AIR QUALITY AND SMOKE MANAGEMENT

Key Points

- In general, air quality at the Fernberg monitoring site in 2008 showed no major change from the past five years. Air pollution outside the Forest is not degrading forest ecosystems, human health or enjoyment of forest resources other than with visibility and mercury deposition. However.
- Smoke monitoring was not conducted in 2008 because no large wildfires occurred and no prescribed fires were conducted.
- Since several new industrial projects are proposed for the Iron Range, it is important to continue to monitor air quality, precipitation, and the resources they affect (e.g. lake and fish chemistry), especially for visibility and mercury deposition.

A. MONITORING AND EVALUATION

Forest Plan Direction

This monitoring was conducted to look at air pollution from sources outside the Forest and its effects on ecosystems, human health, and enjoyment of forest resources. This monitoring is in accordance with Forest Plan Direction: D-AQ-1 Air on the Forest is of high quality so that: 1) ecosystems are not impaired by pollutants originating in the air, 2) the health of visitors, residents, and employees are not impaired, 3) poor visibility does not impair scenic quality and 4) other air quality related values are not adversely affected.

Monitoring Conducted

The Superior National Forest (SNF) monitors the effect of air pollution from sources outside the SNF by measuring: 1) the chemistry of the air and precipitation directly and 2) the health of sensitive parts of the ecosystem (Water Resources chapter).

For this monitoring period, the Forest funded, in partnership with other federal and state agencies, the collection of air and precipitation chemistry monitoring data at the Forest's air monitoring site off the Fernberg Road, 20 miles east of Ely. This is known as the Fernberg monitoring site. Most of the monitoring equipment at Fernberg is part of some national network. This allows for free data analysis by outside parties. For example, detailed analyses of the visibility data will be ongoing as progress of the implementation of the Regional Haze Rule is tracked. One performance measure of our site is the rate of data collection. This rate is generally exceeding each national network's standards, as shown in Table 1.1 (for the most recent calendar year available). However, we did have some exceptions to this rule. The IMPROVE monitor developed a problem with the controller that caused a large loss of data. A contractor worked to trouble shoot the problem which

involved many cycles of mailing new controllers, installing them, and then mailing them back. Even though all the equipment operates in an extreme environment, the SNF is always striving to improve data collection rates.

Trends in air quality often take many years to become evident. For most pollutants monitored at the Fernberg site, for this monitoring period, no major changes were seen from the past five years. As illustrated by Figure 1.1, showing precipitation acidity, trends generally improved. Triangles in the figure denote the years for which data collection did not meet the standard for this network.

It appears, for some of the parameters monitored at Fernberg, the improvement seen over the past 10+ years has plateaued. An example of this is fine particulate matter which is measured for regional haze in the Boundary Waters Canoe Area Wilderness (BWCAW) (Figure 1.2). A decline in deciviews (improvement in visibility) is apparent through the 1990s while the trend flattens out after 2000 indicating no change in visibility from the 1990s.

Sulfate is the largest portion of fine particulate that causes regional haze at Fernberg. Power generation is the dominant source of sulfur dioxide emission which forms sulfate in the atmosphere. Sulfate in the atmosphere can form particles that cause haze or can be washed out as acid rain. The correlation between the sulfate measured in rain at Fernberg and the US power plant sulfur dioxide emission is shown in Figures 1.3 and 1.4. This shows that sources physically located away from the BWCAW can have an effect on air quality and other associated ecosystem characteristics such as water quality and mercury levels in fish. This also shows the positive effects that national air quality regulations, such as the Acid Rain Rule illustrated in Figure 3, can have on the BWCAW.

A similar change was recently reported for mercury in fish. Monson (2009) recently analyzed Minnesota's fish-mercury data and found a year (1992) that divided a period of generally decreasing concentrations (1982 to 1992) from one of increasing concentrations (1992-2006). The reason for this change is not immediately obvious.

There were no major equipment changes to the Fernberg monitoring station in 2008. In partnership with the Minnesota Pollution Control Agency (MPCA) and Environmental Protection Agency (EPA), a passive ammonia sampler was added to the site in 2007, operated in 2008, and will continue to take samples in 2009. Ammonia is a key chemical in relation to fine particulate formation and regional haze. The level of ammonia currently in the atmosphere is not well known but is a key input parameter to atmospheric models used to predict the visibility impact of industrial sources.

