APPENDIX J

Tracking Visibility Progress 2004-2017

(1st RH SIP Metrics)

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MANE - VU
Mid-Atlantic/Northeast Visibility Union

Acknowledgments

This document is to be considered an update to the NESCAUM 2013 revision summary document: (http://www.nescaum.org/documents/manevu-trends-2004-2011-report-final-20130430.pdf/view). This document is also a companion technical document to go with the following report: *Mid-Atlantic/Northeast U.S. Visibility Data 2004-2017 (2nd RH SIP Metrics) – December 2018 Update* (MANE-VU 2018).

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Executive Summary

This document presents visibility trends at IMPROVE (Interagency Monitoring of Protected Visual Environments) monitoring sites at federal Class I areas in and adjacent to the Mid-Atlantic/Northeast Visibility Union (MANE-VU) region that are subject to US Environmental Protection Agency's (USEPA's) Regional Haze Rule (RHR). This document also presents visibility trends at IMPROVE Protocol monitoring sites in and adjacent to the MANE-VU region. The analyses were performed to determine the extent of progress in meeting short-term and long-term visibility goals for the first RHR State Implementation Plan (SIP) period that ends in 2018 using metrics specified in the state SIPs.

This technical document provides an analysis of visibility data collected at the IMPROVE monitoring sites, starting in the baseline period of 2000-2004 through 2013-2017, the most recent five-year period with available data.

The results of this analysis continue to show the following:

- There continues to be definite downward trends in overall haze levels at all Class I areas in and adjacent to the MANE-VU region and at IMPROVE Protocol monitoring sites.
- Based on rolling-five year averages demonstrating progress since the 2000-2004 baseline period, MANE-VU Class I areas are on track to meet 2018 Reasonable Progress Goals (RPG's) for both 20 percent best and 20 percent worst visibility days.
- The trends are mainly driven by large reductions in sulfate light extinction, and to a lesser extent, nitrate light extinction.
- Levels of organic carbon mass (OCM) and light absorbing carbon (LAC) appear to be approaching natural background levels at most MANE-VU Class I areas.
- In all cases, 2018 RPG's for all Class I areas in and adjacent to the MANE-VU region have already been met, and progress beyond these goals appears achievable.
- Percent contribution of nitrate light extinction has been significantly increasing at most of the MANE-VU Class I areas.

1. INTRODUCTION

1.1. Background

Haze, or reduced visibility, occurs when ambient particulate matter and gases scatter or absorb light ("light extinction") that would otherwise reach an observer. Particles responsible for regional haze are produced naturally, from windblown dust, forest fires, and aerosolized sea salt; and by human-caused pollution from vehicles, power plants, and other combustion and dust-generating activities. Haze-forming particles can also cause serious health effects in the lungs and cardiopulmonary system, potentially leading to premature death. In addition, some particle constituents contribute to acidic deposition and other environmental harms.

In 1999, the US Environmental Protection Agency (USEPA) issued a rule under Section 169A of the Clean Air Act (Visibility Protection for the Federal Class I Areas) to address human-caused regional haze: Regional Haze Rule (RHR) [64 FR 35614 (July 1, 1999)]. The RHR is designed to improve visibility at certain national parks and wilderness areas (Class I areas) on the 20 percent haziest ('worst') days while not exacerbating haze on the 20 percent clearest ('best') days. The RHR requires states to submit state implementation plans (SIPs) to USEPA every ten years, setting interim progress goals and strategies consistent with the long-term national visibility goal of achieving natural conditions at Class I areas by 2064. States submitted their first haze SIPs to USEPA beginning in 2008. States additionally are required to track their progress against their historic baseline period[1] in achieving reductions in regional haze, submitting reports every five years, and to adjust their emissions management strategies accordingly.

The Mid-Atlantic/Northeast Visibility Union (MANE-VU) was formed to support visibility planning efforts in the mid-Atlantic and northeastern portion of the country, and includes members listed in Table 1-1. Seven Class I areas in the MANE-VU region (black text) and four Class I areas adjacent to the MANE-VU region (blue text) are shown in Figure 1-1(a). This document also includes analyses for IMPROVE Protocol monitoring sites (see Figure 1-1(b)) with twenty monitors in the MANE-VU region (black text) and one adjacent to the MANE-VU region (blue text)). IMPROVE Protocol sites are in operation to provide expanded spatial coverage for the network. Protocol sites are separately sponsored by state, regional, tribal, and national organizations and use the same instrumentation, monitoring, and analysis protocols as IMPROVE. Table 1-2 contains more detailed information for all IMPROVE and IMPROVE Protocol monitoring sites. The purpose of this report is to support MANE-VU states in meeting the tracking progress requirement of the RHR.

[1] The title of this and earlier trends reports use 2004 as the base year because the trend is based on rolling averages of 5-year periods, and 2004 was the end of the initial 5-year period used as the baseline.

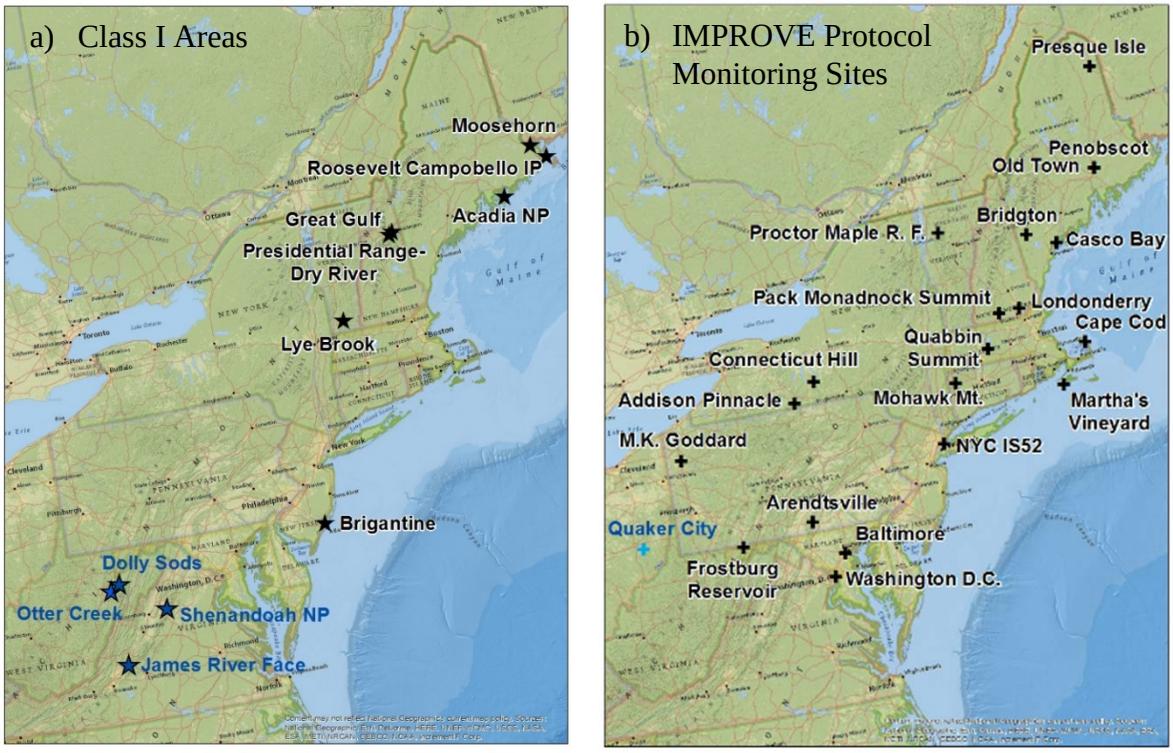
Table 1-1. Members of the Mid-Atlantic/Northeast Visibility Union (MANE-VU)

Connecticut	Pennsylvania
Delaware	Penobscot Indian Nation
District of Columbia	Rhode Island
Maine	St. Regis Mohawk Tribe
Maryland	Vermont
Massachusetts	National Park Service
New Hampshire	U.S. EPA
New Jersey	U.S. Fish and Wildlife Service
New York	U.S. Forest Service

Table 1-2. IMPROVE Monitoring Sites

Site Code	Class I Area or IMPROVE Protocol Site Name	State	Latitude	Longitude	Elevation (m AMSL)	Start Date	End Date
MANE-VU Class I Areas							
ACAD	Acadia National Park	ME	44.3771	-68.261	157	3/1988	Active
BRIG	Brigantine Wilderness	NJ	39.465	-74.4492	5	9/1991	Active
GRGU	Great Gulf Wilderness	NH	44.3082	-71.2177	453	6/1995	Active
LYBR	Lye Brook Wilderness	VT	43.1482	-73.1268	1015	9/1991	9/2012
LYEB	Lye Brook Wilderness	VT	42.9561	-72.9098	882	1/2012	Active
MOOS	Moosehorn Wilderness	ME	45.1259	-67.2661	77	12/1994	Active
Nearby Class I Areas							
DOSO	Dolly Sods Wilderness	WV	39.1053	-79.4261	1182	9/1991	Active
SHEN	Shenandoah National Park	VA	38.5229	-78.4348	1079	3/1988	Active
JARI	James River Face Wilderness	VA	37.6266	-79.5125	289	6/2000	Active
MANE-VU IMPROVE Protocol Sites							
ADPI	Addison Pinnacle	NY	42.0912	-77.2099	512	4/2001	6/2010
AREN	Arendtsville	PA	39.9232	-77.3079	267	4/2001	12/2010
BALT	Baltimore	MD	39.2547	-76.7093	78	7/2004	12/2006
BRMA	Bridgton	ME	44.1074	-70.7292	233	3/2001	12/2015
CABA	Casco Bay	ME	43.8325	-70.0644	26	3/2001	Active
CACO	Cape Cod	MA	41.9758	-70.0242	49	4/2001	Active
COHI	Connecticut Hill	NY	42.4009	-76.6534	519	4/2001	6/2006
FRRE	Frostburg Reservoir	MD	39.7058	-79.0122	767	4/2004	Active
LOND	Londonderry	NH	42.8624	-71.3801	124	1/2011	Active
MAVI	Martha's Vineyard	MA	41.3309	-70.7846	2	1/2003	Active
MKGO	M.K. Goddard	PA	41.4269	-80.1453	379	4/2001	12/2010
MOMO	Mohawk Mt.	CT	41.8214	-73.2973	521	9/2001	Active
NEYO	New York City - IS-52	NY	40.8161	-73.9019	45	8/2004	6/2010
OLTO	Old Town	ME	44.9334	-68.6457	51	7/2001	5/2006
PACK	Pack Monadnock Summit	NH	42.8619	-71.8786	695	10/2007	Active
PENO	Penobscot Nation	ME	44.948	-68.6479	45	1/2006	Active
PMRF	Proctor Maple R. F.	VT	44.5284	-72.8688	401	12/1993	Active
PRIS	Presque Isle	ME	46.6964	-68.0333	165	3/2001	Active
QURE	Quabbin Summit	MA	42.2985	-72.3346	317	3/2001	12/2015
WASH	Washington D.C.	DC	38.8762	-77.0344	15	3/1988	12/2014
Nearby IMPROVE Protocol Site							
QUCI	Quaker City	OH	39.9428	-81.3378	366	5/2001	Active

Figure 1-1. Class I Areas and IMPROVE Protocol Monitoring Sites In and Adjacent to the MANE-VU Region



While this report provides readers with a basic background on regional haze, it does not include in-depth discussions of topics covered in previous reports. For a broader understanding of these topics, readers can visit EPA's regional haze website: https://www.epa.gov/visibility, the IMPROVE technical documentation website: http://vista.cira.colostate.edu/improve/, the Publications section of the MANE-VU website: http://www.otcair.org/manevu/document.asp?Fview=Reports, the MARAMA regional haze website: http://www.marama.org/technical-center/regional-haze-planning and the NESCAUM regional haze documents archive, located at the following web address: http://www.nescaum.org/topics/regional-haze

In the NESCAUM documents archive, readers may find the following of particular interest in understanding regional haze in the MANE-VU region:

- Regional Haze and Visibility in the Northeast and Mid-Atlantic States (2001)
- 2002: A Year in Review (2004)
- Contributions to Regional Haze in the Northeast and Mid-Atlantic United States (2006)
- Public Health Benefits of Reducing Ground-level Ozone and Fine Particulate Matter in the Northeast U.S. (2008)
- MANE-VU Modeling for Reasonable Progress Goals (2008)
- 2018 Visibility Projections (2008)
- Tracking Visibility Progress, 2004-2008 (2010)
- Contribution of Non-Sulfate Aerosols to MANE-VU Regional Haze (2012)
- The Nature of the Fine Particle and Regional Haze Air Quality Problems in the MANE-VU Region: A Conceptual Description (Updated July 31, 2012)
- Tracking Visibility Progress 2004-2011 (Updated (May 24, 2013)

2. PROCESS FOR TRACKING PROGRESS

2.1. Long Term Goals and Natural Visibility

Even in the absence of emissions from human activities, some level of light extinction occurs from natural causes. This "natural haze" represents the best expectation for long-term progress at Class I areas, and is the goal for these areas by 2064.

USEPA (2003a) has guidance for calculating natural haze levels based on measurements of particulate constituents at Class I areas during a baseline period. States combine measurements of several parameters to calculate a "Haze Index" in deciview (dv) units based on estimates of light extinction. A fuller explanation of tracking progress procedures is presented in a 2003 USEPA guidance document for tracking progress (USEPA 2003b; hereafter, "the Guidance"), though readers should note that the calculation for estimating total light extinction has since been updated. Details on the revised IMPROVE algorithm used to estimate light extinction are presented elsewhere (e.g., NESCAUM 2010).

Natural haze levels are calculated for both the 20 percent best days and the 20 percent worst days, because changing natural processes lead to variability in natural visibility. Natural visibility levels on the 20 percent best and 20 percent worst days for the MANE-VU and adjacent Class I areas are presented in Table 2-1. Table 2-2 shows natural visibility levels for IMPROVE Protocol sites. Achievement of these goals through constant annual incremental improvement in the Haze Index (in dv) such that natural conditions will be reach by 2064 is termed a "uniform rate of progress" (also referred to as the glidepath). Natural background haze levels are not available for some Class I areas without monitoring data, i.e., Presidential Range/Dry River Wilderness Area, Roosevelt Campobello International Park and Otter Creek Wilderness Area.

Table 2-1. Natural Visibility Conditions for Class I Areas In and Adjacent to the MANE-VU Region

Class I Area	State Abbr.	Best Days (dv)	Worst Days (dv)
Acadia National Park	ME	4.66	12.43
Moosehorn Wilderness	ME	5.02	12.01
Roosevelt Campobello International Park	ME	*	*
Great Gulf Wilderness	NH	3.73	11.99
Presidential Range/Dry River Wilderness	NH	*	*
Lye Brook Wilderness	VT	2.79	11.73
Brigantine Wilderness	NJ	5.52	12.25
James River Face†	VA	4.39	11.13
Dolly Sods Wilderness†	WV	3.64	10.39
Otter Creek Wilderness†	WV	*	*
Shenandoah National Park†	VA	3.15	11.35

† Class I area adjacent to the MANE-VU region.
** Natural haze values for the Presidential Range/Dry River Wilderness Area, Roosevelt Campobello International Park and Otter Creek Wilderness are represented by the IMPROVE monitors for Great Gulf, Moosehorn and Dolly Sods, respectively.*
Source: IMPROVE Natural Haze Levels II version 2 revised 4/2018.

Table 2-2. Natural Visibility Conditions for IMPROVE Protocol Sites in and Adjacent to the MANE-VU Region

Class I Area	State Abbr.	Best Days (dv)	Worst Days (dv)
Addison Pinnacle (ADPI)	NY	4.12	11.57
Arendtsville (AREN)	PA	4.24	11.77
Baltimore (BALT)	MD	*	*
Bridgton (BRMA)	ME	4.65	12.07
Casco Bay (CABA)	ME	4.83	12.83
Cape Cod (CACO)	MA	5.95	13.20
Connecticut Hill (COHI)	NY	4.30	11.50
Frostburg Reservoir (FRRE)	MD	*	*
Londonderry (LOND)	NH	*	*
Martha's Vineyard (MAVI)	MA	*	*
M. K. Goddard (MKGO)	PA	4.52	11.36
Mohawk Mt. (MOMO)	CT	3.67	12.42
New York IS52 (NEYO)	NY	*	*
Old Town (OLTO)	ME	*	*
Penobscot Nation (PENO)	ME	*	*
Pack Monadnock Summit (PACK)	NH	*	*
Proctor Maple R. F. (PMRF)	VT	3.86	11.84
Presque Isle (PRIS)	ME	4.91	12.42
Quabbin Reservoir (QURE)	MA	3.92	12.05
Washington D.C. (WASH)	DC	5.52	11.86
Quaker City (QUCI)†	OH	4.96	10.97

Note: The IMPROVE Protocol sites are arranged with the areas located in the MANE-VU region presented first, followed by those adjacent to MANE-VU.
** Natural haze values are not calculated for areas with less than 3-years of baseline (2000-04) monitoring data.*
† IMPROVE Protocol site adjacent to the MANE-VU region.
Source: IMPROVE Natural Haze Levels II version 2 revised 4/2018.

2.2. Reasonable Progress Goals

The RHR requires states to evaluate current regional haze conditions at Class I areas subject to the rule relative to conditions during a historic baseline period. The baseline period is the five-year period from 2000 through 2004. State haze SIPs established reasonable progress goals (RPGs) for reduction of regional haze through 2018. Comparison between the five-year average Haze Index in 2018 (average of the 2014-2018 annual Haze Index values) and the baseline Haze Index will determine if a state has met its 2018 RPG.

Class I States, in consultation with other states and federal land managers, set RPGs for the 20 percent worst days and for the 20 percent best days. The RPGs are designed to at least ensure no degradation for 20 percent best days visibility and achievement of reasonable progress toward natural conditions for 20 percent worst days visibility. In most cases, states

In the MANE-VU region have adopted RPGs that achieve lower Haze Index values by 2018 than would be achieved using either the "no degradation" and "uniform rate of progress" rates for 20 percent best days and 20 percent worst days, respectively. Table 2-3 presents the 20 percent best days and 20 percent worst days RPGs adopted by states for each Class I area in or adjacent to the MANE-VU region per state haze SIPs.

Table 2-3. 2018 Goals for Class I Areas in or Adjacent to the MANE-VU Region

Class I Area	IMPROVE SITE DATA CODE(S)	State Abbr.	BEST DAYS		WORST DAYS	
			No Degradation (dv)	Reasonable Progress Goal (dv)	Uniform Rate of Progress (dv)	Reasonable Progress Goal (dv)
Acadia National Park	ACAD	ME	8.78	8.30	20.45	19.40
Moosehorn Wilderness Area	MOOS	ME	9.16	8.60	19.46	19.00
Roosevelt Campobello International Park	MOOS	ME	9.16	8.60	19.46	19.00
Great Gulf Wilderness Area	GRGU	NH	7.66	7.20	20.29	19.10
Presidential Range/Dry River Wilderness Area	GRGU	NH	7.66	7.20	20.29	19.10
Lye Brook Wilderness Area	LYBR 2000-11 LYEB 2012-17	VT	6.37	5.50	21.48	20.90
Brigantine Wilderness Area	BRIG	NJ	14.33	14.30	25.10	25.10
Dolly Sods Wilderness Area†	DOSO	WV	12.28	11.10	24.69	21.70
Otter Creek Wilderness Area†	DOSO	WV	12.28	11.10	24.69	21.70
James River Face Area†	JARI	VA	14.21	12.40	24.92	22.40
Shenandoah National Park†	SHEN	VA	10.93	8.70	25.12	21.90

Note: The Class I areas are arranged with the areas located in the MANE-VU region presented first, followed by those adjacent to MANE-VU.
† Class I area adjacent to the MANE-VU region.
Sources: Maine: 76 FR 73956-73982; New Hampshire: 77 FR 11809-11826; New Jersey: 76 FR 49711-49724; Vermont: 77 FR 11914-11928; Virginia: 77 FR 3691-3711; West Virginia: 76 FR 41158-41177.

2.3. Measurement and Data Support

The Haze Index is calculated using light extinction estimates based on measured concentrations of particulate matter (PM) species. Measurements are taken at a network of monitoring sites in the IMPROVE program at or near Class I areas. IMPROVE is the result of coordination between the National Park Service, the Fish and Wildlife Service, the Bureau of Land Management, the Forest Service, and USEPA. IMPROVE has operated many sites within the MANE-VU region (see Figure 1-1(a) and Figure 1-1(b)).

IMPROVE monitoring data and analyses are available on the Federal Land Manager Environmental Database (FED) website (http://views.cira.colostate.edu/fed/DataWizard/). FED is hosted at the Colorado State University's Cooperative Institute for Research in the Atmosphere (CIRA). Data are also available on the IMPROVE website (http://vista.cira.colostate.edu/Improve/rhr-summary-data/). For all analyses in this report, the latest available (11/3/2018) data was downloaded from the FED website for natural (IMPROVE Natural Haze Levels II version 2) haze levels, daily calculated light extinction and deciview values (using the revised (new) IMPROVE algorithm including patched data) for 2000 through 2017.

3. RESULTS

Haze Index and individual constituent light extinction annual results were analyzed for each IMPROVE monitoring site in and adjacent to the MANE-VU region for years between 2000 and 2017. The following sections describe the results of this analysis. Section 3.1 provides results for the total Haze Index for each site and discusses trends and progress toward short-term goals. Section 3.2 provides individual constituent analysis and trends for each site over the time period in the context of regional emissions reduction efforts and continued regional and federal policy directions. Finally, Section 3.3 summarizes conclusions based on these results. Results indicate consistent improvement in regional haze on the 20 percent best and 20 percent worst visibility days across the region.

3.1. Haze Index Trends

Figure 3-1 through Figure 3-8 present annual Haze Index on the 20 percent best and 20 percent worst days at MANE-VU and adjacent Class I areas between 2000 and 2017 in the context of short and long-term visibility goals. Tables A-1 through Table A-5 in Appendix A presents these data numerically. Table A-6 through Table A-16 in Appendix A presents Haze Index trends numerically for all IMPROVE Protocol sites in and adjacent to the MANE-VU Region.

These figures show that haze levels on the 20 percent best days and 20 percent worst days from 2000 through 2017 have dropped across the entire region. Trends evident in the last report (NESCAUM 2013) for annual average haze levels on 20 percent best days and 20 percent worst days through 2011 have continued through 2017. In 2016 and 2017, most of the areas experienced significantly lower levels of haze on both 20 percent best days and 20 percent worst days as compared to any other years.

The grey region in the figures denotes the range of 20 percent best days to 20 percent worst days haze levels expected to occur under natural conditions. Thus, the uniform rate of progress line intersects with the highest portion of the grey area in 2064 for most sites. For the Brigantine, Dolly Sods and James River Face Wilderness Areas, whose haze levels on the 20 percent best days during the 2000 to 2004 baseline period were higher than estimated natural conditions on the 20 percent worst days, the no degradation line (representing the long-term 20 percent best days goal) is higher than the uniform rate of progress line (representing the long-term 20 percent worst days goal) at dates approaching 2064. This nonsensical situation by 2064 is an artifact of technical guidance and only represents stated haze level goals, not anticipated results.

Comparison of the five-year annual average haze index to the glidepaths for the 2018 SIP commitments show that all areas in and adjacent to the MANE-VU region are well on the way to meeting those commitments. In fact, the 2018 RPGs will be met if five year average levels for 20 percent best days and 20 percent worst days are maintained at all MANE-VU and nearby Class I Areas.

