

CAUSES OF HAZE IN THE MANE-VU REGION

Preliminary findings from MANE-VU's recently published *Contributions to Regional Haze in the Northeast and Mid-Atlantic United States* show that **sulfate alone accounts for one-half to two-thirds of total fine particle mass on the 20 percent haziest days at MANE-VU Class I sites.** Even on the 20 percent clearest days, sulfate generally accounts for the largest fraction (40 percent or more) of total fine particle mass in the region. Sulfate has an even larger effect when considering visibility impacts. These findings indicate that an effective emissions management approach for the northeastern and Mid-Atlantic United States would combine regional SO₂ control efforts aimed at reducing summertime haze with efforts to reduce local SO₂ and organic carbon (OC) emissions.

Substantial visibility impairment, common across the region, is most severe in the southern and western portions which are closest to large power plant sources of sulfur dioxide (SO₂) emissions located in the Ohio and Tennessee River Valleys.

MANE-VU's findings draw a conceptual model of regional haze in which sulfate emerges as the most important single constituent of haze-forming fine particle pollution and the principle cause of visibility impairment across the region.

Summertime visibility is driven almost exclusively by the presence or absence of regional sulfate, whereas wintertime visibility depends on a combination of regional *and* local influences coupled with local meteorological conditions which can lead to the build-up of emissions from local sources.

Regional haze State Implementation Plans (SIPs) due in December 2007 must include an analysis of sources contributing to haze as part of the long-term emissions management strategy for meeting visibility improvement objectives in Class I areas subject to federal haze regulations. The MANE-VU report documents a "weight of evidence" approach integrating the results of numerous analytical techniques.

The report indicates that MANE-VU states account for about 25-30 percent of the sulfate in the Acadia, Brigantine, and Lye Brook Class I areas. Further, the report estimates contributions from other regions of the United States and Canada. Although variation exists across estimates of contribution for different sites and using different techniques, the overall pattern is generally consistent.

For more about MANE-VU's Contribution Assessment work see
www.nescaum.org/topics/regional-haze/mane-vu

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NEW RESOURCE FOR STATES RELEASED

MANE-VU's *BART Resource Guide* indicates that the BART program could represent a significant emission reduction opportunity for the Northeast and Mid-Atlantic States. Prepared by the Northeast States for Coordinated Air Use Management (NESCAUM), the Guide was recently released to aid states and tribes as they prepare to implement the Best Available Retrofit Technology (BART) requirements. States must determine what emissions limits and controls are necessary to meet the December 17, 2007 SIP submittal required by the Regional Haze Rule. This SIP submittal must include a list of sources eligible for BART, a BART determination for each source, and a compliance schedule for installing controls.



Frostburg, MD www.hazecam.net

Although many of the BART eligible emissions reductions are included in the CAIR caps, additional opportunities for primary particulate matter reductions at electrical generation units may be seen as a result of BART. Emissions reductions from several other source sectors – including non-CAIR EGUs, refineries, cement plants and ICI boilers — may be required under BART. These reductions will help meet Reasonable Progress requirements as well as reduce ozone and particulate matter contributions.

The Guide includes information on BART requirements, BART determination, and BART modeling as well as other resources to assist states in the BART process. The Guide is available on the MANE-VU website at <http://www.manevu.org/publications/reports> and technical materials link.

WHAT IS BART?

The Clean Air Act and EPA's Regional Haze Rule require states to determine the most stringent technologically feasible system of controls that can reasonably be installed at each facility eligible for BART. Criteria that determine whether a specific control technology is deemed reasonable include: cost of the controls, other control technology in use at the source, energy and other non-air quality environmental impacts, remaining useful life of the source as well as the degree of visibility improvement anticipated to result from installation of the controls.

BART is designed to ensure appropriate control of larger old emission sources built before New Source Performance Standards and requirements for Prevention of Significant Deterioration at Class I areas. BART applies to facilities built between 1962 and 1977 that have the potential to emit more than 250 tons a year of visibility-impairing pollution. Those facilities fall into 26 categories, including utility and industrial boilers, and large industrial plants such as pulp mills, refineries and smelters.

BART continued...

BART FACTS

Who is subject to BART?

Applicability is limited to those sources which:

1. Are in one of 26 specific source categories as identified in the Clean Air Act
2. Have units that were in existence on August 7, 1977, but had not been in operation for more than fifteen years as of that date (prior to August 7, 1962);
3. Have a potential to emit (PTE) 250 tons per year (TPY) or more of any single visibility impairing pollutant from units that satisfy criterion #2. These pollutants include SO₂, NO_x, VOCs, PM₁₀ and ammonia.

