Arkansas Regional Haze Planning Period II

State Implementation Plan

CHAPTER III: FEDERAL CLASS I AREAS IN OTHER STATES IMPACTED BY ARKANSAS SOURCES

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III. Federal Class I Areas in Other States Impacted by Arkansas Sources

40 CFR § 51.308(f) requires that states address emissions within the state that impair visibility in each mandatory federal Class I area within the state, as well as emissions within the state that may impair visibility in federal Class I areas in other states.

DEQ used the AOI analysis by Ramboll to determine areas of influence for federal Class I areas in and near the CenSARA region. Specifically, DEQ examined distance-weighted residence time plots to identify federal Class I areas that may be influenced by air masses from Arkansas. The RHR does not provide specific guidance for thresholds values for residence time. Therefore, DEQ selected 0.05% as a cut-off to identify areas of influence from the distance-weighted residence time plots.[1]

Based on the AOI analysis, DEQ identified the following Class I areas for which emissions from Arkansas sources may be reasonably anticipated to contribute to visibility impairment:

- Hercules Glades Wilderness (Hercules Glades), MO;
- Mammoth Cave National Park (Mammoth Cave), KY;
- Sipsey Wilderness (Sipsey), AL; and
- Wichita Mountains Wilderness (Wichita Mountains), OK

In addition to the federal Class I areas DEQ identified using distance-weighted residence times, DEQ also identified two additional Class I areas for which the 2016 visibility surrogate or photochemical modeling indicated that a particular source within the state of Arkansas may contribute to visibility impairment: Mingo Wilderness (Mingo), MO and Shining Rock Wilderness (Shining Rock), North Carolina. During source selection for the reasonable progress analysis described in Chapter V, DEQ identified the Independence Power Plant in Arkansas as meeting its threshold for a reasonable progress analysis for Mingo in Missouri. Other state air organizations (WRAP, VISTAS, and LADCO) performed photochemical modeling; only VISTAS made a request of DEQ to perform a reasonable progress analysis for Independence Power Plant in Arkansas, as their modeling shows impacts at Shining Rock in North Carolina. Therefore, DEQ has also included a discussion of Mingo and Shining Rock in this chapter.

DEQ has examined the sources of visibility impairment for each of identified federal Class I areas and progress toward the goal of natural visibility conditions in 2064.

[1] See Appendix B for distance-weighted residence time plots.

A. Hercules Glades Wilderness Area

The Hercules Glades Wilderness Area consists of 12,413 acres of open grasslands, forested knobs, steep rocky hillsides, and narrow drainages. The area is characterized by shallow, droughty soils and limestone outcrops.[2] Figure III-1 illustrates the scenic quality of Hercules Glades.

Figure III-1: Hercules Glades Wilderness[3]

1. Ambient Data Analysis

The Hercules Glades Wilderness Area monitor is located twelve miles east of Forsythe, Missouri at latitude 36.6138, longitude -92.9221, at an elevation of 404 meters above MSL.

Figure III-2 shows that visibility impairment has decreased over time at Hercules Glades on the twenty percent most impaired days. In particular, light extinction on the most impaired days due to ammonium sulfate has decreased dramatically since 2002. Light extinction on the most impaired days due to ammonium nitrate has fluctuated over the period between 2002 and 2019. In 2019, the relative impact on light extinction on the most impaired days was forty percent for ammonium sulfate and thirty-seven percent for ammonium nitrate. Coarse mass, elemental carbon, organic mass, sea salt, and soil have varied over time, but make up smaller fractions of the overall particulate species impairing visibility on the most impaired days.

[2] U.S. Forest Service. https://www.fs.usda.gov/recarea/mtnf/recarea/?recid=21754

[3] Image Credit: Tricia Treece (Left) and National Forest Service https://www.fs.usda.gov/recarea/mtnf/recarea/?recid=21754 (Right)

Figure III-2: Annual Extinction Composition, Most Impaired Days at Hercules Glades, 2002–2019[4]

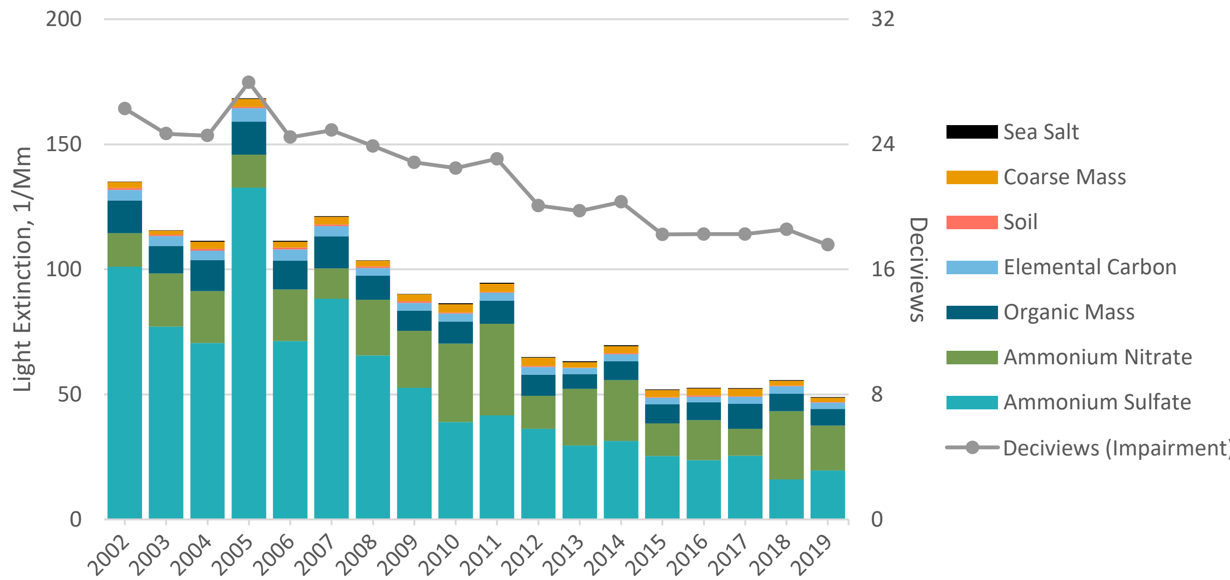


Figure III-3 shows no degradation on the twenty percent clearest days at Hercules Glades.

Figure III-3: Annual Extinction Composition, Clearest Days at Hercules Glades, 2002–2019[5]

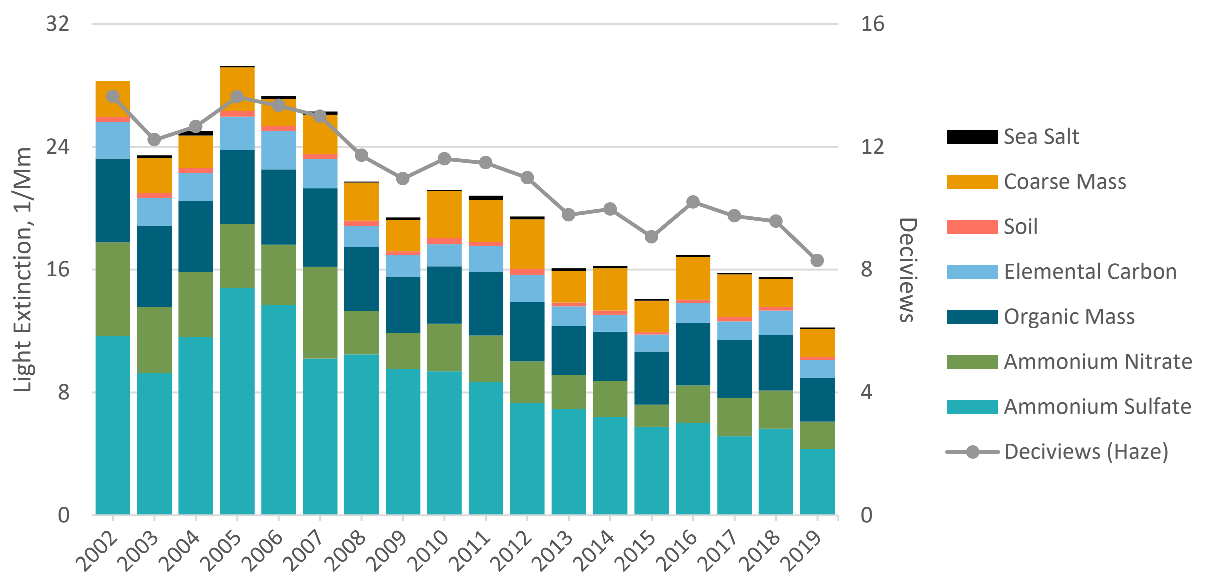


Figure III-4 shows daily haze composition due to anthropogenic sources and Figure III-5 shows

[4] Data obtained from IMPROVE data file sia_impairment_group_means_12_20

[5] Data obtained from IMPROVE data file SIA_group_means_12_20.

daily haze composition due to natural sources on the most impaired days at Hercules Glades in 2018.

Figure III-4: Daily Haze Composition Due to Anthropogenic Sources, Most Impaired Days at Hercules Glades, 2018[6]

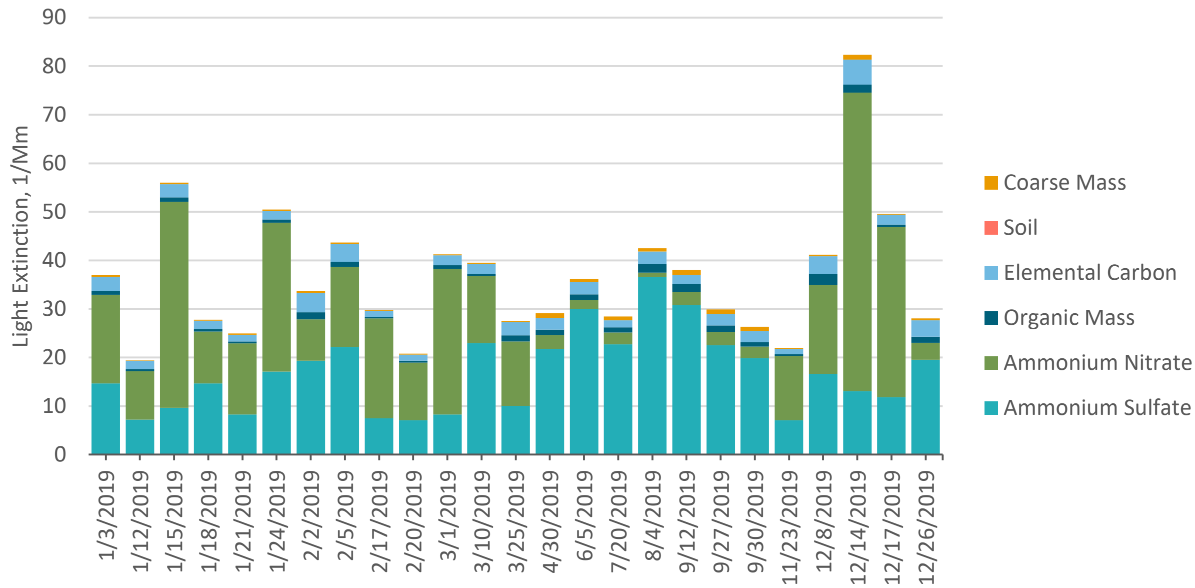
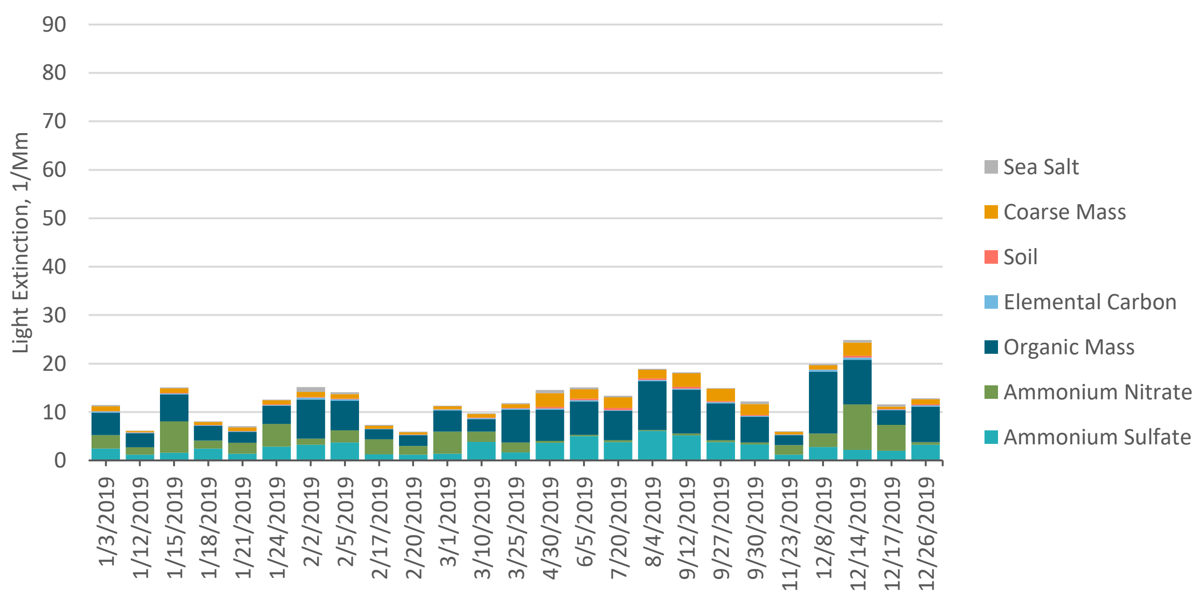


Figure III-5: Daily Haze Composition Due to Natural Sources, Most Impaired Days at Hercules Glades, 2019[7]



[6] Data obtained from IMPROVE data file sia_impairment_daily_budgets_12_20.
[7] Data obtained from IMPROVE data file sia_impairment_daily_budgets_12_20.

Figures III-4 and III-5 show that light extinction on the most impaired days at Hercules Glades in 2018 from ammonium nitrate, ammonium sulfate, and elemental carbon are primarily anthropogenic in nature. Light extinction on the most impaired days at Hercules Glades in 2019 from coarse mass, organic mass, sea salt, and soil are primarily due to natural sources.