Figure 3-1. Annual Haze Index Levels at Acadia National Park

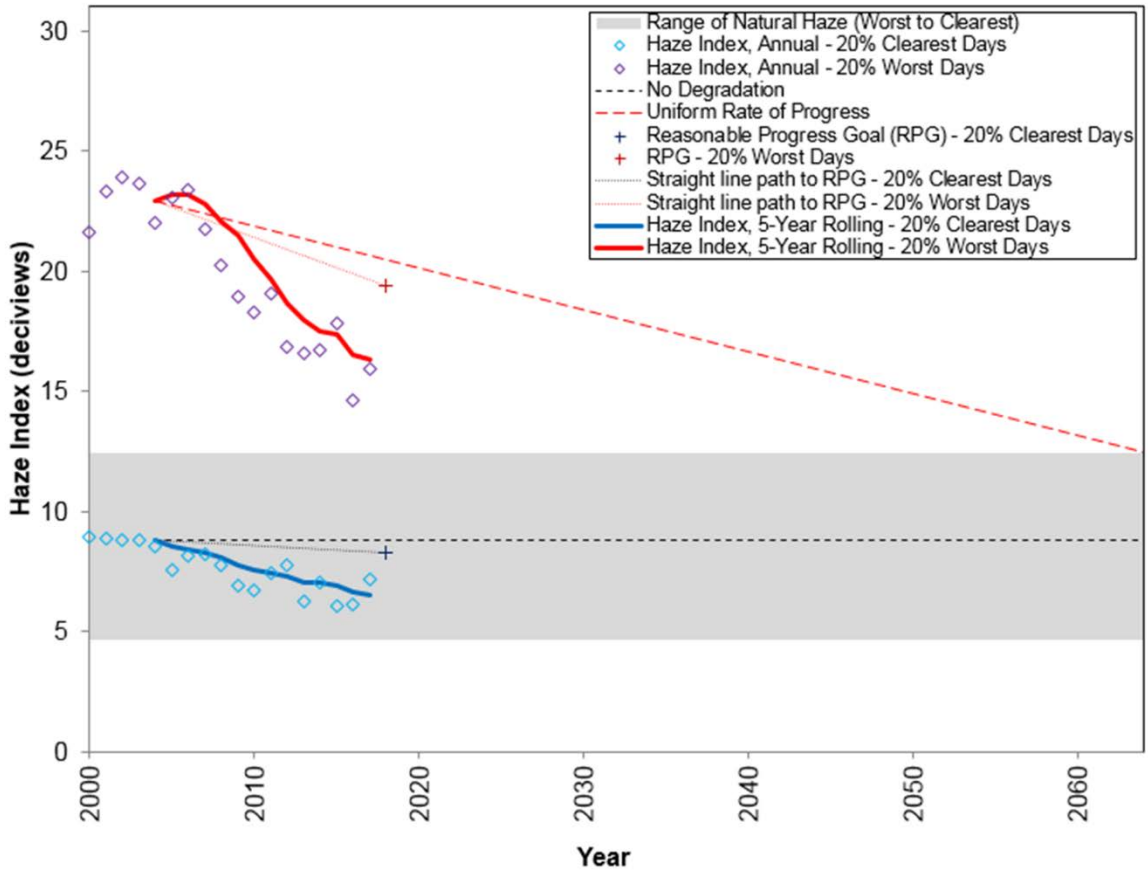


Figure 3-2. Annual Haze Index Levels at Moosehorn Wilderness Area

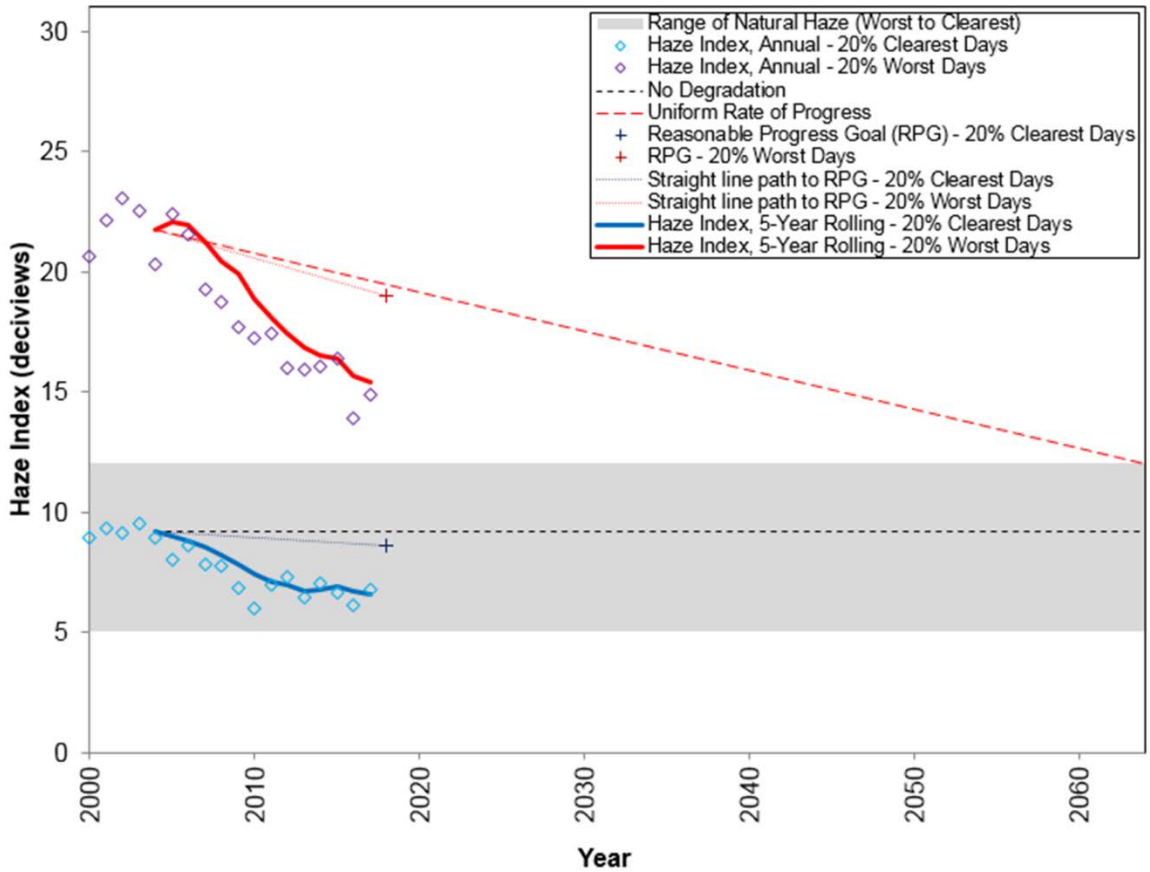


Figure 3-3. Annual Haze Index Levels at Great Gulf Wilderness Area

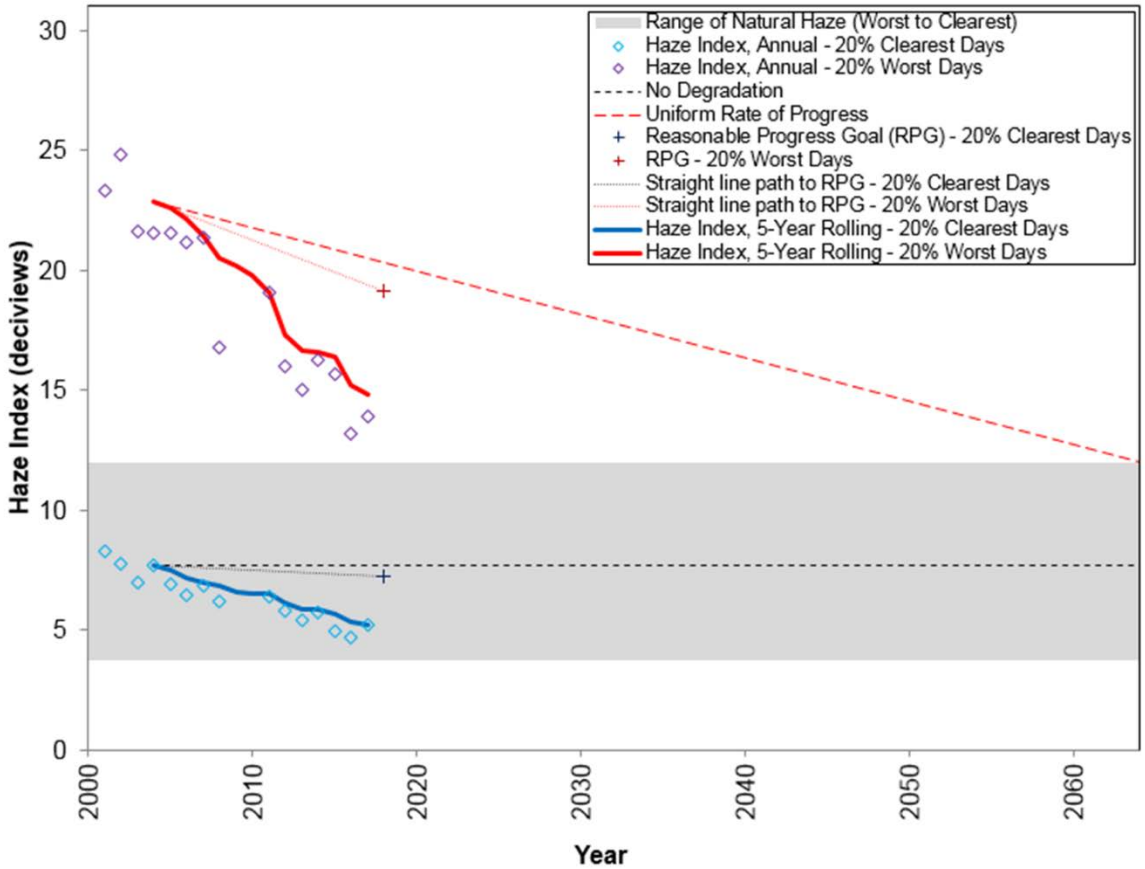


Figure 3-4. Annual Haze Index Levels at Lye Brook Wilderness Area

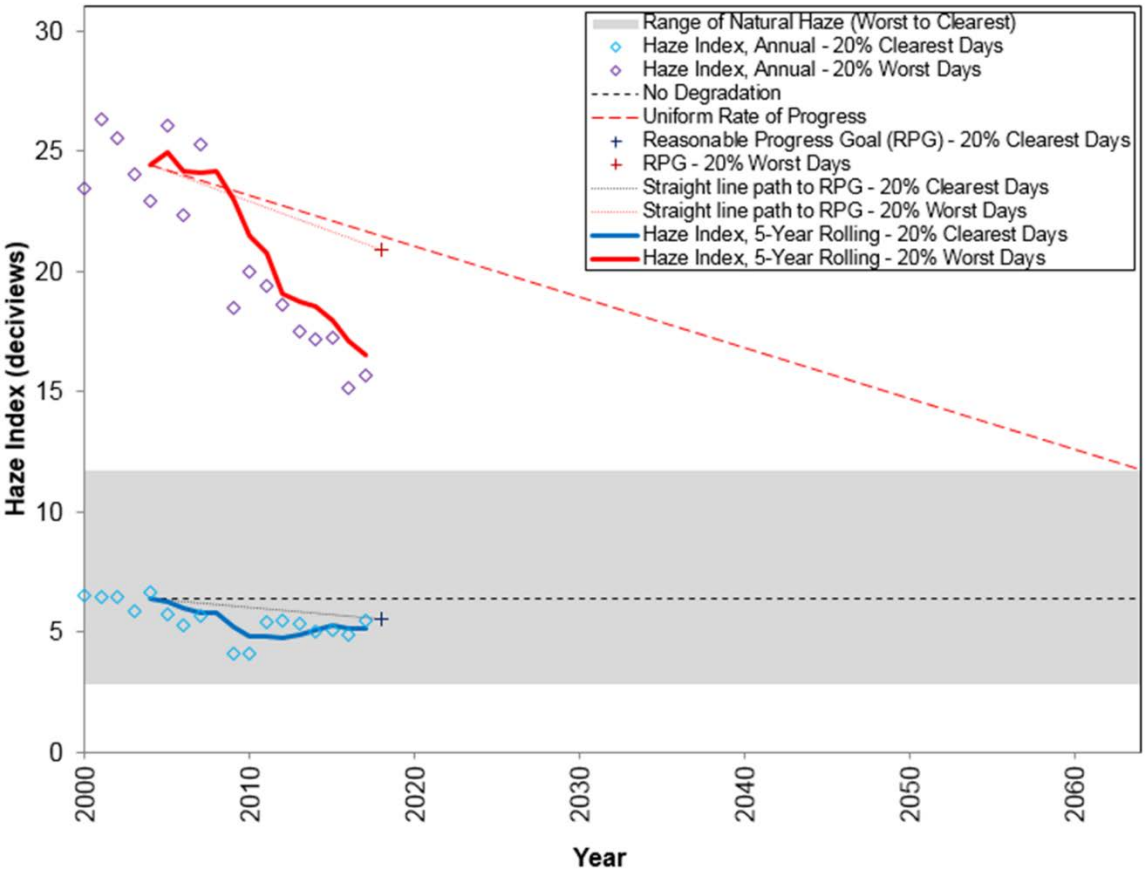


Figure 3-5. Annual Haze Index Levels at Brigantine Wilderness Area

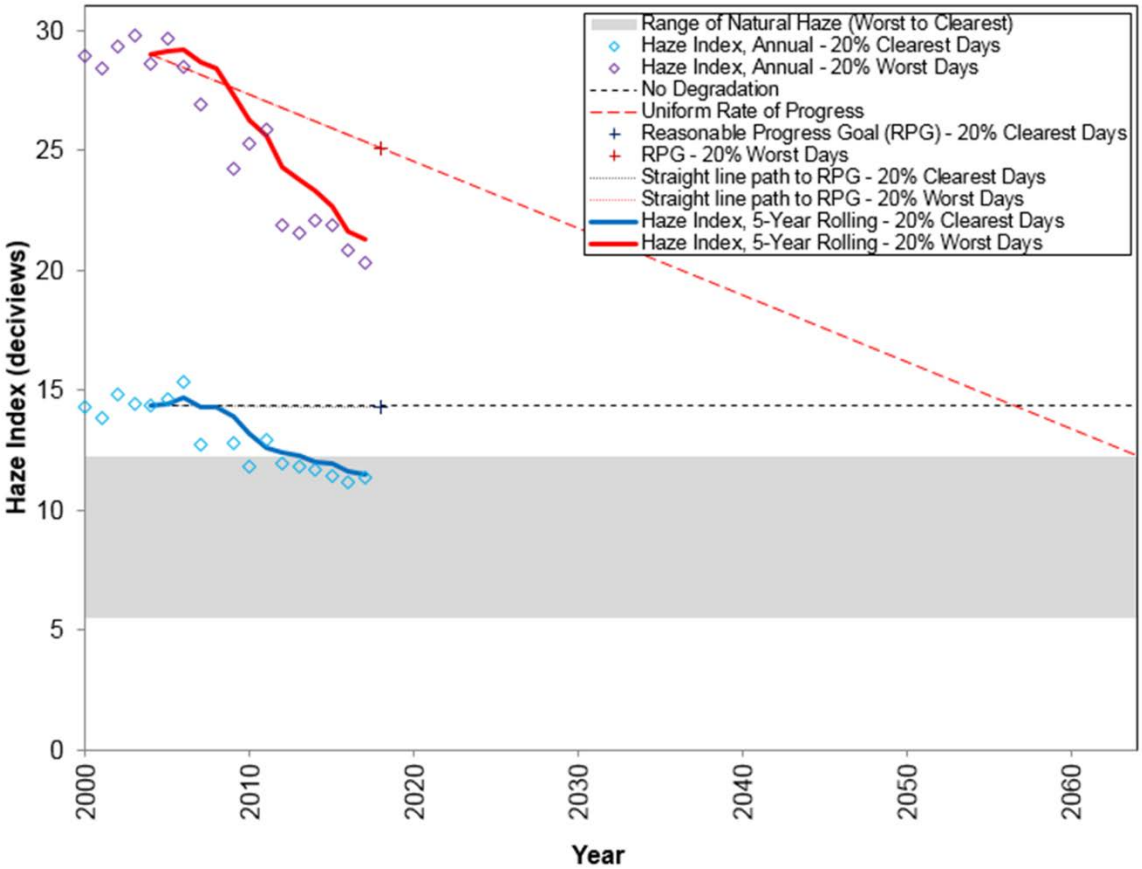


Figure 3-6. Annual Haze Index Levels at Dolly Sods Wilderness Area

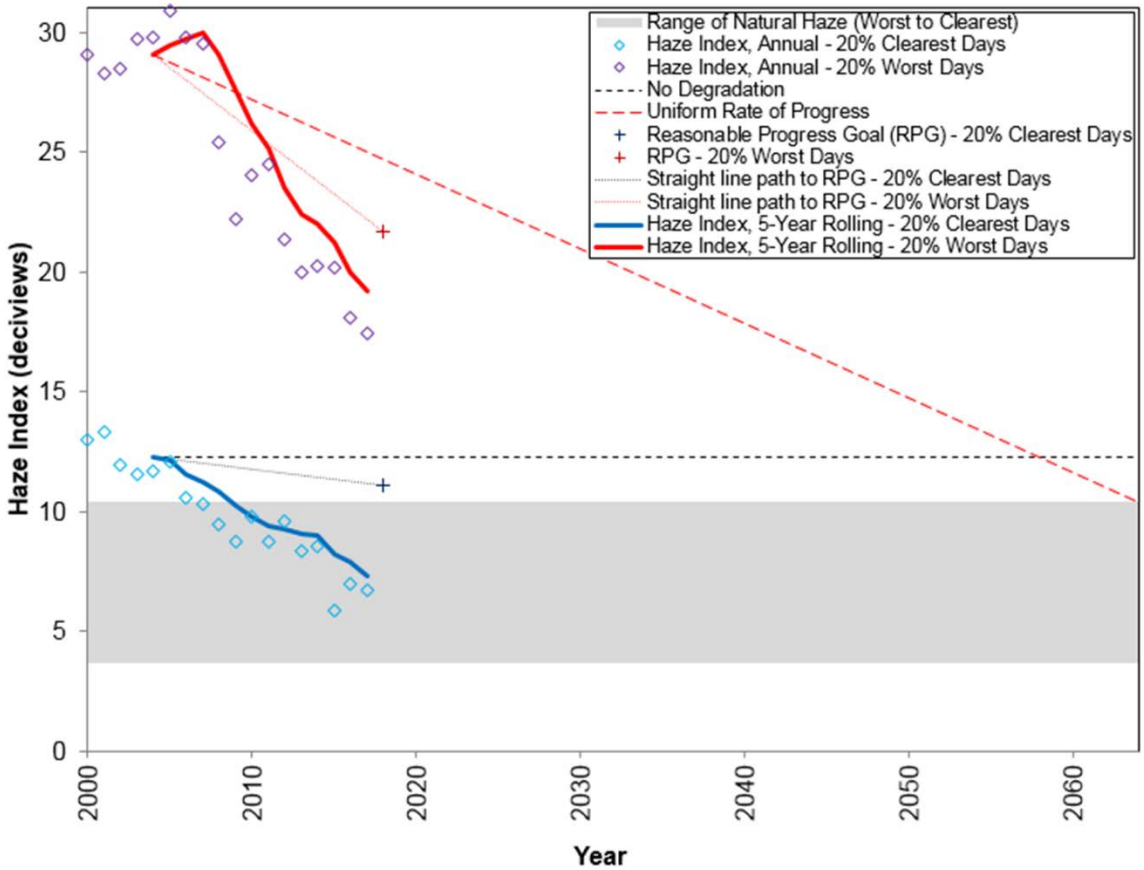


Figure 3-7. Annual Haze Index Levels at Shenandoah National Park

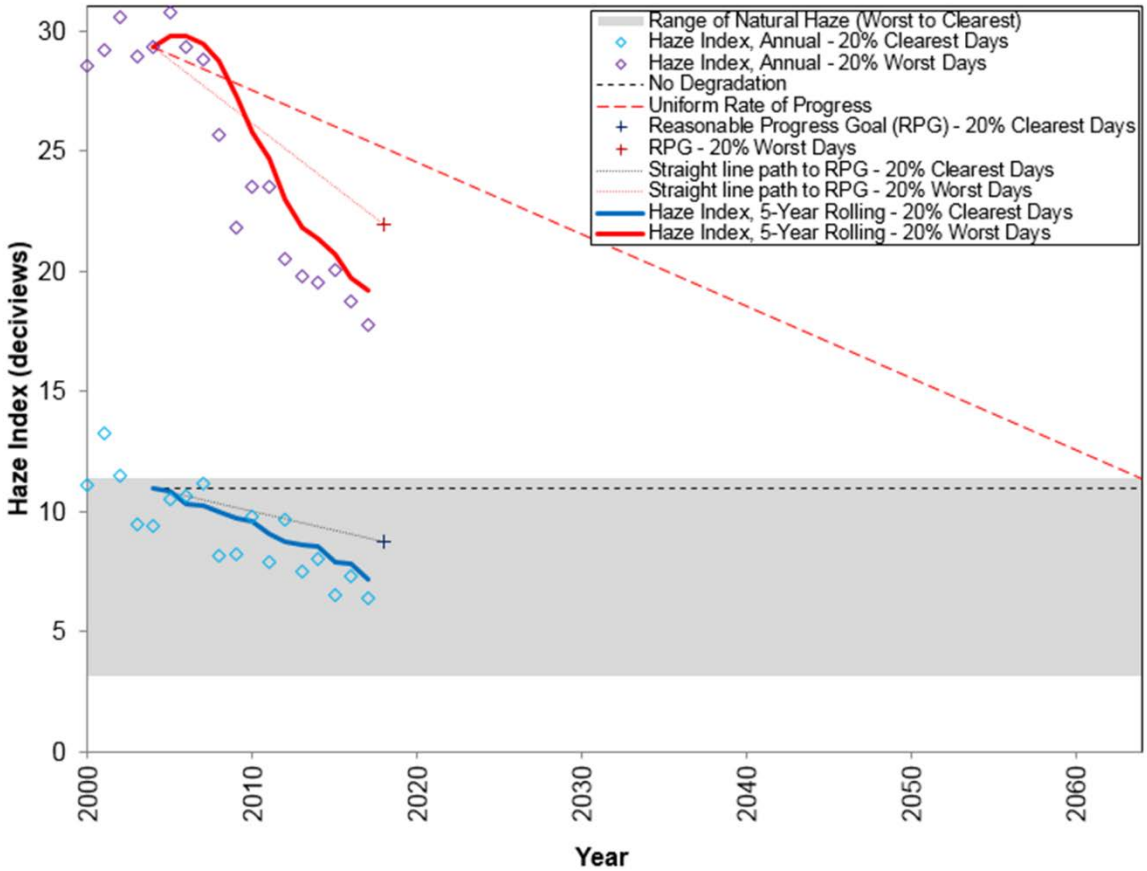
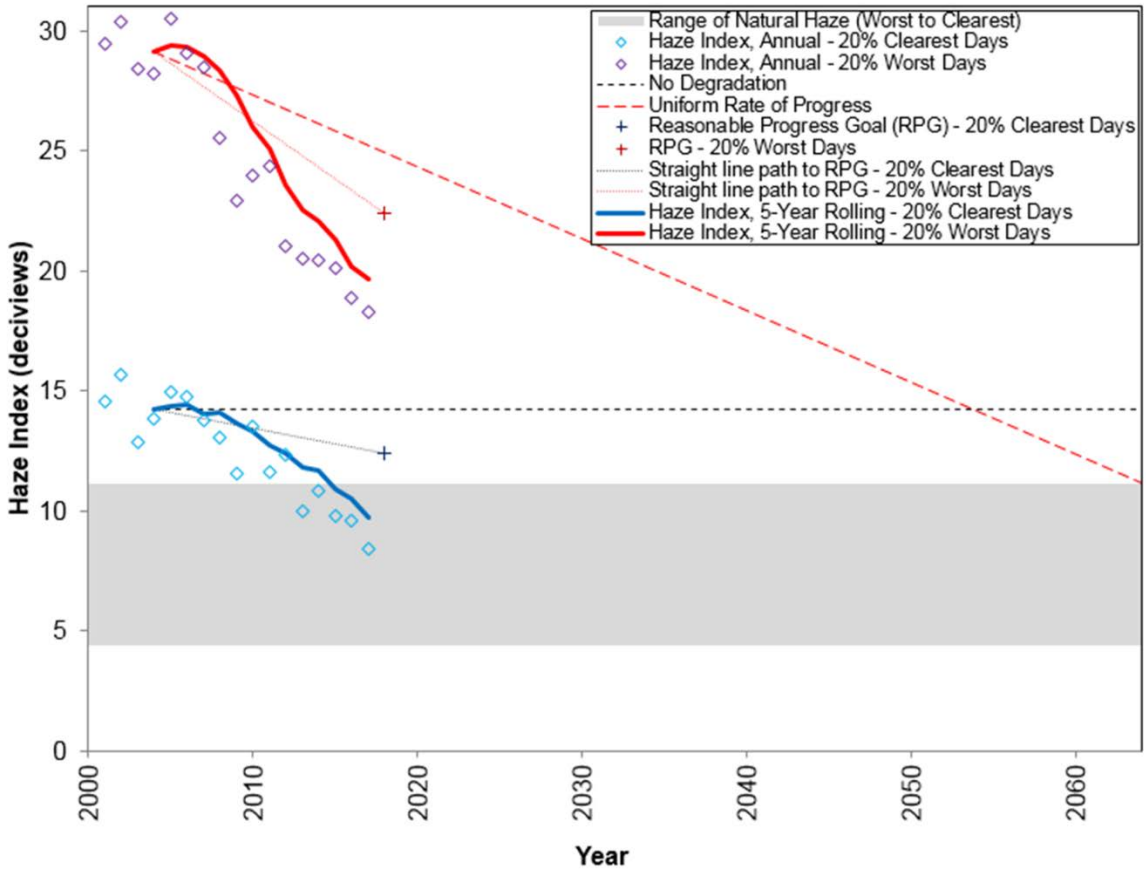


Figure 3-8. Annual Haze Index Levels at James River Face Wilderness



3.2. Constituent Light Extinction Trends

In addition to analyzing trends in overall visibility changes at the IMPROVE sites, changes of individual PM constituent contributions to visibility impairment were analyzed. Figure 3-9 through Figure 3-16 present the annual Haze Index by constituent on the 20 percent best and 20 percent worst days at MANE-VU and adjacent Class I areas between 2000 and 2017 in the context of RPGs. The figures are arranged with the areas located in the MANE-VU region presented first, followed by those adjacent to MANE-VU. Table B-1 and Table B-2 in Appendix B present constituent contributions numerically for natural conditions. Table C-1 through Table C-28 in Appendix C present constituent contributions numerically for all Class I and IMPROVE Protocol sites in and adjacent to the MANE-VU region. Note that data for individual constituents in Appendix B and Appendix C are light extinction (units = inverse megameters (Mm^{-1})) and data plotted in Figure 3-9 through Figure 3-16 are the relative contributions (haze index$*$(constituent light extinction/total light extinction) [units = deciview (dv)]).

These figures show individual constituent relative contributions as stacked bar charts for sulfate, nitrate, organic carbon mass (OCM), light absorbing carbon (LAC), soil, coarse mass, sea salt, and Rayleigh extinction levels on 20 percent best days ("a" plot) and 20 percent worst days ("b" plot). The total of the stacked bars represents annual Haze Index values, and are marked by circles connected by a thin black line. The thick black line represents five-year back annual averages from 2004 to 2017. The 2018 RPG from the state haze SIP is marked with a black plus sign. Two red lines descend from the 2004 five-year back average (i.e., the baseline value): the red dotted line represents the glidepath to the 2018 RPG; and the red dashed line represents the glidepath to the 2064 natural visibility goal, or the "uniform rate of progress" line.

These figures confirm that large reductions in overall Haze Index values on the 20 percent worst days are primarily due to decreases in sulfate visibility impacts at MANE-VU Class I areas. Significant decreases in sulfate contributions started in 2007 at Maine's Class I areas and in 2008 at all other Class I areas analyzed. As the sulfate contributions declined, relative nitrate contributions have started to increase at many sites especially at the Brigantine Wilderness Area. This increase is primarily due to having more winter days in the 20 percent worst mix of days (MANE-VU 2016) during recent years. During the winter, relative nitrate contributions are much higher than during the summer. [Seasonality of nitrogen oxides (NO_x) emissions are shown in the Figure 3-17 monitoring data trends plot for sites located in or close to large cities (Boston, Philadelphia and Baltimore)]. Steady decreases in sulfate and nitrate contributions have reduced overall haze levels on the 20 percent best days. These decreases on the 20 percent best days started to occur after 2004 at most of the studied areas.

At the Brigantine Wilderness Area, the contribution from coarse mass in 2011 was unusually high, indicating a possible anomaly for that year (Pietarinen 2013). This increase in coarse mass contribution offset reductions in both nitrate and sulfate levels from the preceding years. Contribution from OCM appears to be highly variable from year to year at most sites due to natural OCM from forest fires and variations in the cost of residential heating fuels. For instance, high OCM extinction levels at Brigantine and Lye Brook Wilderness Areas in 2002, at Great Gulf Wilderness Area in 2011 and at many sites in 2015 on the 20 percent worst days, undercut declines in contributions from sulfate to raise overall haze levels for those years.

Sulfate remains the most significant contributor to light extinction at all Class I areas on the 20 percent worst days in and adjacent to the MANE-VU region, followed by nitrate and OCM. For the most part, light extinction from soil and sea salt, which help indicate the extent to which natural haze processes contribute to overall haze levels, are insignificant when compared to extinction from sulfate and nitrate. Based on these figures, continued progress in sulfate and nitrate levels appears to be driving the trend in overall improvement in 20 percent worst days and 20 percent best days haze level reductions.

Current and baseline 5-year average light extinction levels for the 20 percent best (see Figure 3-18(a)) and 20 percent worst (see Figure 3-18(b)) visibility days for all Class I IMPROVE sites are shown side by side. This is just another way to show reductions in the region and shows that reductions were primarily due to sulfate reductions with nitrate and OCM reductions more evident during the 20 percent best days. As was mentioned before, because more winter days are in the current 20 percent worst days mix, the relative contribution of nitrates increased from the baseline especially at the Brigantine Wilderness Class I area.

To examine the individual constituent trends more closely, the range of individual light extinction on 20 percent best days and 20 percent worst days from 2000 through 2017 at the Class I areas were plotted against the estimated light extinction under natural conditions. Figure 3-19 through Figure 3-26 show the range of light extinction levels at the MANE-VU Class I areas as compared to natural light extinction for selected constituents. IMPROVE Protocol sites are excluded from this analysis for simplicity and light extinction from soil and sea salt are excluded from this analysis as those contributions are small and are primarily natural. (note: numerical data for all constituents and sites are in Appendix B and Appendix C). Estimated natural light extinction is represented in each chart by a purple line for 20 percent worst days and by a red line for 20 percent best days. For the carbonaceous species, OCM and LAC, the green band is observed OCM and the dark grey band is observed LAC. Note that the observations do not represent the range of the highest and lowest 20 percent light extinction levels for those constituents; rather, they represent the range of constituent light extinction levels on the 20 percent best and 20 percent worst visibility days.

It is clear from these charts that levels of extinction from sulfate have dropped significantly since the baseline period at all Class I areas, although still remaining at levels higher than the estimated natural range at all sites. Extinction due to nitrate is closer to natural levels than sulfates and is approaching natural levels on the 20 percent best days however the range of nitrate extinction has expanded in recent years with the highest levels at southern Class I areas greater than the baseline period. As mentioned earlier, this is primarily due to more winter days in the mix. At the Brigantine Wilderness Area, extinction due to nitrate remains considerably higher than the natural baseline. At most Class I areas, levels of extinction due to carbonaceous constituents and coarse mass appear to be near or slightly above natural range levels. Prior peaks in carbonaceous matter extinction at most sites were driven by OCM levels. At the Brigantine Wilderness Area, carbonaceous matter has been holding steadily above natural levels with little observable trend downward, and coarse mass light extinction levels also remain above natural levels, though the 2011 peak in coarse mass light extinction may be a result of construction activity near the monitor location (Pietarinen 2013).

Figure 3-9. Individual Constituent Contribution to Annual Haze Index Levels at Acadia National Park on 20 Percent Best and Worst Visibility Days

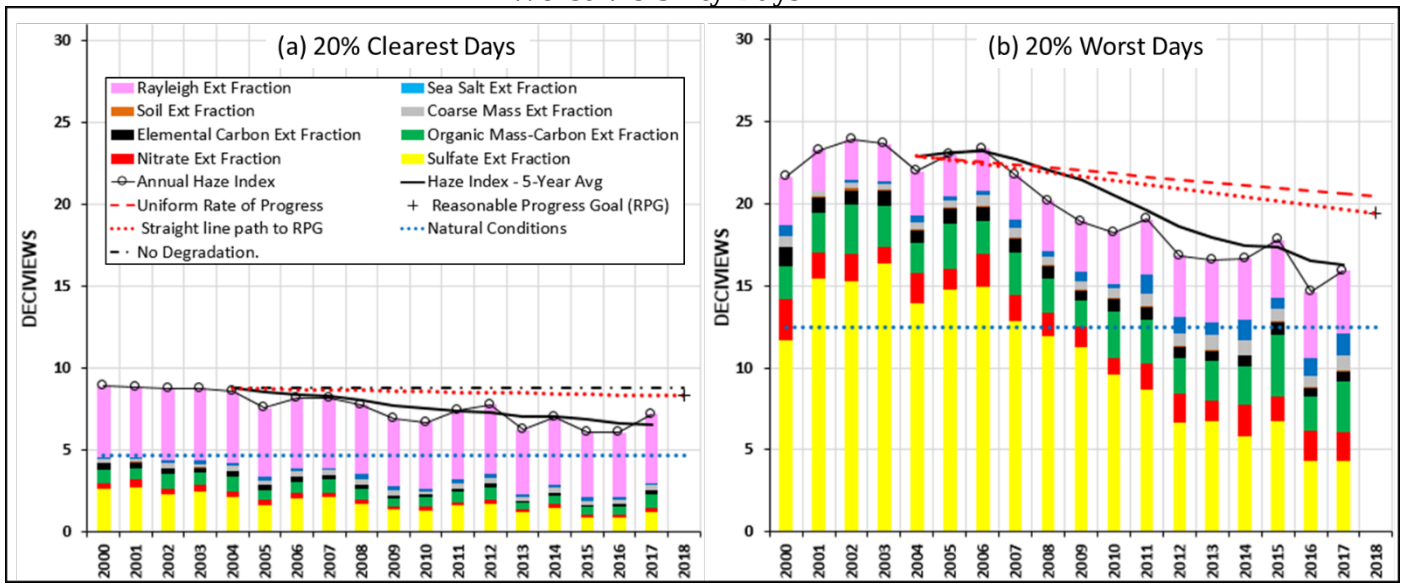


Figure 3-10. Individual Constituent Contribution to Annual Haze Index Levels at Moosehorn Wilderness Area on 20 Percent Best and Worst Visibility Days

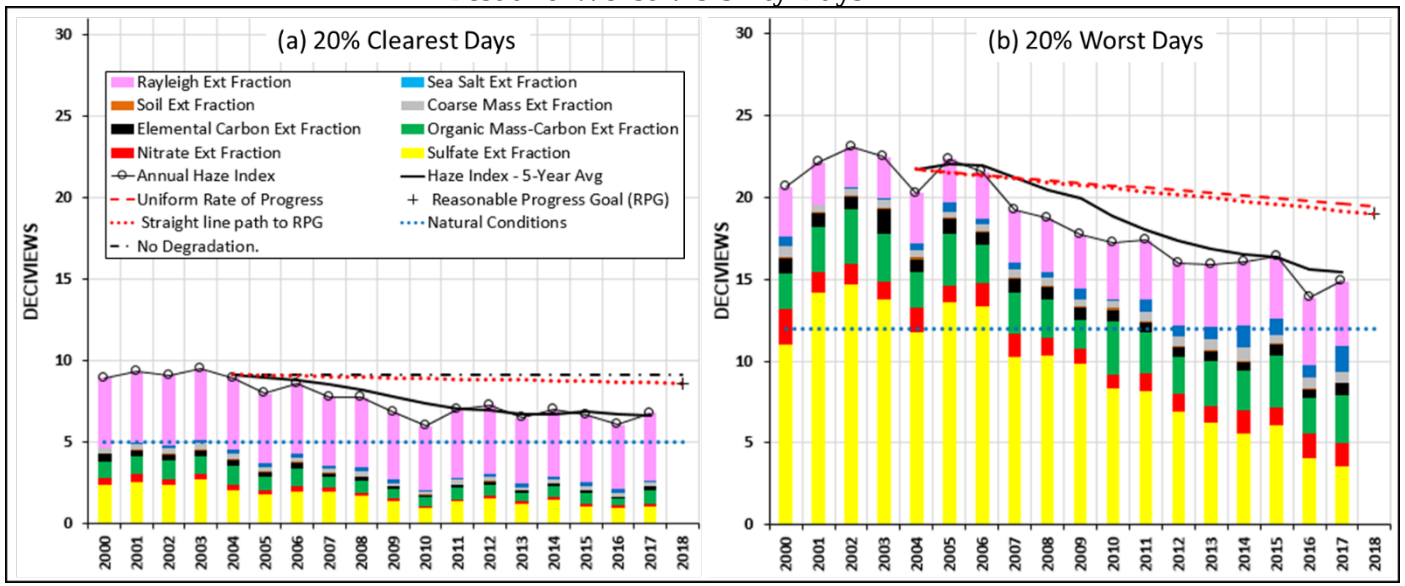


Figure 3-11. Individual Constituent Contribution to Annual Haze Index Levels at Great Gulf Wilderness Area on 20 Percent Best and Worst Visibility Days

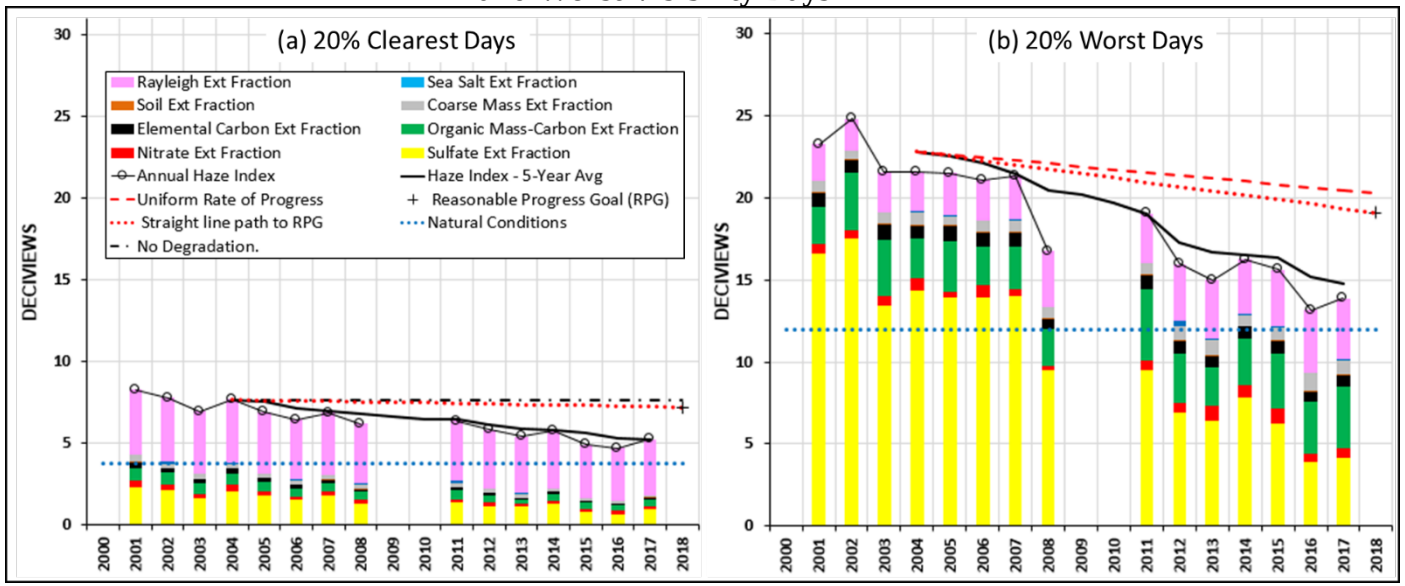


Figure 3-12. Individual Constituent Contribution to Annual Haze Index Levels at Lye Brook Wilderness Area on 20 Percent Best and Worst Visibility Days