The MANE-VU BART Workgroup has recommended that any source wanting to limit emissions to below 250 tons/year in order to be exempt from BART must have a permit cap in place by December 2006, one year before BART determinations are due to EPA. The one year difference is to allow states time to amend permits including any public hearing requirements.

Does the Facility Cause or Contribute to Visibility Impairment?

Once a facility is found to be “eligible” for the BART program states must determine if that facility causes haze or contributes to the formation of haze at any Class I area. EPA’s 2005 rule outlines three options to determine if a source reasonably cause or contribute to regional haze in any Class I area. These options include: individual source assessment, cumulative assessment of all BART “eligible sources, and assessment based on model plants.

In 2005 the MANE-VU Board reaffirmed their commitment to developing strong control measures (including BART) to reduce regional haze. Given the potential emission reductions due to BART controls at BART sources, the Board determined that all BART-eligible sources in MANE-VU would be considered subject to BART.

Are new control requirements appropriate?

Once a facility has been identified as being BART-eligible and found to cause or contribute to haze in a Class I area, each state must determine the most stringent technologically feasible system of controls for that facility. This determination takes into consideration five factors:

- Cost
- Energy and non-air environmental impacts
- Existing controls at source
- Remaining useful life of the source
- Visibility improvement reasonably expected from the technology.

States have flexibility in weighing the importance of each of the factors.

When must enforceable BART requirements be included in SIPs?

The Clean Air Act and EPA rules require States to make BART emission limitations part of their State Implementation Plans (SIPs). Regional Haze SIPs are due to EPA December 17, 2007. As with any SIP revision, States must provide an opportunity for public comment on the BART determinations. Federal Land Managers must be given an opportunity for face-to-face consultation 60 days before public hearings.



Moosehorn Wildlife Refuge, ME
www.hazecam.net

Regional Coordination

SUPPORTING REGIONAL HAZE SIP DEVELOPMENT

MANE-VU has drafted a number of technical support documents to address various SIP elements. Two of the newest are profiled below.

Construction Mitigation TSD

MANE-VU states currently have rules in place to mitigate fugitive dust from construction, according to a draft Construction Activities Mitigation SIP Technical Support Document developed by the Mid-Atlantic Regional Air Management Association (MARAMA).

The purpose of this document is to support States in considering measures to mitigate the impacts of construction activities. The document provides background information on the air quality impacts of construction activities, presents relevant emissions inventory and contribution assessment results, describes potential control measures, and summarizes state regulations currently in place in the MANE-VU Region.

The draft document was reviewed by the MANE-VU Technical Support Committee and enforcement/compliance contacts in the MANE-VU states late last year. A final draft of the document is now posted for public comment at

<http://manevu.org/Document.asp?fview=Reports>

Smoke Management TSD

A recent report from MANE-VU indicates managed fires are not a major contributor to regional Haze in MANE-VU.

MARAMA staff researched MANE-VU Regional emissions attributed to fires and wood burning, and developed a draft Smoke Management memo. The memo describes the Regional Haze Rule requirement for smoke management, analyzes wood smoke emissions and source apportionment data. A final draft of the Smoke Management analysis was reviewed by the MANE-VU Technical Support Committee. It is posted at <http://manevu.org/Document.asp?fview=Reports> for public review.



Mt. Washington, NH: www.hazecam.net

YOUR PARTICIPATION PLEASE ...

Stay Tuned for Comment Opportunities

MANE-VU will soon be taking comments on *Contributions to Regional Haze in the Northeast and Mid-Atlantic United States*.

Thank you for the comments on the Construction Mitigation and Smoke Management Technical Support Documents, the Rural Aerosol Intensive Network (RAIN) Data Analysis, and the Best Available Retrofit Technology (BART) Resource Guide.

If you would like to be added to the stakeholder list to receive notices to comment please contact Susan Stephenson at sstephenson@marama.org or via phone at 410.467.0170.

Project Updates

GATHERING DATA IN MANE-VU

Monitoring the Air: RAIN

The Northeast States for Coordinated Air Use Management (NESCAUM) recently completed a comprehensive analysis of data from the Rural Aerosol Intensive Network (RAIN) for the years July 2004 through March 2005, as well as longer term data for some sites. The report is available for public comment at <http://manevu.org/Document.asp?fview=Reports>.