Based on these monitor data observations, strategies to reduce visibility impairment at Hercules Glades from manmade air pollution during Planning Period II should focus on the following key pollutants: ammonium nitrate and ammonium sulfate.

2. Modeling Data Analysis

Figure III-6 illustrates for Hercules Glades the results of EPA's modeling effort. The figure presents observed data for 2014–2017, 2028 base case projections, and possible glidepaths under different assumptions. The dashed line represents EPA's default adjusted glidepath, which was adjusted based on relative international anthropogenic model contributions and ambient natural conditions.[8] The figure also includes a pie chart representing the specific anthropogenic emissions sector contributions identified as contributing to visibility impairment at Hercules Glades in 2028.

Figure III-6: IMPROVE Site Summary Plot for Hercules Glades

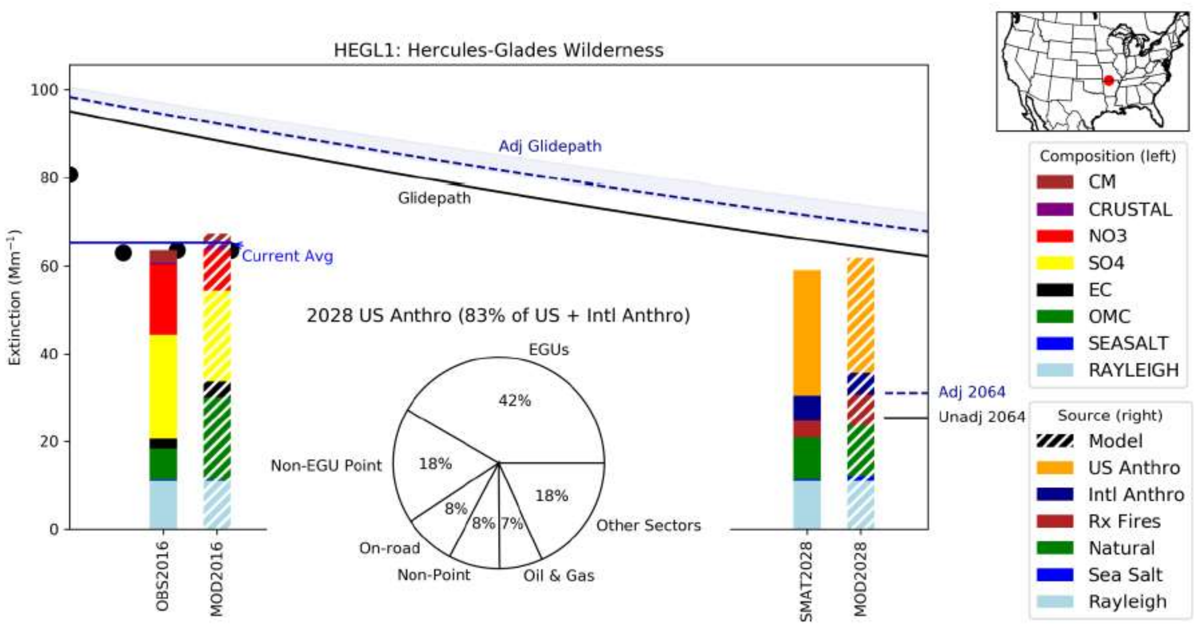


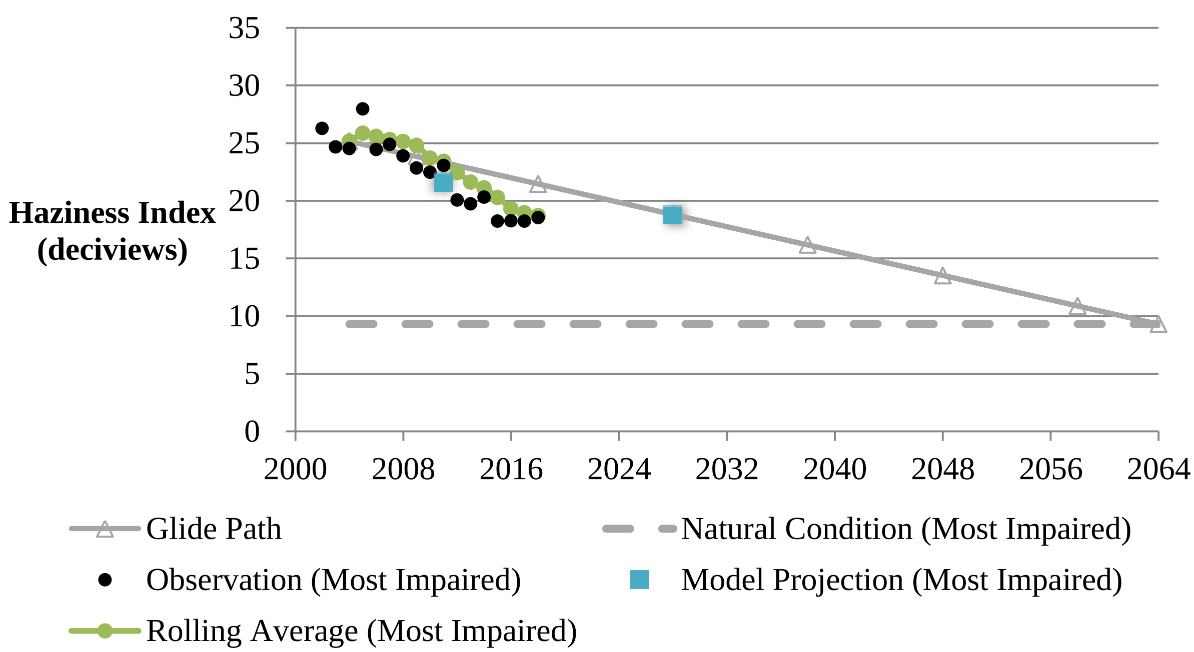
Figure III-6 shows that visibility impairment on the most impaired days in 2028 is projected to remain below any glidepath that the State of Missouri may establish in their Planning Period II SIP even before consideration of additional control measures to ensure reasonable progress.

[8] The different glidepaths EPA included in their summary plots are based on different 2064 endpoint adjustment assumptions.

The pie chart in Figure III-6 represents specific source categories contributing to visibility impairment at Hercules Glades on the most impaired days in 2028 and indicates the most prominent source categories are EGUs and Non-EGU point sources, with smaller contributions from on-road sources, non-point sources, oil and gas, and other sectors. The source apportionment presented in the pie chart suggests that strategies to reduce visibility impairment in 2028 should focus on reducing emissions from the following source categories: EGU and non-EGU point.

Figures III-7 and III-8 illustrate the 2028 base case results for Hercules Glades of the VISTAS modeling effort. The VISTAS modeling base case results project visibility impairment in 2028 at Hercules Glades on the most impaired days (18.80 deciviews) to be just below the unadjusted glidepath (18.82 deciviews).[9] The projected base case results for the clearest days (9.75 deciviews) show no degradation from the 2000–2004 baseline (12.84 deciviews).

Figure III-7: VISTAS Base Case Results for Hercules Glades Wilderness (Most Impaired Days)[10]



[9] Missouri DNR confirmed plans to use the unadjusted URP for this planning period's projections.
[10] Model results obtained from Metro 4/SESARM: Copy of V5_GlidePath_MI20_unitDeciview_07-17-2020

Figure III-8: VISTAS Base Case Results for Hercules Glades Wilderness (Clearest Days)[11]

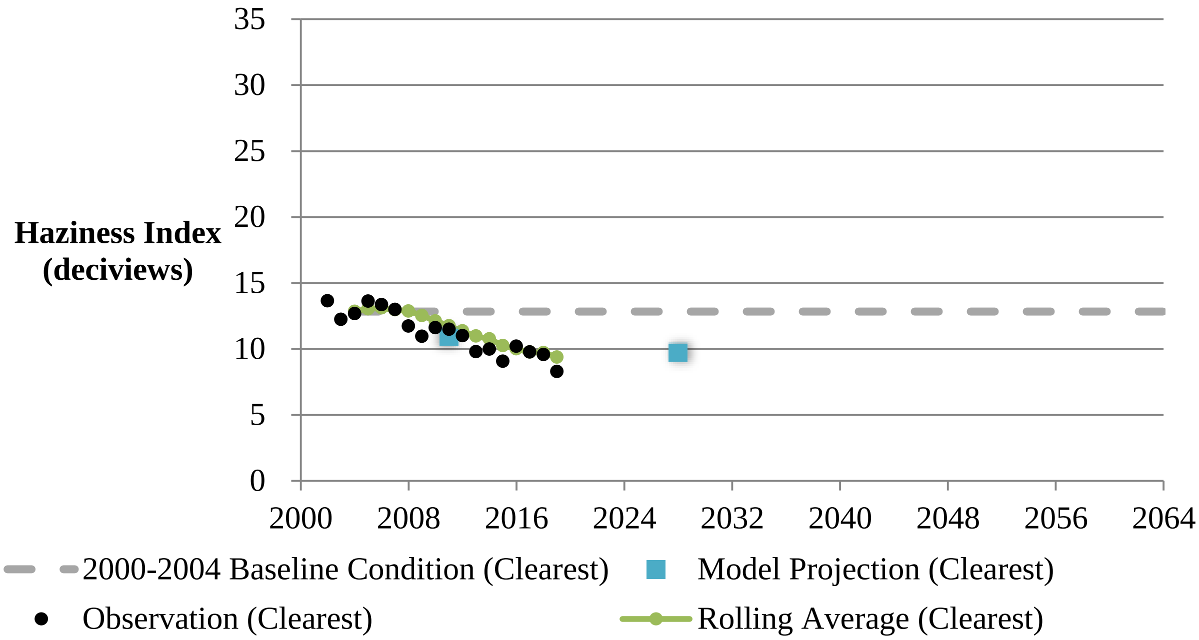


Figure III-9 shows how a vista at Hercules Glades Wilderness would look during the most impaired days in 2002 (left), 2019 (center), and under natural conditions (right). The improvement between the center image and the left image shows how the visibility has improved over time on the most impaired days.

Figure III-9: Hercules Glades Wilderness WinHAZE Visualization Twenty Percent Most Impaired: 2002, 2019, and Natural Conditions[12]

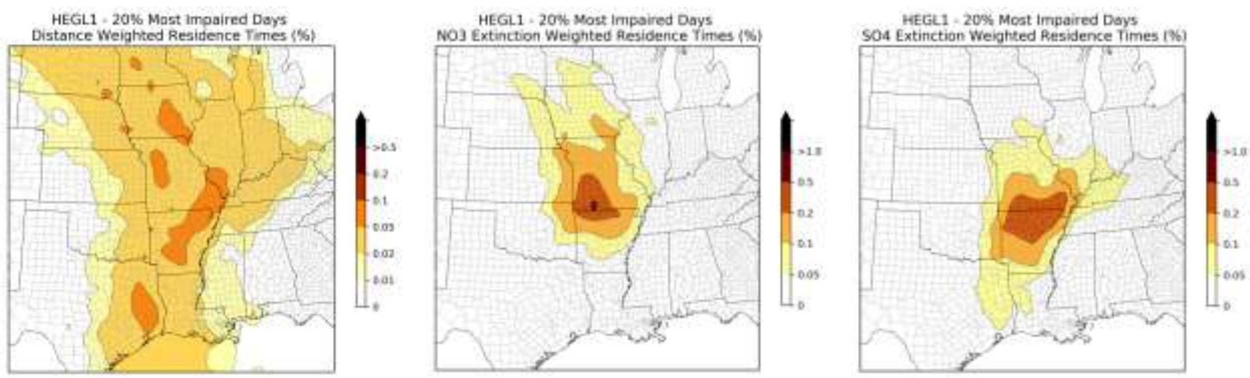
[11] Model results obtained from Metro 4/SESARM: Copy of V5_GlidePath_20C_unitDeciview_07-17-2020

[12] Interagency Monitoring of Protected Visual Environments. http://vista.cira.colostate.edu/Improve/winhaze/

3. AOI Analysis

As described in Chapter II, DEQ used the AOI analysis results produced by Ramboll for the CenSARA states to evaluate which geographic regions and sources have a high probability of contributing to anthropogenic visibility impairment at federal Class I areas within the CenSARA region and in neighboring states. Figure III-10 shows the distance-weighted residence time and pollutant-specific extinction-weighted residence times (EWRT NO_3 and EWRT SO_4) for Hercules Glades for the most impaired days. Based on the distance-weighted residence time plot, air masses from the following states are within the 0.05% distance-weighted residence time contour for Hercules Glades on the most impaired days: Arkansas, Illinois, Iowa, Kentucky, Minnesota, Missouri, Nebraska, Oklahoma, South Dakota, and Texas. The EWRT NO_3 plot indicates that air masses coming from the following states may be impacting ammonium nitrate concentrations at Hercules Glades on the most impaired days: Arkansas, Illinois, Iowa, Kansas, Minnesota, Missouri, Nebraska, Oklahoma, South Dakota, and Wisconsin. The EWRT SO_4 plot indicates that air masses coming from the following states may be impacting ammonium sulfate concentrations at Hercules Glades on the most impaired days: Arkansas, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Mississippi, Missouri, Oklahoma, Tennessee, and Texas. Darker areas on these plots indicate a larger influence on Hercules Glades on the most impaired days for the examined metric.

Figure III-10: All Trajectories Distance-Weighted Residence Times, EWRT NO_3, and EWRT SO_4 for the Twenty-Percent Most Impaired Days—Hercules Glades (Normalized Percentages)



The EWRT NO_3 and EWRT SO_4 plots indicate that air masses from northern Arkansas and southern Missouri have the greatest influence on ammonium nitrate and ammonium sulfate on Hercules Glades on the most impaired days. The individual sources with the highest visibility impact surrogate values for Hercules Glades in 2016 were sources in Arkansas, Illinois, Indiana, Kentucky, Louisiana, Missouri, Nebraska, Oklahoma, Tennessee, and Texas. Thirty-two percent of the inventory's visibility surrogate total for Hercules Glades in 2016 is attributable to Arkansas sources.