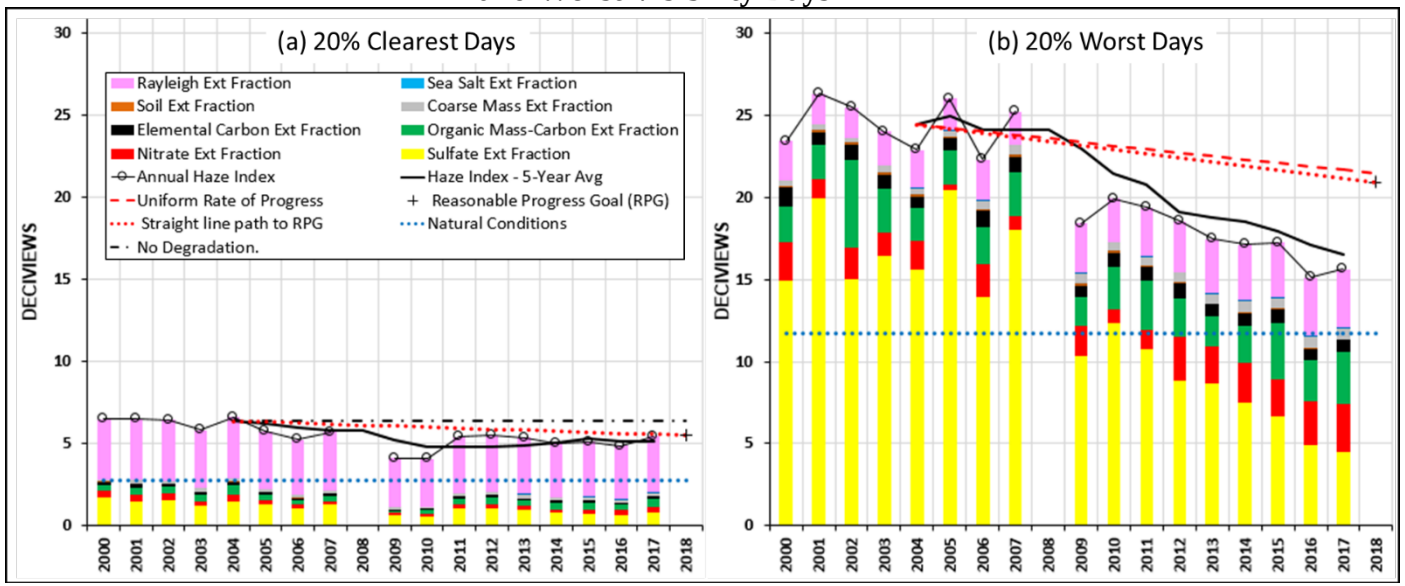


Figure 3-13. Individual Constituent Contribution to Annual Haze Index Levels at Brigantine Wilderness Area on 20 Percent Best and Worst Visibility Days

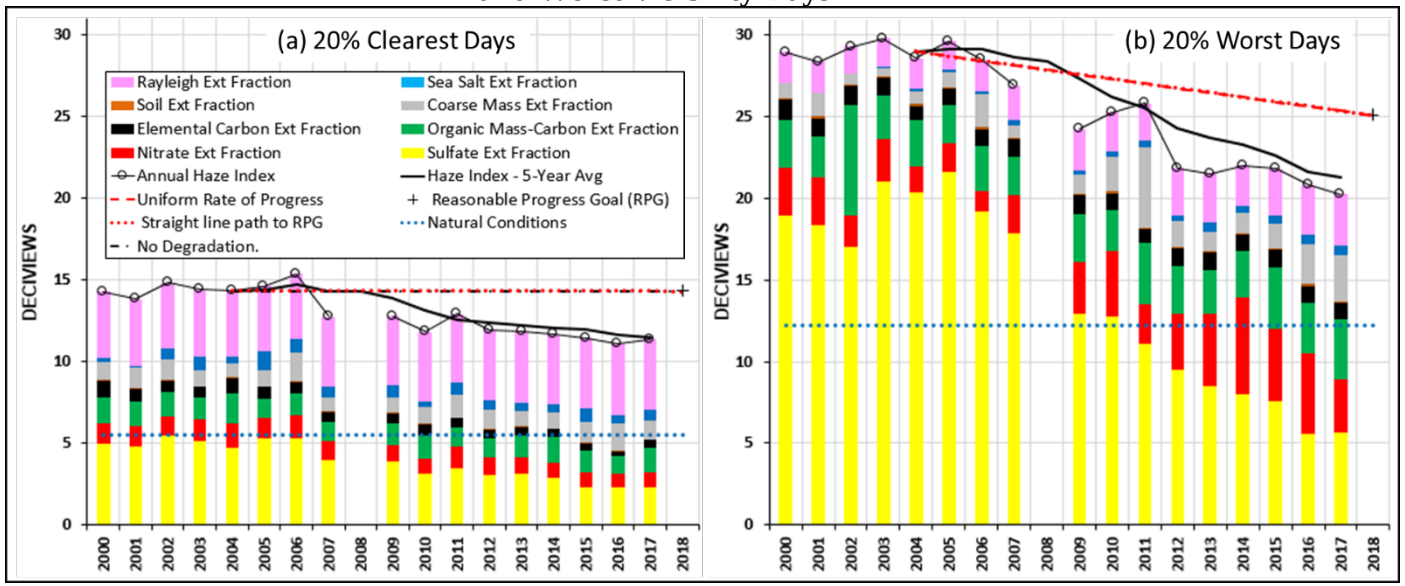


Figure 3-14. Individual Constituent Contribution to Annual Haze Index Levels at Dolly Sods Wilderness Area on 20 Percent Best and Worst Visibility Days

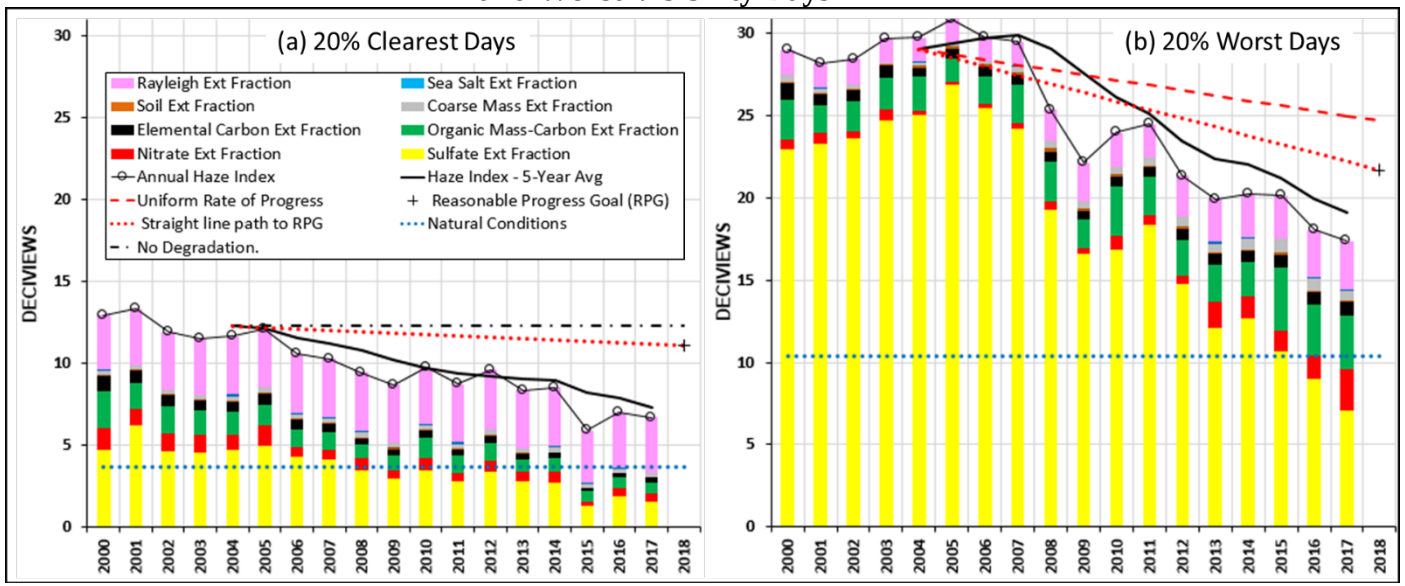


Figure 3-15. Individual Constituent Contribution to Annual Haze Index Levels at Shenandoah National Park on 20 Percent Best and Worst Visibility Days

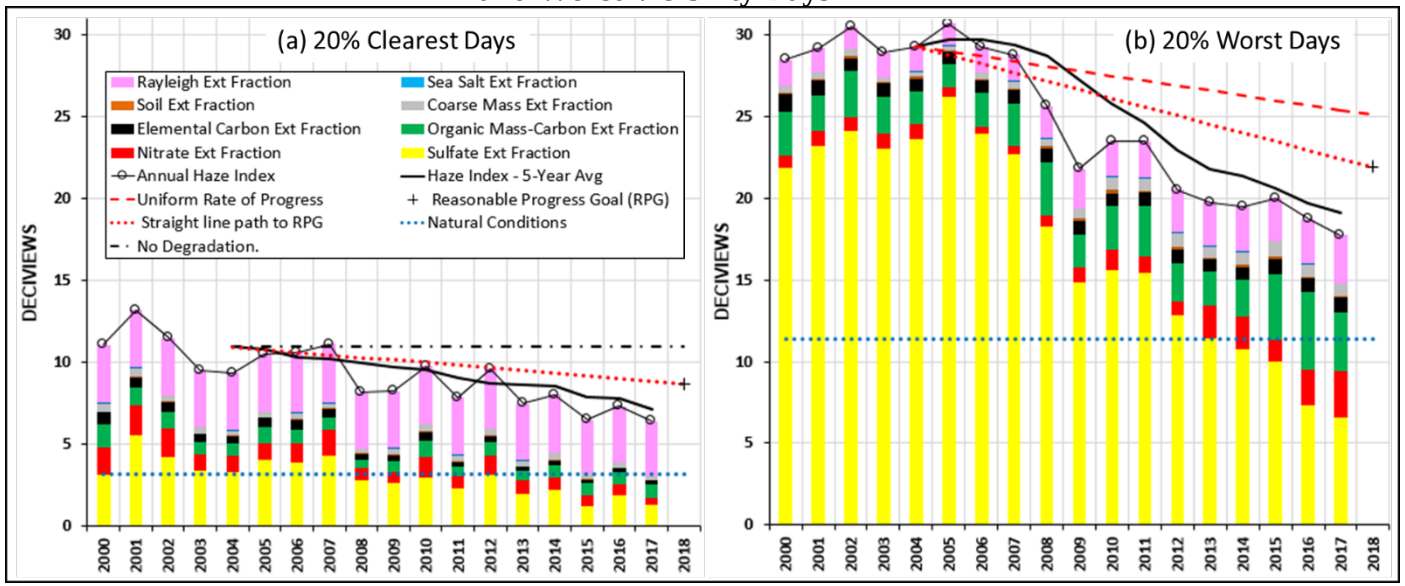


Figure 3-16. Individual Constituent Contribution to Annual Haze Index Levels at James River Face Wilderness Area on 20 Percent Best and Worst Visibility Days

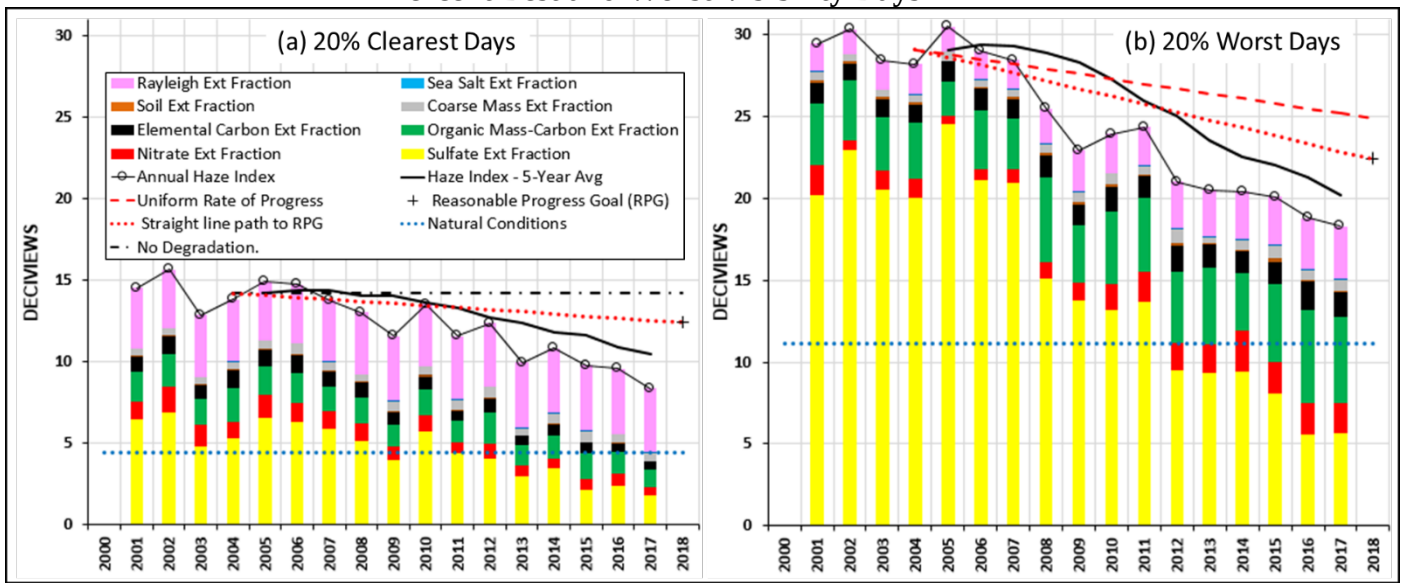


Figure 3-17. 1997-2017 NO_x Trends by Month

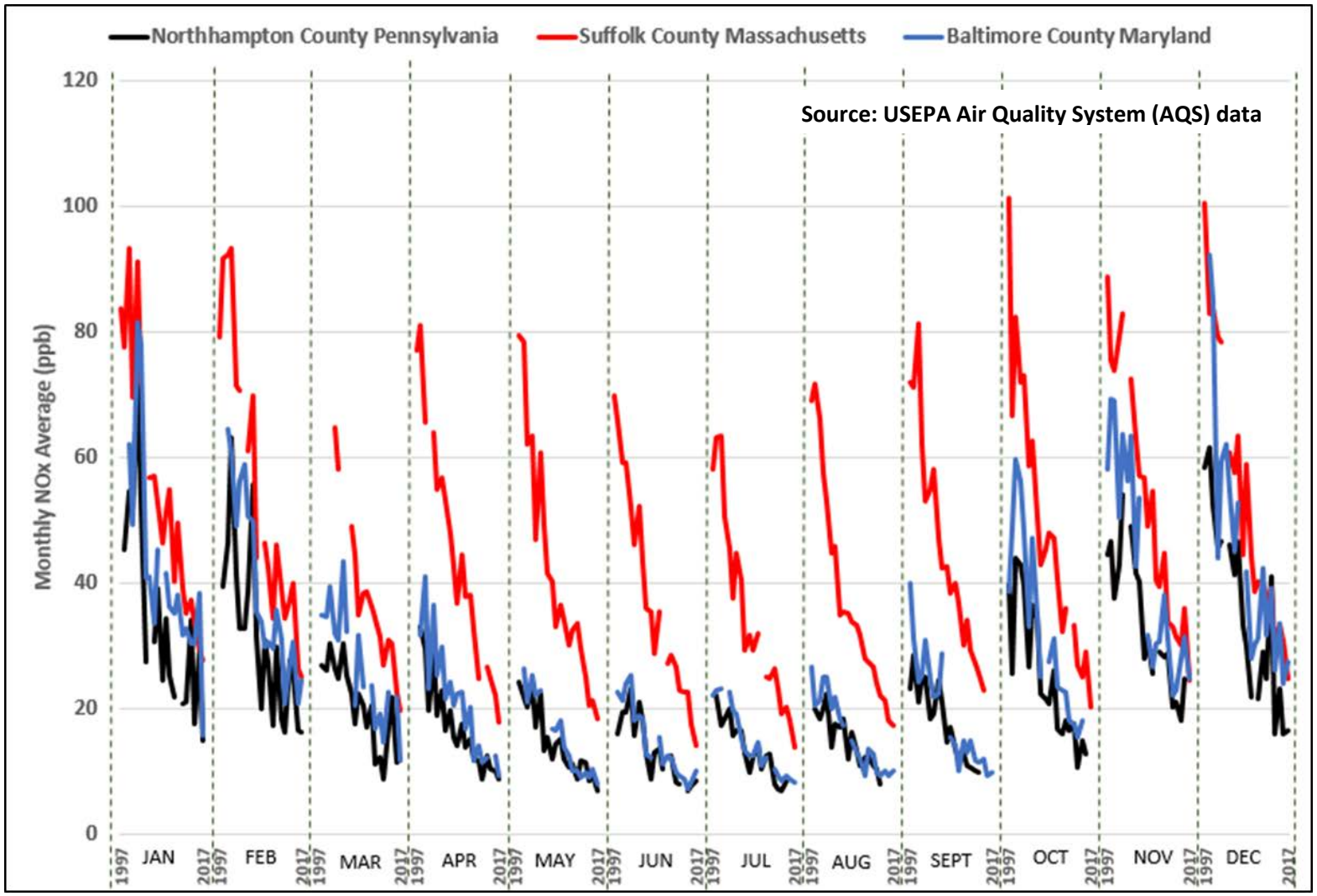


Figure 3-18. Current and Baseline 5-Year Average Light Extinction at Class I Sites on 20 Percent Best and Worst Visibility Days

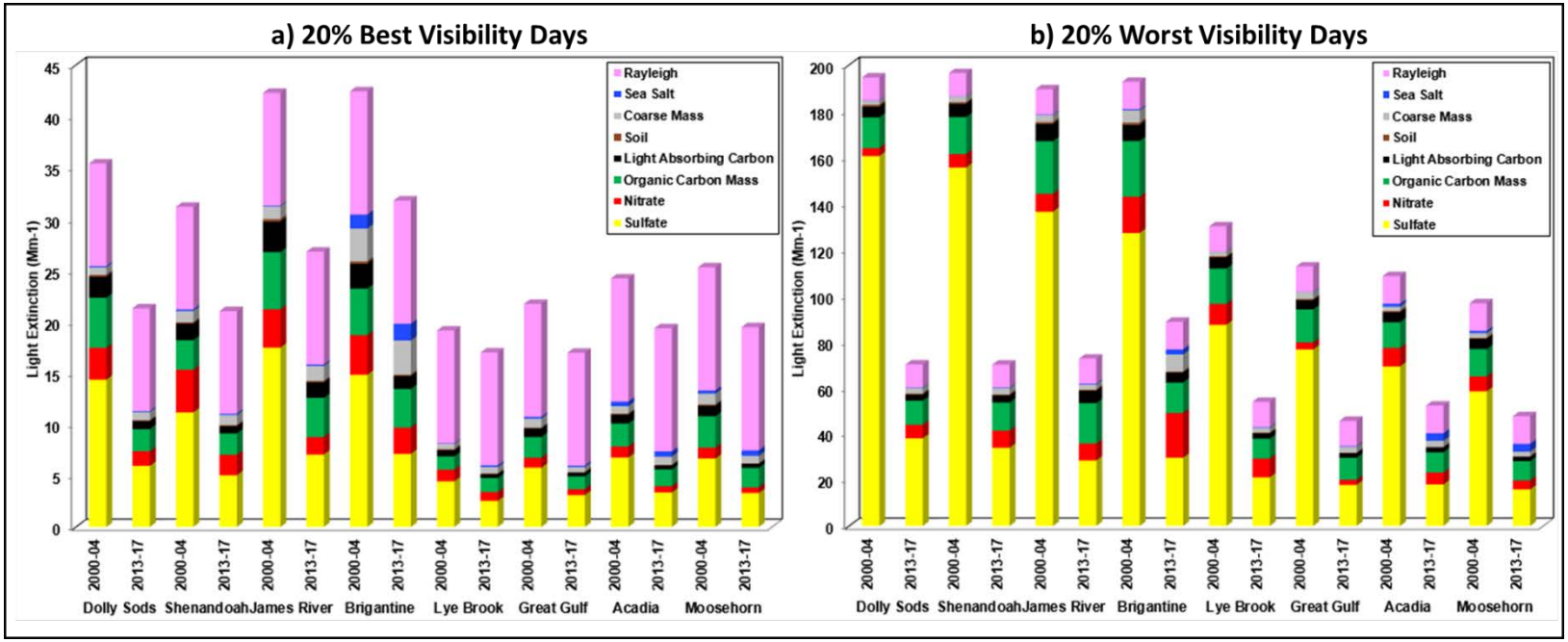
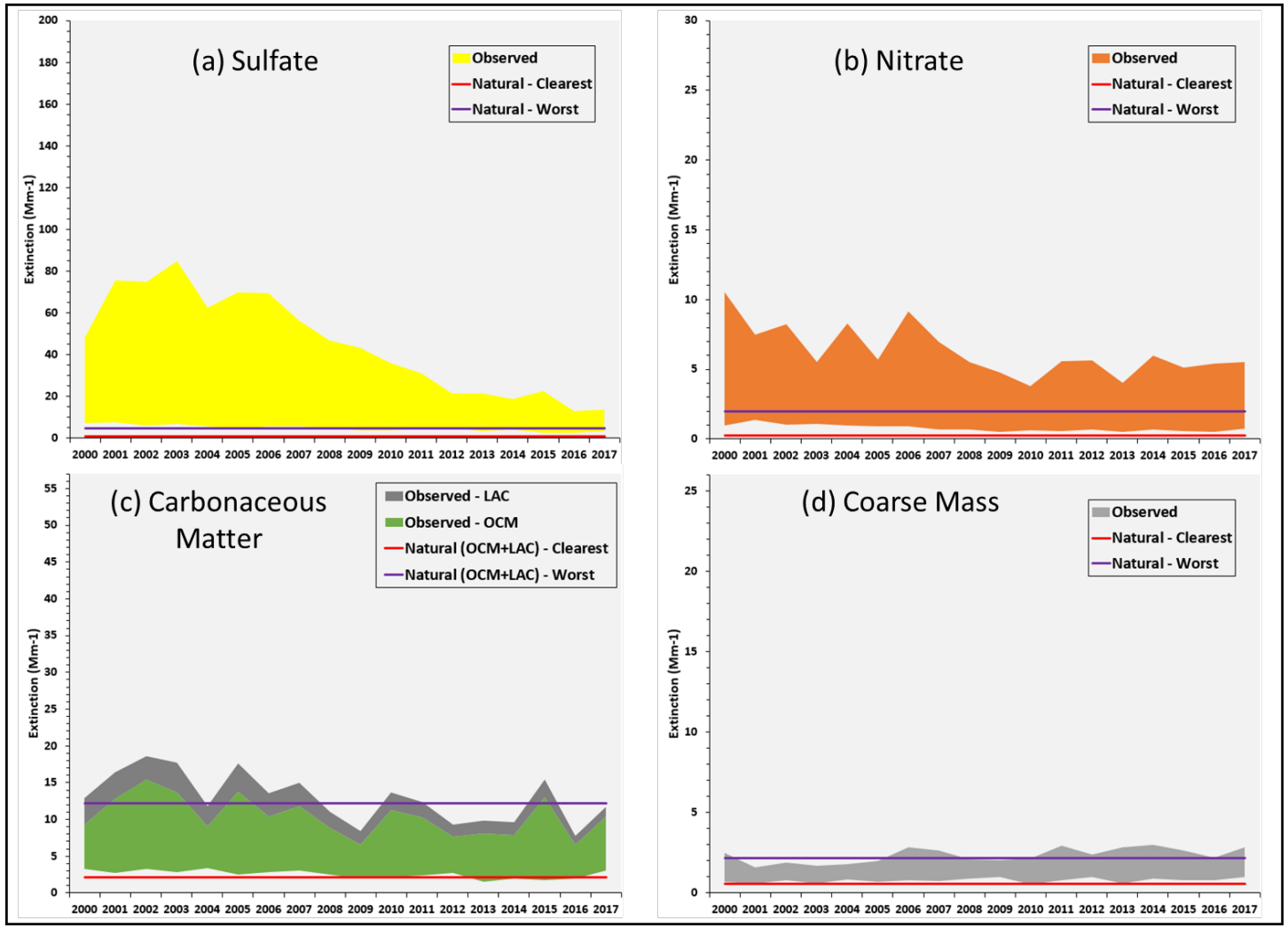
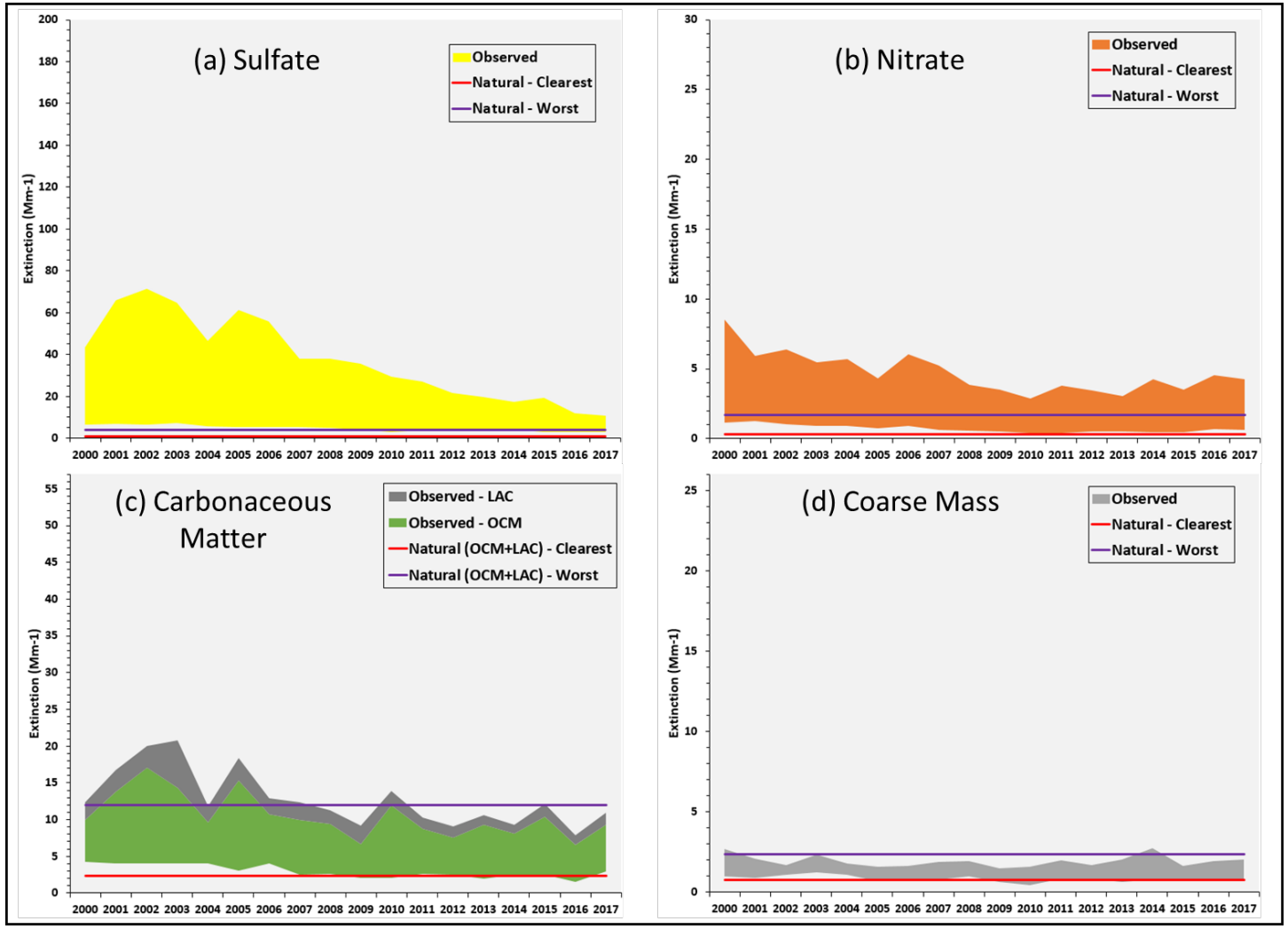


Figure 3-19. Range of Observed and Estimated Natural Light Extinction for Select Individual Constituents at Acadia National Park on 20 Percent Best and Worst Visibility Days



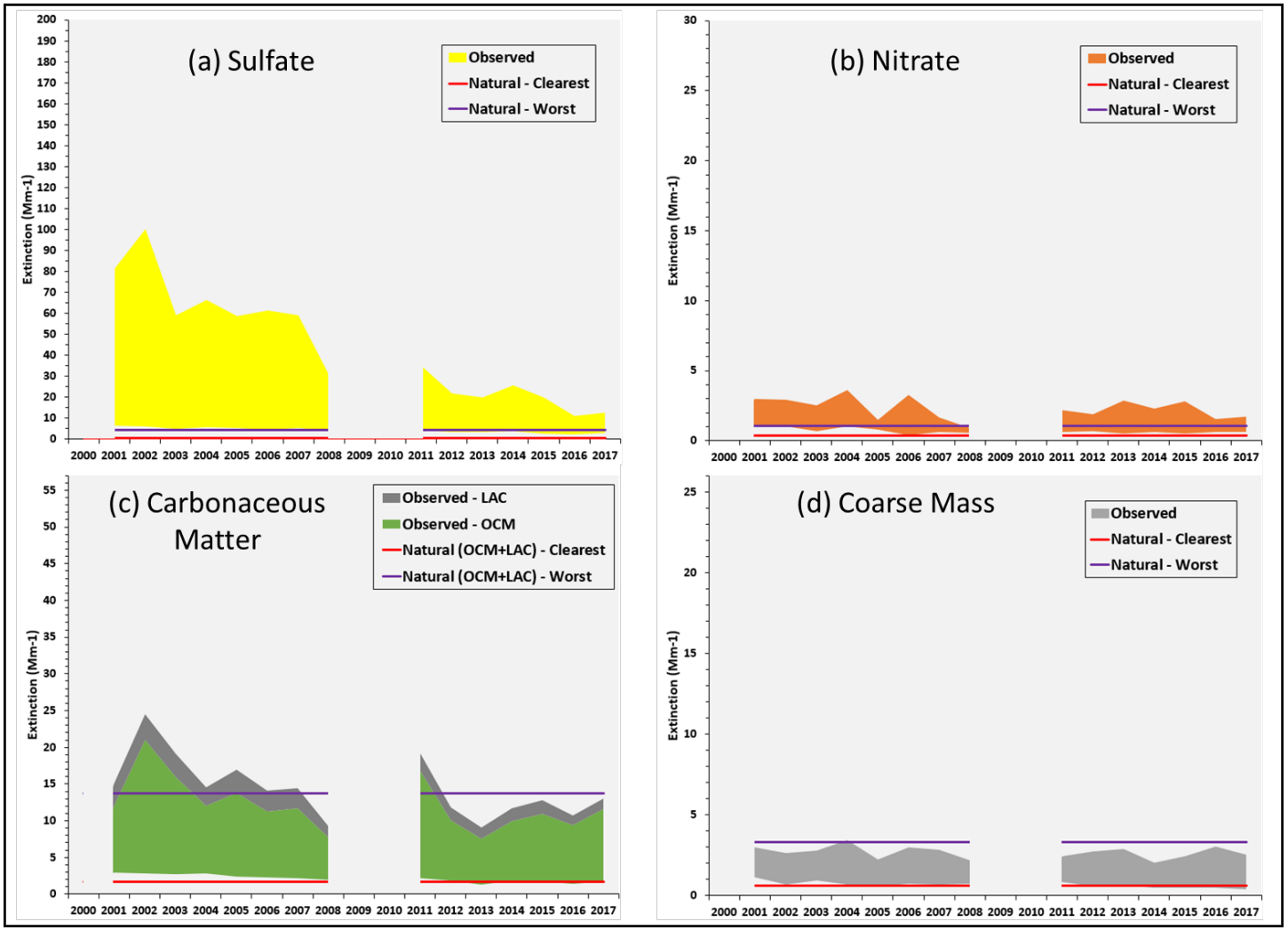
Notes: Light extinction from (a) sulfate, (b) nitrate, (c) carbonaceous matter (i.e., organic carbon mass or OCM and light absorbing carbon or LAC), and (d) coarse mass, alongside estimated natural light extinction from those constituents.