In partnership with the Lake Michigan Air Directors Consortium (LADCO), a particulate sampler was temporarily added to the site that collected samples in 2007 and early in 2008. This was added to assess the contribution of burning biomass and fossil fuels to the organic carbon fraction of fine particulate. Organic carbon (OC) is an important contributor to regional haze on some days on the SNF. OC can come from mobile sources

(such as vehicles), burning biomass (both residential wood combustion and wildland fires), local industrial sources and secondary organic aerosols, The purpose of this study was to increase certainty in the identification and contribution of burning biomass and fossil fuels to fine particulate (and OC) concentrations. A final report was issued in early 2009 concluding that for the samples taken at Fernberg, burning biomass contributed 12 percent of the total fine particulate OC concentrations in the summer and 16 percent in the winter. Annually, only 15 percent of the total visibility impairment measured at Fernberg was due to OC, so burning biomass was a very minor source (approximately two percent) of visibility impairment at the BWCAW. While 2008 was a slow year for large fire activity on the Forest, fires that tend to affect air quality on the Forest are those large wildfire complexes that originate many states away or in Canada (MPCA 2009).

Further monitoring was conducted to look at air pollution caused by Superior National Forest management activities. This monitoring was an attempt to address Forest Plan Desired Condition: D-AQ-3 Air emissions from National Forest management actions do not degrade natural resources or uses of the Forest.

The forest management activity that generates the most air pollution on the SNF is prescribed burning. The MPCA calculates air emissions from sources in Minnesota. For recreation activities and logging in Cook, Lake, and St. Louis counties the total annual emissions of the main common pollutants (nitrogen oxides, sulfur dioxide and particulate matter less than 10 microns) is about 480 tons (Wu 2009). A large prescribed burn may release 50 to 200 tons of just particulate matter less than 10 microns. It would also release nitrogen oxides and a very small amount of sulfur dioxide.

The SNF screens all burning activities for possible air quality impacts during the development of each burn plan. Those burns identified as having the potential to adversely impact air quality are closely studied using models or other tools. Air quality monitors that measure fine particulates are deployed during the implementation of potentially problematic burns. The goal is to measure the maximum smoke impact at sensitive receptors including hospitals, roads or a collection of homes. The data collected is used to educate fire managers, in an adaptive management framework, about what types of conditions lead to adverse smoke impacts to the public.

During fiscal year (FY) 2008, no smoke monitoring took place as no prescribed burns were conducted. Smoke monitoring did not occur on any wildfires either, as no fires that occurred were large enough to justify monitoring.

Evaluation and Conclusions

The SNF continued to achieve data collection at the Forest's air monitoring site at Fernberg at rates exceeding each national network's standards. Overall, air quality monitored at the Fernberg site for the most recent year of complete available data (2007 or 2008 depending on the network) showed no major changes from that seen over the past five years other than mercury and visibility levels. Based on current understanding

and the data from the Fernberg site, air pollution from sources outside the Forest are not degrading forest ecosystems, human health or enjoyment of forest resources except for the following areas: visibility and mercury deposition. The MPCA's regional haze plan describes the important sources of visibility impairment to the BWCAW, none of which are related to SNF management activities. In general, air deposition is the source of mercury to watersheds on the SNF, but a more thorough discussion is in the Water Resources section of this report.

In 2008 the SNF's Air Resource Specialist was selected to serve on a 10 person Minnesota Mercury Total Maximum Daily Load (TMDL) Implementation Oversight Group. The task of this group was to review and evaluate the progress made toward achieving the goals of the Mercury TMDL, which includes a 93 percent reduction in air emissions of mercury. The group will oversee implementation of the emission reductions prescribed for mercury emitting industries in Minnesota. The ultimate goal of the TMDL is to reduce mercury in fish so that advisories for consumption no longer need to be issued.

Figure 1.5 shows the current visibility conditions at Fernberg and the improvement trend towards the 2064 goal of natural visibility. This goal (expressed in deciviews) was taken from the MPCA's proposed first 10 year plan to improve visibility. This plan is still being revised and is scheduled to be submitted to EPA in 2009. Over the next 10 years the visibility monitoring at Fernberg will be critical since it will be used to determine whether the MPCA's plan is achieving its goal.

B. REFERENCES

Minnesota Pollution Control Agency. 2009. Draft Minnesota regional haze plan. Available: www.pca.state.mn.us/air/regionalhaze.html.

Monson, B.A. 2009. Environmental Science & Technology, Vol. 43. pp. 1750-1755.