Based on the pollutant-specific EWRT plots for the dominant pollutants and the relatively large percentage of the AOI inventory's visibility surrogate table attributable to Arkansas sources, DEQ concludes that emissions from Arkansas sources are reasonably anticipated to contribute to visibility impairment at Hercules Glades.

B. Mammoth Cave

The Mammoth Cave National Park federal Class I area consists of 51,303 acres in the Green River valley and contains the world's longest known cave system.[13] Mammoth Cave supports many recreational activities including camping, hiking, cave tours, horseback riding, fishing, and boating.[14] Figure III-11 illustrates the scenic nature of Mammoth Cave.

Figure III-11: Mammoth Cave Wilderness[15]

1. Ambient Data Analysis

The Mammoth Cave monitor is located at latitude 37.1318, longitude -86.1479, at an elevation of 235 meters above MSL.

Figure III-12 shows that visibility impairment has decreased at Mammoth Cave on the twenty percent most impaired days. In particular, light extinction due to ammonium sulfate on the most impaired days has decreased markedly on the most impaired days since 2000. Light extinction due to organic mass, elemental carbon, and soil has also decreased. Light extinction due to

[13] https://www.nps.gov/maca/index.htm
[14] https://www.nps.gov/maca/planyourvisit/things2do.htm
[15] https://npgallery.nps.gov/AssetDetail/c9335a50fca140338a4216fd1e8fb14a# (left)
https://npgallery.nps.gov/AssetDetail/31AE4F7F-1DD8-B71B-0BF11F0110B23707 (right)

ammonium nitrate and sea salt has increased. In 2019, the relative impact on light extinction on the most impaired days was forty-five percent for ammonium sulfate and thirty-three percent for ammonium nitrate. Coarse mass, elemental carbon, organic mass, sea salt, and soil make up smaller fractions of the overall particulate species impairing visibility on the most impaired days.

Figure III-12: Annual Extinction Composition, Most Impaired Days at Mammoth Cave, 2000–2019[16]

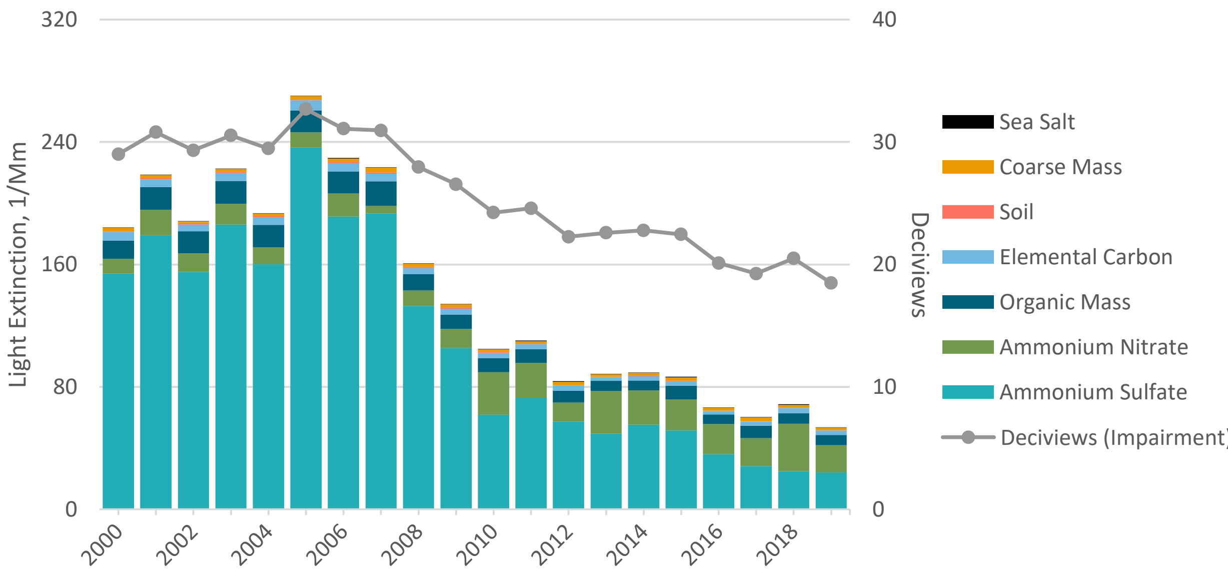


Figure III-13 shows no degradation on the clearest days at Mammoth Cave. Light extinction due to ammonium sulfate on the clearest days has dramatically decreased since 2000.

[16] Data obtained from IMPROVE data file sia_impairment_group_means_12_20.

Figure III-13: Annual Extinction Composition, Clearest Days at Mammoth Cave, 2000–2019[17]

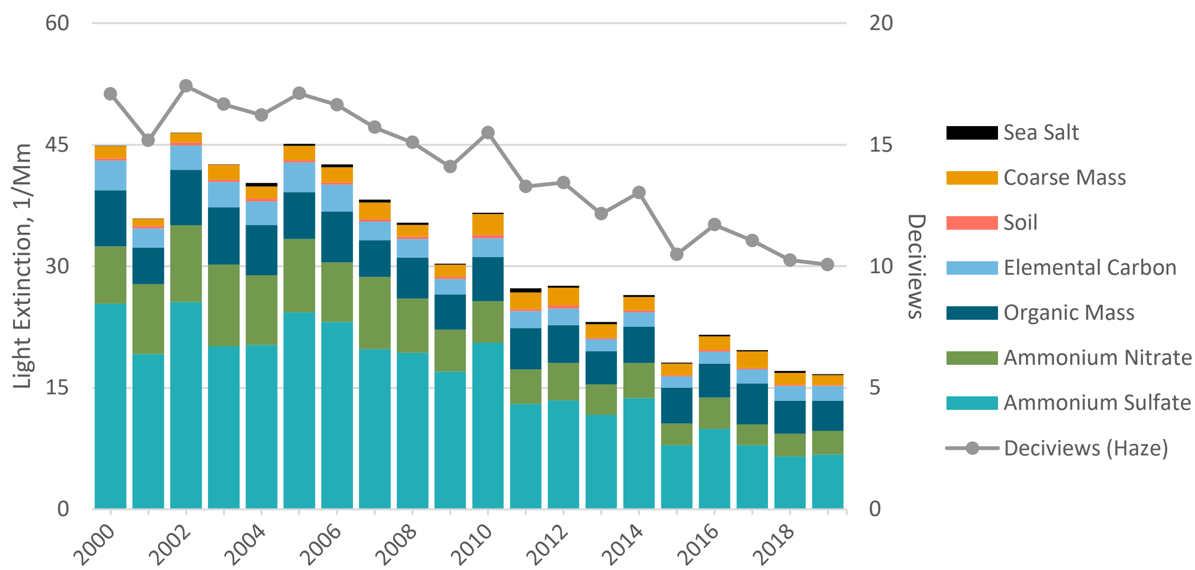
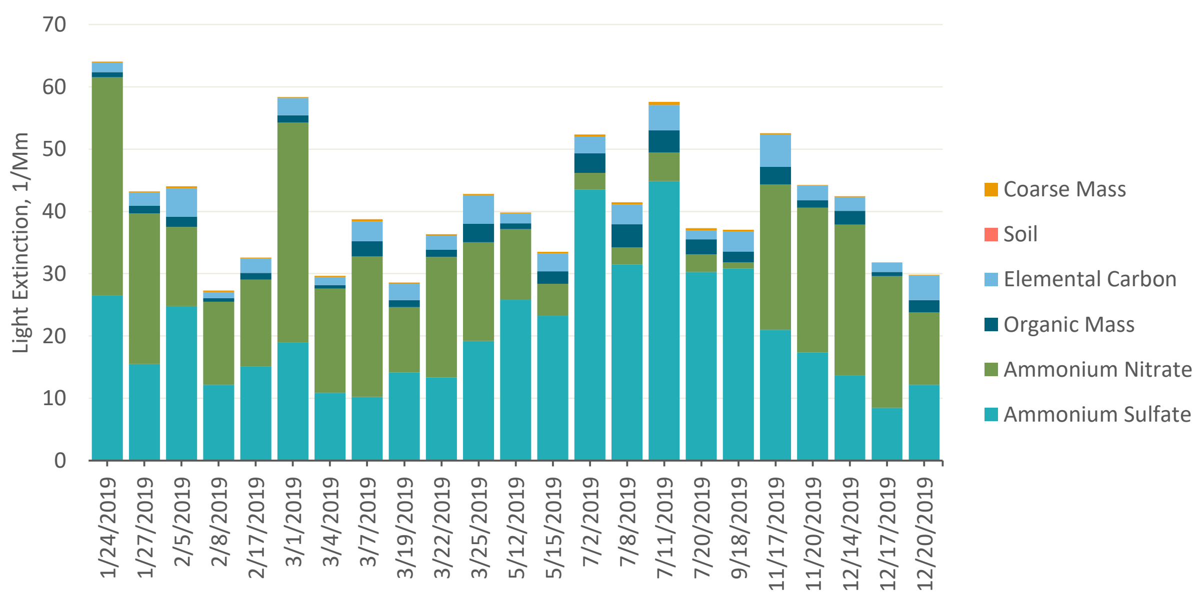


Figure III-14 shows daily haze composition due to anthropogenic sources and Figure III-15 shows daily haze composition due to natural sources on the most impaired days at Mammoth Cave in 2019.

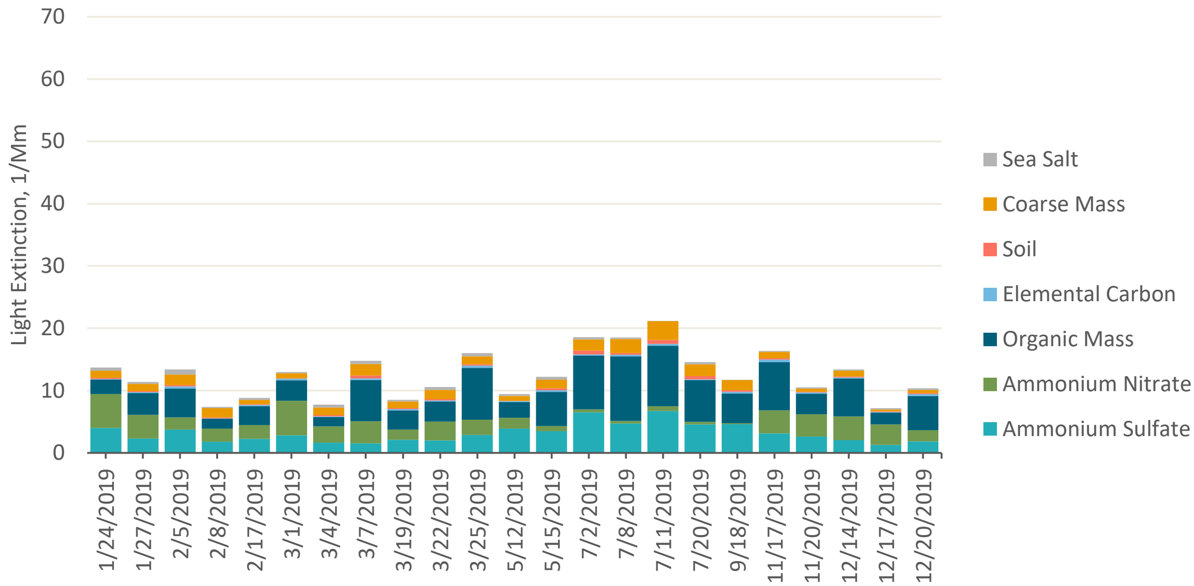
Figure III-14: Daily Haze Composition Due to Anthropogenic Sources, Most Impaired Days at Mammoth Cave, 2019[18]



[17] Data obtained from IMPROVE data file SIA _group_means_12_20.

[18] Data obtained from IMPROVE data file sia_impairment_daily_budgets_12_20.

Figure III-15: Daily Haze Composition Due to Natural Sources, Most Impaired Days at Mammoth Cave, 2019[19]



Figures III-14 and III-15 show that light extinction on the most impaired days at Mammoth Cave during 2018 from ammonium nitrate, ammonium sulfate, and elemental carbon are primarily anthropogenic in nature. Light extinction due to organic mass and coarse mass are primarily from natural sources. On the most impaired days, ammonium nitrate is the predominant species during the cooler months and ammonium sulfate is the predominant species in the summer.

Based on these monitor data observations, strategies to reduce visibility impairment at Mammoth Cave from manmade air pollution during Planning Period II should focus on the following key pollutants: ammonium nitrate and ammonium sulfate.

2. Modeling Data Analysis

Figure III-16 illustrates the results of EPA's modeling effort for Mammoth Cave. The figure presents observed data for 2014–2017, 2028 base case projections, and possible glidepaths under different assumptions. The dashed line represents EPA's default adjusted glidepath, which was adjusted based on relative international anthropogenic model contributions and ambient natural conditions.[20] The figure also includes a pie chart representing the specific anthropogenic emissions sector contributions identified as contributing to visibility impairment at Mammoth Cave in 2028.

[19] Data obtained from IMPROVE data file sia_impairment_daily_budgets_12_20.

[20] The different glidepaths EPA included in their summary plots are based on different 2064 endpoint adjustment assumptions.