Figure 3-20. Range of Observed and Estimated Natural Light Extinction for Select Individual Constituents at Moosehorn Wilderness Area on 20 Percent Best and Worst Visibility Days



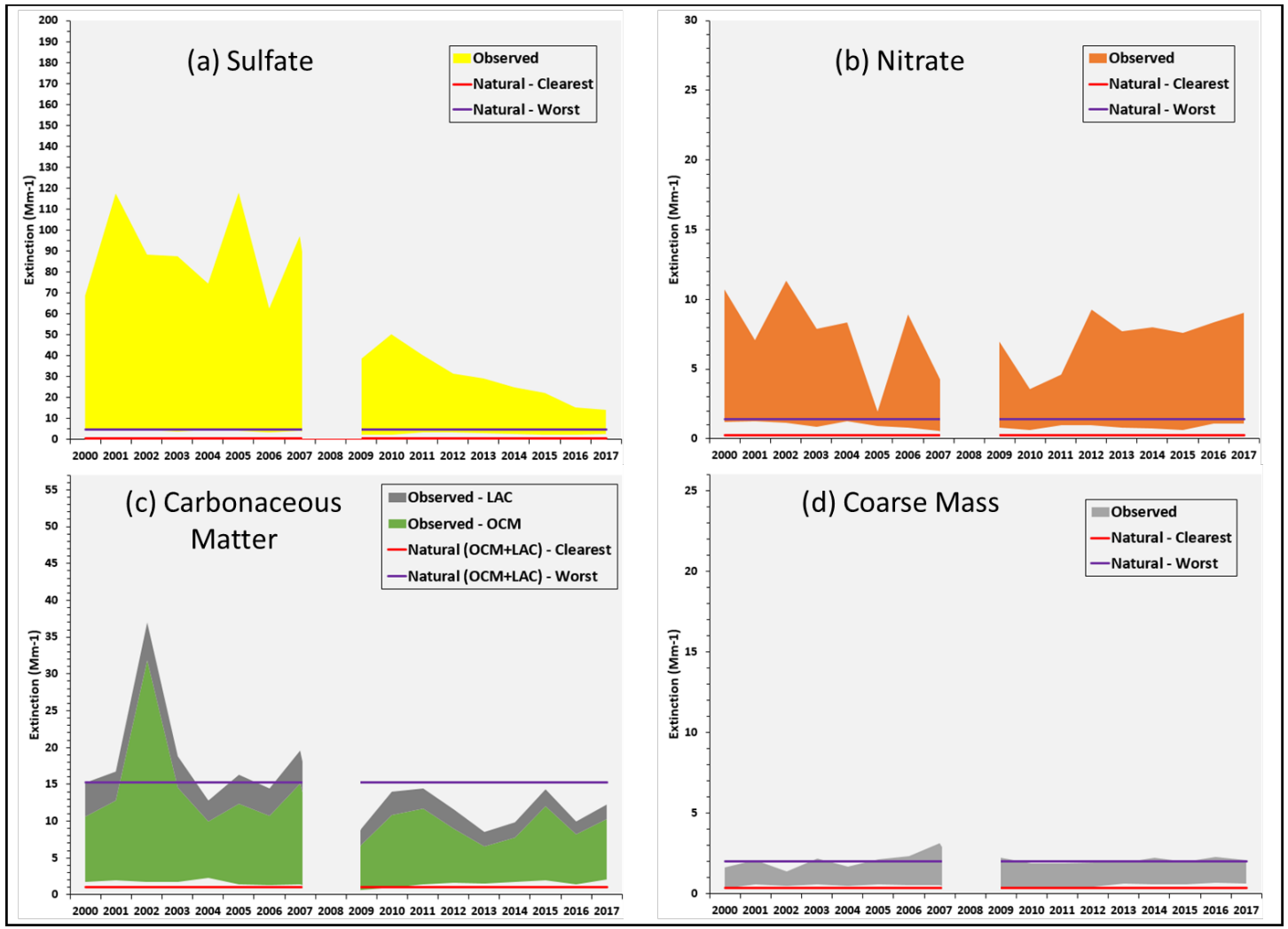
Notes: Light extinction from (a) sulfate, (b) nitrate, (c) carbonaceous matter (i.e., organic carbon mass or OCM and light absorbing carbon or LAC), and (d) coarse mass, alongside estimated natural light extinction from those constituents.

Figure 3-21. Range of Observed and Estimated Natural Light Extinction for Select Individual Constituents at Great Gulf Wilderness Area on 20 Percent Best and Worst Visibility Days



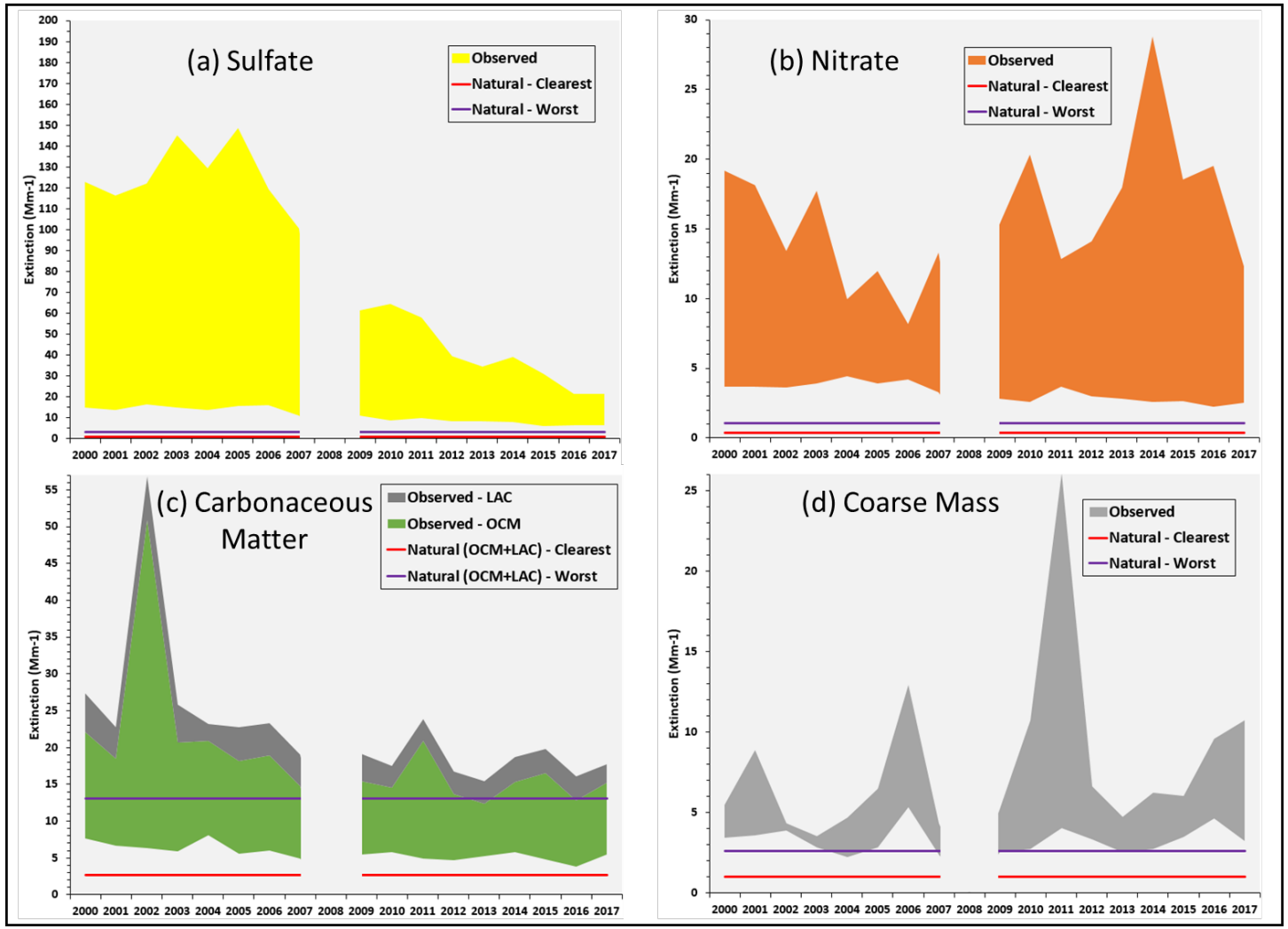
Notes: Light extinction from (a) sulfate, (b) nitrate, (c) carbonaceous matter (i.e., organic carbon mass or OCM and light absorbing carbon or LAC), and (d) coarse mass, alongside estimated natural light extinction from those constituents.

Figure 3-22. Range of Observed and Estimated Natural Light Extinction for Select Individual Constituents at Lye Brook Wilderness Area on 20 Percent Best and Worst Visibility Days



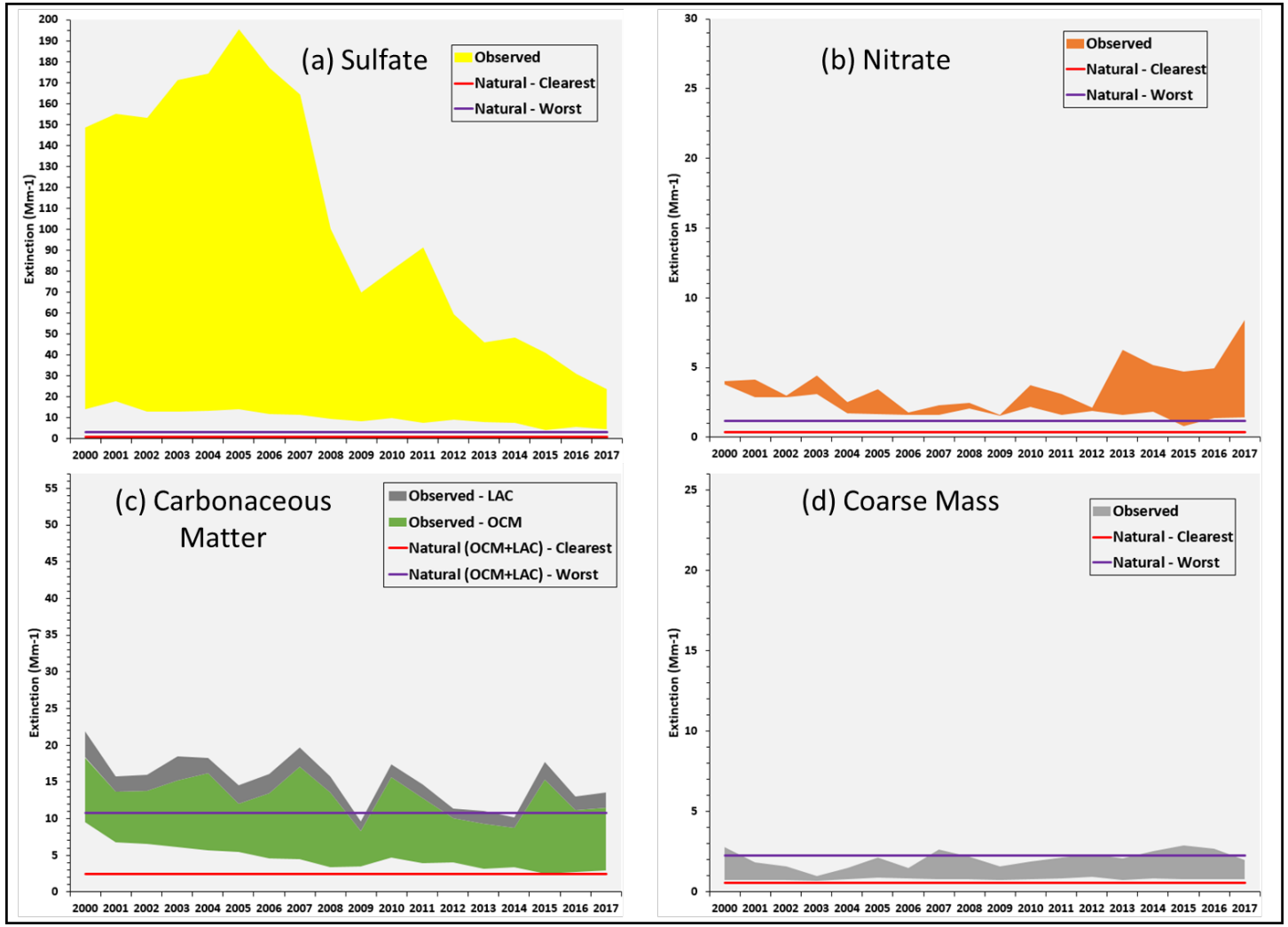
Notes: Light extinction from (a) sulfate, (b) nitrate, (c) carbonaceous matter (i.e., organic carbon mass or OCM and light absorbing carbon or LAC), and (d) coarse mass, alongside estimated natural light extinction from those constituents.

Figure 3-23. Range of Observed and Estimated Natural Light Extinction for Select Individual Constituents at Brigantine Wilderness Area on 20 Percent Best and Worst Visibility Days



Notes: Light extinction from (a) sulfate, (b) nitrate, (c) carbonaceous matter (i.e., organic carbon mass or OCM and light absorbing carbon or LAC), and (d) coarse mass, alongside estimated natural light extinction from those constituents.

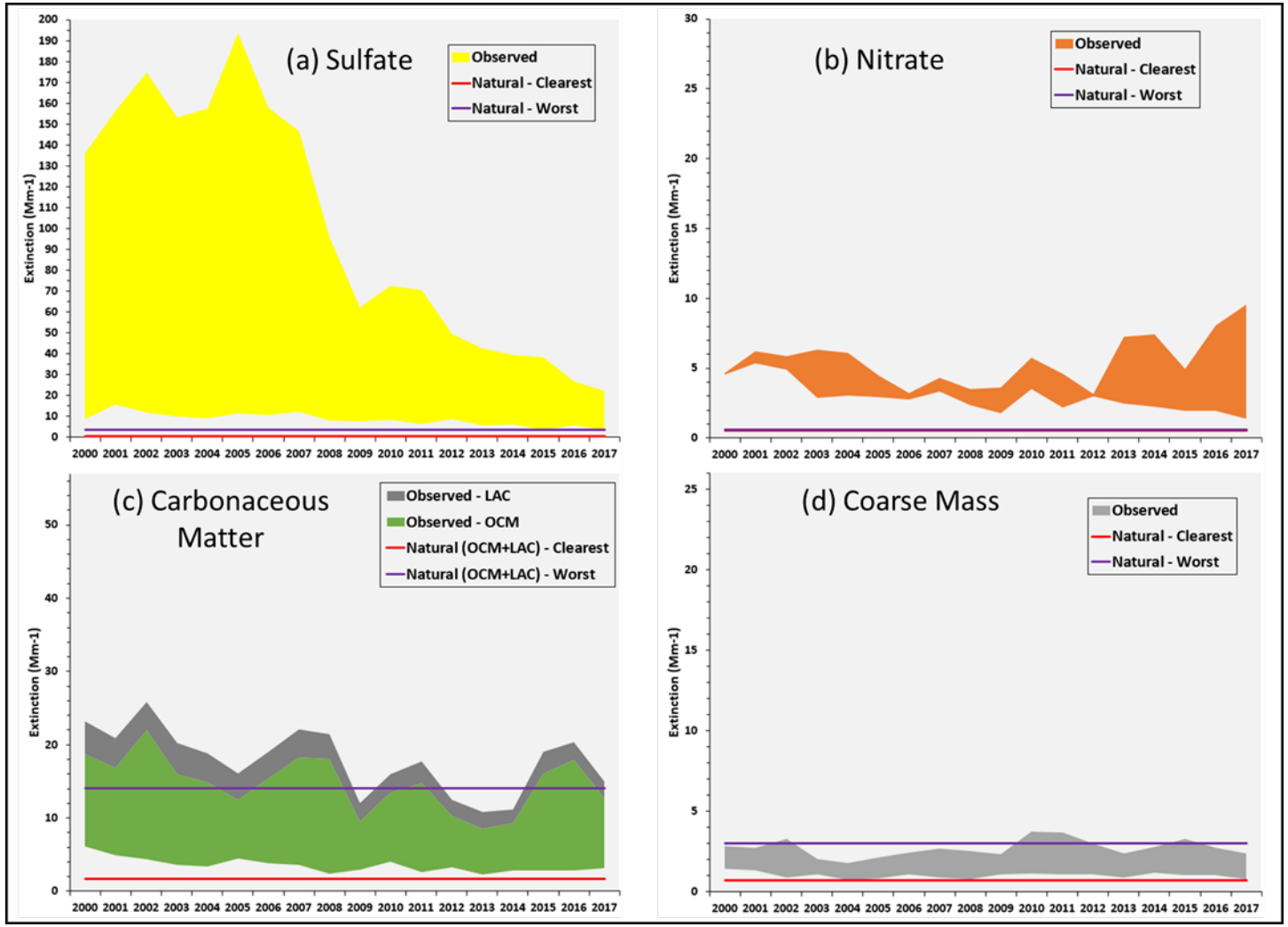
Figure 3-24. Range of Observed and Estimated Natural Light Extinction for Select Individual Constituents at Dolly Sods Wilderness Area on 20 Percent Best and Worst Visibility Days



Notes: Light extinction from (a) sulfate, (b) nitrate, (c) carbonaceous matter (i.e., organic carbon mass or OCM and light absorbing carbon or LAC), and (d) coarse mass, alongside estimated natural light extinction from those

constituents.

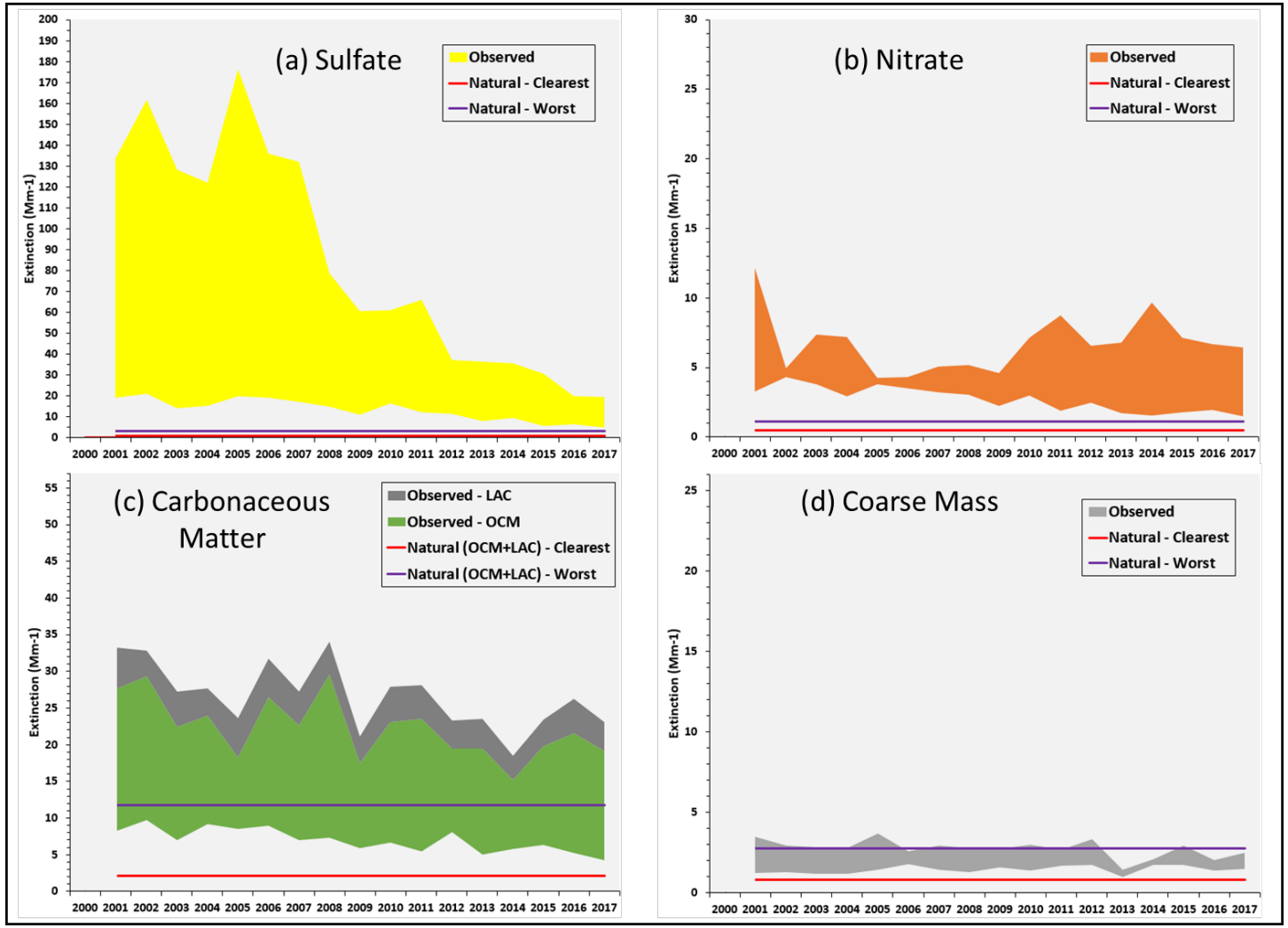
Figure 3-25. Range of Observed and Estimated Natural Light Extinction for Select Individual Constituents at Shenandoah National Park on 20 Percent Best and Worst Visibility Days



Notes: Light extinction from (a) sulfate, (b) nitrate, (c) carbonaceous matter (i.e., organic carbon mass or OCM and

light absorbing carbon or LAC), and (d) coarse mass, alongside estimated natural light extinction from those constituents.

Figure 3-26. Range of Observed and Estimated Natural Light Extinction for Select Individual Constituents at James River Face Wilderness Area on 20 Percent Best and Worst Visibility Days



Notes: Light extinction from (a) sulfate, (b) nitrate, (c) carbonaceous matter (i.e., organic carbon mass or OCM and light absorbing carbon or LAC), and (d) coarse mass, alongside estimated natural light extinction from those constituents.

3.3. Conclusions on Visibility Progress

Despite variability in the year-to-year data, there are definite downward trends in overall haze levels at Class I areas in and adjacent to the MANE-VU region. Based on rolling five-year averages demonstrating progress since the 2000-2004 baseline period, the Class I areas are on track to meet their 2018 RPGs for both 20 percent best visibility days and 20 percent worst visibility days. The trends are mainly driven by large reductions in sulfate light extinction. Levels of nitrate extinction are approaching natural conditions for the 20 percent best days, however, levels are increasing for the 20 percent worst days in recent years as more winter days are in the 20 percent worst days mix, especially for southern Class I areas. Levels of carbonaceous matter (OCM and LAC) appear to be approaching natural levels at most of the Class I areas. In all cases, the levels set by 2018 RPGs have already been met, and progress beyond the 2018 RPGs appears achievable. Though states are on track to meet 2018 RPGs, challenges remain for all Class I Areas going into the future. Continued sulfate and nitrate reductions are primary drivers in continuing to improve visibility.

4. DISCUSSION

Reductions in air pollution continue to bring down levels of fine particulate matter in the eastern United States, which in turn are leading to improved visibility at federally protected Class I areas within and adjacent to the MANE-VU region. Since the last report (NESCAUM 2013), significant improvements in visibility at the MANE-VU Class I sites have been observed, and these changes have been largely driven by reductions in sulfate levels.

Large emission reductions of nitrogen oxides (NO_x) and sulfur dioxide (SO_2) across the region in response to regional emission reduction requirements for power plants (i.e., NO_x SIP Call, NO_x Reasonably Available Control Technology (RACT), Cross State Air Pollution Rule (CSAPR), 2010 SO_2 NAAQS, etc.) is likely a principal driver for these visibility improvements. Reductions have occurred recently as the power sector continued to control or phase out coal plants across the eastern United States in response to competitive pressures from natural gas generation, overall reduced electricity demand, and more stringent requirements to reduce emissions of air toxics (i.e., 2011 Mercury and Air Toxics (MATS) rule).

In addition to addressing emissions from power plants, states across the Northeast have enacted or are in process of enacting low sulfur content requirements for fuel oils, which cover home heating oil (distillate) and residual oils (#4 and #6). At the federal level, USEPA finalized the Tier 3 motor vehicle program in 2014 that includes lowering sulfur content in gasoline. While gasoline combustion is a minor source of SO_2 emissions, the Tier 3 fuel requirements will significantly reduce NO_x emissions from the existing fleet of on-road gasoline vehicles by reducing sulfur poisoning of the catalyst in catalytic converters, thus improving control technology performance. This would lead to lower nitrate levels, most notably during colder weather months when nitrates are more thermally stable. In warmer weather months, NO_x promotes ground-level ozone formation, which in turn can enhance formation of visibility-limiting secondary organic aerosols (Carleton *et al.* 2010). Therefore, lower levels of NO_x as a result of Tier 3 can also improve visibility by reducing ozone formation that leads to carbonaceous PM.

In summary, the visibility data examined in this report demonstrate that broad, regional efforts to reduce emissions of visibility-impairing pollutants have had a beneficial effect at the region's Class I areas. The most recent IMPROVE data indicate that states continue to be on track to meet their 2018 reasonable progress goals for improved visibility. Further progress may occur through additional pollution reductions achievable under recently adopted or proposed regulatory programs.

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Appendix A: Tracking Progress Data for Class I Areas in and Adjacent to the MANE-VU Region

Table A-1. Tracking Progress Data for Acadia National Park (ME) and Brigantine Wilderness (NJ) Class I Areas in the MANE-VU Region (dv)

		20 Percent Best Days		20 Percent Worst Days	
Class I Area	Year	Haze Index, Annual	Haze Index, 5-Year Rolling	Haze Index, Annual	Haze Index, Year Rolling
Acadia National Park (ACAD)	2000	8.90	-	21.64	-
	2001	8.87	-	23.28	-
	2002	8.77	-	23.91	-
	2003	8.77	-	23.65	-
	2004	8.56	8.78	21.98	22.89
	2005	7.58	8.51	23.01	23.17
	2006	8.17	8.37	23.37	23.19
	2007	8.21	8.26	21.74	22.75
	2008	7.76	8.06	20.21	22.06
	2009	6.92	7.73	18.93	21.45
	2010	6.71	7.55	18.27	20.50
	2011	7.45	7.41	19.05	19.64
	2012	7.77	7.32	16.84	18.66
	2013	6.25	7.02	16.54	17.93
	2014	7.03	7.04	16.68	17.47
	2015	6.05	6.91	17.79	17.38
	2016	6.08	6.64	14.63	16.50
	2017	7.18	6.52	15.93	16.31
	2018				
	2018 RPG		**8.30 RPG**		**19.40 RPG**
	2064 NAT		**4.66 NAT**		**12.43 NAT**
Brigantine Wilderness (BRIG)	2000	14.26	-	28.95	-
	2001	13.83	-	28.38	-
	2002	14.83	-	29.31	-
	2003	14.39	-	29.79	-
	2004	14.36	14.33	28.59	29.01
	2005	14.61	14.40	29.62	29.14
	2006	15.35	14.71	28.50	29.16
	2007	12.74	14.29	26.91	28.68
	2008	*	14.26	*	28.41
	2009	12.78	13.87	24.25	27.32
	2010	11.82	13.17	25.28	26.23
	2011	12.92	12.56	25.83	25.57
	2012	11.93	12.36	21.88	24.31
	2013	11.80	12.25	21.51	23.75
	2014	11.66	12.03	22.03	23.31
	2015	11.44	11.95	21.84	22.62
	2016	11.12	11.59	20.83	21.62
	2017	11.36	11.48	20.28	21.30
	2018				
	2018 RPG		**14.30 RPG**		**25.10 RPG**
	2064 NAT		**5.52 NAT**		**12.25 NAT**

"-" = not applicable; "*" = no data available; "RPG" = Reasonable Progress Goal; "NAT" = Natural Conditions

Table A-2. Tracking Progress Data for Great Gulf Wilderness (NH) and Lye Brook Wilderness (VT) Class I Areas in the MANE-VU Region (dv)

		20 Percent Best Days		20 Percent Worst Days	
Class I Area	Year	Haze Index, Annual	Haze Index, 5-Year Rolling	Haze Index, Annual	Haze Index, Year Rolling
Great Gulf Wilderness Area (GRGU)	2000	*	-	*	-
	2001	8.26	-	23.29	-
	2002	7.77	-	24.84	-
	2003	6.94	-	21.59	-
	2004	7.68	7.66	21.56	22.82
	2005	6.90	7.51	21.53	22.56
	2006	6.43	7.14	21.12	22.13
	2007	6.86	6.96	21.35	21.43
	2008	6.20	6.81	16.78	20.47
	2009	*	6.60	*	20.19
	2010	*	6.50	*	19.75
	2011	6.37	6.48	19.04	19.06
	2012	5.81	6.13	15.97	17.26
	2013	5.41	5.87	14.98	16.66
	2014	5.75	5.84	16.27	16.56
	2015	4.92	5.65	15.64	16.38
	2016	4.69	5.32	13.16	15.20
	2017	5.22	5.20	13.88	14.79
	2018				
	2018 RPG		**7.20 RPG**		**19.10 RPG**
	2064 NAT		**3.73 NAT**		**11.99 NAT**
Lye Brook Wilderness Area (LYBR 2000-2011) (LYEB 2012-current)	2000	6.49	-	23.45	-
	2001	6.47	-	26.33	-
	2002	6.43	-	25.52	-
	2003	5.83	-	24.02	-
	2004	6.61	6.37	22.91	24.45
	2005	5.74	6.22	26.04	24.96
	2006	5.24	5.97	22.31	24.16
	2007	5.68	5.82	25.25	24.11
	2008	*	5.82	*	24.13
	2009	4.11	5.19	18.44	23.01
	2010	4.08	4.78	19.96	21.49
	2011	5.40	4.82	19.38	20.76
	2012	5.49	4.77	18.57	19.09
	2013	5.35	4.89	17.46	18.76
	2014	5.00	5.07	17.14	18.50
	2015	5.10	5.27	17.25	17.96
	2016	4.88	5.17	15.13	17.11
	2017	5.43	5.15	15.64	16.52
	2018				
	2018 RPG		**5.50 RPG**		**20.90 RPG**
	2064 NAT		**2.79 NAT**		**11.73 NAT**

"-" = not applicable; "*" = no data available; "RPG" = Reasonable Progress Goal; "NAT" = Natural Conditions

Table A-3. Tracking Progress Data for the Moosehorn Wilderness (ME) Class I Area in the MANE-VU Region (dv)

		20 Percent Best Days		20 Percent Worst Days	
Class I Area	Year	Haze Index, Annual	Haze Index, 5-Year Rolling	Haze Index, Annual	Haze Index, Year Rolling
Moosehorn Wilderness Area (MOOS)	2000	8.94	-	20.63	-
	2001	9.31	-	22.14	-
	2002	9.12	-	23.07	-
	2003	9.48	-	22.50	-
	2004	8.93	9.16	20.28	21.72
	2005	7.99	8.97	22.36	22.07
	2006	8.60	8.82	21.55	21.95
	2007	7.79	8.56	19.24	21.19
	2008	7.75	8.21	18.73	20.43
	2009	6.83	7.79	17.71	19.92
	2010	5.98	7.39	17.20	18.89
	2011	6.97	7.07	17.40	18.06
	2012	7.27	6.96	16.00	17.41
	2013	6.47	6.71	15.91	16.84
	2014	7.00	6.74	16.04	16.51
	2015	6.64	6.87	16.37	16.34
	2016	6.09	6.69	13.86	15.64
	2017	6.77	6.59	14.89	15.42
	2018				
	2018 RPG		**8.60 RPG**		**19.00 RPG**
	2064 NAT		**5.02 NAT**		**12.01 NAT**