Wu, C.Y. 2009. Spreadsheet emailed to Trent Wickman April 2009.

Table 1.1. Air monitoring data from the monitoring station at Fernberg on the Superior National Forest.

Data Set	Monitoring Period (year to present)	Network Data Collection Standard (%)	Data Collection Achieved (%) (year)
Ozone, smog	1976	75/90 - EPA/MPCA	83 (2008)
Acid rain -precipitation chemistry	1980	75	98 (2007)
Visibility - fine particulate chemistry (IMPROVE)	1991	75	80(2007)
Mercury in precipitation	1995	75	94 (2007)
Meteorology	2000	90	99 (2008)
Continuous fine particulate	2005	75/90 - EPA/MPCA	91 (2008)
HazeCam, digital camera to document visibility	2005	75	96 (2008)
Ammonia, gaseous - passive	2007	75	ND

Figure 1.1. Precipitation acidity (annual laboratory pH) recorded at the IMPROVE monitoring station at Fernberg (Site MN18) on the Superior National Forest.

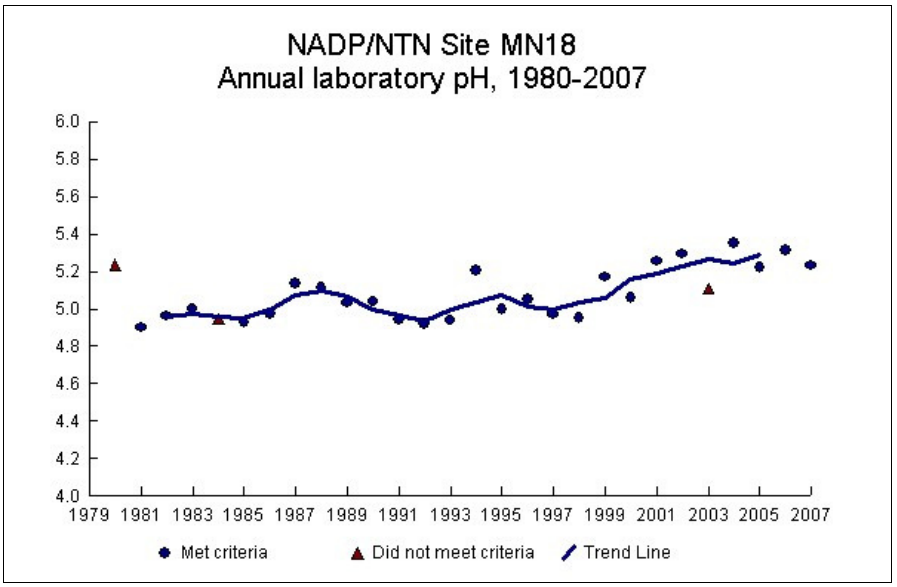

Figure 1.2. Light extinction caused by fine particulate matter (deciviews) on the 20 percent worst visibility days in the Boundary Waters Canoe Area Wilderness (BWCAW).

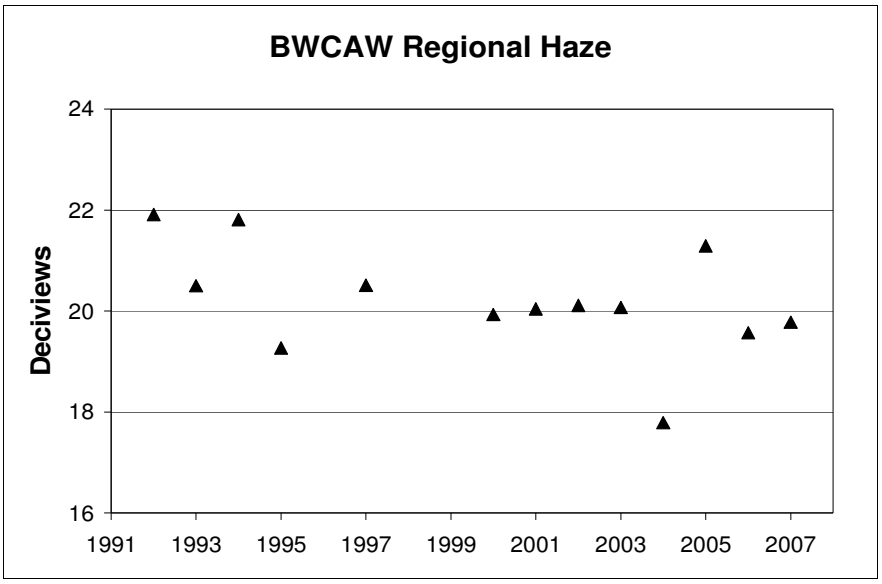

Figure 1.3. US Power Plant Sulfur Dioxide (SO_2) Emissions.