Figure III-16: IMPROVE Site Summary Plot for Mammoth Cave

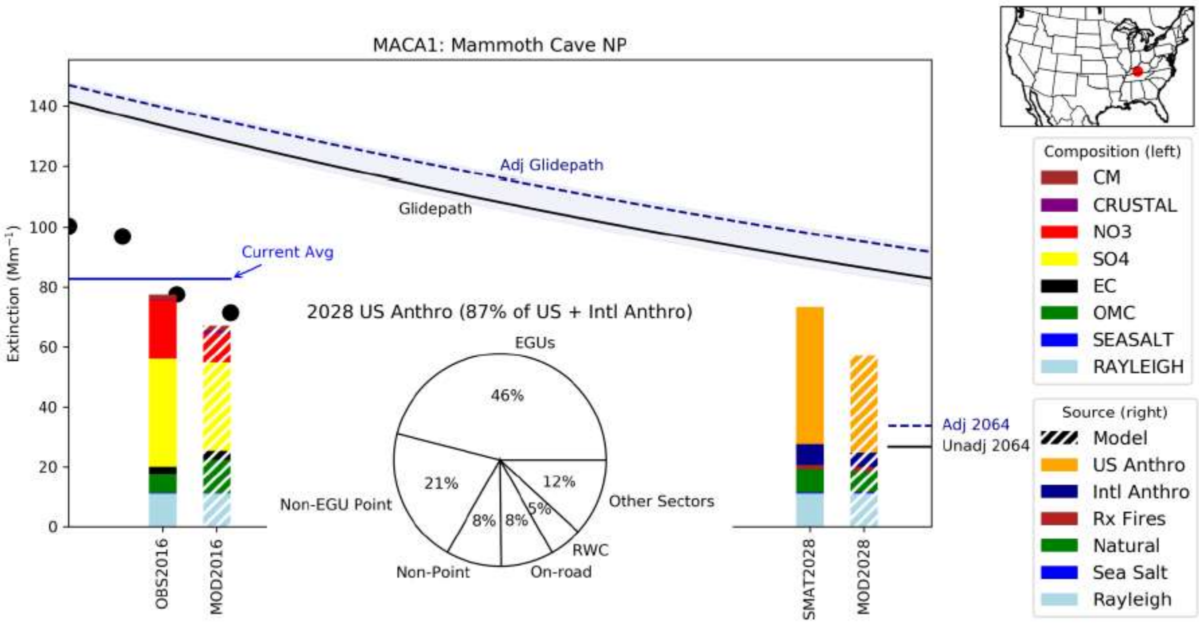


Figure III-16 shows that visibility impairment on the most impaired days in 2028 is projected to remain below any glidepath that the State of Kentucky may establish in their Planning Period II SIP even before consideration of additional control measures to ensure reasonable progress.

The pie chart in Figure III-16 represents specific source categories projected to contribute to visibility impairment at Mammoth Cave on the most impaired days in 2028 and indicates that the most prominent source categories are EGUs and non-EGU point sources, with smaller contributions from non-point sources, on-road sources, other sectors, and residential wood combustion. The source apportionment presented in the pie chart suggests that strategies to reduce visibility impairment in 2028 should focus on reducing emissions from the following source categories: EGU and non-EGU point.

Figures III-17 and III-18 illustrate the 2028 base case results for Mammoth Cave of the VISTAS modeling effort. The VISTAS modeling base case results project visibility impairment in 2028 at Mammoth Cave on the most impaired days (19.27 deciviews) to be above the unadjusted glidepath (21.81 deciviews).[21] The projected base case results for the clearest days (11.66 deciviews) show no degradation from the 2000–2004 baseline (16.51 deciviews).

[21] Kentucky Energy and Environment confirmed plans to use 21.82 deciviews for the 2028 URP for Mammoth Cave based on the updated natural conditions value for most impaired days that is in the 2020 EPA memo (Recommendation for the Use of Patched and Substituted Data and Clarification of Data Completeness for Tracking Visibility Progress for the Second Implementation Period of the Regional Haze Program). In that data update, the natural conditions/endpoint for Mammoth Cave changed to 21.82 deciviews from the prior value of 21.81 deciviews, which shifted the glidepath accordingly.

Figure III-17: VISTAS Base Case Results for Mammoth Cave (Most Impaired Days)[22]

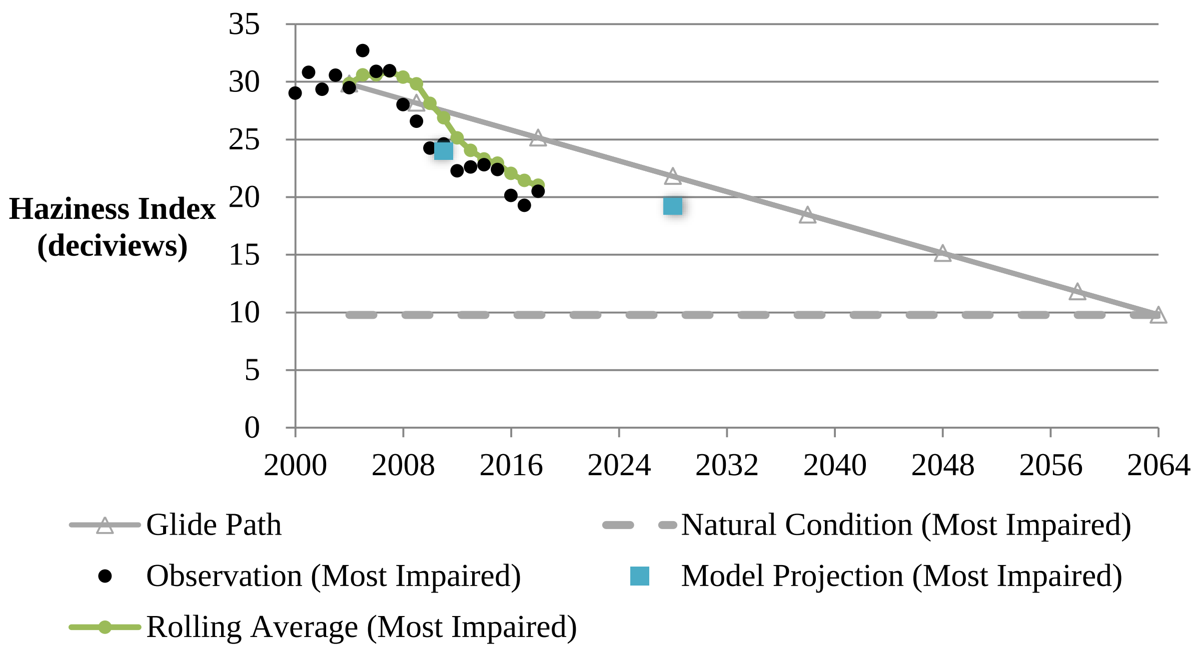
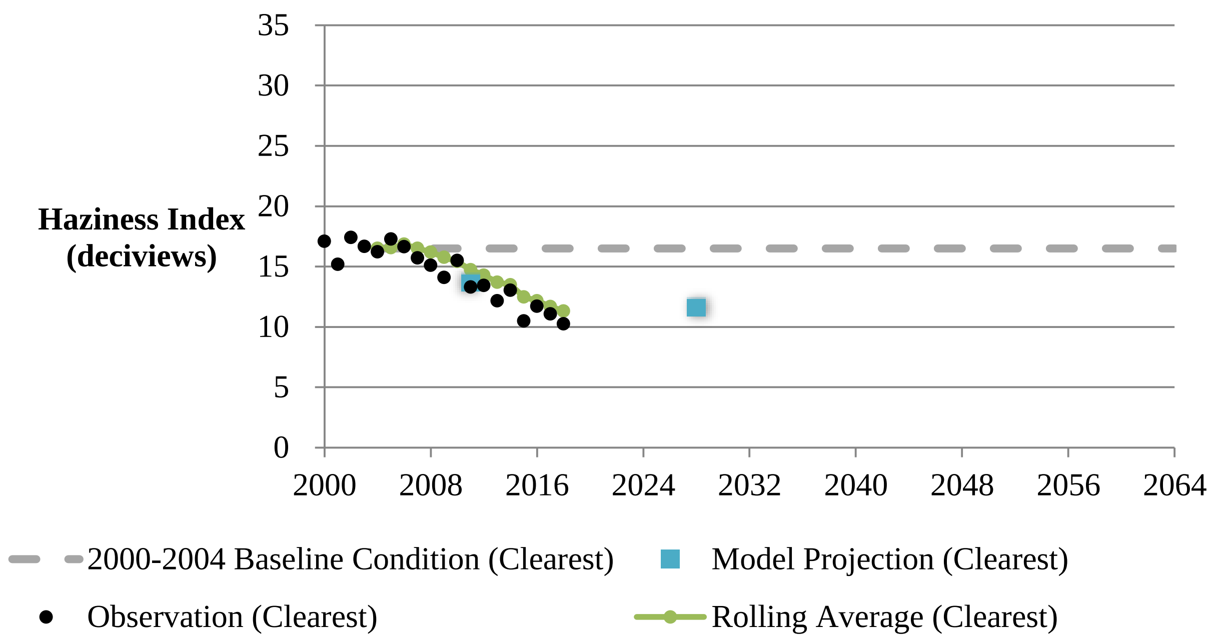


Figure III-18: VISTAS Base Case Modeling Results for Mammoth Cave – 20% Clearest Days[23]



[22] Model results obtained from Metro 4/SESARM: Copy of V5_GlidePath_MI20_unitDeciview_07-17-2020_jb

[23] Model results obtained from Metro 4/SESARM: Copy of V5_GlidePath_20C_unitDeciview_07-17-2020

Figure III-19 shows how a vista at Mammoth Cave would look during the most impaired days in 2002 (left), 2019 (center), and under natural conditions (right). The improvement between the center image and the left image shows how the visibility has improved over time on the most impaired days. The image on the right visualizes natural conditions for the area.

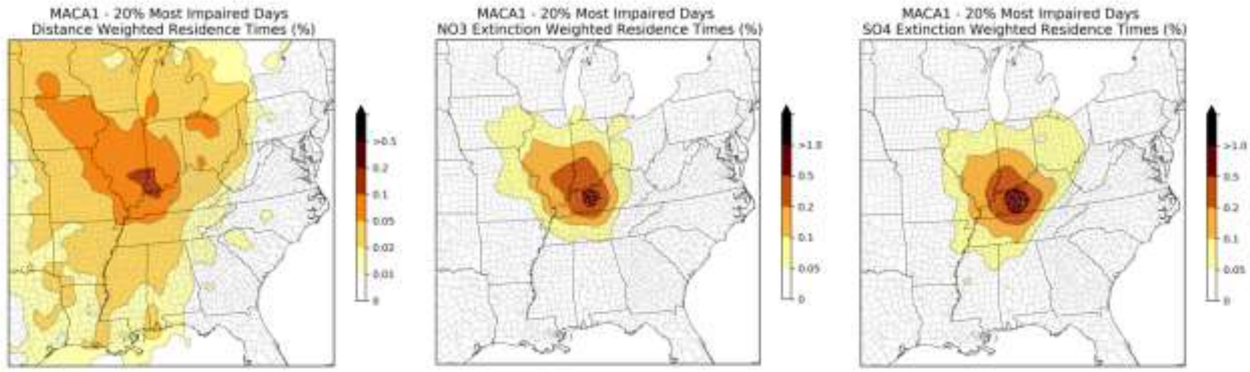
Figure III-19: Mammoth Cave WinHAZE Visualization Twenty Percent Most Impaired: 2002, 2019, and Natural Conditions[24]

3. AOI Analysis

As described in Chapter II, DEQ used the AOI analysis results produced by Ramboll for the CenSARA states to evaluate which geographic regions and sources have a high probability of contributing to anthropogenic visibility impairment at federal Class I areas within the CenSARA region and in neighboring states. Figure III-20 shows the distance-weighted residence time and pollutant-specific extinction-weighted residence times (EWRT NO_3 and EWRT SO_4) for Mammoth Cave for the most impaired days. Based on the distance-weighted residence time plot, air masses from the following states are within the 0.05% distance-weighted residence time contour for Mammoth Cave on the most impaired days: Illinois, Indiana, Iowa, Kentucky, Michigan, Minnesota, Missouri, Ohio, Tennessee and Wisconsin. The EWRT NO_3 plot indicates that air masses coming from the following states may be impacting ammonium nitrate concentrations at Mammoth Cave on the most impaired days: Alabama, Arkansas, Illinois, Indiana, Iowa, Kentucky, Michigan, Missouri, Tennessee, and Ohio. The EWRT SO_4 plot indicates that air masses coming from the following states may be impacting ammonium sulfate concentrations at Mammoth Cave on the most impaired days: Alabama, Arkansas, Illinois, Indiana, Iowa, Kentucky, Louisiana, Michigan, Mississippi, Missouri, Ohio, Tennessee and West Virginia. Darker areas on these plots indicate a larger influence on Mammoth Cave on the most impaired days for the examined metric.

[24] Interagency Monitoring of Protected Visual Environments. http://vista.cira.colostate.edu/Improve/winhaze/

Figure III-20: All Trajectories Distance-Weighted Residence Times, EWRT NO_3, and EWRT SO_4 for the Twenty-Percent Most Impaired Days—Mammoth Cave (Normalized Percentages)



Based on the EWRT NO_3 and EWRT SO_4 plots, air masses from Kentucky have the greatest influence on ammonium nitrate and air masses from Indiana, Kentucky, and Tennessee the plot, air masses from Indiana, Kentucky, and Tennessee have the greatest influence on ammonium sulfate at Mammoth Cave on the most impaired days. The individual sources with the highest visibility impact surrogate values for Mammoth Cave in 2016 were sources in Indiana, Kentucky, and Tennessee. Less than one percent of the inventory's visibility surrogate total for Mammoth Cave in 2016 is attributable to Arkansas sources.

Although only a small percentage of the AOI inventory's visibility surrogate table attributable to Arkansas sources, the pollutant-specific EWRT plots do extend into Arkansas. Therefore, DEQ concludes that emissions from Arkansas sources are reasonably anticipated to contribute to visibility impairment at Mammoth Cave.

C. Mingo Wilderness

The Mingo National Wildlife Refuge Wilderness Area consists of 7,730 acres of swamp, riparian areas, and Ozark Plateau uplands.[25] Mingo Wilderness supports multiple recreational activities including hiking and fishing. Figure III-21 shows two photographs that illustrate the scenic quality of the Mingo Wilderness.

[25] National Wildlife Refuge System. https://www.fws.gov/refuge/mingo/

Figure III-21: Mingo Wilderness Area[26]

1. Ambient Data Analysis

The Mingo Wilderness Area monitor is located in southeastern Missouri at latitude 36.9717 and longitude -90.1432 at an elevation of 111 meters above MSL.