"-" = not applicable; "RPG" = Reasonable Progress Goal; "NAT" = Natural Conditions

Table A-4. Tracking Progress Data for the Dolly Sods Wilderness (WV) Class I Area Adjacent to the MANE-VU Region (dv)

		20 Percent Best Days		20 Percent Worst Days	
Class I Area	Year	Haze Index, Annual	Haze Index, 5-Year Rolling	Haze Index, Annual	Haze Index, Year Rolling
Dolly Sods Wilderness (DOSO)	2000	12.96	-	29.03	-
	2001	13.30	-	28.24	-
	2002	11.91	-	28.47	-
	2003	11.54	-	29.73	-
	2004	11.67	12.28	29.76	29.05
	2005	12.09	12.10	30.89	29.42
	2006	10.57	11.56	29.80	29.73
	2007	10.27	11.23	29.52	29.94
	2008	9.44	10.81	25.39	29.07
	2009	8.70	10.21	22.17	27.55
	2010	9.74	9.74	24.02	26.18
	2011	8.75	9.38	24.50	25.12
	2012	9.59	9.25	21.38	23.49
	2013	8.34	9.03	19.94	22.40
	2014	8.52	8.99	20.25	22.02
	2015	5.88	8.22	20.15	21.24
	2016	7.00	7.87	18.07	19.96
	2017	6.71	7.29	17.41	19.16
	2018				
	2018 RPG		**11.10 RPG**		**21.70 RPG**
	2064 NAT		**3.64 NAT**		**10.39 NAT**

"-" = not applicable; "RPG" = Reasonable Progress Goal; "NAT" = Natural Conditions

Table A-5. Tracking Progress Data for James River Face Wilderness and Shenandoah National Park (VA) Class I Areas Adjacent to the MANE-VU Region (dv)

		20 Percent Best Days		20 Percent Worst Days	
Class I Area	Year	Haze Index, Annual	Haze Index, 5-Year Rolling	Haze Index, Annual	Haze Index, Year Rolling
James River Face (JARI)	2000	*	-	*	-
	2001	14.54	-	29.46	-
	2002	15.65	-	30.36	-
	2003	12.85	-	28.42	-
	2004	13.80	14.21	28.23	29.12
	2005	14.92	14.35	30.52	29.40
	2006	14.75	14.39	29.03	29.31
	2007	13.78	14.02	28.47	28.93
	2008	13.03	14.06	25.52	28.35
	2009	11.55	13.61	22.93	27.29
	2010	13.51	13.33	23.93	25.98
	2011	11.57	12.69	24.36	25.04
	2012	12.35	12.40	21.01	23.55
	2013	9.94	11.79	20.50	22.55
	2014	10.81	11.64	20.45	22.05
	2015	9.76	10.89	20.12	21.29
	2016	9.57	10.49	18.83	20.18
	2017	8.38	9.69	18.29	19.64
	2018				
	2018 RPG		**12.40 RPG**		**22.40 RPG**
	2064 NAT		**4.39 NAT**		**11.13 NAT**
Shenandoah National Park (SHEN)	2000	11.08	-	28.53	-
	2001	13.21	-	29.21	-
	2002	11.49	-	30.54	-
	2003	9.48	-	28.94	-
	2004	9.37	10.93	29.32	29.31
	2005	10.48	10.81	30.75	29.75
	2006	10.59	10.28	29.30	29.77
	2007	11.13	10.21	28.79	29.42
	2008	8.16	9.95	25.65	28.76
	2009	8.23	9.72	21.81	27.26
	2010	9.79	9.58	23.51	25.81
	2011	7.87	9.04	23.50	24.65
	2012	9.63	8.73	20.52	23.00
	2013	7.50	8.60	19.78	21.82
	2014	8.02	8.56	19.52	21.37
	2015	6.50	7.90	20.01	20.66
	2016	7.32	7.79	18.71	19.71
	2017	6.39	7.14	17.78	19.16
	2018				
	2018 RPG		**8.70 RPG**		**21.90 RPG**
	2064 NAT		**3.15 NAT**		**11.35 NAT**

"-" = not applicable; "*" = no data available; "RPG" = Reasonable Progress Goal; "NAT" = Natural Conditions

Table A-6. Tracking Progress Data for Addison Pinnacle (NY) and Arendtsville (PA) IMPROVE Protocol Sites in the MANE-VU Region (dv)

		20 Percent Best Days		20 Percent Worst Days	
Class I Area	Year	Haze Index, Annual	Haze Index, 5-Year Rolling	Haze Index, Annual	Haze Index, Year Rolling
Addison Pinnacle (ADPI)	2000	*	-	*	-
	2001	*	-	*	-
	2002	12.38	-	29.04	-
	2003	11.79	-	28.18	-
	2004	11.18	11.78	27.67	28.29
	2005	11.63	11.75	29.47	28.59
	2006	10.22	11.44	26.98	28.27
	2007	10.65	11.09	28.12	28.08
	2008	10.99	10.93	25.10	27.47
	2009	9.57	10.61	22.90	26.52
	2010	*	*	*	*
	2011	*	*	*	*
	2012	*	*	*	*
	2013	*	*	*	*
	2014	*	*	*	*
	2015	*	*	*	*
	2016	*	*	*	*
	2017	*	*	*	*
	2018				
	2064 NAT		**4.12 NAT**		**11.57 NAT**
Arendtsville (AREN)	2000	*	-	*	-
	2001	*	-	*	-
	2002	15.49	-	31.32	-
	2003	14.32	-	30.26	-
	2004	12.87	14.23	30.59	30.72
	2005	14.41	14.27	31.40	30.89
	2006	13.29	14.08	29.60	30.63
	2007	13.22	13.62	28.79	30.13
	2008	13.59	13.48	26.94	29.46
	2009	11.70	13.24	26.05	28.55
	2010	11.74	12.71	25.33	27.34
	2011	*	*	*	*
	2012	*	*	*	*
	2013	*	*	*	*
	2014	*	*	*	*
	2015	*	*	*	*
	2016	*	*	*	*
	2017	*	*	*	*
	2018				
	2064 NAT		**4.24 NAT**		**11.77 NAT**

"-" = not applicable; "*" = no data available; "NAT" = Natural Conditions

Table A-7. Tracking Progress Data for Baltimore (MD) and Bridgton (ME) IMPROVE Protocol Sites in the MANE-VU Region (dv)

		20 Percent Best Days		20 Percent Worst Days	
Class I Area	Year	Haze Index, Annual	Haze Index, 5-Year Rolling	Haze Index, Annual	Haze Index, Year Rolling
Baltimore (BALT)	2000	*	-	*	-
	2001	*	-	*	-
	2002	*	-	*	-
	2003	*	-	*	-
	2004	*	*	*	*
	2005	16.35	*	31.96	*
	2006	15.13	*	30.83	*
	2007	*	*	*	*
	2008	*	*	*	*
	2009	*	*	*	*
	2010	*	*	*	*
	2011	*	*	*	*
	2012	*	*	*	*
	2013	*	*	*	*
	2014	*	*	*	*
	2015	*	*	*	*
	2016	*	*	*	*
	2017	*	*	*	*
	2018				
	2064 NAT		*****		*****
Bridgton (BRMA)	2000	*	-	*	-
	2001	*	-	*	-
	2002	9.34	-	24.29	-
	2003	8.92	-	22.99	-
	2004	9.19	9.15	22.71	23.33
	2005	7.77	8.81	21.23	22.81
	2006	8.15	8.67	22.80	22.80
	2007	7.76	8.36	20.97	22.14
	2008	7.88	8.15	18.89	21.32
	2009	6.64	7.64	18.21	20.42
	2010	6.30	7.34	18.48	19.87
	2011	7.33	7.18	18.76	19.06
	2012	7.44	7.12	17.07	18.28
	2013	6.71	6.89	16.09	17.72
	2014	6.93	6.94	16.67	17.41
	2015	6.22	6.93	16.80	17.08
	2016	*	*	*	*
	2017	*	*	*	*
	2018				
	2064 NAT		**4.65 NAT**		**12.07 NAT**

"-" = not applicable; "*" = no data available

Table A-8. Tracking Progress Data for Casco Bay (ME) and Cape Cod (MA) IMPROVE Protocol Sites in the MANE-VU Region (dv)

		20 Percent Best Days		20 Percent Worst Days	
Class I Area	Year	Haze Index, Annual	Haze Index, 5-Year Rolling	Haze Index, Annual	Haze Index, Year Rolling
Casco Bay (CABA)	2000	*	-	*	-
	2001	*	-	*	-
	2002	9.84	-	24.50	-
	2003	9.52	-	25.10	-
	2004	10.12	9.82	22.84	24.15
	2005	8.88	9.59	23.26	23.93
	2006	8.98	9.47	23.72	23.88
	2007	8.77	9.25	22.45	23.47
	2008	9.65	9.28	20.82	22.62
	2009	7.75	8.80	20.75	22.20
	2010	7.64	8.56	19.35	21.42
	2011	8.84	8.53	20.28	20.73
	2012	9.17	8.61	19.04	20.05
	2013	7.68	8.22	17.81	19.45
	2014	7.81	8.23	17.80	18.86
	2015	7.67	8.23	18.25	18.64
	2016	7.35	7.94	16.03	17.79
	2017	8.01	7.70	16.98	17.37
	2018				
	2064 NAT		**4.83 NAT**		**12.83 NAT**
Cape Cod (CACO)	2000	*	-	*	-
	2001	*	-	*	-
	2002	11.18	-	25.25	-
	2003	11.00	-	26.13	-
	2004	11.97	11.38	24.44	25.27
	2005	12.12	11.57	25.62	25.36
	2006	10.96	11.45	23.98	25.08
	2007	10.02	11.21	25.10	25.05
	2008	10.82	11.18	22.20	24.27
	2009	9.89	10.76	21.80	23.74
	2010	9.81	10.30	20.79	22.77
	2011	10.35	10.18	20.69	22.12
	2012	9.74	10.12	19.12	20.92
	2013	9.43	9.84	18.68	20.21
	2014	9.12	9.69	18.26	19.51
	2015	8.74	9.48	18.60	19.07
	2016	8.33	9.07	16.79	18.29
	2017	9.61	9.05	17.34	17.93
	2018				
	2064 NAT		**5.95 NAT**		**13.20 NAT**

"-" = not applicable; "*" = no data available; "NAT" = Natural Conditions

Table A-9. Tracking Progress Data for Connecticut Hill (NY) and Frostburg Reservoir (MD) IMPROVE Protocol Sites in the MANE-VU Region (dv)

		20 Percent Best Days		20 Percent Worst Days	
Class I Area	Year	Haze Index, Annual	Haze Index, 5-Year Rolling	Haze Index, Annual	Haze Index, Year Rolling
Connecticut Hill (COHI)	2000	*	-	*	-
	2001	*	-	*	-
	2002	12.07	-	28.79	-
	2003	11.76	-	27.43	-
	2004	11.43	11.75	27.17	27.80
	2005	12.27	11.88	29.55	28.24
	2006	*	*	*	*
	2007	*	*	*	*
	2008	*	*	*	*
	2009	*	*	*	*
	2010	*	*	*	*
	2011	*	*	*	*
	2012	*	*	*	*
	2013	*	*	*	*
	2014	*	*	*	*
	2015	*	*	*	*
	2016	*	*	*	*
	2017	*	*	*	*
	2018				
	2064 NAT		**4.30 NAT**		**11.50 NAT**
Frostburg Reservoir (FRRE)	2000	*	-	*	-
	2001	*	-	*	-
	2002	*	-	*	-
	2003	*	-	*	-
	2004	*	*	*	*
	2005	14.49	*	32.22	*
	2006	13.69	*	30.06	*
	2007	12.82	13.67	29.26	30.52
	2008	12.74	13.44	25.43	29.24
	2009	10.85	12.92	24.08	28.21
	2010	11.81	12.38	24.92	26.75
	2011	11.11	11.87	24.83	25.70
	2012	11.76	11.66	21.81	24.21
	2013	10.57	11.22	21.52	23.43
	2014	10.94	11.24	21.88	22.99
	2015	9.44	10.77	20.63	22.13
	2016	9.37	10.42	18.71	20.91
	2017	9.53	9.97	19.21	20.39
	2018				
	2064 NAT		*****		*****

"-" = not applicable; "*" = no data available; "NAT" = Natural Conditions

Table A-10. Tracking Progress Data for Londonderry (NH) and Martha's Vineyard (MA) IMPROVE Protocol Sites in the MANE-VU Region (dv)

		20 Percent Best Days		20 Percent Worst Days	
Class I Area	Year	Haze Index, Annual	Haze Index, 5-Year Rolling	Haze Index, Annual	Haze Index, Year Rolling
Londonderry (LOND)	2000	*	-	*	-
	2001	*	-	*	-
	2002	*	-	*	-
	2003	*	-	*	-
	2004	*	*	*	*
	2005	*	*	*	*
	2006	*	*	*	*
	2007	*	*	*	*
	2008	*	*	*	*
	2009	*	*	*	*
	2010	*	*	*	*
	2011	9.84	*	21.17	*
	2012	9.34	*	19.95	*
	2013	8.17	9.12	19.35	20.16
	2014	8.33	8.92	18.61	19.77
	2015	7.98	8.73	19.38	19.69
	2016	7.79	8.32	17.16	18.89
	2017	8.72	8.20	18.06	18.51
	2018				
	2064 NAT		*****		*****
Martha's Vineyard (MAVI)	2000	*	-	*	-
	2001	*	-	*	-
	2002	*	-	*	-
	2003	11.83	-	27.55	-
	2004	12.25	*	24.82	*
	2005	12.31	12.13	26.59	26.32
	2006	11.17	11.89	25.83	26.20
	2007	10.50	11.61	24.42	25.84
	2008	10.77	11.40	24.37	25.21
	2009	9.94	10.94	23.08	24.86
	2010	9.98	10.47	22.39	24.02
	2011	11.24	10.49	22.47	23.35
	2012	9.93	10.37	20.38	22.54
	2013	8.92	10.00	20.56	21.78
	2014	10.23	10.06	20.27	21.21
	2015	10.14	10.09	21.50	21.03
	2016	9.42	9.73	19.70	20.48
	2017	10.03	9.75	20.76	20.56
	2018				
	2064 NAT		*****		*****

"-" = not applicable; "*" = no data available

Table A-11. Tracking Progress Data for M.K. Goddard (PA) and Mohawk Mt. (CT) IMPROVE Protocol Sites in the MANE-VU Region (dv)

		20 Percent Best Days		20 Percent Worst Days	
Class I Area	Year	Haze Index, Annual	Haze Index, 5-Year Rolling	Haze Index, Annual	Haze Index, Year Rolling
M.K. Goddard (MKGO)	2000	*	-	*	-
	2001	*	-	*	-
	2002	14.75	-	29.36	-
	2003	13.76	-	28.29	-
	2004	13.76	14.09	28.41	28.69
	2005	14.78	14.26	31.48	29.39
	2006	13.07	14.02	28.24	29.16
	2007	12.91	13.66	29.10	29.11
	2008	13.30	13.56	26.67	28.78
	2009	11.81	13.17	25.84	28.27
	2010	11.54	12.53	26.24	27.22
	2011	*	*	*	*
	2012	*	*	*	*
	2013	*	*	*	*
	2014	*	*	*	*
	2015	*	*	*	*
	2016	*	*	*	*
	2017	*	*	*	*
	2018				
	2064 NAT		**4.52 NAT**		**11.36 NAT**
Mohawk Mt. (MOMO)	2000	*	-	*	-
	2001	*	-	*	-
	2002	10.34	-	26.93	-
	2003	9.31	-	26.63	-
	2004	9.85	9.83	27.13	26.90
	2005	8.87	9.59	28.39	27.27
	2006	8.39	9.35	26.06	27.03
	2007	7.88	8.86	27.01	27.04
	2008	*	8.75	*	27.15
	2009	6.97	8.03	21.02	25.62
	2010	6.71	7.49	21.36	23.86
	2011	8.06	7.40	21.66	22.76
	2012	7.68	7.36	19.78	20.95
	2013	6.70	7.22	18.92	20.55
	2014	7.35	7.30	17.82	19.91
	2015	6.08	7.17	18.76	19.39
	2016	6.30	6.82	17.67	18.59
	2017	6.19	6.53	16.51	17.93
	2018				
	2064 NAT		**3.67 NAT**		**12.42 NAT**

"-" = not applicable; "*" = no data available; "NAT" = Natural Conditions

Table A-12. Tracking Progress Data for New York IS 52 and Old Town/Penobscot Nation (ME) IMPROVE Protocol Sites in the MANE-VU Region (dv)

		20 Percent Best Days		20 Percent Worst Days	
Class I Area	Year	Haze Index, Annual	Haze Index, 5-Year Rolling	Haze Index, Annual	Haze Index, Year Rolling
New York IS 52 (NEYO)	2000	*	-	*	-
	2001	*	-	*	-
	2002	*	-	*	-
	2003	*	-	*	-
	2004	*	*	*	*
	2005	16.41	*	31.86	*
	2006	14.73	*	30.26	*
	2007	15.19	15.45	30.58	30.90
	2008	15.79	15.53	27.49	30.05
	2009	14.48	15.32	27.11	29.46
	2010	*	*	*	*
	2011	*	*	*	*
	2012	*	*	*	*
	2013	*	*	*	*
	2014	*	*	*	*
	2015	*	*	*	*
	2016	*	*	*	*
	2017	*	*	*	*
	2018				
	2064 NAT		*****		*****
Old Town (OLTO 2003-05) Penobscot Nation (PENO 2006-current)	2000	*	-	*	-
	2001	*	-	*	-
	2002	*	-	*	-
	2003	10.86	-	26.33	-
	2004	11.05	*	23.94	*
	2005	10.20	10.70	24.64	24.97
	2006	9.10	10.30	22.78	24.42
	2007	8.37	9.92	21.92	23.92
	2008	8.52	9.45	21.08	22.87
	2009	7.55	8.75	21.51	22.38
	2010	7.24	8.16	20.45	21.55
	2011	8.38	8.01	20.57	21.10
	2012	8.50	8.04	18.99	20.52
	2013	8.19	7.97	18.65	20.03
	2014	7.77	8.02	18.11	19.35
	2015	6.96	7.96	19.55	19.17
	2016	6.74	7.63	17.15	18.49
	2017	8.11	7.55	16.23	17.94
	2018				
	2064 NAT		*****		*****

"-" = not applicable; "*" = no data available

Table A-13. Tracking Progress Data for Pack Monadnock Summit (NH) and Proctor Maple R. F. (VT) IMPROVE Protocol Sites in the MANE-VU Region (dv)

		20 Percent Best Days		20 Percent Worst Days	
Class I Area	Year	Haze Index, Annual	Haze Index, 5-Year Rolling	Haze Index, Annual	Haze Index, Year Rolling
Pack Monadnock Summit (PACK)	2000	*	-	*	-
	2001	*	-	*	-
	2002	*	-	*	-
	2003	*	-	*	-
	2004	*	*	*	*
	2005	*	*	*	*
	2006	*	*	*	*
	2007	*	*	*	*
	2008	6.56	*	19.64	*
	2009	4.89	*	18.97	*
	2010	5.14	5.53	19.29	19.30
	2011	5.63	5.56	18.89	19.20
	2012	5.55	5.55	18.01	18.96
	2013	5.12	5.27	16.62	18.36
	2014	4.75	5.24	16.67	17.90
	2015	4.57	5.12	16.89	17.41
	2016	4.57	4.91	14.21	16.48
	2017	5.27	4.85	14.54	15.78
	2018				
	2064 NAT		*****		*****
Proctor Maple R. F. (PMRF)	2000	*	-	*	-
	2001	*	-	*	-
	2002	8.67	-	26.29	-
	2003	7.82	-	23.82	-
	2004	8.26	8.25	24.67	24.93
	2005	7.94	8.17	25.93	25.18
	2006	7.97	8.13	22.34	24.61
	2007	7.71	7.94	24.07	24.16
	2008	7.58	7.89	20.32	23.46
	2009	6.27	7.49	19.24	22.38
	2010	6.77	7.26	19.37	21.07
	2011	7.82	7.23	20.19	20.64
	2012	6.40	6.97	17.75	19.37
	2013	6.48	6.75	16.76	18.66
	2014	6.54	6.80	17.47	18.31
	2015	5.70	6.59	17.84	18.00
	2016	5.65	6.15	14.65	16.89
	2017	6.07	6.09	15.14	16.37
	2018				
	2064 NAT		**3.86 NAT**		**11.84 NAT**

"-" = not applicable; "*" = no data available; "NAT" = Natural Conditions

Table A-14. Tracking Progress Data for Presque Isle (ME) and Quabbin Summit (MA) IMPROVE Protocol Sites in the MANE-VU Region (dv)

		20 Percent Best Days		20 Percent Worst Days	
Class I Area	Year	Haze Index, Annual	Haze Index, 5-Year Rolling	Haze Index, Annual	Haze Index, Year Rolling
Presque Isle (PRIS)	2000	*	-	*	-
	2001	*	-	*	-
	2002	9.39	-	23.73	-
	2003	9.53	-	21.69	-
	2004	9.52	9.48	21.62	22.35
	2005	8.80	9.31	21.15	22.05
	2006	9.45	9.34	21.48	21.93
	2007	8.24	9.11	18.17	20.82
	2008	8.21	8.85	20.23	20.53
	2009	8.40	8.62	19.26	20.06
	2010	6.81	8.23	18.66	19.56
	2011	8.25	7.99	17.88	18.84
	2012	7.85	7.91	17.74	18.75
	2013	7.20	7.70	16.52	18.01
	2014	8.39	7.70	17.08	17.57
	2015	6.66	7.67	16.92	17.23
	2016	7.26	7.47	15.01	16.65
	2017	7.68	7.44	15.78	16.26
	2018				
	2064 NAT		**4.91 NAT**		**12.42 NAT**
Quabbin Summit (QURE)	2000	*	-	*	-
	2001	*	-	*	-
	2002	9.83	-	27.45	-
	2003	9.43	-	26.13	-
	2004	10.06	9.77	25.26	26.28
	2005	9.11	9.61	27.23	26.52
	2006	8.50	9.39	25.77	26.37
	2007	8.32	9.08	25.78	26.03
	2008	*	9.00	*	26.01
	2009	7.46	8.35	21.56	25.08
	2010	6.82	7.77	21.42	23.63
	2011	7.74	7.58	20.63	22.35
	2012	7.45	7.37	19.51	20.78
	2013	6.33	7.16	18.32	20.29
	2014	6.64	7.00	17.53	19.48
	2015	6.41	6.91	19.32	19.06
	2016	*	*	*	*
	2017	*	*	*	*
	2018				
	2064 NAT		**3.92 NAT**		**12.05 NAT**

"-" = not applicable; "*" = no data available; "NAT" = Natural Conditions

Table A-15. Tracking Progress Data for the Washington D.C. IMPROVE Protocol Site in the MANE-VU Region (dv)

		20 Percent Best Days		20 Percent Worst Days	
Class I Area	Year	Haze Index, Annual	Haze Index, 5-Year Rolling	Haze Index, Annual	Haze Index, Year Rolling
Washington D.C. (WASH)	2000	17.83	-	30.65	-
	2001	17.10	-	30.58	-
	2002	17.92	-	30.65	-
	2003	16.79	-	30.34	-
	2004	16.29	17.19	30.13	30.47
	2005	17.71	17.16	31.99	30.74
	2006	17.19	17.18	29.15	30.45
	2007	16.80	16.95	29.48	30.22
	2008	16.30	16.86	27.73	29.70
	2009	15.01	16.60	25.76	28.82
	2010	*	16.32	*	28.03
	2011	14.17	15.57	24.72	26.92
	2012	13.16	14.66	23.25	25.37
	2013	*	14.11	*	24.58
	2014	12.69	13.34	23.61	23.86
	2015	*	*	*	*
	2016	*	*	*	*
	2017	*	*	*	*
	2018				
	2064 NAT		**5.52 NAT**		**11.86 NAT**

"-" = not applicable; "*" = no data available; "NAT" = Natural Conditions

Table A-16. Tracking Progress Data for the Quaker City (OH) IMPROVE Protocol Site Adjacent to the MANE-VU Region (dv)

		20 Percent Best Days		20 Percent Worst Days	
Class I Area	Year	Haze Index, Annual	Haze Index, 5-Year Rolling	Haze Index, Annual	Haze Index, Year Rolling
Quaker City (QUCI)	2000	*	-	*	-
	2001	*	-	*	-
	2002	15.59	-	30.73	-
	2003	15.30	-	30.13	-
	2004	14.79	15.23	30.54	30.46
	2005	16.09	15.44	32.52	30.98
	2006	14.65	15.28	29.40	30.66
	2007	14.89	15.14	30.51	30.62
	2008	14.04	14.89	26.66	29.93
	2009	13.02	14.54	25.33	28.88
	2010	*	14.15	*	27.98
	2011	12.80	13.69	26.29	27.20
	2012	12.14	13.00	23.35	25.41
	2013	12.12	12.52	23.51	24.62
	2014	12.47	12.38	23.86	24.25
	2015	11.53	12.21	22.97	23.99
	2016	10.49	11.75	20.69	22.87
	2017	10.17	11.36	20.49	22.30
	2018				
	2064 NAT		**4.96 NAT**		**10.97 NAT**

"-" = not applicable; "*" = no data available; "NAT" = Natural Conditions

Appendix B: Natural Conditions for Class I Areas and IMPROVE Protocol Sites in and Adjacent to the MANE-VU Region

Table B-1. 20 Percent Best Days Natural Conditions for Class I and IMPROVE Protocol Sites in and Adjacent to the MANE-VU Region

Site	Deciview (dv)	Sulfate Extinction (Mm-1)	Nitrate Extinction (Mm-1)	Organic Mass Carbon Extinction (Mm-1)	Light Absorbing Carbon Extinction (LAC or EC) (Mm-1)	Coarse Mass Extinction (Mm-1)	Sea Salt Extinction (Mm-1)	Soil Extinction (Mm-1)
MANE-VU Class I Areas								
ACAD	4.66	0.7595	0.2730	2.0005	0.0835	0.5637	0.1863	0.1043
BRIG	5.52	0.8812	0.3524	2.5448	0.1196	1.0397	0.2223	0.2423
GRGU	3.73	0.6705	0.3543	1.6115	0.0820	0.6313	0.1070	0.0962
LYBR	2.79	0.3948	0.2593	1.0268	0.0589	0.3773	0.0462	0.0857
MOOS	5.02	0.8399	0.3252	2.2457	0.1245	0.7514	0.1612	0.1196
Nearby Class I Areas								
DOSO	3.64	0.7995	0.3831	2.3514	0.1045	0.5750	0.0698	0.1678
SHEN	3.15	0.5570	0.5537	1.6363	0.0838	0.7178	0.0711	0.1449
JARI	4.39	0.8129	0.4689	2.0729	0.0962	0.8321	0.0638	0.1978
MANE-VU IMPROVE Protocol Sites								
ADPI	4.12	0.6648	0.3750	2.0577	0.0899	0.6184	0.1917	0.1261
AREN	4.24	0.6960	0.2867	2.0404	0.0918	0.8223	0.1702	0.1927
BALT	*	*	*	*	*	*	*	*
BRMA	4.65	0.7448	0.3002	1.8444	0.0781	0.6553	0.2117	0.1086
CABA	4.83	0.7265	0.2298	1.9915	0.0796	0.8690	0.1760	0.1680
CACO	5.95	0.7803	0.4336	2.5550	0.1174	1.0377	1.1255	0.1444
COHI	4.30	0.6786	0.4191	2.1085	0.0889	0.7231	0.2415	0.1442
FRRE	*	*	*	*	*	*	*	*
LOND	*	*	*	*	*	*	*	*
MAVI	*	*	*	*	*	*	*	*
MKGO	4.52	0.7938	0.4743	2.1387	0.0899	0.8723	0.2068	0.1993
MOMO	3.67	0.6412	0.2817	1.6037	0.0798	0.5512	0.1542	0.1597
NEYO	*	*	*	*	*	*	*	*
OLTO/ PENO	*	*	*	*	*	*	*	*
PACK	*	*	*	*	*	*	*	*
PMRF	3.86	0.5701	0.2456	2.0416	0.0870	0.5556	0.1459	0.0884
PRIS	4.91	0.7197	0.2682	2.0451	0.1177	0.8076	0.2050	0.2071
QURE	3.92	0.6233	0.2170	1.8398	0.0800	0.7206	0.2309	0.1189
WASH	5.52	0.8651	0.3912	2.3469	0.1282	1.1902	0.1747	0.2892
Nearby IMPROVE Protocol Site								
QUCI	4.96	0.7689	0.5849	2.6676	0.1145	0.9722	0.1241	0.2230

* = no data available

Table B-2. 20 Percent Worst Days Natural Conditions for Class I and IMPROVE Protocol Sites in and Adjacent to the MANE-VU Region

Site	Deciview (dv)	Sulfate Extinction (Mm-1)	Nitrate Extinction (Mm-1)	Organic Mass Carbon Extinction (Mm-1)	Light Absorbing Carbon Extinction (LAC or EC) (Mm-1)	Coarse Mass Extinction (Mm-1)	Sea Salt Extinction (Mm-1)	Soil Extinction (Mm-1)
MANE-VU Class I Areas								
ACAD	12.43	4.7938	1.9725	11.8060	0.3984	2.1727	2.1266	0.5171
BRIG	12.25	3.1557	1.0712	12.7780	0.2888	2.6208	3.5770	0.8464
GRGU	11.99	4.5183	1.0773	13.3285	0.3758	3.2946	0.1126	0.5272
LYBR	11.73	4.8210	1.4101	14.8187	0.4443	2.0124	0.0986	0.6646
MOOS	12.01	4.0468	1.7126	11.6411	0.3554	2.3472	1.5153	0.3980
Nearby Class I Areas								
DOSO	10.39	3.1743	1.1875	10.4959	0.2926	2.2789	0.3489	0.7503
SHEN	11.35	3.5743	0.6118	13.7010	0.3436	3.0203	0.1859	0.8311
JARI	11.13	3.1837	1.1060	11.4800	0.2935	2.7547	0.2565	0.8107
MANE-VU IMPROVE Protocol Sites								
ADPI	11.57	4.0435	1.0870	13.1229	0.3389	2.5252	0.2276	0.8356
AREN	11.77	3.0944	1.3121	12.5786	0.3170	2.8528	1.4241	0.9127
BALT	*	*	*	*	*	*	*	*
BRMA	12.07	4.4127	1.5194	12.7723	0.3840	1.9131	0.5394	0.5898
CABA	12.83	3.5904	1.4688	14.1171	0.3408	3.1164	2.7239	0.6534
CACO	13.20	3.2401	1.0399	13.0792	0.3146	2.4678	6.7525	0.6412
COHI	11.50	3.8570	1.2038	11.9970	0.3449	2.4144	0.4405	0.8520
FRRE	*	*	*	*	*	*	*	*
LOND	*	*	*	*	*	*	*	*
MAVI	*	*	*	*	*	*	*	*
MKGO	11.36	3.7290	1.1855	10.5895	0.3040	2.8081	0.8853	0.8369
MOMO	12.42	4.2753	1.3525	14.2693	0.3722	2.4683	1.3911	0.8018
NEYO	*	*	*	*	*	*	*	*
OLTO/ PENO	*	*	*	*	*	*	*	*
PACK	*	*	*	*	*	*	*	*
PMRF	11.84	4.8277	1.4642	12.8883	0.3771	2.1432	0.2927	0.6634
PRIS	12.42	3.9481	1.8214	12.6747	0.3279	3.0528	0.7848	0.9000
QURE	12.05	4.0619	1.6509	14.8310	0.3837	2.5297	0.3974	0.8275
WASH	11.86	2.5865	1.3201	11.4738	0.2832	2.5099	2.3017	0.7971
Nearby IMPROVE Protocol Site								
QUCI	10.97	3.6478	0.7340	10.3656	0.2864	2.5784	0.7847	0.9253

