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SOURCE APPORTIONMENT ANALYSIS of AIR QUALITY MONITORING DATA—PHASE I

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The objective of this study was to identify emissions sources contributing to fine particle concentrations and visibility impairment in rural areas in the Midwestern and eastern U.S. (see map). The final report on Phase I of the study was completed by Battelle Memorial Institute with assistance from Sonoma Technologies, Inc. It includes an independent review by Dr. John Watson of the Desert Research Institute and an analysis of related studies by Richard Poirot of Vermont's Department of Environmental Conservation.

The report is available electronically at www.marama.org under Regional Haze. The Mid-Atlantic/Northeast Visibility Union (MANE-VU) and the Midwest Regional Planning Organization (Midwest RPO) sponsored the study under grants provided by the U.S. Environmental Protection Agency. The Mid-Atlantic Regional Air Management Association (MARAMA) supervised preparation of the report.

Summary of the Preliminary Source Identifications

The draft report contains a preliminary identification of source types affecting visibility and fine particle concentrations at sixteen monitoring sites in the northeastern US. Contributions to light extinction on the 20% best and 20% worst days were evaluated. Source identifications are preliminary and subject to refinement.

- The authors report that at all sites studied, the major contributor to visibility impairment during the worst visibility days are sources of secondary sulfates.
- "Secondary" pollutants are formed in the atmosphere from "primary" emissions that undergo chemical transformation as they are transported by winds and weather patterns.
- Secondary sulfates in this region are predominately due to sulfur emitting sources, such as coal combustion. Watson's and Poirot's reviews note that this source identification is consistent with results from other studies.
- Organics are also a significant contributor to visibility impairment during the worst visibility days at many sites. At Boundary Waters, the contribution of organics to visibility impairment is

almost as much as sulfates. Organics were also a significant contributor to haze at the only urban site studied, Washington DC. Further work is needed to determine the sources of the organics.

- In terms of fine particle concentrations, the major contributors are secondary sulfates and organics.

These results suggest that air quality planning for fine mass and visibility in this part of the country should address sulfates (especially for visibility) and organics. (It should be noted that this analysis did not consider the contribution of nitrates.)

Monitoring Data and Sites Studied

This study used data from air quality monitoring sites located in fourteen states and the District of Columbia. Sites with long-term data records were selected to represent a broad geographical area. The monitoring sites analyzed are listed below. The ten IMPROVE sites are part of a monitoring network operated at major parks and wilderness areas. The six CASTNET sites analyzed were established to measure the effects of the U.S. acid rain control program under Title IV of the Clean Air Act.

IMPROVE Sites:

- Acadia National Park (ME)
- Boundary Waters Canoe Area (MN)
- Brigantine Wilderness (NJ)
- Dolly Sods Wilderness Area (WV)
- Great Smoky Mountains National Park (NC-TN)
- Jefferson/James River Face Wilderness Area (VA)
- Lye Brook Wilderness Area (VT)
- Mammoth Cave National Park (KY)
- Shenandoah National Park (VA)
- Washington, D.C.

CASTNET Sites:

- Arendtsville (PA)
- Bondville (IL)
- Connecticut Hill (NY)
- Livonia (IN)
- M.K. Goddard State Park (PA)
- Quaker City (OH)

The authors evaluated the available monitoring data, and in general the data were determined to be very good, with at most 10% of the observations being flagged as unusual. Due to changes in monitoring techniques, data from CASTNET sites prior to fall 1996 were excluded from the study. Data extends back to 1988 for four IMPROVE sites (Acadia, Great Smokies, Shenandoah, and Washington, DC). The remaining IMPROVE sites were established in 1991, except Jefferson/James River Face, which has been operating since 1994.

Methods Employed in Phase I

The authors used two receptor models (PMF and UNMIX) to analyze the monitoring data. These models rely on statistical methods to attempt to determine source composition and source contributions at each monitoring site. The authors reviewed the types of chemical species in order to make preliminary identifications of the types sources that might be affecting the site.

- The two models are slightly different, and comparing the results can give the modelers more confidence in their interpretations of the data. UNMIX was used to identify six types of sources affecting each site. PMF was used to identify nine types of sources.

- The preliminary source identifications in the report were based on the PMF model results. The UNMIX results in many cases confirm the PMF results. However, some of the UNMIX sources appear to be composites of several types of sources.