Figure III-22 shows that visibility impairment has decreased over time at Mingo on the twenty percent most impaired days. In particular, light extinction on the most impaired days due to ammonium sulfate has decreased markedly since 2000. Light extinction on the most impaired days due to ammonium nitrate has fluctuated over the period between 2000 and 2018 and has surpassed ammonium sulfate in relative contribution to light extinction on the most impaired days at Mingo. In 2001, the relative impact on light extinction for the most impaired days was fifty-eight percent for ammonium sulfate and twenty-five percent for ammonium nitrate. In 2018, the relative impact on light extinction on the most impaired days was thirty percent for ammonium sulfate and forty-nine percent for ammonium nitrate. Coarse mass, elemental carbon, organic mass, sea salt, and soil have varied over time, but make up smaller fractions of the overall particulate species impairing visibility.

[26] Image Credit: https://www.fws.gov/Refuge/Mingo/wildlife_and_habitat/wilderness.html (Left) and https://www.fws.gov/refuge/Mingo/about.html (Right)

Figure III-22: Annual Extinction Composition, Most Impaired Days at Mingo, 2001–2019[27]

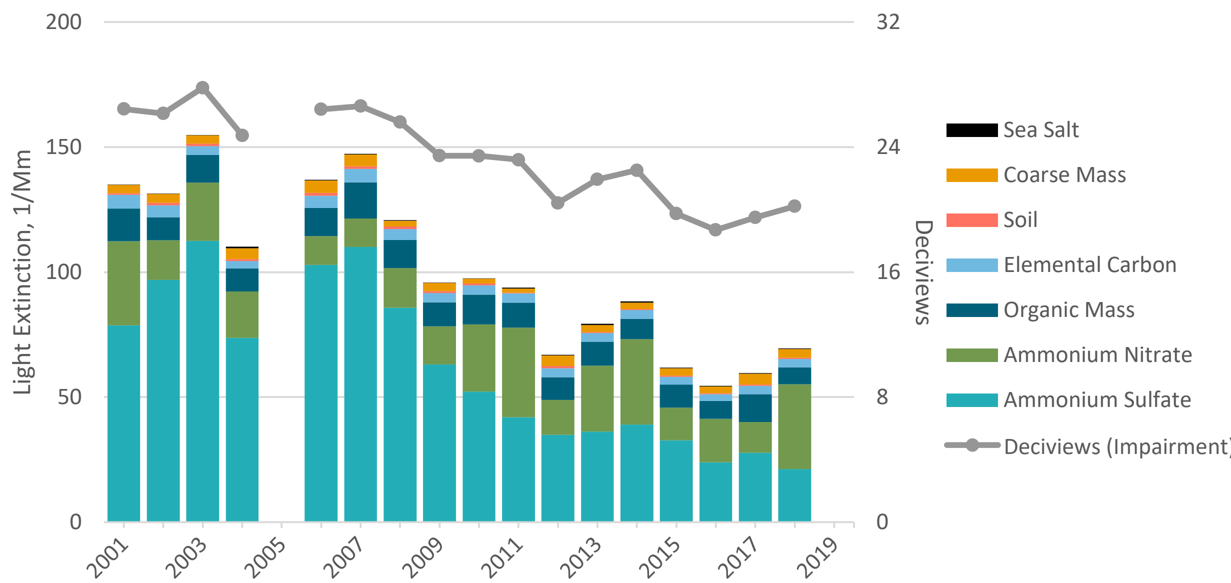
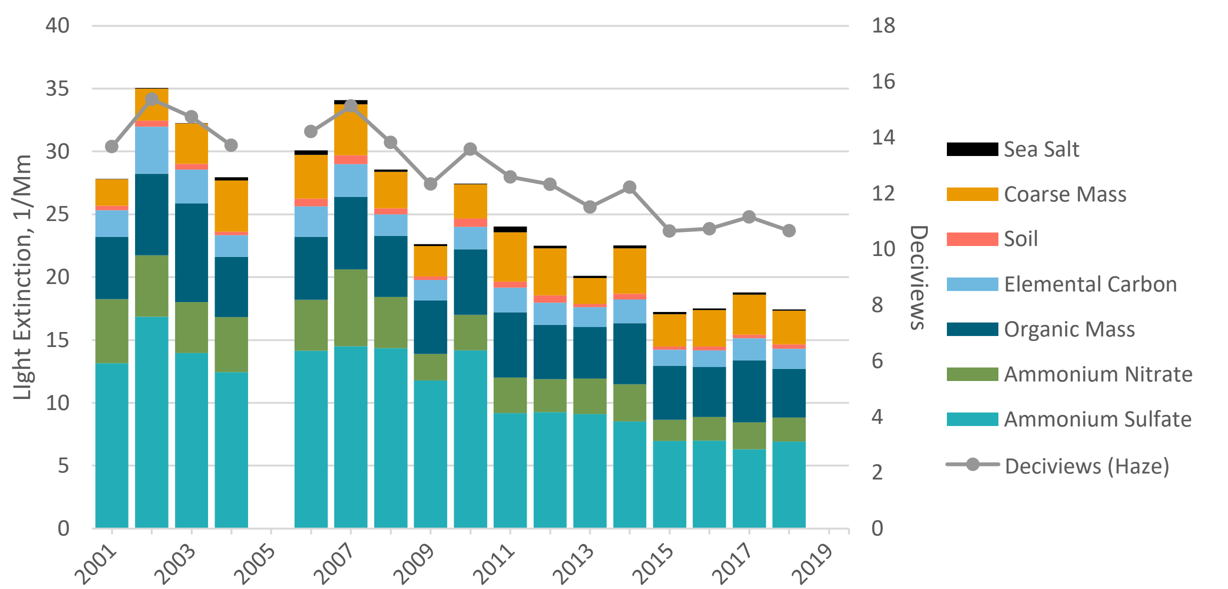


Figure III-23 shows no degradation on the twenty percent clearest days at Mingo.

Figure III-23: Annual Extinction Composition, Clearest Days at Mingo, 2001–2019[28]



[27] Data obtained from IMPROVE data file sia_impairment_group_means_12_20. There are no impairment means for 2019 for Mingo because the monitor did not meet completeness criteria.

[28] Data obtained from IMPROVE data file SIA_group_means_12_20. There are no impairment means for 2019 for Mingo because the monitor did not meet completeness criteria.

Figure III-24 shows daily haze composition due to anthropogenic sources and Figure III-25 shows daily haze composition due to natural sources on the most impaired days at Mingo in 2018.

Figure III-24: Daily Haze Composition Due to Anthropogenic Sources, Most Impaired Days at Mingo, 2018[29]

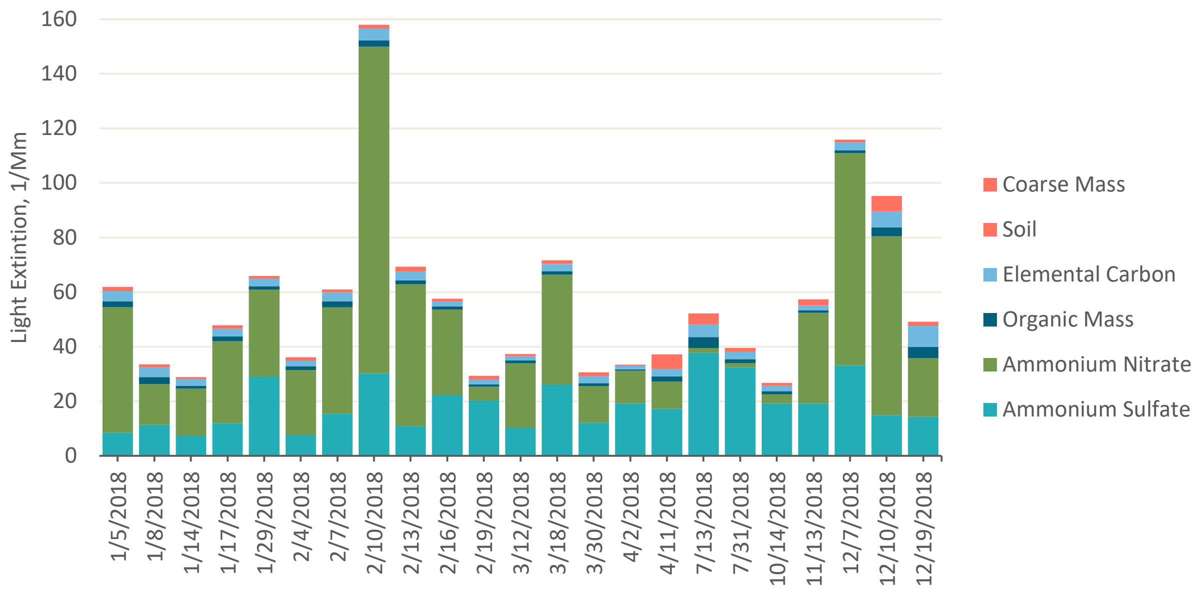
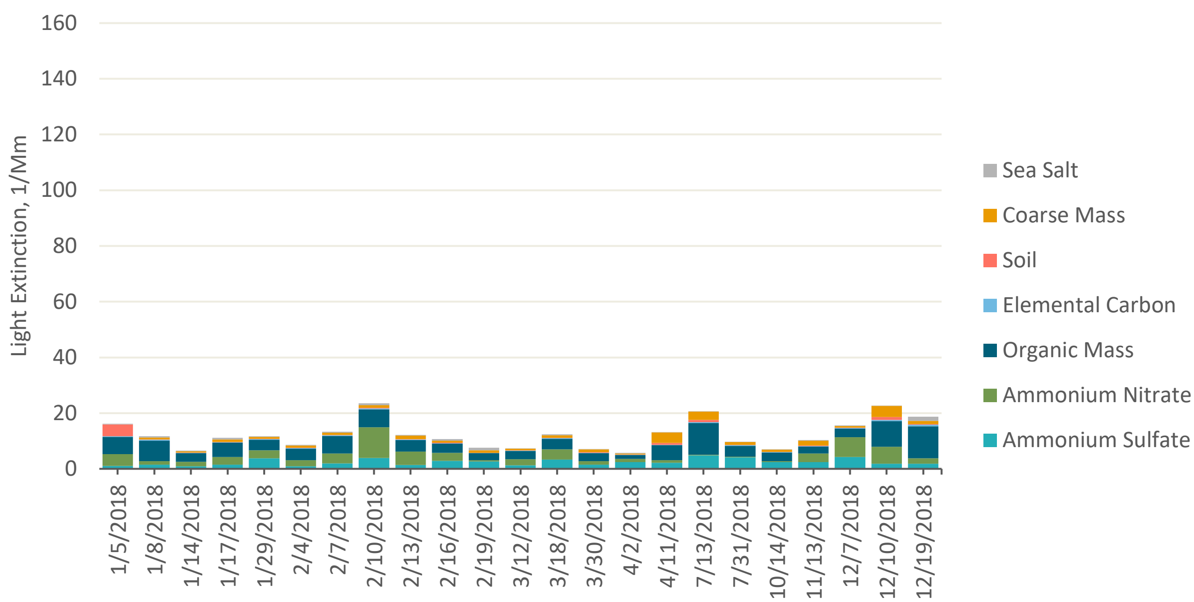


Figure III-25: Daily Haze Composition Due to Natural Sources, Most Impaired Days at Mingo, 2018[30]



[29] Data obtained from IMPROVE data file sia_impairment_daily_budgets_12_20.
[30] Data obtained from IMPROVE data file sia_impairment_daily_budgets_12_20.

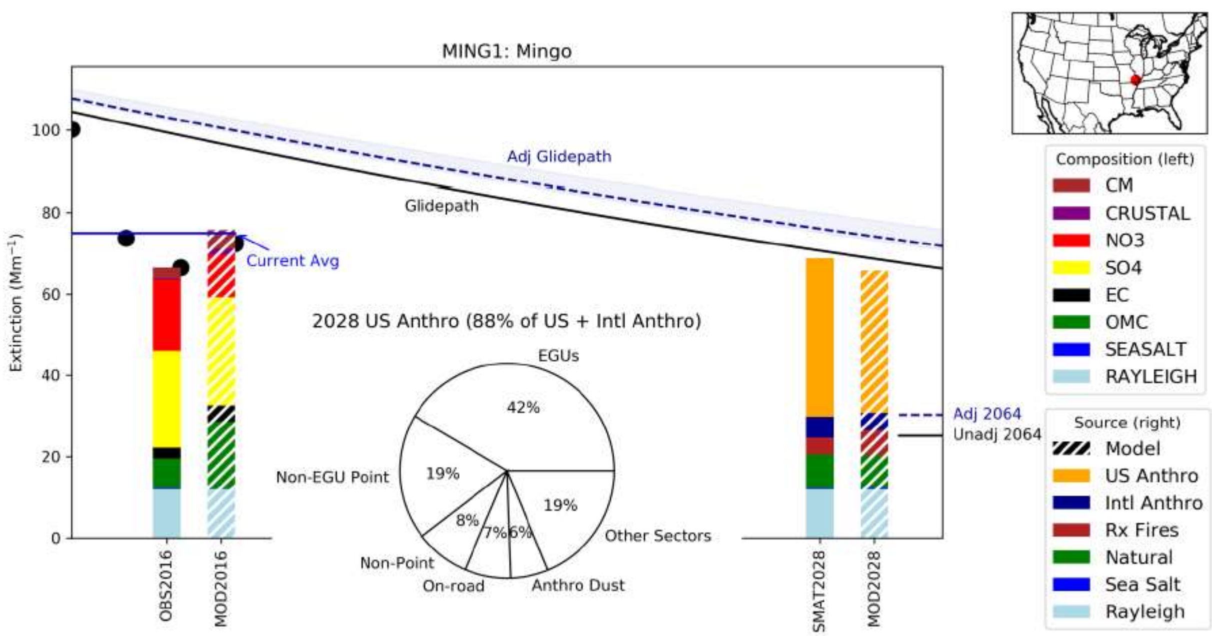
Figures III-24 and III-25 show that light extinction on the most impaired days at Mingo in 2018 from ammonium nitrate, ammonium sulfate, and elemental carbon are primarily anthropogenic in nature. Light extinction on the most impaired days at Mingo from coarse mass, organic mass, sea salt, and soil is primarily due to natural sources.

Based on these monitor data observations, strategies to reduce visibility impairment at Mingo from manmade air pollution during Planning Period II should focus on the following key pollutants: ammonium nitrate and ammonium sulfate.