* = no data available

Appendix C: Constituent Light Extinction Data for Class I Areas and IMPROVE Protocol Sites in and Adjacent to the MANE-VU Region

Table C-1. Observed Light Extinction Conditions for the Acadia National Park (ME) MANE-VU Class I Area

Year	Sulfate (Mm^{-1})	Nitrate (Mm^{-1}))	Organic Mass Carbon (Mm^{-1})	Light Absorbing Carbon (LAC or EC) (Mm^{-1})	Coarse Mass (Mm^{-1})	Sea Salt (Mm^{-1})	Soil (Mm^{-1})	Total PM[@] (Mm^{-1})
20 PERCENT BEST DAYS								
2000	7.2439	0.9890	2.2073	1.0977	0.6710	0.2676	0.0982	12.5746
2001	7.5656	1.3663	1.8168	0.8588	0.6108	0.1218	0.1346	12.4748
2002	6.2921	1.0140	2.4590	0.8563	0.8157	0.6305	0.0969	12.1646
2003	6.8416	1.0701	2.0937	0.7825	0.6141	0.6702	0.1005	12.1727
2004	5.8580	0.9467	2.6046	0.7523	0.8663	0.5067	0.1235	11.6581
2005	4.7059	0.9316	1.7707	0.7716	0.6932	0.7887	0.0681	9.7297
2006	5.7226	0.8888	1.9404	0.8722	0.8172	0.6234	0.0764	10.9409
2007	5.8610	0.7017	2.3054	0.7483	0.7392	0.3777	0.0995	10.8328
2008	4.9094	0.6604	1.9764	0.5716	0.9105	0.8242	0.0898	9.9423
2009	3.9262	0.5181	1.5387	0.4616	0.9874	0.5966	0.0904	8.1191
2010	3.8472	0.6466	1.6922	0.5004	0.5350	0.4318	0.0746	7.7278
2011	4.6339	0.5538	1.8537	0.5208	0.8091	0.7817	0.0453	9.1983
2012	4.9331	0.6886	2.0719	0.6228	0.9935	0.5476	0.0904	9.9478
2013	3.5974	0.5339	1.2331	0.3073	0.5955	0.5328	0.0421	6.8422
2014	4.3119	0.6779	1.5715	0.3670	0.8943	0.5999	0.0466	8.4690
2015	2.6593	0.5998	1.4613	0.2484	0.8013	0.6041	0.0331	6.4073
2016	2.7208	0.5094	1.5919	0.3522	0.7841	0.4607	0.0391	6.4582
2017	3.5016	0.7208	2.3469	0.6753	0.9776	0.3367	0.0581	8.6169
2018								
20 PERCENT WORST DAYS								
2000	48.3659	10.5613	8.2161	4.6455	2.4776	3.0650	0.3200	77.6513
2001	75.4901	7.4842	11.9347	4.5252	1.5811	0.0238	0.6013	101.6404
2002	74.8401	8.2284	14.5603	4.0425	1.8699	0.7600	0.8162	105.1175
2003	84.9202	5.5528	12.8398	4.8698	1.6909	0.6118	0.4707	110.9560
2004	62.4690	8.2750	8.2863	3.5744	1.8095	1.9132	0.4056	86.7329
2005	70.0505	5.6918	13.0198	4.5688	2.0004	1.3250	0.2582	96.9146
2006	69.6108	9.1610	9.4641	4.1107	2.8336	1.3395	0.3600	96.8797
2007	56.3828	6.9572	11.0731	3.8705	2.6551	1.8771	0.3860	83.2018
2008	46.6651	5.5000	8.2498	2.7879	2.0962	1.3100	0.3294	66.9384
2009	43.5207	4.7636	6.1035	2.3529	2.0470	1.9810	0.3837	61.1524
2010	35.8810	3.8200	10.7852	2.8918	2.1605	0.7101	0.4099	56.6585
2011	31.0418	5.5548	9.7822	2.5459	2.9447	4.0405	0.2004	56.1102
2012	21.6178	5.6383	6.9844	2.2933	2.3679	3.3557	0.2628	42.5201
2013	21.4273	4.0362	7.7598	2.0869	2.8644	2.4650	0.2356	40.8751
2014	18.8637	5.9896	7.5501	2.1235	2.9911	4.0283	0.1819	41.7281
2015	22.7416	5.1292	12.7561	2.6503	2.6623	2.1537	0.2380	48.3312
2016	12.9688	5.3942	6.2469	1.5688	2.1977	3.2296	0.1451	31.7511
2017	13.7880	5.5243	9.7080	1.9956	2.8538	4.3831	0.1970	38.4499
2018								

"[@]" = does not include Rayleigh (12 Mm^{-1})

Table C-2. Observed Light Extinction Conditions for the Brigantine Wilderness Area (NJ) MANE-VU Class I Area

Year	Sulfate (Mm^{-1})	Nitrate (Mm^{-1}))	Organic Mass Carbon (Mm^{-1})	Light Absorbing Carbon (LAC or EC) (Mm^{-1})	Coarse Mass (Mm^{-1})	Sea Salt (Mm^{-1})	Soil (Mm^{-1})	Total PM@ (Mm^{-1})
20 PERCENT BEST DAYS								
2000	14.8238	3.6542	4.6951	2.9656	3.4484	0.7103	0.2252	30.5226
2001	13.9839	3.6573	4.3049	2.3899	3.5978	0.2006	0.2412	28.3755
2002	16.3451	3.6267	4.3113	2.0506	3.9049	2.0065	0.2334	32.4786
2003	15.1058	3.9268	4.0418	1.9022	2.8311	2.6278	0.1906	30.6260
2004	13.8696	4.4112	5.3658	2.7658	2.2370	1.2595	0.2807	30.1895
2005	15.7543	3.9352	3.3387	2.1872	2.8512	3.4870	0.1678	31.7215
2006	16.1510	4.1794	3.9553	2.0306	5.3474	2.6397	0.2519	34.5552
2007	11.2823	3.2614	3.2743	1.6435	2.3860	1.9732	0.2112	24.0319
2008	*	*	*	*	*	*	*	*
2009	10.9321	2.8349	3.8262	1.6765	2.5362	2.0940	0.2574	24.1573
2010	8.8392	2.6038	3.8829	1.8747	2.7450	0.9082	0.2386	21.0923
2011	9.9082	3.6809	3.3135	1.6273	4.0391	1.9930	0.1506	24.7126
2012	8.4524	2.9757	3.3331	1.3942	3.3176	1.5212	0.1470	21.1413
2013	8.5972	2.8276	3.6730	1.5700	2.5344	1.4887	0.1325	20.8234
2014	8.0833	2.5614	4.5244	1.2381	2.7491	1.3747	0.1385	20.6695
2015	6.2453	2.6372	3.6758	1.1527	3.5153	2.1706	0.1648	19.5617
2016	6.3094	2.2466	2.9277	0.8905	4.6521	1.4024	0.1265	18.5552
2017	6.3476	2.5019	4.1128	1.3472	3.2181	1.7228	0.1425	19.3928
2018								
20 PERCENT WORST DAYS								
2000	122.7397	19.1973	19.1837	8.1374	5.5064	0.4700	0.6489	175.8834
2001	116.1949	18.1227	16.0999	6.6620	8.8879	0.1096	1.1152	167.1923
2002	122.0994	13.3958	48.8899	7.8816	4.3365	0.0564	1.0951	197.7547
2003	145.3202	17.7621	18.7848	6.9933	3.5191	0.4207	0.8308	193.6311
2004	129.2826	9.9709	18.0991	5.1344	4.6975	0.9303	1.1542	169.2689
2005	148.4988	11.9817	15.9732	6.8266	6.5111	0.8561	0.5899	191.2374
2006	119.2774	8.1999	16.9367	6.3685	12.9434	0.7768	0.7994	165.3022
2007	100.4473	13.2819	13.1603	5.9229	4.3276	1.6337	0.6711	139.4448
2008	*	*	*	*	*	*	*	*
2009	61.3245	15.3091	13.6988	5.4207	5.2587	1.3388	0.7267	103.0772
2010	64.3917	20.3210	12.6229	4.9314	10.7119	1.5839	0.8129	115.3756
2011	58.0357	12.8624	19.2698	4.5503	26.0453	1.9280	0.3860	123.0776
2012	39.3715	14.0830	12.2865	4.4238	6.6244	1.3666	0.4090	78.5647
2013	34.5306	17.9804	10.7885	4.6177	4.7240	2.3304	0.3055	75.2769
2014	39.1323	28.7918	14.0240	4.7237	6.2264	2.0129	0.4558	95.3670
2015	31.1216	18.5360	15.3749	4.4328	6.0159	2.0455	0.5580	78.0847
2016	21.6416	19.5248	11.9343	4.1391	9.5626	2.2528	0.3913	69.4467
2017	21.4893	12.3241	13.8185	3.9042	10.7272	2.2413	0.2881	64.7926
2018								

"*" = no data available; "@" = does not include Rayleigh (12 Mm^{-1})

Table C-3. Observed Light Extinction Conditions for the Great Gulf Wilderness Area (NH) MANE-VU Class I Area

Year	Sulfate (Mm^{-1})	Nitrate (Mm^{-1}))	Organic Mass Carbon (Mm^{-1})	Light Absorbing Carbon (LAC or EC) (Mm^{-1})	Coarse Mass (Mm^{-1})	Sea Salt (Mm^{-1})	Soil (Mm^{-1})	Total PM[@] (Mm^{-1})
20 PERCENT BEST DAYS								
2000	*	*	*	*	*	*	*	*
2001	6.4643	1.1261	2.1295	0.8689	1.1306	0.0493	0.1617	11.9304
2002	5.9630	1.0314	2.0081	0.8356	0.6854	0.3935	0.0607	10.9777
2003	4.8105	0.6938	1.8576	0.8166	0.9618	0.0462	0.0691	9.2556
2004	5.8601	1.0328	2.0283	0.8013	0.7181	0.2029	0.1182	10.7616
2005	5.2539	0.7792	1.6723	0.7775	0.5980	0.1316	0.0554	9.2679
2006	4.7361	0.4188	1.5973	0.6683	0.7403	0.0730	0.0818	8.3155
2007	5.2079	0.6450	1.4722	0.6859	0.7000	0.1614	0.0980	8.9704
2008	4.0328	0.5706	1.4574	0.4780	0.7648	0.2821	0.0806	7.6662
2009	*	*	*	*	*	*	*	*
2010	*	*	*	*	*	*	*	*
2011	4.0137	0.6572	1.6326	0.5217	0.8591	0.2971	0.0426	8.0239
2012	3.5133	0.6748	1.4012	0.4949	0.6135	0.1974	0.0656	6.9606
2013	3.5433	0.5099	0.9524	0.3053	0.6614	0.3016	0.0431	6.3168
2014	3.9499	0.6105	1.3963	0.4815	0.4897	0.0938	0.0459	7.0676
2015	2.6693	0.5148	1.4270	0.2617	0.5017	0.0420	0.0264	5.4429
2016	2.3030	0.6382	1.1407	0.2984	0.5188	0.1261	0.0327	5.0579
2017	3.0619	0.6171	1.3255	0.4418	0.4000	0.1018	0.0386	5.9866
2018								
20 PERCENT WORST DAYS								
2000	*	*	*	*	*	*	*	*
2001	80.8830	3.0088	11.0283	3.9139	2.9959	0.0230	0.5884	102.4412
2002	100.0603	2.9084	20.1324	4.3690	2.6542	0.1749	0.7400	131.0392
2003	58.9896	2.5345	15.1511	4.0040	2.7977	0.0043	0.4226	83.9038
2004	66.4482	3.6233	11.1862	3.3987	3.4473	0.3163	0.5414	88.9614
2005	58.7447	1.4928	12.9885	4.0071	2.2202	0.1929	0.2458	79.8919
2006	61.4704	3.2653	10.6060	3.4807	2.9956	0.0943	0.4249	82.3370
2007	59.2138	1.6866	11.0284	3.4519	2.8290	0.3260	0.4542	78.9899
2008	30.7636	0.9423	7.3264	1.9225	2.2051	0.0225	0.3305	43.5129
2009	*	*	*	*	*	*	*	*
2010	*	*	*	*	*	*	*	*
2011	35.0642	2.1682	16.2482	2.9283	2.4605	0.2788	0.1954	59.3436
2012	21.7584	1.8814	9.5289	2.2825	2.7268	0.9790	0.2369	39.3940
2013	19.8853	2.8601	7.2428	1.8643	2.9087	0.2771	0.2693	35.3076
2014	25.6404	2.2760	9.4763	2.2395	2.0312	0.2143	0.1905	42.0682
2015	19.7974	2.8343	10.6724	2.1291	2.4266	0.2766	0.2657	38.4020
2016	11.1879	1.5445	9.1074	1.6214	3.0200	0.0671	0.2124	26.7606
2017	12.4994	1.7471	11.1117	1.9527	2.5294	0.4163	0.1781	30.4346
2018								

"*" = no data available; "[@]" = does not include Rayleigh (11 Mm^{-1})

Table C-4. Observed Light Extinction Conditions for the Lye Brook Wilderness Area^ (VT) MANE-VU Class I Area

Year	Sulfate (Mm^{-1})	Nitrate (Mm^{-1}))	Organic Mass Carbon (Mm^{-1})	Light Absorbing Carbon (LAC or EC) (Mm^{-1})	Coarse Mass (Mm^{-1})	Sea Salt (Mm^{-1})	Soil (Mm^{-1})	Total PM@ (Mm^{-1})
20 PERCENT BEST DAYS								
2000	5.0730	1.2224	1.1102	0.5864	0.3690	0.0141	0.0787	8.4537
2001	4.3964	1.2348	1.2440	0.6783	0.5800	0.0107	0.1613	8.3056
2002	4.6585	1.1722	1.2096	0.5562	0.5116	0.0731	0.0579	8.2390
2003	3.6867	0.8746	1.1944	0.5886	0.6148	0.0541	0.0549	7.0682
2004	4.3933	1.2637	1.6766	0.5782	0.4973	0.1027	0.1148	8.6265
2005	4.0182	0.9138	0.9613	0.4954	0.6019	0.0403	0.0468	7.0776
2006	3.3859	0.7785	0.8306	0.4587	0.5574	0.0733	0.0629	6.1473
2007	4.0784	0.5532	0.9245	0.4713	0.5213	0.1313	0.0737	6.7536
2008	*	*	*	*	*	*	*	*
2009	2.2098	0.7777	0.3783	0.2772	0.3799	0.1260	0.0578	4.2067
2010	2.1616	0.6283	0.7178	0.2853	0.3021	0.0485	0.0643	4.2080
2011	3.3050	0.9908	1.0028	0.4270	0.4547	0.1268	0.0433	6.3502
2012	3.2847	0.9485	1.1227	0.5641	0.4243	0.0964	0.0511	6.4919
2013	3.0485	0.7958	1.1521	0.3481	0.6484	0.2108	0.0478	6.2515
2014	2.5889	0.7431	1.3781	0.3925	0.6074	0.1360	0.0369	5.8830
2015	2.4516	0.6370	1.5611	0.3714	0.6150	0.2240	0.0574	5.9174
2016	2.1129	1.0996	1.0990	0.3044	0.6968	0.0952	0.0437	5.4515
2017	2.5184	1.0784	1.6167	0.4661	0.6342	0.0818	0.0805	6.4761
2018								
20 PERCENT WORST DAYS								
2000	68.6622	10.7131	10.0128	5.1871	1.6389	0.0219	0.3715	96.6076
2001	117.4323	7.0978	12.0870	4.6629	2.0764	0.0305	0.7603	144.1472
2002	88.2080	11.3277	31.2475	5.7232	1.3926	0.0592	0.8317	138.7900
2003	87.7013	7.9077	13.9783	4.8251	2.1835	0.1924	0.5132	117.3017
2004	74.4244	8.3599	9.3994	3.4105	1.6874	0.1713	0.7252	98.1780
2005	117.9252	1.9816	11.8146	4.4331	2.1328	0.2047	0.3870	138.8790
2006	62.4308	8.9458	10.2500	4.2267	2.3200	0.2413	0.4470	88.8617
2007	97.0645	4.5098	14.6689	4.9400	3.1261	0.1541	0.6902	125.1536
2008	*	*	*	*	*	*	*	*
2009	38.4431	6.9467	6.4857	2.4615	2.2390	0.5348	0.5334	57.6442
2010	50.4386	3.5436	10.5743	3.3830	1.9089	0.0452	0.5967	70.4904
2011	40.2514	4.5920	11.3046	3.0941	1.9087	0.2379	0.2856	61.6744
2012	31.3152	9.2599	8.3565	3.2062	1.9609	0.1807	0.3336	54.6130
2013	29.2746	7.7260	6.2276	2.2830	1.9427	0.2318	0.2596	47.9453
2014	24.7463	8.0242	7.4222	2.4254	2.2545	0.3150	0.2955	45.4832
2015	22.1533	7.6226	11.6653	2.6946	1.9929	0.2952	0.3293	46.7532
2016	15.3087	8.3623	7.8544	2.0779	2.2816	0.2776	0.2566	36.4191
2017	14.0200	9.0166	9.8526	2.3465	2.0693	0.2179	0.2196	37.7425
2018								

"*" = no data available; "^" = site location changed in 2012; "@" = does not include Rayleigh (11 Mm^{-1})

Table C-5. Observed Light Extinction Conditions for the Moosehorn Wilderness Area (ME) MANE-VU Class I Area

Year	Sulfate (Mm^{-1})	Nitrate (Mm^{-1}))	Organic Mass Carbon (Mm^{-1})	Light Absorbing Carbon (LAC or EC) (Mm^{-1})	Coarse Mass (Mm^{-1})	Sea Salt (Mm^{-1})	Soil (Mm^{-1})	Total PM@ (Mm^{-1})
20 PERCENT BEST DAYS								
2000	6.6094	1.1516	3.0241	1.2397	0.9853	0.0436	0.0933	13.1471
2001	7.0210	1.2883	3.0124	1.0359	0.9001	0.1404	0.1360	13.5341
2002	6.5543	1.0383	3.0820	1.0036	1.0919	0.2597	0.1245	13.1543
2003	7.3850	0.9131	3.0920	0.9067	1.2369	0.3470	0.1041	13.9848
2004	5.7625	0.9065	3.1237	0.9300	1.1010	0.7105	0.1144	12.6485
2005	5.1411	0.7229	2.2331	0.8519	0.7050	0.8046	0.0784	10.5369
2006	5.4998	0.9418	2.8619	1.1318	0.6747	0.7096	0.1060	11.9256
2007	5.5015	0.6425	1.9018	0.6390	0.7789	0.3474	0.1051	9.9162
2008	4.8291	0.5542	2.0217	0.6440	1.0175	0.7004	0.1278	9.8947
2009	4.0301	0.5086	1.6421	0.4299	0.6257	0.6457	0.0794	7.9616
2010	2.9271	0.4116	1.5581	0.4693	0.4481	0.4170	0.0802	6.3114
2011	3.9249	0.3987	2.0636	0.5066	0.8260	0.4426	0.0325	8.1948
2012	4.3322	0.5173	1.9993	0.5145	0.8500	0.5350	0.0878	8.8361
2013	3.5033	0.5274	1.6247	0.3689	0.6483	0.5338	0.0413	7.2476
2014	4.1757	0.4658	2.0379	0.4181	0.7746	0.3532	0.0625	8.2878
2015	2.9793	0.4800	2.1457	0.3508	0.7836	0.7284	0.0397	7.5075
2016	2.8048	0.6860	1.3279	0.2047	0.7386	0.6593	0.0433	6.4646
2017	3.0473	0.6140	2.4057	0.5582	0.7249	0.3768	0.0754	7.8024
2018								
20 PERCENT WORST DAYS								
2000	43.4688	8.5142	8.7600	3.6188	2.7035	2.0578	0.2794	69.4024
2001	66.0637	5.9004	12.7952	3.9643	2.0879	0.0260	0.4696	91.3071
2002	71.4989	6.3950	16.0319	3.9885	1.6725	0.4941	0.4241	100.5050
2003	64.6918	5.4923	13.4746	7.2680	2.3338	0.3941	0.3581	94.0127
2004	46.5303	5.6726	8.6520	3.1750	1.7769	1.8077	0.3867	68.0012
2005	61.2351	4.3371	14.4797	3.9331	1.5805	2.6280	0.2519	88.4454
2006	55.7664	6.0578	9.5989	3.2654	1.6432	1.3639	0.2835	77.9791
2007	37.9364	5.2368	9.3126	3.0747	1.8871	1.4063	0.3069	59.1609
2008	37.7977	3.8736	8.7369	2.5083	1.9413	1.1788	0.3534	56.3900
2009	35.7548	3.5030	6.2632	2.8799	1.5061	2.2807	0.3906	52.5784
2010	29.3617	2.8803	11.4338	2.4710	1.5779	0.3536	0.4067	48.4850
2011	27.0803	3.7689	8.2791	2.0185	1.9824	2.6168	0.1829	45.9289
2012	21.6051	3.4404	7.0696	2.0116	1.6731	2.1414	0.2351	38.1763
2013	19.6180	3.0487	8.8790	1.7385	2.0250	2.4859	0.2111	38.0060
2014	17.5658	4.2435	7.6589	1.6380	2.7352	4.2737	0.1902	38.3054
2015	19.4455	3.5188	10.0740	2.1104	1.6495	3.2636	0.2240	40.2858
2016	11.9114	4.5330	6.3156	1.5502	1.9475	2.2782	0.1608	28.6967
2017	10.8081	4.2471	8.7102	2.2305	2.0439	4.6335	0.1729	32.8463
2018								

"@" = does not include Rayleigh (12 Mm^{-1})

Table C-6. Observed Light Extinction Conditions for the Dolly Sods Wilderness Area (WV) Nearby Adjacent Class I Area

Year	Sulfate (Mm^{-1})	Nitrate (Mm^{-1}))	Organic Mass Carbon (Mm^{-1})	Light Absorbing Carbon (LAC or EC) (Mm^{-1})	Coarse Mass (Mm^{-1})	Sea Salt (Mm^{-1})	Soil (Mm^{-1})	Total PM@ (Mm^{-1})
20 PERCENT BEST DAYS								
2000	14.1466	4.0176	6.5973	2.8846	0.7419	0.1281	0.2106	28.7267
2001	17.9991	2.8831	4.6931	2.1210	0.7378	0.0141	0.1950	28.6431
2002	13.1993	2.9989	4.6255	1.9693	0.7351	0.0028	0.1443	23.6752
2003	12.9810	3.0857	4.4461	1.6669	0.6758	0.0656	0.1626	23.0838
2004	13.4115	2.5299	4.0154	1.6233	0.7774	0.4166	0.1786	22.9527
2005	14.1525	3.4712	3.5653	1.8713	0.9139	0.1391	0.1609	24.2743
2006	12.0237	1.6111	2.9423	1.5956	0.8240	0.1772	0.1714	19.3452
2007	11.5849	1.6258	3.0507	1.4260	0.8161	0.2150	0.1849	18.9034
2008	9.7196	2.0432	2.3644	1.0493	0.7962	0.3067	0.1588	16.4381
2009	8.3081	1.5507	2.4941	1.0434	0.7285	0.1285	0.2595	14.5128
2010	10.0016	2.1692	3.4043	1.3171	0.7944	0.0642	0.2051	17.9559
2011	7.7774	1.5901	2.8769	1.0764	0.8510	0.3453	0.1047	14.6219
2012	9.3727	1.9137	2.7927	1.2251	0.9676	0.0776	0.1834	16.5328
2013	8.0718	1.5874	2.2204	0.9367	0.7561	0.0835	0.0959	13.7516
2014	7.4931	1.8611	2.3603	0.9700	0.8653	0.1416	0.1192	13.8107
2015	4.1304	0.8187	1.8949	0.5658	0.7754	0.1075	0.0884	8.3811
2016	5.5703	1.3965	2.0647	0.6652	0.7795	0.0845	0.0947	10.6555
2017	4.5396	1.4293	2.2045	0.7778	0.8010	0.0681	0.0712	9.8915
2018								
20 PERCENT WORST DAYS								
2000	148.6200	3.8184	15.4418	6.4424	2.7819	0.0298	0.5922	177.7265
2001	155.1238	4.1211	11.5071	4.2094	1.8356	0.2999	0.7941	177.8910
2002	153.2829	2.8646	11.8235	4.1404	1.5747	0.0056	0.8210	174.5127
2003	171.2086	4.4413	13.5167	4.9432	1.0043	0.0044	0.5542	195.6728
2004	174.3876	1.7374	14.5899	3.6744	1.4804	0.3166	1.1032	197.2895
2005	195.2850	1.6633	10.1625	4.4360	2.1427	0.1269	0.7156	214.5320
2006	176.8509	1.7525	11.8044	4.3055	1.5012	0.1695	0.7331	197.1171
2007	164.2747	2.2995	15.6813	4.0479	2.6374	0.1388	0.8596	189.9391
2008	100.3560	2.4915	12.5541	3.2405	2.2032	0.1127	0.8920	121.8499
2009	69.7018	1.5870	7.2627	2.3286	1.5886	0.0169	0.6646	83.1502
2010	80.4749	3.7158	14.3111	3.0461	1.9083	0.0415	0.8686	104.3663
2011	91.4807	3.1020	11.6794	3.0053	2.1495	0.2819	0.4124	112.1111
2012	59.3904	2.1242	8.8378	2.5771	2.3631	0.2416	0.6059	76.1401
2013	46.1389	6.2854	8.3851	2.6365	2.0981	0.3550	0.3192	66.2181
2014	48.3608	5.1561	7.8162	2.3998	2.5455	0.2296	0.5796	67.0876
2015	40.9752	4.7093	14.7332	3.0441	2.9129	0.1663	0.6927	67.2337
2016	30.9497	4.9478	10.5118	2.4911	2.6737	0.1917	0.3220	52.0879
2017	23.5923	8.4035	10.7167	2.8068	1.9946	0.1033	0.2332	47.8503
2018								

"@" = does not include Rayleigh (10 Mm^{-1})

Table C-7. Observed Light Extinction Conditions for the Shenandoah National Park (VA) Nearby Adjacent Class I Area

Year	Sulfate (Mm^{-1})	Nitrate (Mm^{-1}))	Organic Mass Carbon (Mm^{-1})	Light Absorbing Carbon (LAC or EC) (Mm^{-1})	Coarse Mass (Mm^{-1})	Sea Salt (Mm^{-1})	Soil (Mm^{-1})	Total PM@ (Mm^{-1})
20 PERCENT BEST DAYS								
2000	8.7478	4.6604	4.0378	2.0622	1.4201	0.0906	0.1602	21.1790
2001	15.7978	5.3540	3.1117	1.7873	1.3521	0.2586	0.2044	27.8660
2002	11.9042	4.8729	2.7816	1.6172	0.9004	0.0029	0.1368	22.2160
2003	10.0164	2.9020	2.2700	1.3118	1.0800	0.1302	0.1665	17.8768
2004	9.3532	3.0335	2.1409	1.2039	0.7366	0.2529	0.1188	16.8397
2005	11.5988	2.9367	2.7523	1.6925	0.8282	0.1313	0.1311	20.0708
2006	10.8099	3.2486	2.3501	1.5255	1.1004	0.2713	0.2052	19.5111
2007	12.1544	4.3317	2.1840	1.3783	0.8723	0.1863	0.1395	21.2465
2008	8.0929	2.3305	1.5283	0.8868	0.7935	0.1485	0.1268	13.9073
2009	7.7142	1.7652	1.9921	0.9887	1.0924	0.0972	0.1407	13.7905
2010	8.3517	3.4914	2.7915	1.2714	1.1434	0.0751	0.1637	17.2882
2011	6.5673	2.1707	1.7210	0.8535	1.0937	0.2929	0.0727	12.7718
2012	8.6585	3.1769	2.2517	1.0074	1.0954	0.1083	0.1496	16.4479
2013	5.6372	2.4554	1.6530	0.6622	0.8900	0.2996	0.1150	11.7124
2014	6.2681	2.2664	1.9677	0.8285	1.1921	0.1635	0.1031	12.7893
2015	3.8239	1.9364	2.2123	0.6580	1.0629	0.0848	0.0534	9.8318
2016	5.5528	1.9586	2.1164	0.6997	1.0231	0.0488	0.0932	11.4926
2017	3.9204	1.3711	2.4161	0.7356	0.7898	0.0524	0.0545	9.3399
2018								
20 PERCENT WORST DAYS								
2000	135.8777	4.5372	16.6831	6.5454	2.8225	0.0290	0.4442	166.9391
2001	156.1980	6.2072	15.0748	5.8770	2.7548	0.0334	0.6043	186.7495
2002	174.8349	5.8912	20.3997	5.4766	3.2744	0.0057	1.1222	211.0046
2003	153.0304	6.3358	14.6814	5.5678	2.0471	0.0044	0.4846	182.1515
2004	157.5948	6.1272	13.6740	5.1187	1.7911	0.3654	0.9681	185.6393
2005	193.4325	4.4850	10.7779	5.2921	2.1451	0.3586	0.5107	217.0019
2006	158.0071	2.7336	13.8519	5.1587	2.4656	0.3622	0.7060	183.2852
2007	146.6409	3.3144	16.8593	5.1953	2.6936	0.3890	0.7548	175.8473
2008	95.8189	3.5008	17.1203	4.3557	2.5391	0.3281	0.7541	124.4170
2009	62.0411	3.6471	8.5018	3.4959	2.3426	0.2287	0.5696	80.8268
2010	72.3735	5.7566	12.2175	3.7365	3.7651	0.0759	0.9286	98.8537
2011	70.7822	4.6113	13.9277	3.7712	3.7112	0.3643	0.3831	97.5510
2012	49.4737	3.0188	9.2545	3.1828	2.9667	0.3163	0.6214	68.8341
2013	42.7826	7.2473	7.8324	3.0251	2.3703	0.3314	0.2563	63.8454
2014	39.3801	7.4255	8.4173	2.7147	2.7895	0.3150	0.6468	61.6889
2015	38.3717	4.9448	15.4702	3.5481	3.2827	0.2075	0.6143	66.4393
2016	26.8804	8.0695	17.2567	3.1107	2.7570	0.2265	0.2992	58.6000
2017	22.1201	9.5353	11.9217	3.0842	2.3830	0.2184	0.3748	49.6375
2018								

"@" = does not include Rayleigh (10 Mm^{-1})

Table C-8. Observed Light Extinction Conditions for the James River Face Wilderness Area (VA) Nearby Adjacent Class I Area