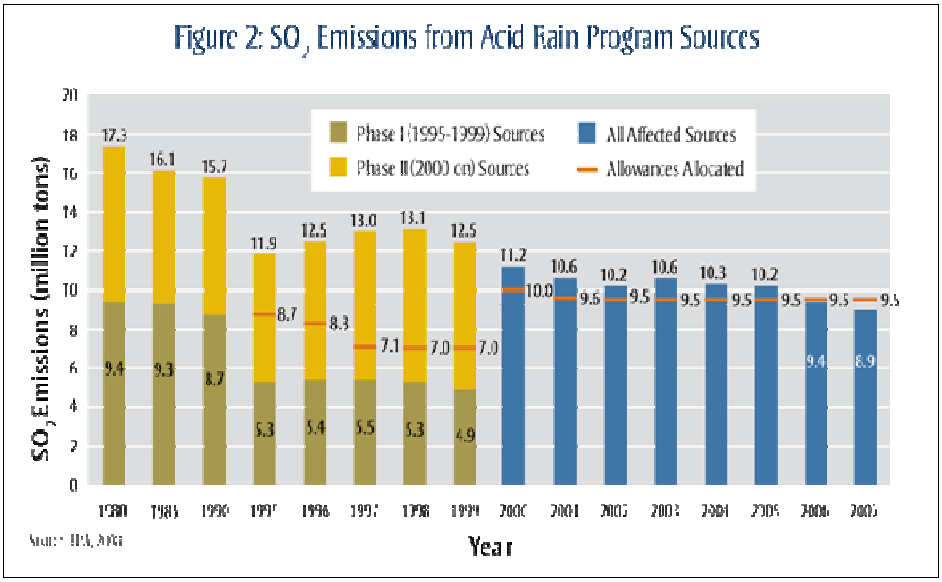

Figure 1.4. Sulfate (SO4) in rain measured at the Fernberg monitoring station (Site MN18) on the Superior National Forest. Note how the annual trend in this figure compares to the overall trend in sulfur emissions in Figure 1.3.

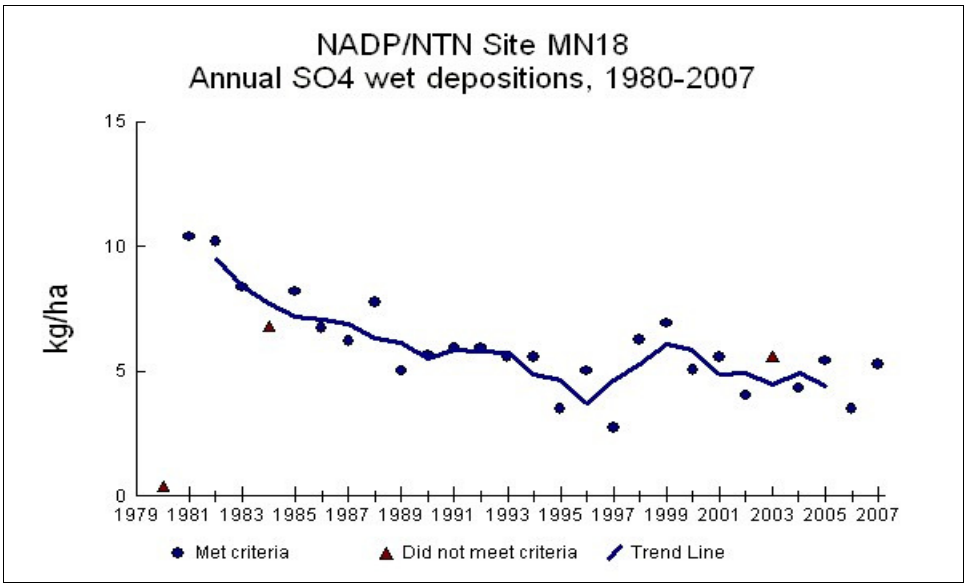

Figure 1.5. Graph of the current 20 percent worst (blue) and best (pink) visibility days at the Boundary Waters Canoe Area Wilderness (BWCAW) and predictions for 2018 along with the long term goal in 2064. A decrease in deciviews reflects clearer air. (Source: MPCA Regional Haze Plan, chapter 7)