2. Modeling Data Analysis

Figure III-26 illustrates for Mingo the results of EPA's modeling effort. The figure presents observed data for 2014–2017, 2028 base case projections, and possible glidepaths under different assumptions. The dashed line represents EPA's default adjusted glidepath, which was adjusted based on relative international anthropogenic model contributions and ambient natural conditions.[31] The figure also includes a pie chart representing the specific anthropogenic emissions sector contributions identified as contributing to visibility impairment at Mingo Wilderness in 2028.

Figure III-26: EPA Regional Haze Summary Plot for Mingo Wilderness[32]



[31] The different glidepaths EPA included in their summary plots are based on different 2064 endpoint adjustment assumptions.

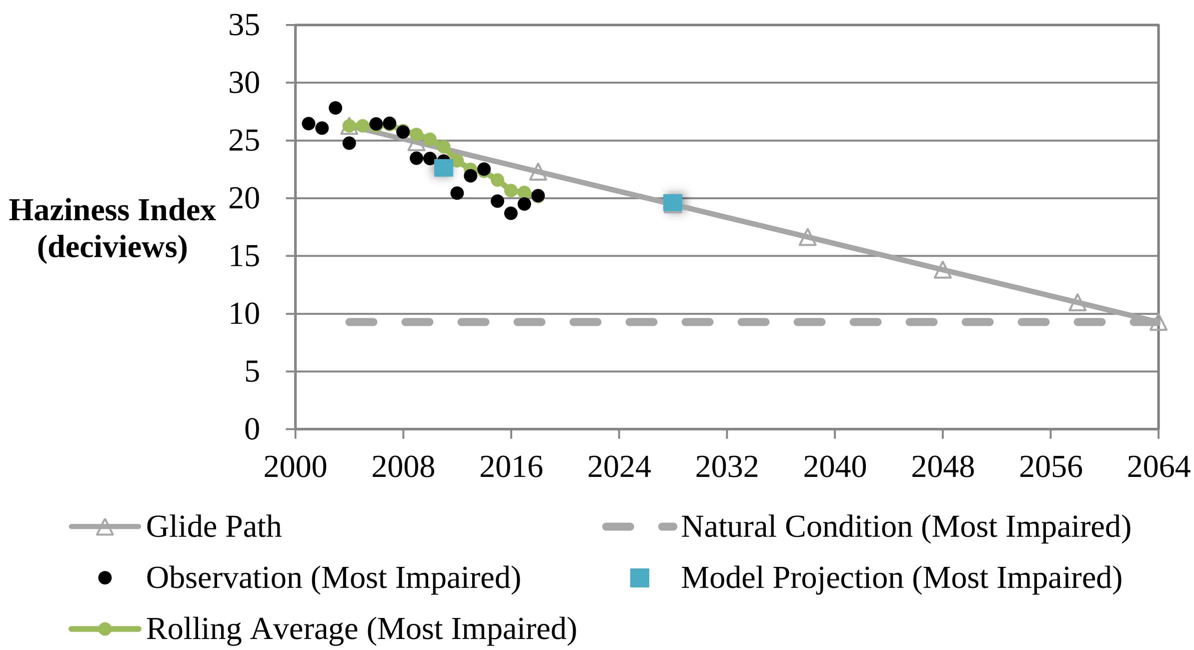
[32] EPA (2019). Updated 2028 Regional Haze Modeling Technical Support Document. https://www.epa.gov/visibility/technical-support-document-epas-updated-2028-regional-haze-modeling

Figure III-26 shows that visibility impairment on the most impaired days in 2028 is projected to remain below any glidepath that the State of Missouri may establish in their Planning Period II SIP even before consideration of additional control measures to ensure reasonable progress.

The pie chart in Figure III-26 represents specific source categories contributing to visibility impairment at Mingo in 2028 and indicates the most prominent source categories are EGUs and Non-EGU point sources, and with smaller contributions from on-road sources, non-point sources, dust, and other sectors. The source apportionment presented in the pie chart suggests that strategies to reduce visibility impairment in 2028 should focus on reducing emissions from the following source categories: EGU and non-EGU point.

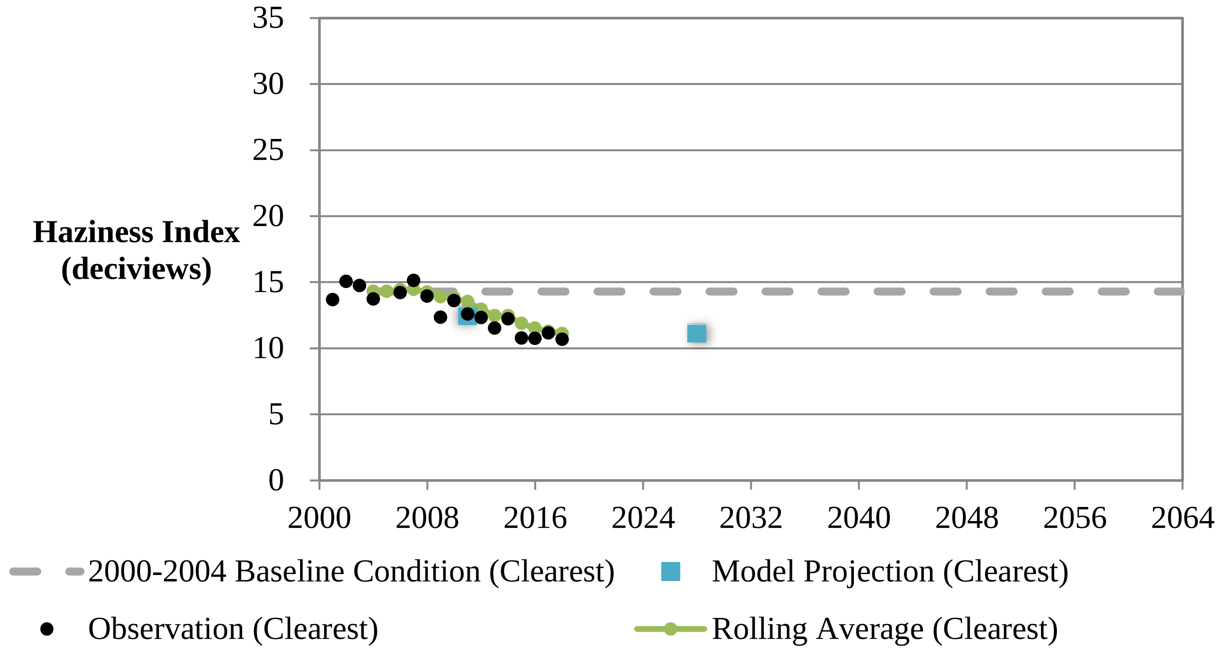
Figures III-27 and III-28 illustrate the 2028 base case results for Mingo of the VISTAS modeling effort. The VISTAS modeling base case results project visibility impairment in 2028 at Mingo on the most impaired days (19.69 deciviews) to be above the unadjusted glidepath (19.48 deciviews).[33] The projected base case results for the clearest days (11.14 deciviews) show no degradation from the 2000–2004 baseline (14.29 deciviews).

Figure III-27: VISTAS Base Case Results for Mingo Wilderness (Most Impaired Days)[34]



[33] Missouri DNR confirmed plans to use the unadjusted URP for this planning period.
[34] Model results obtained from Metro 4/SESARM: Copy of V5_GlidePath_MI20_unitDeciview_07-17-2020_jb

Figure III-28: VISTAS Base Case Results for Mingo Wilderness (Clearest Days)[35]



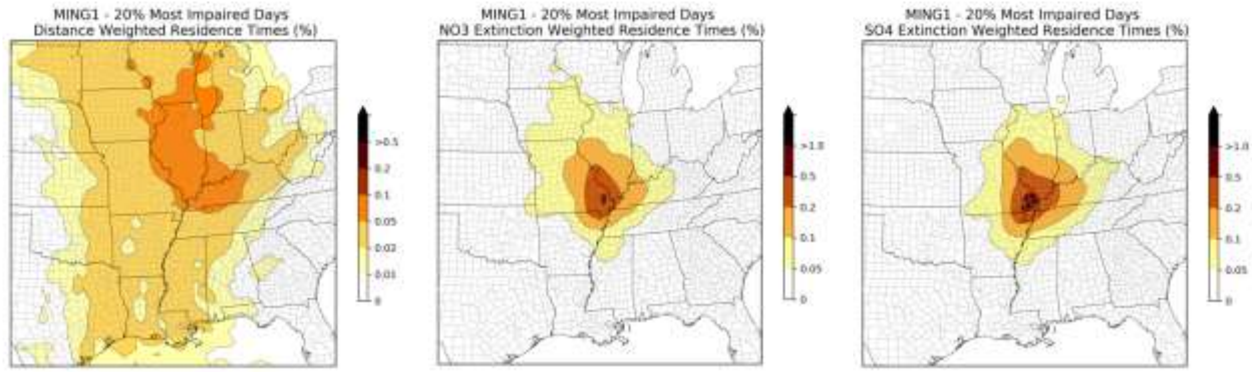
The WinHaze Tool does not include Mingo as a federal Class I area for which visibility impairment can be visualized using the tool.

3. AOI Data Analysis

As described in Chapter II, DEQ used the AOI analysis results produced by Ramboll for the CenSARA states to evaluate which geographic regions and sources have a high probability of contributing to anthropogenic visibility impairment at federal Class I areas within the CenSARA region and in neighboring states. Figure III-29 shows the distance-weighted residence time and pollutant-specific extinction-weighted residence times (EWRT NO_3 and EWRT SO_4) for Mingo for the most impaired days. Based on the distance-weighted residence time plot, air masses from the following states are within the 0.05% distance-weighted residence time contour for Mingo on the most impaired days: Illinois, Indiana, Iowa, Kentucky, Michigan, Minnesota, Missouri, Tennessee, and Wisconsin. The EWRT NO_3 plot indicates that air masses coming from the following states may be impacting ammonium nitrate concentrations at Mingo on the most impaired days: Arkansas, Illinois, Indiana, Iowa, Kansas, Kentucky, Michigan, Minnesota, Mississippi, Missouri, Oklahoma, Tennessee, and Wisconsin. The EWRT SO_4 plot indicates that air masses coming from the following states may be impacting ammonium sulfate concentrations at Mingo on the most impaired days: Arkansas, Illinois, Indiana, Iowa, Kentucky, Mississippi, Missouri, Ohio, and Tennessee. Darker areas on these plots indicate a larger influence on Mingo on the most impaired days for the examined metric.

[35] Model results obtained from Metro 4/SESARM: Copy of V5_GlidePath_20C_unitDeciview_07-17-2020

Figure III-29: All Trajectories Distance-Weighted Residence Times, EWRT NO_3, and EWRT SO_4 for the Twenty-Percent Most Impaired Days—Mingo (Normalized Percentages)



Based on the EWRT NO_3 and EWRT SO_4 plots, air masses from Missouri have the greatest influence on ammonium nitrate and air masses from Illinois and Missouri have the greatest influence on ammonium sulfate at Mingo on the most impaired days. The individual sources with the highest visibility impact surrogate values for Mingo in 2016 were sources in Arkansas, Illinois, Indiana, Missouri, and Tennessee. Four percent of the inventory's visibility surrogate total for Mingo in 2016 is attributable to Arkansas sources.

Based on the pollutant-specific EWRT plots for the dominant pollutants and the percentage of the AOI inventory's visibility surrogate table attributable to Arkansas sources, DEQ concludes that emissions from Arkansas sources are reasonably anticipated to contribute to visibility impairment at Mingo.

D. Shining Rock

The Shining Rock federal Class I area consists of over 18,000 acres[36] on the north side of the Pisgah Ledge in the Blue Ridge Mountains in North Carolina. This wilderness supports hiking, horseback riding, and dispersed camping.[37] Figure III-30 illustrates the scenic nature of Shining Rock.

[36] 13,350 acres when originally designated

[37] https://www.fs.usda.gov/recarea/nfsnc/recarea/?recid=48260

Figure III-30: Shining Rock[38]

1. Ambient Data Analysis

The Shining Rock monitor is located at latitude 35.3937, longitude -82.774 at an elevation of 1617 meters above MSL.

Figure III-31 shows that visibility impairment decreased between 2001 and 2019 at Shining Rock on the most impaired days. Light extinction due to ammonium sulfate decreased over the same time period, while ammonium nitrate increased. In 2019, the relative impact on light extinction on the most impaired days was fifty-one percent for ammonium sulfate, nineteen percent for organic carbon, and sixteen percent for ammonium nitrate. Elemental carbon and coarse mass constituted six percent each of the light extinction budget on the most impaired days in 2019.