About RAIN

RAIN is a network of rural air quality monitoring sites deployed in 2004 to supplement IMPROVE data for assessing sources of haze for the MANE-VU region. While coordinated by NESCAUM, it is a cooperative effort of MANE-VU, US EPA, and the National Park Service. RAIN sites are located in western Maryland, northwest Connecticut, and Acadia National Park on the Maine coast.

The RAIN sites collect hourly data or 2-hour data for sulfates, particulate matter, and organics. This data provides much more information about short-term variation in air quality than IMPROVE sites. Such understanding helps scientists understand the formation of regional haze.

Data from the RAIN sites indicated that sulfate concentrations are higher in the western part of MANE-VU (generally nearer the sources) than in the northeastern parts of the region.

Select Report Findings

- Organic carbon concentrations during periods of high ozone suggest that the atmospheric processes that produce ozone also help generate organic aerosols,
- Organic carbon and sulfate account for more than 75 percent of measured (nephelometer) visibility degradation with very good correlation.

Project Updates

SEEING IS BELIEVING: CAMNET

The CAMNET Hazecam network of real-time visibility cameras in the MANE-VU region continues to provide high-quality real-time and archival images of urban and rural scenes from Western MD to Northern New England:

<http://hazecam.net>

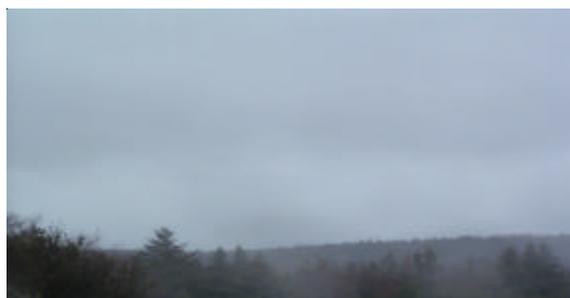
Currently 11 sites operate in the MANE-VU region. In 2006 additional Hazecams may be sited in the Baltimore area and at Brigantine Wildlife Refuge, which is a Class I area. The most recent addition was the Frostburg MD camera, part of the RAIN measurements at that Western MD site. CAMNET pictures document actual visibility conditions every 15-minutes, and are used both for public outreach/education and for research.



Camera Location -- Acadia Haze cam



Visible landmarks, Acadia from Haze Cam pictures



Acadia Haze Cam, 3pm photo April 4, 2006

VERSION 3 OF 2002 MANE-VU INVENTORY COMPLETED

Version 3 of the MANE-VU baseline 2002 Emission Inventory (EI) was completed in March 2006. This inventory provides the basis for modeling to assess sources of haze affecting the MANE-VU region. All MANE-VU states contributed to the inventory's development.

In the near future, all Regional Planning Organization (RPO) emission inventories will be housed on a web site funded by each RPO and developed by the Environmental Research Group (ERG) under contract to MARAMA. The Inter-RPO Emissions Inventory Warehouse will be a powerful tool as states, RPO's, and others work to address air quality issues. This web-based system not only stores, manages, and delivers quality assured emissions inventory data for modeling purposes, but allows data from across the country to be uploaded by each RPO and downloaded by any public user. Each RPO will be responsible for uploading data to the system.

Please check www.manevu.org for more information and release details.

Rules and Regulations

FINE PARTICULATE MATTER STANDARDS TO BE REVISED

On January 17, 2006 EPA published in the Federal Register its proposal to revise the National Ambient Air Quality Standards (NAAQS) for particulate matter. Key elements of the proposal include:

- Lowering the daily fine particulate matter (PM_{2.5}) standard to 35 micrograms per cubic meter (μm^3), down from the current standard of 65 μm^3 ,
- Maintaining the current annual standard of 15 μm^3 , and
- Creating a new indicator coarse particles (PM Coarse) which range from 2.5 to 10 μm^3 in diameter.

EPA's interim Regulatory Impact Analysis investigates the costs and benefits of attaining the standard by 2015 in five metropolitan areas. EPA's national analysis will be released when it finalizes new standards in September 2006.

In addition, EPA also issued an Advanced Notice of Proposed Rule Making in February to address various implementation issues in the event the standards are revised. In the document EPA highlights and provides preliminary thinking on how to address some of the key New Source Review issues related to the proposed new PM coarse standard and the transition from a PM₁₀ to a PM coarse standard. EPA has not made a final decision to adopt the proposed standards.