Year	Sulfate (Mm^{-1})	Nitrate (Mm^{-1}))	Organic Mass Carbon (Mm^{-1})	Light Absorbing Carbon (LAC or EC) (Mm^{-1})	Coarse Mass (Mm^{-1})	Sea Salt (Mm^{-1})	Soil (Mm^{-1})	Total PM[@] (Mm^{-1})
20 PERCENT BEST DAYS								
2000	*	*	*	*	*	*	*	*
2001	19.1849	3.2609	5.3709	2.8101	1.2455	0.0531	0.2245	32.1499
2002	21.1568	4.9388	6.2412	3.4439	1.3101	0.0039	0.2379	37.3326
2003	14.0850	3.8128	4.5797	2.4597	1.1918	0.0287	0.2739	26.4316
2004	15.4764	2.9258	6.0497	3.1613	1.1898	0.2229	0.2445	29.2706
2005	19.9807	4.2811	5.2626	3.2265	1.4257	0.1126	0.2319	34.5212
2006	19.2788	3.4986	5.5706	3.4102	1.8087	0.1551	0.2657	33.9877
2007	17.3316	3.2157	4.3385	2.7048	1.4582	0.2023	0.2249	29.4760
2008	14.9188	3.0528	4.6712	2.6783	1.2790	0.1013	0.2087	26.9101
2009	10.9888	2.2523	3.8284	2.0831	1.5694	0.1648	0.2033	21.0900
2010	16.4704	3.0192	4.5629	2.1453	1.4140	0.0464	0.3205	27.9787
2011	12.3627	1.8692	3.7655	1.7429	1.6762	0.2397	0.1593	21.8155
2012	11.5967	2.4637	5.6302	2.4316	1.7589	0.1271	0.2318	24.2399
2013	8.2139	1.7395	3.5919	1.4437	0.9826	0.2296	0.1687	16.3699
2014	9.6828	1.5492	4.0243	1.7648	1.7273	0.1115	0.1411	19.0011
2015	5.8387	1.7649	4.5823	1.7035	1.7368	0.1577	0.1371	15.9209
2016	6.6056	1.9722	3.8130	1.4122	1.3947	0.0954	0.1169	15.4099
2017	4.9494	1.4940	3.0558	1.2448	1.4754	0.0561	0.1301	12.4057
2018								
20 PERCENT WORST DAYS								
2000	*	*	*	*	*	*	*	*
2001	133.4376	12.1635	24.7589	8.5259	3.4717	0.5034	0.8717	183.7325
2002	161.7551	4.3346	25.8320	7.0289	2.9599	0.0057	1.0697	202.9860
2003	128.1132	7.3677	20.0045	7.2228	2.8328	0.0042	0.5565	166.1016
2004	122.1241	7.2071	20.7599	6.9376	2.8074	0.4728	0.8491	161.1579
2005	176.1055	3.8026	15.0078	8.6139	3.6799	0.1789	0.5149	207.9035
2006	135.7779	4.3070	23.0447	8.6613	2.6009	0.3543	0.6427	175.3887
2007	131.9792	5.0850	19.9011	7.3430	2.9584	0.2926	0.7641	168.3234
2008	78.6144	5.1924	26.8931	7.0977	2.8043	0.3144	0.7461	121.6622
2009	60.8337	4.5891	15.3913	5.7674	2.7370	0.1225	0.5909	90.0317
2010	61.1252	7.1418	20.9104	6.9805	3.0034	0.0296	0.7117	99.9024
2011	65.9647	8.7429	21.7585	6.3750	2.6945	0.3725	0.3647	106.2727
2012	37.3962	6.5564	17.0837	6.2427	3.3402	0.2095	0.6234	71.4519
2013	36.4907	6.7989	18.0007	5.5381	1.4371	0.2535	0.2841	68.8032
2014	35.7306	9.6953	13.4648	4.9778	2.0805	0.5612	0.4066	66.9167
2015	30.5682	7.1552	18.0547	5.3315	2.9235	0.2588	0.8445	65.1364
2016	19.8247	6.7025	20.1711	6.1300	2.0633	0.3105	0.3119	55.5140
2017	19.3861	6.4564	17.8969	5.1708	2.4933	0.1085	0.2983	51.8103
2018								

"*" = no data available; "[@]" = does not include Rayleigh (11 Mm^{-1})

Table C-9. Observed Light Extinction Conditions for the Addison Pinnacle (NY) MANE-VU IMPROVE Protocol Site

Year	Sulfate (Mm^{-1})	Nitrate (Mm^{-1}))	Organic Mass Carbon (Mm^{-1})	Light Absorbing Carbon (LAC or EC) (Mm^{-1})	Coarse Mass (Mm^{-1})	Sea Salt (Mm^{-1})	Soil (Mm^{-1})	Total PM@ (Mm^{-1})
20 PERCENT BEST DAYS								
2002	14.3098	3.2439	3.2420	1.6765	1.1586	0.0475	0.1581	23.8365
2003	12.0673	3.5573	3.5365	1.6258	0.8857	0.1424	0.1445	21.9594
2004	10.3916	3.0171	3.3263	1.6408	0.9852	0.4677	0.1308	19.9594
2005	12.9827	3.2517	2.6764	1.8089	0.9346	0.1856	0.1189	21.9587
2006	9.2887	1.7348	2.9776	1.4604	1.2672	0.2287	0.2046	17.1621
2007	9.6633	2.5217	2.9100	1.4816	1.2204	0.1937	0.1669	18.1576
2008	10.1652	2.6421	3.5225	1.5237	1.2474	0.1716	0.2107	19.4831
2009	8.8203	1.4799	2.3712	1.0268	1.2121	0.1999	0.1353	15.2455
20 PERCENT WORST DAYS								
2002	146.3168	15.4657	14.2878	6.4500	2.5001	0.0485	0.8535	185.9224
2003	133.5324	12.9956	13.6605	5.8010	2.1050	0.0545	0.6142	168.7633
2004	123.2334	8.7556	19.0872	5.4404	1.8744	0.3501	0.7454	159.4865
2005	163.4224	9.1979	10.2683	5.2760	2.3569	0.3509	0.5199	191.3924
2006	111.2973	10.9870	12.3002	6.0104	2.3068	0.3280	0.5771	143.8067
2007	127.0224	8.3061	15.8843	6.4382	3.5983	0.2273	0.8507	162.3273
2008	86.6166	10.0703	10.9011	4.6905	2.7707	0.2401	0.6783	115.9676
2009	61.3650	14.6719	8.8577	4.4220	2.0589	0.4318	0.5428	92.3501

"@" = does not include Rayleigh (11 Mm^{-1})

Table C-10. Observed Light Extinction Conditions for the Arendtsville (PA) MANE-VU IMPROVE Protocol Site

Year	Sulfate (Mm^{-1})	Nitrate (Mm^{-1}))	Organic Mass Carbon (Mm^{-1})	Light Absorbing Carbon (LAC or EC) (Mm^{-1})	Coarse Mass (Mm^{-1})	Sea Salt (Mm^{-1})	Soil (Mm^{-1})	Total PM@ (Mm^{-1})
20 PERCENT BEST DAYS								
2002	22.0022	6.4678	4.5852	2.4352	1.3356	0.0395	0.2230	37.0884
2003	16.1986	6.2926	4.8707	2.3333	1.5366	0.0830	0.2085	31.5232
2004	12.0715	5.0880	4.4856	2.1399	1.4076	0.4677	0.1880	25.8484
2005	17.9307	6.9589	3.6971	2.7031	1.5183	0.5123	0.1592	33.4796
2006	15.0883	3.6052	3.6534	2.2960	2.0266	0.3328	0.3637	27.3660
2007	14.0387	4.4303	3.8319	2.2713	2.0327	0.4273	0.1952	27.2274
2008	15.7186	4.8699	4.0369	1.9598	1.4737	0.4338	0.2840	28.7767
2009	11.9705	2.5735	3.4752	1.5925	1.4796	0.3480	0.2354	21.6748
2010	11.1675	3.0761	3.5510	1.6060	1.8222	0.1833	0.2213	21.6273
20 PERCENT WORST DAYS								
2002	161.9823	24.0903	30.7137	7.2597	3.9596	0.8442	1.4057	230.2555
2003	133.1753	39.7815	18.2857	7.4714	3.1853	0.9438	0.6889	203.5318
2004	137.0108	37.9577	20.2229	7.5022	3.5375	1.7047	0.8707	208.8064
2005	177.0792	20.8561	14.8365	7.5559	3.8499	0.8199	0.6994	225.6969
2006	130.2355	25.7145	18.3780	8.4525	3.2547	0.9764	0.5948	187.6064
2007	119.0132	20.3159	18.8258	7.3366	3.8245	0.7587	0.6502	170.7250
2008	90.2707	27.7559	14.4755	5.3935	3.0534	1.0501	0.6577	142.6568
2009	70.8032	34.2957	12.5439	5.8117	2.4768	0.7264	0.6657	127.3233
2010	71.9924	20.2489	16.2779	5.5194	3.6005	0.2872	0.6910	118.6173

"@" = does not include Rayleigh (11 Mm^{-1})

Table C-11. Observed Light Extinction Conditions for the Baltimore (MD) MANE-VU IMPROVE Protocol Site

Year	Sulfate (Mm^{-1})	Nitrate (Mm^{-1}))	Organic Mass Carbon (Mm^{-1})	Light Absorbing Carbon (LAC or EC) (Mm^{-1})	Coarse Mass (Mm^{-1})	Sea Salt (Mm^{-1})	Soil (Mm^{-1})	Total PM@ (Mm^{-1})
20 PERCENT BEST DAYS								
2005	20.7144	6.7091	5.2773	3.9675	2.8526	1.0273	0.3081	40.8563
2006	15.6950	6.0582	5.1599	3.6313	2.8208	0.4703	0.4319	34.2674
20 PERCENT WORST DAYS								
2005	164.8057	26.0692	25.9423	14.1794	5.3116	1.4430	0.9133	238.6645
2006	138.5668	22.7526	27.0426	16.0339	5.1294	2.1810	1.0404	212.7468

"@" = does not include Rayleigh (12 Mm^{-1})

Table C-12. Observed Light Extinction Conditions for the Bridgton (ME) MANE-VU IMPROVE Protocol Site

Year	Sulfate (Mm^{-1})	Nitrate (Mm^{-1}))	Organic Mass Carbon (Mm^{-1})	Light Absorbing Carbon (LAC or EC) (Mm^{-1})	Coarse Mass (Mm^{-1})	Sea Salt (Mm^{-1})	Soil (Mm^{-1})	Total PM@ (Mm^{-1})
20 PERCENT BEST DAYS								
2002	6.5068	1.1147	3.3996	1.3354	0.9291	0.2309	0.0941	13.6107
2003	6.4513	0.9757	2.5871	1.0466	0.8844	0.5976	0.1004	12.6430
2004	6.4566	1.3435	2.9691	1.1354	0.7100	0.4664	0.1437	13.2247
2005	5.3204	0.8802	1.9260	0.9305	0.6332	0.2303	0.0673	9.9879
2006	5.9962	0.7028	2.0918	0.8815	0.8410	0.2012	0.1347	10.8493
2007	5.4504	0.6410	1.8614	0.7950	0.7357	0.2481	0.1088	9.8405
2008	4.8453	0.7733	2.3597	0.8825	0.8528	0.2418	0.1466	10.1022
2009	3.3433	0.5732	1.9008	0.7066	0.7854	0.1462	0.0558	7.5112
2010	3.2480	0.4166	1.8345	0.6461	0.5718	0.0909	0.0893	6.8972
2011	4.2680	0.4760	2.4528	0.7117	0.7644	0.1871	0.0491	8.9091
2012	4.4539	0.6537	2.2453	0.7930	0.8536	0.1320	0.0927	9.2241
2013	3.8550	0.5873	1.7434	0.5043	0.6199	0.3390	0.0412	7.6900
2014	4.1292	0.4561	2.3145	0.5896	0.6553	0.0670	0.0715	8.2832
2015	3.0030	0.4985	1.9250	0.4655	0.7191	0.0961	0.0490	6.7562
20 PERCENT WORST DAYS								
2002	79.2865	6.6624	18.2860	5.5670	1.5782	0.0460	0.7020	112.1282
2003	68.2368	6.3815	16.7144	5.9108	2.1079	0.0034	0.4498	99.8045
2004	74.5008	6.7080	11.0543	4.4748	1.6398	0.5357	0.6606	99.5741
2005	54.8889	3.8208	10.4129	4.8447	1.6374	0.2882	0.3054	76.1983
2006	68.0791	5.5818	12.9944	6.0704	1.8750	0.2547	0.4056	95.2610
2007	49.2148	4.5179	12.5837	4.3122	2.6875	0.3214	0.4071	74.0447
2008	37.3014	2.9176	9.9856	3.6605	2.3600	0.2583	0.4866	56.9698
2009	37.3525	3.7582	8.2563	3.4638	1.7036	0.1467	0.4181	55.0993
2010	32.4376	1.8721	19.3407	3.8107	1.6974	0.0696	0.4707	59.6987
2011	31.6662	3.5307	13.3260	3.4454	1.9014	0.4334	0.2085	54.5117
2012	21.9794	4.2609	11.1191	3.9258	1.9651	0.2763	0.2737	43.8003
2013	20.6671	5.6804	8.9259	3.1597	1.0233	0.5714	0.2528	40.2807
2014	21.4352	4.6638	10.8055	3.5295	0.9392	0.4111	0.1788	41.9633
2015	18.6215	4.8334	13.0961	3.1304	2.0599	0.7351	0.2266	42.7029

"@" = does not include Rayleigh (12 Mm^{-1})

Table C-13. Observed Light Extinction Conditions for the Casco Bay (ME) MANE-VU IMPROVE Protocol Site

Year	Sulfate (Mm^{-1})	Nitrate (Mm^{-1}))	Organic Mass Carbon (Mm^{-1})	Light Absorbing Carbon (LAC or EC) (Mm^{-1})	Coarse Mass (Mm^{-1})	Sea Salt (Mm^{-1})	Soil (Mm^{-1})	Total PM@ (Mm^{-1})
20 PERCENT BEST DAYS								
2002	6.9717	1.3286	3.3737	1.4910	1.1093	0.4593	0.2577	14.9912
2003	7.0204	1.0527	3.0516	1.3818	1.0457	0.4674	0.1226	14.1422
2004	7.2197	1.2592	3.5968	1.4790	1.1877	0.8551	0.1411	15.7387
2005	6.3643	0.9904	2.6444	1.4617	0.7411	0.4118	0.1010	12.7146
2006	5.9500	0.9737	2.7449	1.4267	1.1580	0.4858	0.1161	12.8552
2007	6.0368	0.8225	2.6782	1.1812	0.9444	0.4763	0.0981	12.2376
2008	6.6669	1.2631	3.1171	1.2708	1.1315	0.9036	0.1327	14.4858
2009	3.7985	0.8163	2.6830	1.0390	0.9768	0.4165	0.0829	9.8129
2010	4.0077	0.4863	2.6941	0.9420	0.9060	0.4040	0.1037	9.5439
2011	5.6707	0.7078	2.8931	1.2188	1.2024	0.4985	0.0699	12.2612
2012	5.4883	0.9129	3.3724	1.3128	1.5722	0.4018	0.1052	13.1656
2013	4.1198	0.8417	2.4618	0.8302	0.9247	0.4673	0.0450	9.6906
2014	4.6067	0.6526	2.6086	0.7785	1.0936	0.3798	0.0845	10.2041
2015	3.6036	0.6904	2.6868	0.8427	1.2129	0.5999	0.0736	9.7100
2016	3.3965	0.7968	2.3699	0.7629	1.0312	0.5289	0.0506	8.9366
2017	4.0325	0.9554	2.7486	0.9078	1.0970	0.6043	0.0944	10.4400
2018								
20 PERCENT WORST DAYS								
2002	65.6121	10.2400	24.0365	7.2943	2.9821	0.9420	0.7040	111.8109
2003	64.7336	7.0499	40.8487	8.4572	3.3465	0.1983	0.5704	125.2046
2004	56.2620	11.3940	13.5610	5.5877	2.6254	2.8045	0.6230	92.8576
2005	60.5685	8.8052	13.5842	7.1359	1.5797	1.2869	0.2860	93.2464
2006	66.1281	8.6896	14.5315	6.9753	2.3267	0.9283	0.4208	100.0003
2007	49.5755	8.6318	16.9973	6.2850	2.7267	2.1288	0.3808	86.7259
2008	44.1462	5.0533	11.6809	4.7395	3.1136	1.3550	0.3882	70.4768
2009	42.0949	5.8726	14.6223	5.4458	1.8820	1.6069	0.4458	71.9702
2010	33.2786	4.1076	15.6548	5.5351	2.7175	0.5691	0.4802	62.3430
2011	28.5742	5.5634	19.3321	5.9926	3.7015	1.2945	0.2371	64.6953
2012	18.8352	8.8136	16.0206	5.7675	3.4580	2.5422	0.2333	55.6705
2013	20.7630	7.6767	10.6179	4.3752	2.3929	2.9797	0.2176	49.0229
2014	18.5218	7.9536	11.1267	4.3103	2.8640	2.7763	0.1893	47.7420
2015	19.4111	7.3882	13.7728	4.2225	3.3473	2.6964	0.3032	51.1415
2016	10.8558	6.8440	10.8259	3.9525	3.1288	2.7710	0.2362	38.6142
2017	11.7017	6.8359	13.3249	3.9352	2.8419	4.4853	0.2342	43.3591
2018								

"@" = does not include Rayleigh (12 Mm^{-1})

Table C-14. Observed Light Extinction Conditions for the Cape Cod (MA) MANE-VU IMPROVE Protocol Site

Year	Sulfate (Mm^{-1})	Nitrate (Mm^{-1}))	Organic Mass Carbon (Mm^{-1})	Light Absorbing Carbon (LAC or EC) (Mm^{-1})	Coarse Mass (Mm^{-1})	Sea Salt (Mm^{-1})	Soil (Mm^{-1})	Total PM@ (Mm^{-1})
20 PERCENT BEST DAYS								
2002	8.7183	2.1123	2.7332	1.0693	2.1392	1.7875	0.1288	18.6888
2003	8.0773	2.0469	2.6667	0.9823	2.4270	1.9618	0.1005	18.2624
2004	9.3367	2.1563	3.1652	1.1716	2.2252	3.0661	0.1319	21.2530
2005	9.0531	2.0156	3.0087	1.1159	2.6698	3.8321	0.1087	21.8038
2006	8.3215	1.5172	2.5552	0.8530	1.9050	2.7402	0.1215	18.0137
2007	6.4979	1.5679	2.3042	0.6978	1.6533	2.5264	0.0759	15.3235
2008	7.3679	1.8205	3.1270	0.9675	2.1612	2.0988	0.1357	17.6786
2009	6.3511	1.5907	2.0891	0.6154	1.4596	2.9063	0.0988	15.1110
2010	5.2003	1.2133	2.5608	0.7940	2.0873	2.8893	0.1028	14.8477
2011	6.5535	1.4917	2.5496	0.8673	1.9673	2.7183	0.1103	16.2580
2012	5.5078	1.5293	2.7486	0.7840	1.8231	2.1637	0.0718	14.6283
2013	4.7140	1.3181	2.4550	0.7923	2.0687	2.4438	0.0888	13.8806
2014	4.7730	1.1507	2.3014	0.5282	1.9366	2.2738	0.0768	13.0405
2015	4.2916	1.1158	2.2686	0.4204	1.9361	2.0517	0.0575	12.1417
2016	3.6306	1.2773	1.6470	0.4767	1.6836	2.3156	0.0596	11.0903
2017	4.4379	1.8601	2.6997	0.7354	2.1515	2.2944	0.0728	14.2518
2018								
20 PERCENT WORST DAYS								
2002	76.9690	9.8577	24.2551	5.0389	3.8638	0.3438	0.7736	121.1019
2003	107.3463	6.7442	15.2486	5.2450	3.9724	2.6797	0.6668	141.9030
2004	82.2743	6.4592	11.7384	3.9660	3.4149	1.2208	0.7460	109.8195
2005	101.6966	6.3236	10.9021	4.6435	3.5508	4.4338	0.4226	131.9729
2006	68.2498	9.0970	13.5476	5.1921	3.1310	3.0262	0.4716	102.7152
2007	90.2604	7.2246	10.0402	4.0574	3.8453	1.9939	0.5280	117.9498
2008	54.0542	7.3232	12.3511	3.3542	3.2503	2.4045	0.4898	83.2273
2009	55.4258	6.8537	8.5985	3.4067	2.7395	1.6083	0.6563	79.2887
2010	39.1814	7.1997	9.7024	2.6973	4.5743	8.5274	0.4956	72.3782
2011	35.2951	7.2305	12.9008	3.6168	4.4377	4.5831	0.2798	68.3437
2012	28.8485	7.7051	9.3144	3.1433	3.1817	4.4294	0.2871	56.9096
2013	23.6981	7.0942	8.6471	2.5401	4.2454	7.5834	0.4369	54.2452
2014	19.7156	8.1713	6.7172	2.1295	5.0251	8.4275	0.4227	50.6088
2015	24.4474	7.2773	10.5801	2.6688	3.6594	4.0091	0.4907	53.1327
2016	15.7461	5.2801	6.7115	1.7978	4.3687	8.3907	0.2738	42.5686
2017	15.0939	5.4181	8.5020	1.9707	4.8447	9.2458	0.2957	45.3709
2018								

"@" = does not include Rayleigh (12 Mm^{-1})

Table C-15. Observed Light Extinction Conditions for the Connecticut Hill (NY) MANE-VU IMPROVE Protocol Site

Year	Sulfate (Mm^{-1})	Nitrate (Mm^{-1}))	Organic Mass Carbon (Mm^{-1})	Light Absorbing Carbon (LAC or EC) (Mm^{-1})	Coarse Mass (Mm^{-1})	Sea Salt (Mm^{-1})	Soil (Mm^{-1})	Total PM@ (Mm^{-1})
20 PERCENT BEST DAYS								
2002	13.4423	3.9927	2.9526	1.3587	0.9538	0.1793	0.1593	23.0387
2003	10.6877	4.0304	3.7690	1.6017	1.0717	0.5295	0.1547	21.8447
2004	11.2351	3.7072	2.9054	1.2993	0.9151	0.4207	0.1540	20.6369
2005	13.8840	3.8265	2.9981	1.7393	1.4630	0.1919	0.1677	24.2705
20 PERCENT WORST DAYS								
2002	135.0254	22.6956	16.1648	5.6355	2.4001	0.2292	1.0160	183.1665
2003	119.7051	12.2546	12.2175	5.3526	1.9909	0.0890	0.5932	152.2029
2004	111.8198	13.9262	13.8022	5.0618	1.9690	0.6581	0.9059	148.1430
2005	159.8236	9.6011	12.4985	5.3881	2.8178	0.2778	0.5340	190.9410

"@" = does not include Rayleigh (11 Mm^{-1})

Table C-16. Observed Light Extinction Conditions for the Frostburg Reservoir (MD) MANE-VU IMPROVE Protocol Site

Year	Sulfate (Mm^{-1})	Nitrate (Mm^{-1}))	Organic Mass Carbon (Mm^{-1})	Light Absorbing Carbon (LAC or EC) (Mm^{-1})	Coarse Mass (Mm^{-1})	Sea Salt (Mm^{-1})	Soil (Mm^{-1})	Total PM@ (Mm^{-1})
20 PERCENT BEST DAYS								
2005	19.5307	4.6939	3.8228	2.7718	1.4485	0.1692	0.2050	32.6420
2006	16.6169	3.4710	3.8400	2.5899	1.7274	0.1224	0.3124	28.6799
2007	15.7978	2.4874	3.3963	2.2525	1.5201	0.1794	0.2561	25.8895
2008	15.2038	3.3614	3.4822	1.9813	1.4243	0.0867	0.2515	25.7913
2009	12.4382	1.8374	2.1476	1.3663	1.0161	0.0913	0.1622	19.0590
2010	13.3502	2.7730	3.0765	1.7378	1.5518	0.1217	0.2502	22.8612
2011	11.5495	2.4756	2.9537	1.4885	1.1988	0.3958	0.1254	20.1872
2012	11.2503	2.9650	3.4149	1.8485	2.1214	0.1353	0.2560	21.9914
2013	9.8060	2.4969	2.3486	1.1689	1.9725	0.2133	0.1410	18.1471
2014	10.0682	2.6941	2.9209	1.4022	1.9191	0.2274	0.1654	19.3973
2015	7.3375	2.3083	3.1229	1.4135	1.0481	0.0730	0.1190	15.4223
2016	6.7722	2.2396	3.0257	1.2230	1.5861	0.1175	0.1266	15.0907
2017	7.2708	2.3975	2.9038	1.1779	1.2158	0.0879	0.0997	15.1535
2018								
20 PERCENT WORST DAYS								
2005	223.2837	3.3317	10.9371	5.4107	2.0464	0.0588	0.7143	245.7826
2006	176.0734	2.4902	11.6520	4.8670	2.3361	0.0450	0.7322	198.1959
2007	155.2803	2.5941	15.4957	5.2125	3.1590	0.0850	0.8886	182.7151
2008	95.4048	4.4401	11.5946	4.1517	2.5751	0.0577	0.8228	119.0468
2009	80.7827	7.4065	8.1013	3.6029	2.2215	0.1159	0.7069	102.9377
2010	85.9685	5.7974	12.5940	4.0307	3.4058	0.0114	0.7376	112.5455
2011	90.3056	3.7734	13.3879	3.9890	3.3577	0.2615	0.3716	115.4467
2012	53.9858	7.0423	9.4493	3.8708	3.3908	0.2233	0.5056	78.4680
2013	46.7828	12.1985	9.1271	4.0653	3.7819	0.3149	0.2770	76.5475
2014	48.3676	15.5712	7.7072	4.1887	2.5524	0.1951	0.2852	78.8675
2015	41.3228	7.8231	12.6700	3.7083	2.8577	0.2481	0.6062	69.2362
2016	31.0301	7.6389	9.5691	3.0762	2.6110	0.1954	0.2725	54.3931
2017	28.2064	13.0064	10.9324	3.5525	2.5175	0.1571	0.2484	58.6207
2018								

"@" = does not include Rayleigh (11 Mm^{-1})

Table C-17. Observed Light Extinction Conditions for the Londonderry (NH) MANE-VU IMPROVE Protocol Site

Year	Sulfate (Mm^{-1})	Nitrate (Mm^{-1}))	Organic Mass Carbon (Mm^{-1})	Light Absorbing Carbon (LAC or EC) (Mm^{-1})	Coarse Mass (Mm^{-1})	Sea Salt (Mm^{-1})	Soil (Mm^{-1})	Total PM[@] (Mm^{-1})
20 PERCENT BEST DAYS								
2011	6.2645	1.1709	4.0150	1.7625	1.2097	0.3493	0.1037	14.8757
2012	5.4793	1.2984	3.5015	1.4822	1.4031	0.3723	0.1040	13.6407
2013	4.3779	0.9793	2.6627	1.0693	1.0926	0.5664	0.0834	10.8316
2014	4.6697	0.8976	3.2118	1.1417	1.2596	0.3351	0.1018	11.6173
2015	4.1106	0.8347	2.8049	0.9961	1.1157	0.3105	0.1129	10.2853
2016	3.6141	0.9369	2.5247	0.9780	1.4608	0.3658	0.0859	9.9662
2017	4.0964	1.4122	3.3031	1.2478	1.4828	0.3975	0.0903	12.0300
2018								
20 PERCENT WORST DAYS								
2011	35.4592	6.8467	19.7280	6.0461	2.5523	1.2074	0.3211	72.1609
2012	25.2688	8.8236	17.3961	6.6660	2.4520	1.7893	0.3513	62.7470
2013	26.1322	9.2913	13.9935	5.0330	2.5473	0.5710	0.4772	58.0455
2014	22.6958	8.6120	12.6102	5.0912	2.6498	0.9105	0.3077	52.8771
2015	22.8504	10.3893	15.7321	5.0945	3.7612	0.8478	0.3942	59.0694
2016	13.3659	9.0657	13.3981	5.2861	2.4325	0.8194	0.2604	44.6282
2017	13.9456	8.8526	17.2661	5.5406	2.9938	0.8763	0.2511	49.7261
2018								

"[@]" = does not include Rayleigh (12 Mm^{-1})

Table C-18. Observed Light Extinction Conditions for the Martha's Vineyard (MA) MANE-VU IMPROVE Protocol Site

Year	Sulfate (Mm^{-1})	Nitrate (Mm^{-1}))	Organic Mass Carbon (Mm^{-1})	Light Absorbing Carbon (LAC or EC) (Mm^{-1})	Coarse Mass (Mm^{-1})	Sea Salt (Mm^{-1})	Soil (Mm^{-1})	Total PM@ (Mm^{-1})
20 PERCENT BEST DAYS								
2003	10.8222	2.0740	3.7599	1.2498	1.9621	1.1291	0.1424	21.1395
2004	9.3018	2.4877	3.4634	1.4371	2.3856	2.9856	0.1487	22.2098
2005	10.8933	2.3023	2.3525	1.2992	2.0316	3.5102	0.1185	22.5076
2006	8.6764	1.7992	2.6706	1.2176	1.9884	2.2495	0.1228	18.7245
2007	7.1104	1.8843	2.1647	0.8424	2.2370	2.2968	0.1081	16.6437
2008	8.0043	1.9408	2.3850	0.9749	2.0102	2.1225	0.1534	17.5911
2009	6.3300	1.4967	2.1481	0.8140	2.0975	2.1173	0.1216	15.1251
2010	5.4134	1.3882	2.6449	0.8812	2.1720	2.6969	0.1266	15.3232
2011	6.9767	1.8929	3.0550	0.8395	2.8383	3.2830	0.1136	18.9993
2012	5.7813	1.5651	2.7404	0.8143	2.2629	1.8954	0.1025	15.1619
2013	4.0052	1.3179	1.9339	0.6963	3.0522	2.0821	0.0828	13.1703
2014	5.6109	1.9058	2.3256	0.7689	2.8817	2.3271	0.1140	15.9340
2015	4.6062	1.2953	2.2204	0.5726	4.5833	2.3162	0.0879	15.6819
2016	4.2220	1.5061	1.8954	0.5895	3.6326	1.8536	0.0767	13.7759
2017	5.0410	1.9351	2.5496	0.7648	2.5959	2.3530	0.0841	15.3236
2018								
20 PERCENT WORST DAYS								
2003	120.7355	9.7245	13.8212	4.7265	2.8499	4.3522	0.5325	156.7423
2004	86.6474	8.7644	9.3555	3.6070	3.3953	2.9070	0.7885	115.4651
2005	110.4844	9.4524	8.5527	4.7600	4.1462	5.7937	0.4906	143.6801
2006	92.2873	9.0308	12.4111	3.9473	4.1149	6.4804	0.5313	128.8031
2007	75.2799	9.1185	7.0299	3.1276	5.1033	6.6171	0.5087	106.7850
2008	64.6912	9.5810	17.8475	3.6473	4.2788	5.1967	0.6646	105.9071
2009	56.3161	9.0951	7.8704	2.8245	4.5701	9.7038	0.6566	91.0367
2010	43.6522	12.5457	9.7842	2.8800	5.4344	11.1602	0.6920	86.1488
2011	46.5144	9.9539	11.6253	2.9831	9.2744	9.6147	0.3339	90.2997
2012	26.5702	9.5465	7.8691	2.3789	6.1319	12.9385	0.3410	65.7760
2013	27.0827	9.9083	7.2395	2.3795	8.3504	11.7510	0.4243	67.1356
2014	22.5089	11.3138	6.6194	1.9156	9.4221	12.4187	0.5312	64.7296
2015	29.8599	10.6007	10.3980	2.4349	12.8145	7.7343	0.6342	74.4764
2016	14.9683	9.1303	7.1539	2.1572	16.3892	11.6348	0.3106	61.7443
2017	16.5963	7.6481	8.4941	1.8543	30.8788	14.1015	0.3392	79.9122
2018								

"@" = does not include Rayleigh (12 Mm^{-1})

Table C-19. Observed Light Extinction Conditions for the M.K. Goddard (PA) MANE-VU IMPROVE Protocol Site

Year	Sulfate (Mm^{-1})	Nitrate (Mm^{-1}))	Organic Mass Carbon (Mm^{-1})	Light Absorbing Carbon (LAC or EC) (Mm^{-1})	Coarse Mass (Mm^{-1})	Sea Salt (Mm^{-1})	Soil (Mm^{-1})	Total PM@ (Mm^{-1})
20 PERCENT BEST DAYS								
2002	17.7122	6.0997	5.2179	2.7078	1.2241	0.0033	0.1928	33.1580
2003	13.3865	6.1889	5.4603	2.6730	1.3967	0.2096	0.2142	29.5292
2004	14.3822	5.4775	5.1188	2.5964	1.1767	0.4740	0.1987	29.4243
2005	18.4982	5.3294	5.2542	2.9640	1.7132	0.3384	0.1862	34.2836
2006	13.4433	3.9845	4.1680	2.7179	1.5477	0.4714	0.2543	26.5870
2007	12.3619	4.4558	4.4874	2.6555	1.3001	0.4348	0.1908	25.8862
2008	13.6642	4.5931	5.0039	2.4250	1.1841	0.2529	0.2546	27.3777
2009	11.1118	2.4858	4.3083	2.0400	1.3470	0.2770	0.1891	21.7589
2010	9.4091	2.7387	4.7290	2.4187	1.2865	0.3600	0.2448	21.1867
20 PERCENT WORST DAYS								
2002	134.6414	20.2613	18.6476	7.3463	3.2484	0.3960	1.0977	185.6387
2003	114.5140	19.3518	18.4484	7.9008	2.6836	0.9395	0.5717	164.4097
2004	115.0278	19.4937	20.9981	7.9563	2.8604	0.8545	0.8248	168.0157
2005	187.3292	13.7414	16.5004	8.7013	3.2440	0.4571	0.6509	230.6243
2006	121.1514	14.7069	15.5965	8.0506	2.6496	0.5419	0.6858	163.3826
2007	129.7793	15.0581	19.3348	8.5274	3.1525	0.4538	0.9364	177.2422
2008	87.5414	20.4168	18.6933	7.1778	2.5829	0.3890	0.7841	137.5853
2009	75.4269	24.7889	14.9856	6.7626	2.6803	0.4299	0.7344	125.8086
2010	81.3483	20.2700	18.0775	6.6612	2.3036	0.3784	0.7549	129.7938