[38] Image Credit: National Scenic Byways Program http://www.fhwa.dot.gov/byways/photos/76067 (left) and Ken Thomas (Public Domain) obtained from https://commons.wikimedia.org/wiki/File:Cold_Mountain-27527.jpg (right)

Figure III-31: Annual Extinction Composition, Most Impaired Days at Shining Rock, 2001–2019[39]

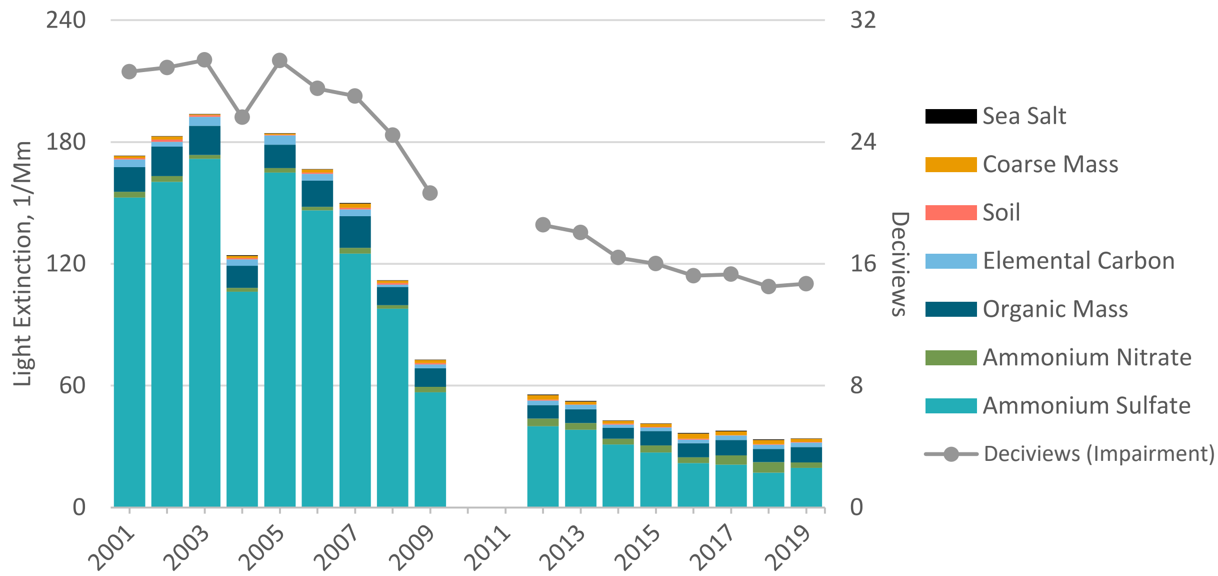
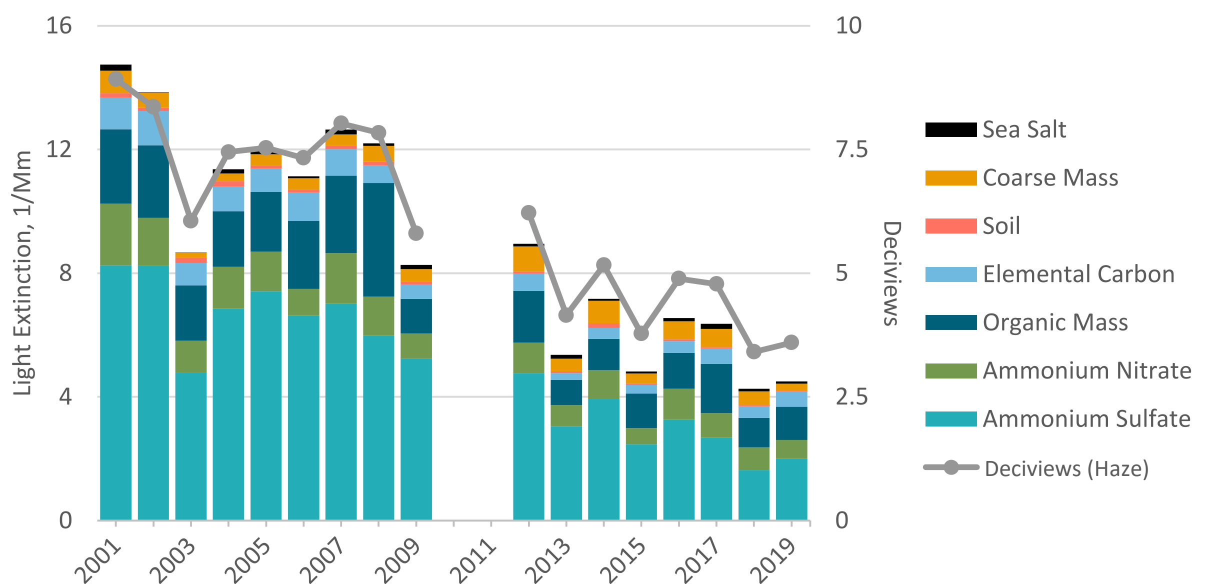


Figure III-32 shows no degradation on the clearest days at Shining Rock during the 2001 to 2019 period.

Figure III-32: Annual Extinction Composition, Clearest Days at Shining Rock, 2001–2019[40]



[39] Data obtained from IMPROVE data file sia_impairment_group_means_12_20.
[40] Data obtained from IMPROVE data file SIA_group_means_12_20.

Figure III-33 shows daily haze composition due to anthropogenic sources, and Figure III-34 shows daily haze composition due to natural sources on the most impaired days at Shining Rock in 2018.

Figure III-33: Daily Haze Composition Due to Anthropogenic Sources, Most Impaired Days at Shining Rock, 2019[41]

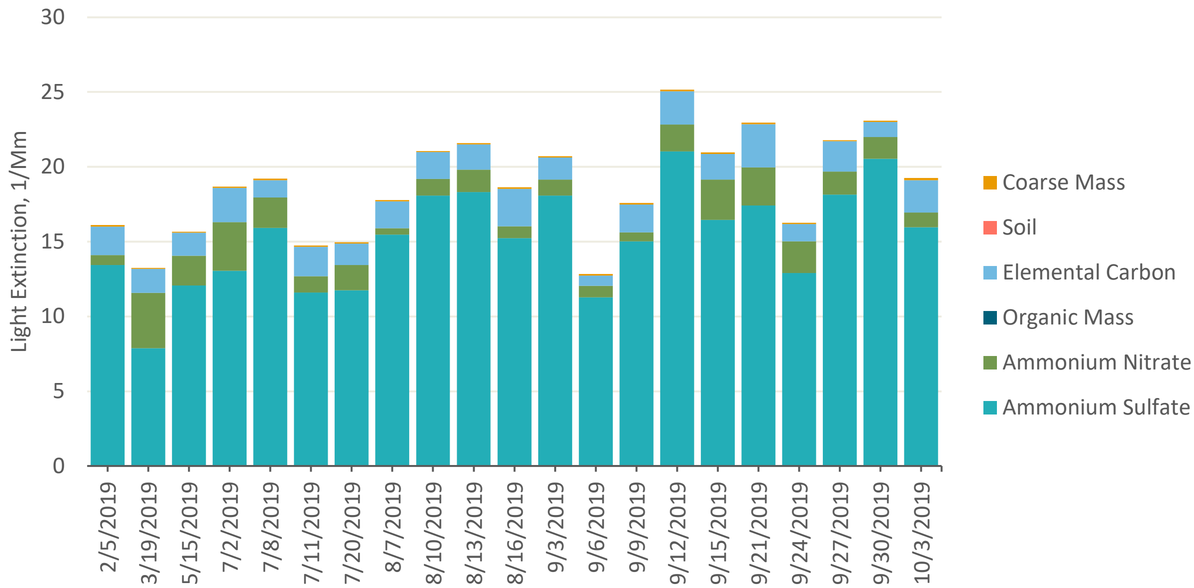
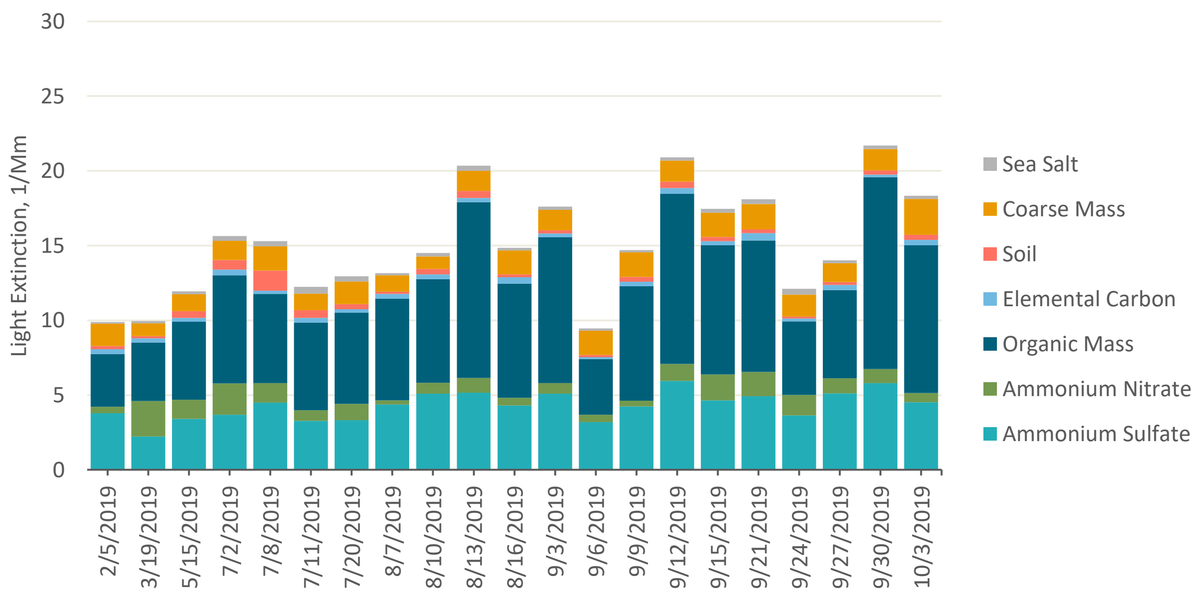


Figure III-34: Daily Haze Composition Due to Natural Sources, Most Impaired Days at Shining Rock, 2019[42]



[41] Data obtained from IMPROVE data file sia_impairment_daily_budgets_12_20.
[42] Data obtained from IMPROVE data file sia_impairment_daily_budgets_12_20.

Figures III-33 and III-34 show that light extinction on the most impaired days at Shining Rock from ammonium sulfate, ammonium nitrate and elemental carbon are primarily anthropogenic in nature. Impairment due to coarse mass and organic mass at Shining Rock come primarily from natural sources.

Based on these monitor data observations, strategies to reduce visibility impairment at Shining Rock from manmade air pollution during Planning Period II should focus on the following key pollutant: ammonium sulfate.

2. Modeling Data Analysis

Figure III-35 illustrates for Shining Rock the results of EPA's 2016-based CAMx modeling effort. The figure presents observed data for 2014–2017, 2028 base case projections, and possible glidepaths under different assumptions. The dashed line represents EPA's default adjusted glidepath, which was adjusted based on relative international anthropogenic model contributions and ambient natural conditions.[43] The figure also includes a pie chart representing the specific anthropogenic emissions sector contributions identified as contributing to visibility impairment Shining Rock in 2028.

Figure III-35: IMPROVE Site Summary Plot for Shining Rock

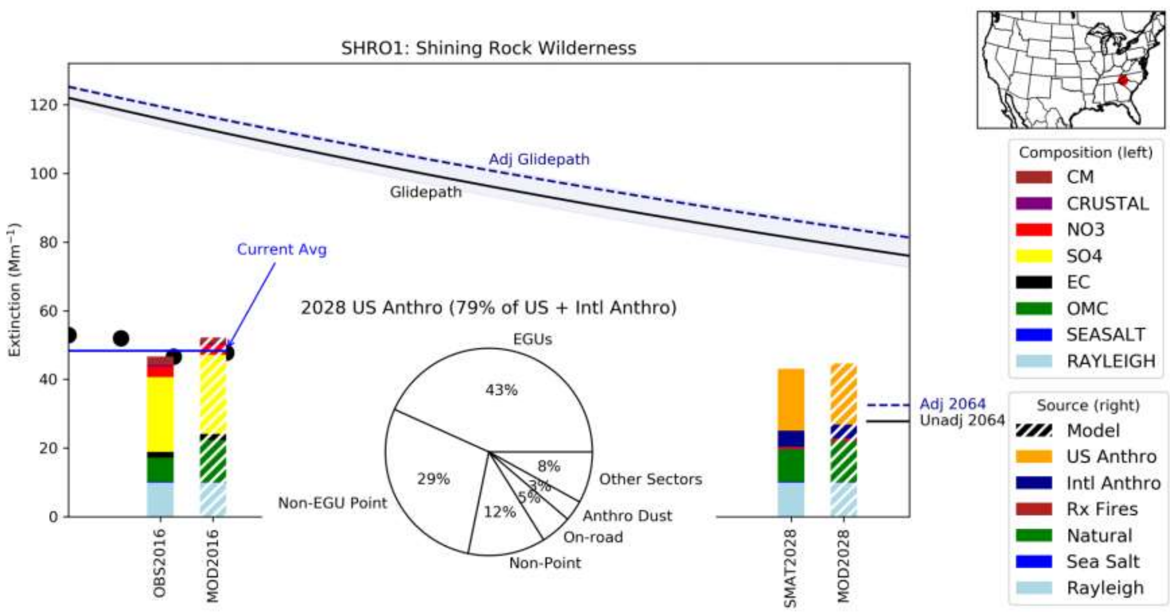


Figure III-35 shows that visibility impairment on the most impaired days in 2028 is projected to remain below any glidepath North Carolina may set for Shining Rock.

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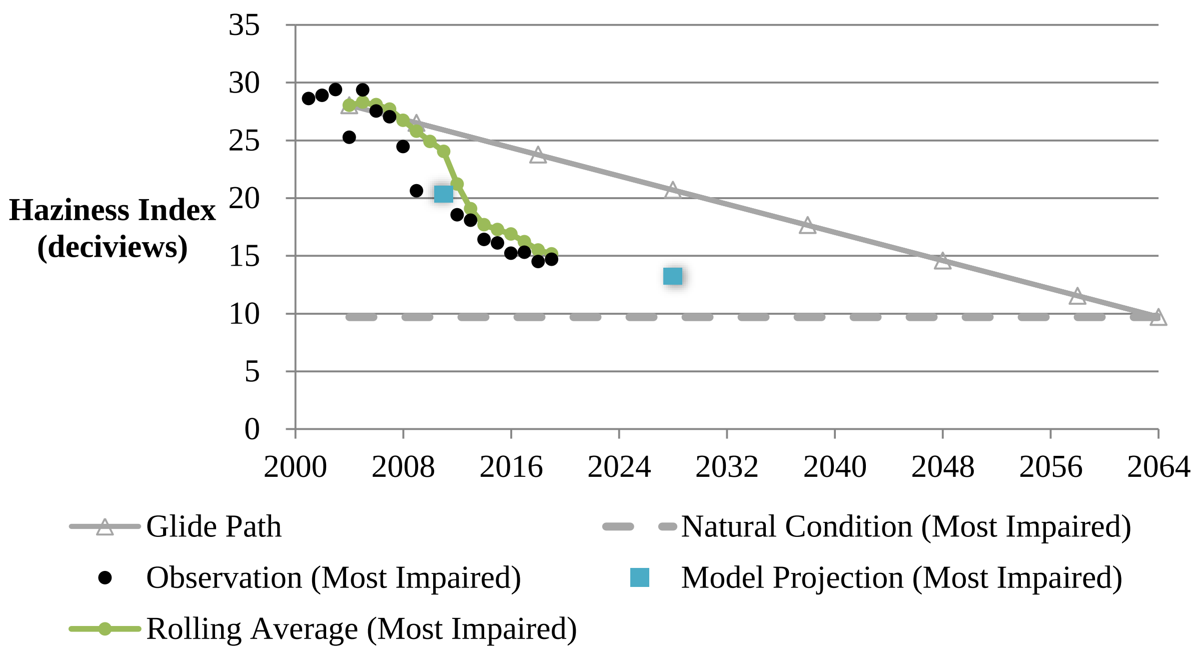
[43] The different glidepaths EPA included in their summary plots are based on different 2064 endpoint adjustment assumptions.