POTENTIAL TIME LINES

EPA will determine a proposal for implementing the new Standards. Two implementation schedules would apply (one for PM_{2.5} and another for PM_{10-2.5}) if EPA revises the PM NAAQS. Below are possible timelines.

Fine Particles (PM_{2.5})

- Potential effective date of new daily standard: December 2006
- Using monitoring data from 2005-2007, states would make recommendations by December 2007 for areas to be designated attainment and nonattainment.
- EPA would make final designations by December 2009; those designations would become effective in April 2010.
- State Implementation Plans, outlining how states will reduce pollution to meet the standards, would be due three years after designations, in April 2013.
- States would have to meet the standards by April 2015.
- In some cases, a state could receive additional time to meet the standard (up to April 2020).

Coarse Particles (PM_{10-2.5})

- EPA would not designate attainment and nonattainment areas until it has three consecutive years of monitoring data showing PM_{10-2.5} levels. EPA anticipates that data will be available in 2012 (2009-2011 data).
- States would make recommendations in July 2012 for areas to be designated attainment and nonattainment.
- EPA would make final designations in May 2013; those designations would become effective in July 2013.
- SIPs would be due 3 years after designations, in July 2016.
- States would have to meet the standards by July 2018.
- In some cases, a state could receive additional time to meet the standard (up to July 2023).

REVISING VISIBILITY CALCULATIONS

To quantify visibility, scientists use measurements of particles and gases. An algorithm, or series of equations, defines the steps to convert measurements or air pollution into estimates of light extinction. The following article describes the changes that have been made to these equations to obtain more accurate estimates of regional haze.

The IMPROVE air quality monitoring network provides data for these estimates. Direct measurements made with nephelometers at a few IMPROVE sites are used to judge the accuracy of the algorithm. The new algorithm appears to give less biased results on all but the haziest days.

Background¹

The original IMPROVE algorithm for estimating light extinction using IMPROVE particle data was first used in 1993, and has been a useful tool in the understanding of haze by the various particle components in aerosols (sulfate, nitrate, organic compounds, elemental or black carbon, fine soil, and coarse mass). This algorithm for estimating light extinction was adopted by the Environmental Protection Agency as the basis for the regional haze metric used to track progress in reducing haze levels for visibility-protected areas under the 1999 Regional Haze Rule [Rule].

As a result, the IMPROVE algorithm has been scrutinized carefully to assess deficiencies that could bias the implementation of the [Rule]. In light of the concerns raised by its use in the [Rule], the IMPROVE Steering Committee initiated an internal review including recommendations for revisions of the algorithm for estimating light extinction. [MANE-VU member representatives David Krask, MD and Rich Poirot, VT are members of the Steering Committee] A review of the old algorithm and suggested revisions were presented in The IMPROVE Newsletter, 2nd Quarter 2005. In December 2005, the IMPROVE Steering Committee voted to adopt this revised algorithm for use by IMPROVE as an alternative to the current approach.

MANE-VU Monitoring Sites Hit 100% Reporting

According to the 2005 4th Quarter IMPROVE Newsletter, the following MANE-VU sites achieved 90%, 95% and 100% data collection.

100% Sites

Aerosol (Channel A)

Addison Pinnacle
Baltimore
Casco Bay
Great Gulf
MK Goddard
Mohawk Mountain
Proctor Research Center
Quabbin Reservoir

Nephelometer

Acadia

95% Sites

Aerosol (Channel A)

Acadia
Frostberg Reservoir
Martha's Vineyard
New York
Washington, DC

90% Sites

Aerosol (Channel A)

Arendsville
Cape Code
Moosehorn
Presque Isle

1. Excerpted with permission from an Article Written by Marc Pitchford, NOAA, Originally Printed in IMPROVE Newsletter, Volume 14, Number 4. For more information about the IMPROVE calculation and the revision please see http://vista.cira.colostate.edu/improve/Publications/news_letters.htm

IMPROVE Continued

[What Was Changed?]

