agencies will work directly with ERM on developing the discussion of the Regional Haze SIP for the SDEIS. Therefore, further revision to the report to address this topic is not necessary.
67	JW8		59		Ozone and PM reductions from WI's/MI's upcoming SIP's cannot be predicted. It is not even certain what the NAAQS are going to be, much less what areas these reductions will come from. Reductions are meant to address interstate transport, not NE MN's RH issues.	See response to comment 54.		It will be assumed that the absence of a comment in Column H indicates that the original comment has been adequately addressed unless the commenter indicates otherwise.
68	JW9				The MN RH SIP is not enforcable yet, the text should mention this. We've already seen one taconite facility use their proposed "RH reduction" for other purposes, and there is nothing to preclude other facilities from doing this.	Section 1.4.4 states that the MN SIP is under current review by the EPA. A footnote will be added to Table 1 indicating that the MN SIP is not yet approved and that BART requirements are not finalized.		It will be assumed that the absence of a comment in Column H indicates that the original comment has been adequately addressed unless the commenter indicates otherwise.
69	JW10	4			The text should mention that some reductions in emissions came from plant shutdowns due to economic conditions, and were one-time occurances.	See response to comment 43.		It will be assumed that the absence of a comment in Column H indicates that the original comment has been adequately addressed unless the commenter indicates otherwise.