"@" = does not include Rayleigh (11 Mm^{-1})

Table C-20. Observed Light Extinction Conditions for the Mohawk Mt. (CT) MANE-VU IMPROVE Protocol Site

Year	Sulfate (Mm^{-1})	Nitrate (Mm^{-1}))	Organic Mass Carbon (Mm^{-1})	Light Absorbing Carbon (LAC or EC) (Mm^{-1})	Coarse Mass (Mm^{-1})	Sea Salt (Mm^{-1})	Soil (Mm^{-1})	Total PM[@] (Mm^{-1})
20 PERCENT BEST DAYS								
2002	9.3532	2.3162	2.8952	1.4436	1.2737	0.0992	0.1617	17.5429
2003	8.0144	1.5965	2.7895	1.2836	0.7407	0.0873	0.1418	14.6537
2004	8.1904	2.1376	2.9937	1.2570	0.8491	0.4916	0.1467	16.0660
2005	7.5203	1.5636	2.3574	1.2520	0.9531	0.2256	0.1157	13.9876
2006	6.5565	1.3116	2.4017	1.1065	0.9348	0.1889	0.1432	12.6431
2007	6.2404	0.9544	1.9199	0.9959	0.8145	0.2144	0.1082	11.2477
2008	*	*	*	*	*	*	*	*
2009	4.1491	1.0581	1.7300	0.8088	1.1085	0.3136	0.0724	9.2406
2010	3.9627	1.1592	1.8881	0.7093	0.7556	0.1923	0.1383	8.8055
2011	5.5822	1.6276	2.2673	0.9437	0.9948	0.2398	0.0714	11.7268
2012	5.3238	1.6446	2.0054	0.8277	0.7062	0.2604	0.0889	10.8571
2013	4.2424	1.1461	1.7616	0.6410	0.7125	0.2032	0.0626	8.7695
2014	4.6490	1.4651	2.1135	0.7509	1.2191	0.1324	0.0607	10.3906
2015	3.0929	1.0114	1.8668	0.6171	0.7940	0.1185	0.0733	7.5740
2016	3.1386	1.1654	1.9228	0.6367	0.8212	0.1955	0.0683	7.9485
2017	3.2054	1.2010	1.7936	0.6363	0.7471	0.0984	0.0599	7.7416
2018								
20 PERCENT WORST DAYS								
2002	110.2930	11.9054	17.7061	6.3317	2.5839	0.2034	0.8029	149.8264
2003	100.9785	14.7080	16.8173	6.7164	2.2713	1.9688	0.7045	144.1648
2004	114.5274	6.2810	29.4253	5.0081	1.5875	0.1887	1.0178	158.0360
2005	142.2760	9.4440	15.1461	7.1472	2.4099	0.1855	0.6216	177.2304
2006	99.1197	8.7903	16.9922	6.5207	2.5203	0.2607	0.6214	134.8254
2007	119.8707	6.4189	14.7297	5.4869	2.9893	0.1693	0.6987	150.3635
2008	*	*	*	*	*	*	*	*
2009	52.4388	9.0261	9.3379	3.5752	1.7563	0.0984	0.5988	76.8315
2010	49.2946	7.7508	12.9270	4.5257	2.6761	0.1216	0.6036	77.8993
2011	46.9085	8.8546	13.7997	4.4630	3.0442	0.3683	0.2801	77.7184
2012	33.5902	11.8147	10.5042	4.1983	2.0630	0.3745	0.3338	62.8787
2013	30.4161	9.3327	9.7888	3.6249	2.3221	0.3028	0.2976	56.0850
2014	23.8952	9.0779	8.1309	3.0922	3.9281	0.5387	0.3431	49.0060
2015	26.3677	10.2936	12.8209	3.8251	2.5652	0.3220	0.4441	56.6385
2016	17.9577	9.2098	20.4432	3.8927	2.7249	0.4526	0.3082	54.9892
2017	15.6933	8.6647	11.0518	3.1265	2.4416	0.2877	0.2489	41.5145
2018								

"*" = no data available; "[@]" = does not include Rayleigh (11 Mm^{-1})

Table C-21. Observed Light Extinction Conditions for the New York IS52 MANE-VU IMPROVE Protocol Site

Year	Sulfate (Mm^{-1})	Nitrate (Mm^{-1}))	Organic Mass Carbon (Mm^{-1})	Light Absorbing Carbon (LAC or EC) (Mm^{-1})	Coarse Mass (Mm^{-1})	Sea Salt (Mm^{-1})	Soil (Mm^{-1})	Total PM[@] (Mm^{-1})
20 PERCENT BEST DAYS								
2005	16.2048	5.5089	5.6857	9.0383	2.9957	0.9099	0.4191	40.7624
2006	12.7629	2.6411	5.5325	6.7224	3.2993	0.6544	0.4864	32.0989
2007	12.0078	3.9511	5.5859	7.6124	3.9051	0.6352	0.4443	34.1418
2008	13.7515	5.0618	5.6993	8.5164	2.7126	0.7443	0.5144	37.0003
2009	11.9879	2.8026	5.1633	6.8856	2.8806	0.7275	0.4515	30.8988
20 PERCENT WORST DAYS								
2005	135.6633	42.2070	23.5403	24.7026	7.4958	2.5319	1.2577	237.3987
2006	113.1066	35.0082	23.6647	21.7802	6.2358	2.2148	1.2458	203.2561
2007	100.9238	39.8379	27.2368	23.8920	7.7657	3.3033	1.3658	204.3253
2008	69.0512	28.8275	21.4957	17.9683	6.4917	1.8682	1.2633	146.9658
2009	57.3049	38.1262	18.3016	19.2219	6.5340	2.3384	1.3413	143.1683

"[@]" = does not include Rayleigh (12 Mm^{-1})

Table C-22. Observed Light Extinction Conditions for the Old Town/Penobscot Nation# (ME) MANE-VU IMPROVE Protocol Site

Year	Sulfate (Mm^{-1})	Nitrate (Mm^{-1}))	Organic Mass Carbon (Mm^{-1})	Light Absorbing Carbon (LAC or EC) (Mm^{-1})	Coarse Mass (Mm^{-1})	Sea Salt (Mm^{-1})	Soil (Mm^{-1})	Total PM@ (Mm^{-1})
20 PERCENT BEST DAYS								
2003	8.9815	0.8444	3.5614	2.1298	1.4546	0.8049	0.1526	17.9292
2004	8.4670	1.0120	3.7397	2.5136	2.1746	0.3595	0.2757	18.5421
2005	7.6879	0.6801	3.0584	2.4721	2.0031	0.3598	0.1543	16.4157
2006	6.3824	0.8709	2.5743	1.3770	1.2729	0.5033	0.1584	13.1390
2007	5.4866	0.6090	2.7115	1.1489	0.7900	0.4125	0.1342	11.2927
2008	5.2648	0.7396	2.6271	1.2742	1.1349	0.5205	0.1387	11.6998
2009	3.8265	0.6526	2.3481	0.9930	1.2474	0.2427	0.1308	9.4410
2010	3.8102	0.4320	2.2784	0.8915	0.9777	0.3284	0.1058	8.8240
2011	5.1089	0.5069	2.7476	1.0301	1.5062	0.3117	0.0849	11.2962
2012	4.6924	0.7005	2.6865	1.0140	1.4501	0.9624	0.1152	11.6211
2013	4.4052	0.7072	2.3957	0.9256	2.0916	0.3450	0.1286	10.9990
2014	4.3162	0.5338	2.6455	0.8321	1.5159	0.1684	0.0628	10.0746
2015	2.8211	0.5757	2.4916	0.6927	1.2763	0.3106	0.0742	8.2422
2016	2.9048	0.6724	1.9979	0.6864	1.0099	0.4040	0.0748	7.7503
2017	3.9128	0.7030	2.9301	0.9145	1.8129	0.2182	0.1365	10.6281
2018								
20 PERCENT WORST DAYS								
2003	71.5431	8.5678	36.1099	10.8892	5.8938	1.4658	0.8268	135.2963
2004	68.9408	7.6041	16.4892	6.0680	4.0303	1.2446	0.7802	105.1570
2005	61.5575	7.8930	24.9542	10.4768	3.3206	1.4455	0.4273	110.0750
2006	54.6224	6.6465	16.1038	7.0816	3.6923	0.4982	0.4849	89.1297
2007	43.4663	6.4638	19.3963	6.6226	3.3099	0.9511	0.5498	80.7598
2008	40.8102	6.5735	18.5258	6.8773	2.1922	0.7038	0.4781	76.1610
2009	42.4270	4.5753	18.6675	7.3398	4.6312	0.8227	0.6986	79.1621
2010	32.4003	4.4419	21.0106	6.0560	4.0799	0.6339	0.6164	69.2390
2011	29.1564	6.9708	18.0983	6.9007	5.5236	1.6153	0.3640	68.6290
2012	23.4129	5.7649	15.1394	5.8241	4.6490	1.3708	0.4257	56.5869
2013	18.8027	6.1634	14.5590	5.1297	7.2259	1.8482	0.7115	54.4405
2014	17.8915	6.3791	14.4945	4.7432	4.1269	2.5830	0.2992	50.5174
2015	20.4943	6.9872	22.5398	6.0722	3.9290	1.3155	0.3609	61.6990
2016	13.3539	6.8491	13.3317	5.4007	4.1124	2.2112	0.3772	45.6362
2017	11.3945	5.2965	13.5627	4.0808	3.3815	1.4041	0.2694	39.3895
2018								

"*" = no data available; "#" = Penobscot Nation site started in 2006; "@" = does not include Rayleigh (12 Mm^{-1})

Table C-23. Observed Light Extinction Conditions for the Pack Monadnock Summit (NH) MANE-VU IMPROVE Protocol Site

Year	Sulfate (Mm^{-1})	Nitrate (Mm^{-1}))	Organic Mass Carbon (Mm^{-1})	Light Absorbing Carbon (LAC or EC) (Mm^{-1})	Coarse Mass (Mm^{-1})	Sea Salt (Mm^{-1})	Soil (Mm^{-1})	Total PM[@] (Mm^{-1})
20 PERCENT BEST DAYS								
2008	4.3131	0.8160	1.6656	0.6319	0.8070	0.1731	0.0897	8.4963
2009	2.4704	0.4882	1.3798	0.4875	0.4023	0.1938	0.0590	5.4809
2010	2.7436	0.5448	1.5079	0.4668	0.4713	0.1038	0.0716	5.9098
2011	3.1593	0.4990	1.8138	0.6292	0.6312	0.0588	0.0587	6.8498
2012	3.4098	0.6552	1.2654	0.5682	0.4384	0.1979	0.0604	6.5952
2013	3.0724	0.5540	1.1161	0.4599	0.4193	0.2254	0.0392	5.8863
2014	2.5548	0.5531	1.2615	0.3394	0.3986	0.2928	0.0294	5.4297
2015	2.2442	0.4814	1.3628	0.3782	0.4183	0.0606	0.0335	4.9790
2016	1.8194	0.5932	1.3948	0.4004	0.6169	0.1107	0.0341	4.9693
2017	2.3033	0.8320	1.6444	0.6696	0.4862	0.0822	0.0443	6.0619
2018								
20 PERCENT WORST DAYS								
2008	46.6548	2.6606	9.7811	2.8596	2.4691	0.1586	0.4932	65.0771
2009	41.5541	5.2114	8.2553	2.8709	1.9207	0.0586	0.5466	60.4175
2010	42.3140	2.9636	11.6129	3.0015	1.9608	0.0121	0.4987	62.3638
2011	35.8563	3.7712	11.1519	3.0512	2.4435	0.2346	0.2608	56.7694
2012	27.7733	6.9608	9.6796	3.4847	1.8317	0.8833	0.3585	50.9719
2013	24.4724	6.6301	6.9698	2.5010	1.8329	0.4034	0.3956	43.2051
2014	23.2547	6.2792	8.2482	2.7699	1.5729	0.3432	0.2630	42.7310
2015	21.3399	7.1847	10.8197	2.7721	2.1450	0.2474	0.3452	44.8540
2016	12.7468	6.2573	8.0930	2.1885	1.7194	0.3326	0.2540	31.5917
2017	12.5757	5.1072	9.8629	2.4153	2.0984	0.1792	0.2249	32.4636
2018								

"[@]" = does not include Rayleigh (11 Mm^{-1})

Table C-24. Observed Light Extinction Conditions for the Proctor Maple R.F. (VT) MANE-VU IMPROVE Protocol Site

Year	Sulfate (Mm^{-1})	Nitrate (Mm^{-1}))	Organic Mass Carbon (Mm^{-1})	Light Absorbing Carbon (LAC or EC) (Mm^{-1})	Coarse Mass (Mm^{-1})	Sea Salt (Mm^{-1})	Soil (Mm^{-1})	Total PM@ (Mm^{-1})
20 PERCENT BEST DAYS								
2002	5.9488	1.4018	3.0953	1.1501	1.1571	0.1783	0.1033	13.0348
2003	5.3978	0.9670	2.7246	1.0366	0.6116	0.2143	0.0839	11.0358
2004	5.6241	1.3382	2.7812	1.0793	0.7034	0.3640	0.1134	12.0037
2005	5.4871	1.2700	2.4577	1.2398	0.8252	0.1872	0.0779	11.5449
2006	5.0904	0.9190	2.7036	1.1789	1.1897	0.2374	0.1095	11.4285
2007	5.1846	1.3521	2.2895	0.9050	0.5334	0.3441	0.1075	10.7161
2008	5.0932	1.0848	2.2435	0.6846	1.0269	0.2432	0.1113	10.4876
2009	3.6918	0.6024	1.9927	0.6681	0.7540	0.1458	0.0734	7.9282
2010	3.9128	0.9372	2.2889	0.7910	0.5350	0.2666	0.1139	8.8452
2011	5.3599	0.8719	2.5922	0.7943	1.0853	0.2028	0.0720	10.9783
2012	3.6687	0.7775	1.8291	0.5613	0.8108	0.3887	0.0748	8.1110
2013	4.0806	0.8304	1.7347	0.6038	0.7588	0.2549	0.0606	8.3238
2014	4.1222	0.7259	1.8746	0.6909	0.7842	0.1444	0.0656	8.4078
2015	3.0361	0.6941	1.9656	0.3961	0.6178	0.0762	0.0416	6.8275
2016	2.6504	0.9036	1.6867	0.4434	0.7424	0.2113	0.0489	6.6867
2017	3.1405	0.9037	2.0984	0.6265	0.6749	0.0460	0.0542	7.5442
2018								
20 PERCENT WORST DAYS								
2002	112.4366	11.4085	15.1052	5.1512	1.9273	0.1004	0.7000	146.8292
2003	78.1299	6.9579	16.2064	4.8809	1.8934	0.0036	0.4841	108.5563
2004	90.3864	10.8146	12.5491	4.5785	1.6240	0.3195	0.7432	121.0155
2005	112.9023	3.5843	12.6820	5.1128	1.6682	0.1703	0.3925	136.5123
2006	61.8690	7.5964	11.6051	4.2892	1.7886	0.2462	0.3912	87.7857
2007	80.1810	8.5807	12.1715	4.7919	1.1544	0.1736	0.5738	107.6267
2008	50.1987	4.6447	9.3677	3.1254	1.9114	0.0715	0.5003	69.8196
2009	42.1562	6.6839	8.7034	3.1308	1.7651	0.1652	0.4305	63.0352
2010	41.2814	4.9089	11.1071	3.2940	0.9555	0.0914	0.4582	62.0966
2011	38.1624	10.6142	14.2299	3.4799	1.8109	0.3284	0.2399	68.8656
2012	28.0512	6.1056	8.5279	3.0581	1.8019	0.9486	0.2652	48.7585
2013	26.1099	5.6494	7.4941	2.2749	1.7985	0.1646	0.2159	43.7073
2014	27.6472	6.7908	8.5097	2.8324	1.9150	0.3374	0.2195	48.2520
2015	24.9043	6.6628	11.7303	3.3793	2.1636	0.3627	0.2640	49.4670
2016	15.4764	4.0127	8.7614	2.1047	1.9106	0.6110	0.2392	33.1159
2017	13.3849	5.3793	11.9756	2.6549	1.8330	0.1163	0.1937	35.5376
2018								

"@" = does not include Rayleigh (11 Mm^{-1})

Table C-25. Observed Light Extinction Conditions for the Presque Isle (ME) MANE-VU IMPROVE Protocol Site

Year	Sulfate (Mm^{-1})	Nitrate (Mm^{-1}))	Organic Mass Carbon (Mm^{-1})	Light Absorbing Carbon (LAC or EC) (Mm^{-1})	Coarse Mass (Mm^{-1})	Sea Salt (Mm^{-1})	Soil (Mm^{-1})	Total PM@ (Mm^{-1})
20 PERCENT BEST DAYS								
2002	6.0901	0.7359	3.2724	1.4467	1.8093	0.0368	0.3474	13.7386
2003	5.3617	0.6920	3.4593	1.9003	2.1466	0.2825	0.2750	14.1174
2004	5.9751	0.8713	3.0309	1.8203	1.8130	0.4302	0.2017	14.1424
2005	5.5373	0.6303	2.6188	1.6274	1.3859	0.4887	0.1444	12.4329
2006	6.0962	0.6243	3.1503	1.6649	1.9762	0.2590	0.2047	13.9755
2007	5.3524	0.4205	2.2781	1.0287	1.4070	0.3224	0.1541	10.9632
2008	4.8733	0.4654	2.3033	0.9115	1.8232	0.2663	0.1988	10.8420
2009	4.9813	0.8105	2.2257	1.1078	1.5624	0.3810	0.1772	11.2459
2010	3.2246	0.3181	1.9121	0.6511	1.3050	0.3750	0.1558	7.9417
2011	4.9538	0.5305	2.5015	0.8497	1.6678	0.3191	0.1139	10.9362
2012	4.2667	0.5303	2.3279	0.9150	1.5563	0.3455	0.1403	10.0820
2013	3.4235	0.4123	2.0976	0.6348	1.5787	0.4709	0.0874	8.7052
2014	4.7842	0.6336	2.4693	0.9183	1.8361	0.4225	0.1376	11.2014
2015	2.5756	0.4277	2.1263	0.5518	1.5566	0.2870	0.1027	7.6277
2016	2.8498	0.5620	2.3831	0.8328	1.7029	0.3653	0.1041	8.7999
2017	3.0695	0.6813	2.6322	0.9161	1.9994	0.2201	0.2000	9.7186
2018								
20 PERCENT WORST DAYS								
2002	62.6758	10.1117	23.1017	6.0062	5.0444	0.5740	0.9588	108.4725
2003	39.9631	5.6406	19.5539	5.5960	6.0991	0.1817	0.8968	77.9311
2004	51.0076	6.0510	13.5734	4.7341	4.8516	0.7049	0.8432	81.7659
2005	44.3080	4.9349	14.8551	5.5380	4.5885	0.6205	0.6038	75.4487
2006	51.0229	5.2599	14.0177	5.2876	3.8238	0.2365	0.5059	80.1542
2007	26.5364	4.0698	9.3756	4.1743	4.9629	0.6518	0.7793	50.5501
2008	33.9447	4.9290	12.6360	5.3390	8.4930	0.8916	1.1360	67.3694
2009	32.5261	4.7758	11.9569	4.5115	5.4237	1.1411	0.7235	61.0586
2010	24.6190	3.8632	19.4805	3.6522	4.6484	0.4391	0.8405	57.5428
2011	23.9996	3.8930	12.2181	3.7062	3.5243	0.8277	0.3076	48.4766
2012	15.9481	5.0243	12.5829	4.5720	6.7769	2.5411	0.6094	48.0546
2013	15.1578	4.6850	10.0623	3.4060	5.9470	1.1952	0.6457	41.0990
2014	18.6125	4.8726	8.5678	3.5478	5.1134	2.3691	0.5599	43.6432
2015	17.3155	4.9968	11.1571	2.9413	4.9870	1.4346	0.4523	43.2846
2016	12.0985	5.1435	7.8613	3.0947	4.2818	0.6339	0.4051	33.5187
2017	9.7952	3.7486	11.3201	3.0631	5.9753	2.6349	0.5142	37.0514
2018								

"@" = does not include Rayleigh (12 Mm^{-1})

Table C-26. Observed Light Extinction Conditions for the Quabbin Summit (MA) MANE-VU IMPROVE Protocol Site

Year	Sulfate (Mm^{-1})	Nitrate (Mm^{-1}))	Organic Mass Carbon (Mm^{-1})	Light Absorbing Carbon (LAC or EC) (Mm^{-1})	Coarse Mass (Mm^{-1})	Sea Salt (Mm^{-1})	Soil (Mm^{-1})	Total PM[@] (Mm^{-1})
20 PERCENT BEST DAYS								
2002	8.7360	1.4980	3.1423	1.4287	1.0350	0.0682	0.1367	16.0449
2003	8.1061	1.3763	2.6126	1.3030	0.9913	0.4342	0.1069	14.9303
2004	8.4933	2.0595	3.1251	1.1864	0.8605	0.6640	0.1592	16.5479
2005	8.1678	1.4947	2.5061	1.3084	0.7654	0.3605	0.0996	14.7023
2006	6.8134	0.9413	2.4860	1.1023	1.0471	0.3127	0.1578	12.8606
2007	6.3782	0.8752	2.5085	1.1659	0.8128	0.3377	0.1115	12.1898
2008	*	*	*	*	*	*	*	*
2009	4.4180	1.1751	2.5844	0.9510	0.7106	0.3178	0.0958	10.2527
2010	4.4277	0.8346	2.0701	0.8020	0.5855	0.1490	0.1004	8.9692
2011	4.9204	0.9940	2.6365	0.9750	0.9782	0.2626	0.0770	10.8437
2012	4.9341	1.0878	2.2377	0.8340	0.7773	0.2506	0.0777	10.1993
2013	3.5838	0.8489	1.8138	0.6467	0.6720	0.3885	0.0595	8.0133
2014	3.6155	0.7482	2.6904	0.8088	0.7503	0.1924	0.0674	8.8730
2015	3.2001	0.7587	2.4806	0.6919	0.7758	0.1779	0.0547	8.1397
20 PERCENT WORST DAYS								
2002	94.9783	16.0056	34.5178	8.2025	2.6258	0.4188	0.9675	157.7163
2003	96.8952	13.7581	20.1704	6.4130	2.3130	0.0577	0.6209	140.2284
2004	98.7057	9.1547	14.0715	5.3242	1.7504	0.3820	0.9474	130.3359
2005	123.9323	8.7332	15.4454	6.7514	1.1875	0.1757	0.5627	156.7882
2006	89.9086	9.3467	19.0391	6.8225	2.2673	0.2604	0.6033	128.2478
2007	98.5007	6.4816	15.2749	6.1661	2.3457	0.2616	0.6573	129.6879
2008	*	*	*	*	*	*	*	*
2009	52.2320	9.3619	11.4253	4.6238	2.1734	0.1033	0.6529	80.5726
2010	51.2908	8.9012	14.1810	4.8281	1.4956	0.1970	0.6411	81.5349
2011	39.1146	6.7497	14.9753	4.7875	2.4120	0.3901	0.3076	68.7368
2012	31.0536	9.9089	11.9536	4.7295	2.2535	0.3091	0.3257	60.5339
2013	25.9548	10.3127	10.7275	3.8798	1.3210	0.3580	0.3945	52.9481
2014	22.5443	8.4412	10.1761	3.6808	1.7543	0.3296	0.2829	47.2092
2015	24.8543	12.8486	14.5175	4.1727	2.6172	0.4235	0.3710	59.8048

"*" = no data available; "[@]" = does not include Rayleigh (11 Mm^{-1})

Table C-27. Observed Light Extinction Conditions for the Washington D.C. MANE-VU IMPROVE Protocol Site

Year	Sulfate (Mm^{-1})	Nitrate (Mm^{-1}))	Organic Mass Carbon (Mm^{-1})	Light Absorbing Carbon (LAC or EC) (Mm^{-1})	Coarse Mass (Mm^{-1})	Sea Salt (Mm^{-1})	Soil (Mm^{-1})	Total PM@ (Mm^{-1})
20 PERCENT BEST DAYS								
2000	20.2290	8.3613	8.1563	7.8486	2.9868	0.2903	0.4916	48.3639
2001	21.8856	6.4138	6.9678	5.2682	2.5693	0.4244	0.4576	43.9868
2002	24.7875	7.7029	7.3664	5.3982	2.3853	0.4245	0.4397	48.5045
2003	18.7825	8.9710	6.6378	5.2137	2.3440	0.1197	0.4276	42.4963
2004	15.9874	6.9398	6.7776	5.1714	3.2455	0.9924	0.4796	39.5935
2005	21.0992	7.5743	6.4890	7.3366	3.6654	1.0452	0.4160	47.6257
2006	16.5686	6.5176	7.9629	9.0311	3.4080	0.7728	0.5712	44.8322
2007	18.7606	5.7842	6.3020	7.1679	2.9891	0.5558	0.4960	42.0557
2008	16.5293	6.2891	6.4253	6.3233	2.7337	0.8000	0.6174	39.7181
2009	16.1941	3.3231	4.7106	5.8078	2.4292	0.4784	0.4419	33.3851
2010	*	*	*	*	*	*	*	*
2011	11.4729	3.7464	5.5214	5.0912	2.9435	0.7431	0.3690	29.8875
2012	12.0839	2.8738	4.0092	3.2173	2.8258	0.4443	0.3253	25.7796
2013	*	*	*	*	*	*	*	*
2014	9.4982	2.9110	5.4467	3.2020	2.1887	0.5367	0.3278	24.1112
20 PERCENT WORST DAYS								
2000	113.5965	33.0634	39.2184	16.2489	4.1454	1.0331	1.0690	208.3748
2001	119.4093	32.3164	34.1628	13.3039	4.2747	1.4804	1.0361	205.9837
2002	132.5002	18.7666	40.9715	10.4469	4.1965	0.5892	1.4800	208.9509
2003	132.4142	26.1522	28.0508	11.4543	3.3395	0.7320	1.1018	203.2450
2004	123.9995	29.6067	27.0897	10.0325	4.1258	1.4599	1.3178	197.6319
2005	166.9213	25.3508	23.6579	16.4593	5.2546	1.4072	0.9782	240.0293
2006	120.9600	14.1742	22.1339	15.1002	4.5035	1.2874	1.0618	179.2209
2007	123.5947	17.3948	22.6938	13.0413	3.9470	1.4121	1.0697	183.1533
2008	97.8115	13.4819	24.0772	11.7833	4.2498	0.6935	1.2566	153.3538
2009	63.4336	21.4488	20.7057	12.2235	3.6289	1.3932	0.9224	123.7561
2010	*	*	*	*	*	*	*	*
2011	52.1519	16.6910	20.9920	11.8570	4.7160	0.8187	0.7173	107.9440
2012	31.8452	25.2318	18.8845	11.1488	4.0693	0.9108	0.7269	92.8174
2013	*	*	*	*	*	*	*	*
2014	35.2157	32.8476	14.6222	8.9530	3.9380	1.5735	0.6205	97.7705

"*" = no data available; "@" = does not include Rayleigh (12 Mm^{-1})

Table C-28. Observed Light Extinction Conditions for the Quaker City (OH) Nearby Adjacent IMPROVE Protocol Site

Year	Sulfate (Mm^{-1})	Nitrate (Mm^{-1}))	Organic Mass Carbon (Mm^{-1})	Light Absorbing Carbon (LAC or EC) (Mm^{-1})	Coarse Mass (Mm^{-1})	Sea Salt (Mm^{-1})	Soil (Mm^{-1})	Total PM[@] (Mm^{-1})
20 PERCENT BEST DAYS								
2002	20.5021	6.5356	5.1468	2.7708	1.6979	0.1220	0.2376	37.0128
2003	17.6515	7.5608	5.5429	2.8919	2.0305	0.0030	0.2955	35.9762
2004	17.8375	6.6934	4.4398	2.3143	1.7140	0.3865	0.2687	33.6542
2005	23.3790	5.9021	4.4962	3.0408	2.1995	0.2783	0.2602	39.5560
2006	19.1357	4.0837	4.2366	2.7183	2.2009	0.2075	0.2323	32.8151
2007	18.8184	5.4690	4.3600	2.5641	2.0017	0.3315	0.2555	33.8003
2008	17.1187	3.6323	4.3403	2.1668	2.4037	0.1282	0.3142	30.1041
2009	15.3529	2.8048	3.2733	1.7114	2.5106	0.1752	0.2954	26.1237
2010	*	*	*	*	*	*	*	*
2011	12.0258	3.8813	4.1104	2.1617	2.5419	0.5807	0.1825	25.4842
2012	11.8023	2.9627	3.6892	1.8430	2.7258	0.1412	0.2876	23.4517
2013	12.0585	3.0855	3.0215	1.6305	2.7867	0.1984	0.2033	22.9844
2014	12.0703	3.7801	3.3463	1.9473	2.4510	0.1887	0.2086	23.9924
2015	9.4963	2.5841	4.4384	1.9158	2.3409	0.1248	0.2370	21.1371
2016	8.3378	2.5489	3.1611	1.3198	2.4612	0.1001	0.1234	18.0524
2017	7.2834	2.6762	3.3910	1.5753	1.9262	0.0667	0.1337	17.0525
2018								
20 PERCENT WORST DAYS								
2002	183.2875	6.1682	16.2389	5.6048	2.8213	0.0059	1.5280	215.6545
2003	171.9215	6.3603	12.6530	6.3921	2.1062	0.6484	0.6145	200.6960
2004	179.6134	7.5725	15.0949	5.9782	2.8915	0.3989	1.2361	212.7854
2005	227.2283	5.3662	11.5926	6.1563	4.6017	0.1252	0.7331	255.8034
2006	159.1919	3.0619	13.4763	6.1771	3.5103	0.1270	0.7171	186.2616
2007	169.1557	7.9614	16.4540	6.5789	4.8702	0.1625	1.1472	206.3299
2008	106.3263	9.3804	13.6502	5.4429	4.3391	0.2279	0.9622	140.3289
2009	86.8202	11.9099	11.0178	5.4825	3.2276	0.0942	0.7840	119.3361
2010	*	*	*	*	*	*	*	*
2011	93.8585	12.4591	12.9713	4.8908	4.5084	0.4304	0.4272	129.5457
2012	56.8658	12.8955	8.7745	4.2917	9.6266	0.3414	0.6109	93.4063
2013	57.8524	22.2571	7.9429	4.5810	4.0105	0.4690	0.4017	97.5146
2014	49.8108	29.2059	8.7798	6.6579	3.2153	0.5282	0.5004	98.6983
2015	49.5568	18.2888	14.0456	5.2524	3.3367	0.3042	0.4225	91.2070
2016	28.6430	21.6646	11.4633	3.7633	3.3265	0.2835	0.3109	69.4551
2017	30.4569	17.2925	12.1613	4.5141	3.3122	0.1743	0.3588	68.2700
2018								

"*" = no data available; "[@]" = does not include Rayleigh (11 Mm^{-1})