The new IMPROVE algorithm for estimating light extinction from particle speciation data contains five major revisions from the original algorithm:

1. A sea salt term has been added. Sea salt is a particular concern for coastal locations where the sum of the major components of light extinction and mass have been deficient.
2. The assumed organic mass to organic carbon ratio has been changed from 1.4 to 1.8, to reflect more peer-reviewed literature on the subject.
3. The Rayleigh scattering factor has been changed from a network-wide constant to a site-specific value. This factor is based on the elevation and annual average temperature of individual monitoring sites.
4. A split component extinction efficiency model for sulfate, nitrate, and organic carbon components has been developed. The model includes new water growth terms for sulfate and nitrate to better estimate light extinction at the high and low extremes of the range of extinction.
5. An NO_2 light absorption term has been added. This term can only be used at sites with available NO_2 concentration data.

Summary of Old vs. New

One of the most compelling reasons for developing a new algorithm was to reduce the biases in light scattering estimates at the extremes, when compared to nephelometer measurements which directly measure particle scattering. Analysis shows that the new

algorithm has lower fractional bias than the original algorithm, in all but the haziest conditions.

In sum, the new algorithm for estimating haze reduces the biases compared to measurements at the high and low extremes, and is most apparent for the hazier eastern sites. The composition of “best and worst days” are very similar by the original and new algorithms. Most of the reduction of bias associated with the new algorithm is attributed to the use of the split component extinction efficiency method for sulfate, nitrate, and organic components, that permitted variable extinction efficiency depending on the component mass concentration. The new algorithm also contains specific changes that reflect a better understanding of the atmosphere as reflected in more recent scientific literature, reflect a more complete accounting for contributors to haze (e.g., sea salt and NO_2 terms), and the use of site-specific Rayleigh scattering terms to reduce elevation-related bias.

Efforts are currently underway to develop monthly average $f(\text{RH})$ terms for all IMPROVE monitoring sites. Once that work is completed, the new algorithm will be added to the suite of data analysis tools on the Visibility Information Exchange Web Site (VIEWS). At this time there has been no formal recommendation from the EPA on use of the new IMPROVE algorithm in tracking visibility progress under the Regional Haze Rule.

A more complete discussion and report is available on the IMPROVE Web site at http://vista.cira.colostate.edu/IMPROVE/Publications/GrayLit/Gray_literature.htm.

The new algorithm for estimating the light extinction from particle components in aerosols is:

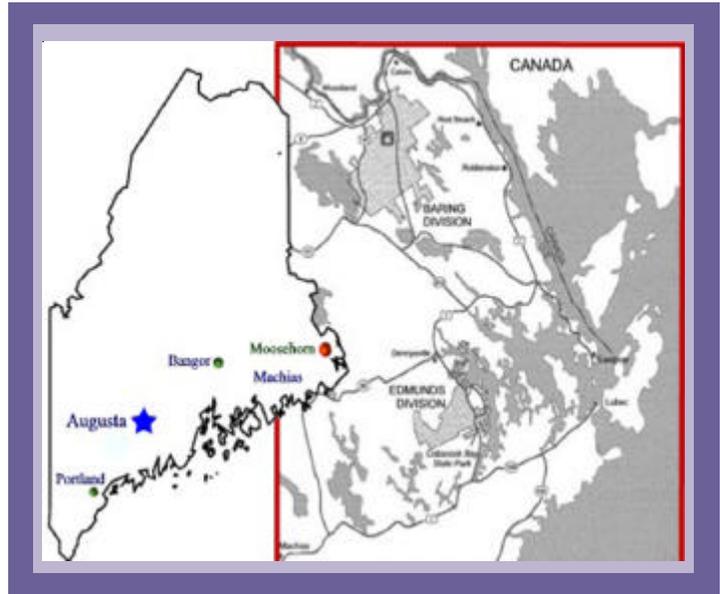
$$\begin{aligned} b_{\text{ext}} = & 2.2 \times f_s(\text{RH}) \times [\text{small sulfate}] + 4.8 \times f_l(\text{RH}) \times [\text{large sulfate}] \\ & + 2.4 \times f_s(\text{RH}) \times [\text{small nitrate}] + 5.1 \times f_l(\text{RH}) \times [\text{large nitrate}] \\ & + 2.8 \times [\text{small organic mass}] + 6.1 \times [\text{large organic mass}] \\ & + 10 \times [\text{elemental carbon}] \\ & + 1 \times [\text{fine soil}] \\ & + 1.7 \times f_{\text{ss}}(\text{RH}) \times [\text{sea salt}] \\ & + 0.6 \times [\text{coarse mass}] \\ & + \text{Rayleigh scattering (site-specific)} \\ & + 0.33 \times [\text{NO}_2 \text{ (ppb)}] \end{aligned}$$

Moosehorn Wildlife Refuge

Spotlight on the Region's Wild Places Moosehorn Wildlife Refuge

Purchased from the proceeds of Duck Stamp funds in the 1930s and designated by Congress as a national wilderness in 1970, Moosehorn Wildlife Refuge has a long and proud tradition in American conservation. It is the eastern most refuge in the Atlantic Flyway. As such it serves an important role in the protection of many types of wildlife including migrating waterfowl, wading birds, shorebirds, upland game birds, songbirds, and birds of prey.

Named for the Moosehorn Stream, Moosehorn is host to a wide variety of animals. Not the least of which is the moose – although they are less prevalent than the name might lead you to believe. Moosehorn is also the only refuge where the American woodcock is studied and managed. Reclusive by day this bird primarily ventures out for food and courtship during the evening.



VISITOR'S SERVICES / RECREATIONAL ACTIVITIES

Trails — Over 50 miles of dirt roads and trails are available for walking, biking, and skiing. These roads are a great way to observe wildlife. Three self-guided interpretive trails give insight into refuge wildlife and management.

Wildlife Observation – Two observation decks offer good vantage points for eagles, osprey, and other wildlife. Stop by the office to ask about other wildlife hotspots. Click here for [viewing tips](#).

Visitors are invited to accompany wildlife biologists on woodcock and waterfowl banding operations (call ahead to schedule).

Tours and Programs – Refuge staff offer free tours and programs at various times during the year, mostly during the summer. Annual events include the Children's Fishing Derby in June and National Wildlife Refuge Week in October. Please contact the refuge for current information.

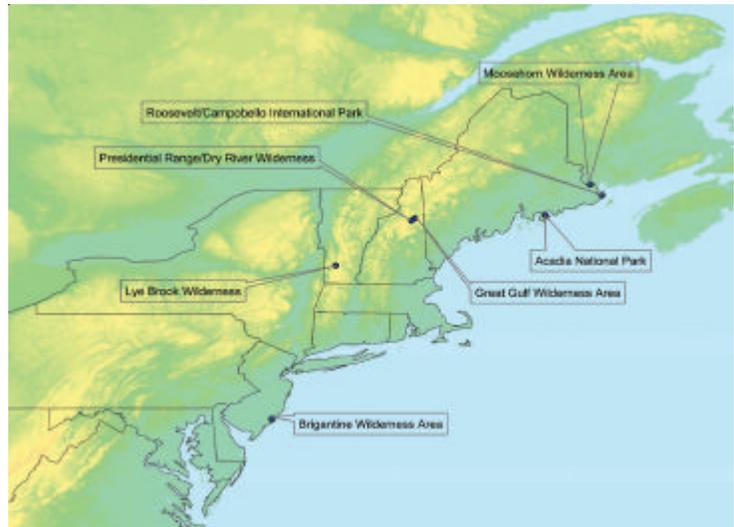
Fishing and Hunting – Several lakes and streams are open to fishing throughout the refuge. Contact the office for current locations and regulations.

ABOUT MANE-VU

The Mid-Atlantic/Northeast Visibility Union (MANE-VU) was formed by the Mid-Atlantic and Northeastern states, tribes, and federal agencies to coordinate regional haze planning activities for the region. MANE-VU was formed to encourage a coordinated approach to meeting the requirements of EPA's regional haze rules and reducing visibility impairment in major national parks and wilderness areas in the Northeast and Mid-Atlantic region.

MANE-VU provides technical assessments and assistance to its members, evaluates linkages to other regional air pollution issues, provides a forum for discussion, and encourages coordinated actions. MANE-VU also facilitates coordination with other regions.

MANE-VU's structure includes a board comprised of state and tribal Commissioners/Secretaries, air program directors and two committees comprised of agency personnel: a Technical Support committee to assess the nature of regional haze, the sources that contribute to regional haze and the technical tools that states will use to develop their programs and a Communications Committee to develop outreach messages and approaches.



Class I Areas in MANE-VU Region

MANE-VU MEMBERS

Connecticut	US Environmental
Delaware	Protection Agency
District of Columbia	National Park Service
Maine	US Fish and Wildlife
Maryland	Service
Massachusetts	US Forest Service
New Hampshire	
New Jersey	
New York	
Pennsylvania	
Penobscot Indian Nation	
Rhode Island	
Vermont	

Mid-Atlantic/Northeast Visibility Union

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