The pie chart shows that the largest contributors to visibility impairment in 2028 are projected to be EGUs followed by non-EGU point sources. Nonpoint, on-road, anthropogenic dust, and other sectors are projected to make up a smaller contribution to light extinction on the most impaired days at Shining Rock in 2028. The source apportionment presented in the pie chart suggests that strategies to reduce visibility impairment in 2028 should focus on reducing emissions from the following source categories: EGU and non-EGU point.

Figures III-36 and III-37 illustrate the 2028 base case results for Shining Rock of the VISTAS modeling effort. The VISTAS modeling base case results project visibility impairment in 2028 at Shining Rock on the most impaired days (13.31 deciviews) to be below the unadjusted glidepath (20.70 deciviews).[44] The projected base case results for the clearest days (4.54 deciviews) show no degradation form the 2000–2004 baseline (7.70 deciviews).

Figure III-36: VISTAS Base Case Results for Shining Rock (Most Impaired Days)[45]



[44] North Carolina Department of Environmental Quality confirmed plans to use 20.98 deciviews for the 2028 URP for Shining Rock based on the updated natural conditions value for most impaired days that is in the 2020 EPA memo (Recommendation for the Use of Patched and Substituted Data and Clarification of Data Completeness for Tracking Visibility Progress for the Second Implementation Period of the Regional Haze Program). In that data update, the natural conditions/endpoint for Shining Rock changed to 20.98 deciviews from the prior value of 20.70 deciviews, which shifted the glidepath accordingly.

[45] Model results obtained from Metro 4/SESARM: Copy of V5_GlidePath_MI20_unitDeciview_07-17-2020_jb

Figure III-37: VISTAS Base Case Modeling Results for Shining Rock (Clearest Days)[46]

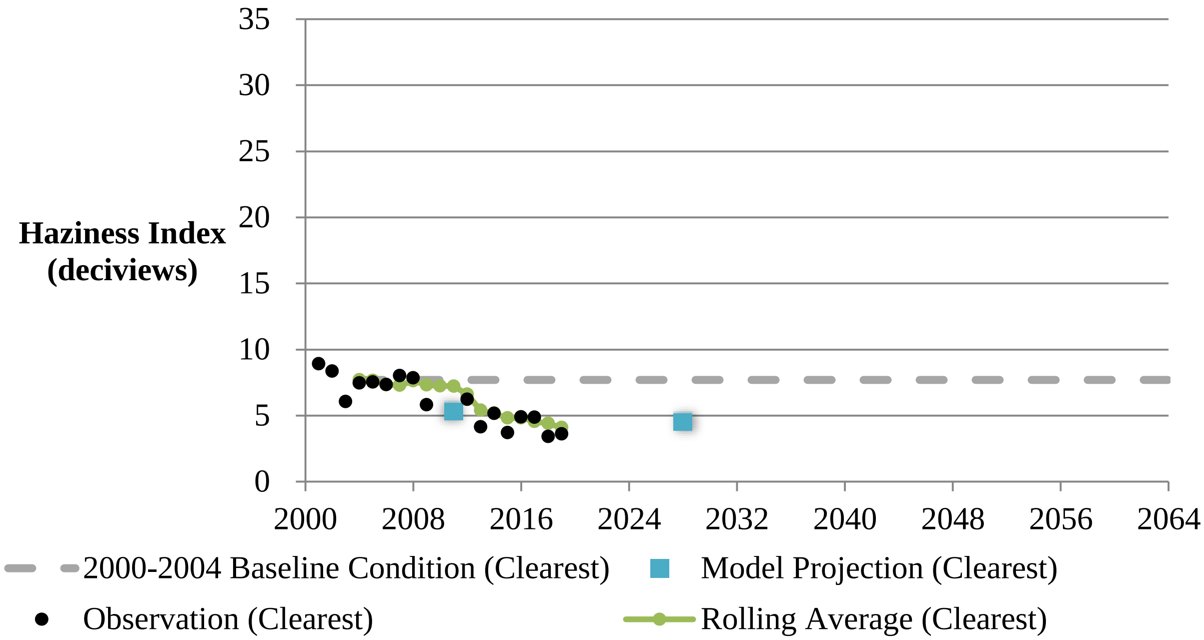


Figure III-38 shows how a vista at Shining Rock would look during the most impaired days in 2002 (left), 2017 (center), and under natural conditions.

Figure III-38: Shining Rock WinHAZE Visualization Twenty Percent Most Impaired: 2002, 2017, and Natural Conditions[47]

3. AOI Analysis

Shining Rock was not included in the CenSARA AOI analysis.

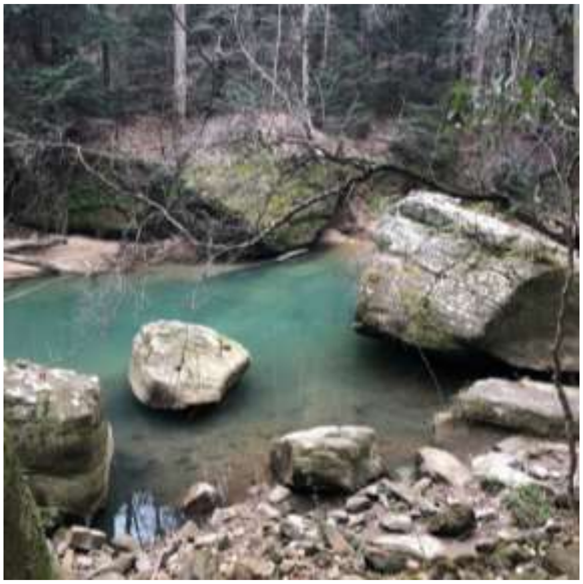
[46] Model results obtained from Metro 4/SESARM: Copy of V5_GlidePath_20C_unitDeciview_07-17-2020

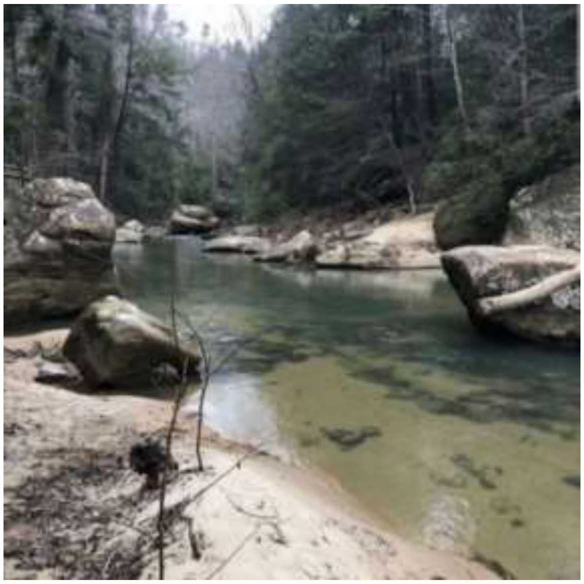
[47] Interagency Monitoring of Protected Visual Environments. http://vista.cira.colostate.edu/Improve/winhaze/

E. Sipsey

The Sipsey Wilderness federal Class I area consists of 12,646 acres in the Bankhead National Forest. Sipsey Wilderness Area offers a number of recreational activities including hiking, camping, hunting, horseback riding, and fishing.[48] Figure III-3 illustrates the scenic nature of the Sipsey Wilderness Area.

Figure III-39: Sipsey Wilderness Area [49]





1. Ambient Data Analysis

The Sipsey Wilderness Area monitor is located four miles north of Grayson Alabama at latitude 34.3433, longitude -87.3388, at an elevation of 286 meters above MSL.

Figure III-40 shows that visibility impairment on the most impaired days has decreased at Sipsey. During this period, light extinction due to ammonium sulfate decreased dramatically. Organic mass and elemental carbon, which make up a relatively small portion of the haze budget during the 2000–2019 period also decreased. Light extinction due to ammonium nitrate increased over this period. In 2019, the relative impact on light extinction on the most impaired days was fifty percent for ammonium sulfate, fourteen percent for ammonium nitrate, twenty-three percent for organic carbon, and eight percent for elemental carbon.

[48] https://www.fs.usda.gov/detail/alabama/about-forest/districts/?cid=fsbdev3_002553

[49] Image Credit: Tricia Treece (both left and right)

Figure III-40: Annual Extinction Composition, Most Impaired Days at Sipsey, 2001–2019[50]

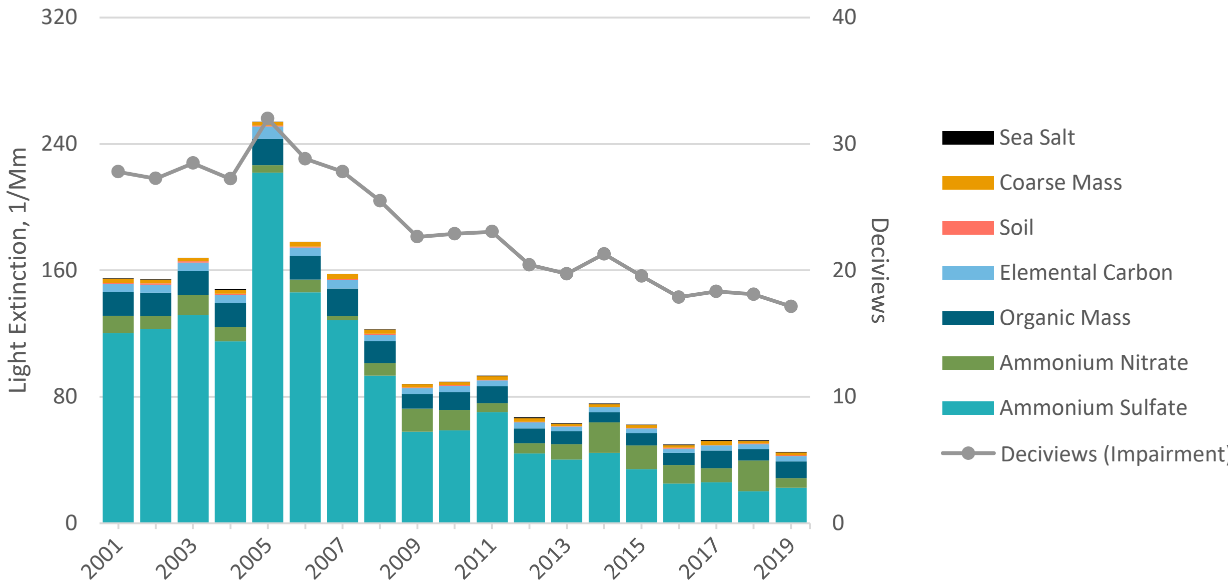


Figure III-41 shows no degradation in visibility on the clearest days at Sipsey. Ammonium nitrate and ammonium sulfate light extinction decreased on the clearest days.

Figure III-41: Annual Extinction Composition, Clearest Days at Sipsey, 2001–2019[51]

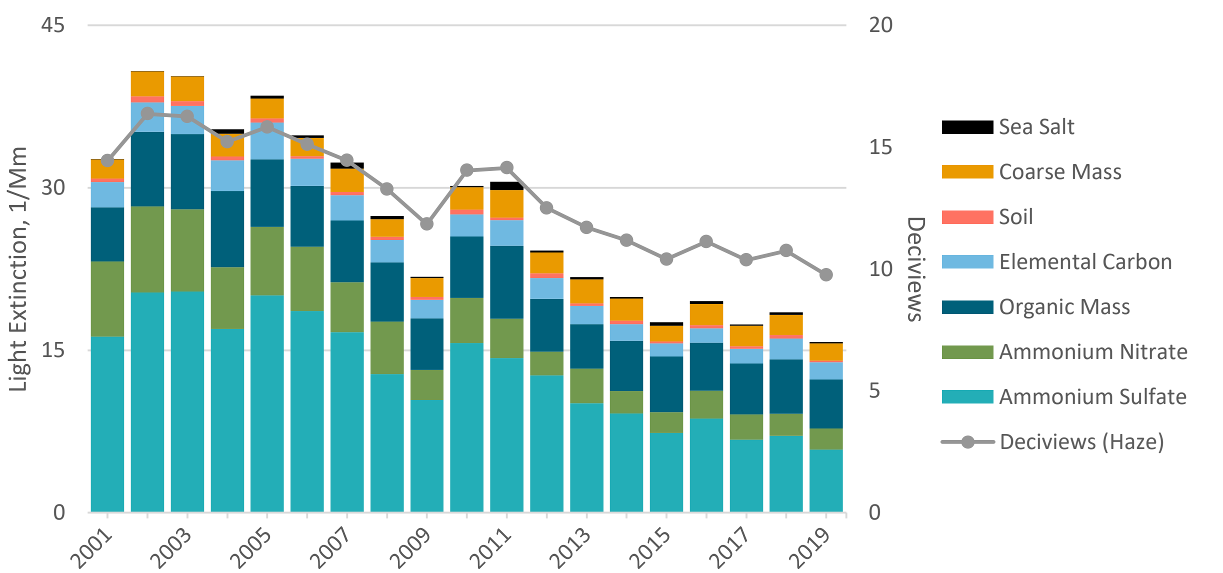


Figure III-42 shows daily haze composition due to anthropogenic sources and Figure III-43

[50] Data obtained from IMPROVE data file sia_impairment_group_means_12_20.
[51] Data obtained from IMPROVE data file SIA_group_means_12_20.

shows daily haze composition due to natural sources on the most impaired days at Sipsey in 2019.

Figure III-42: Daily Haze Composition Due to Anthropogenic Sources, Most Impaired Days at Sipsey, 2019[52]

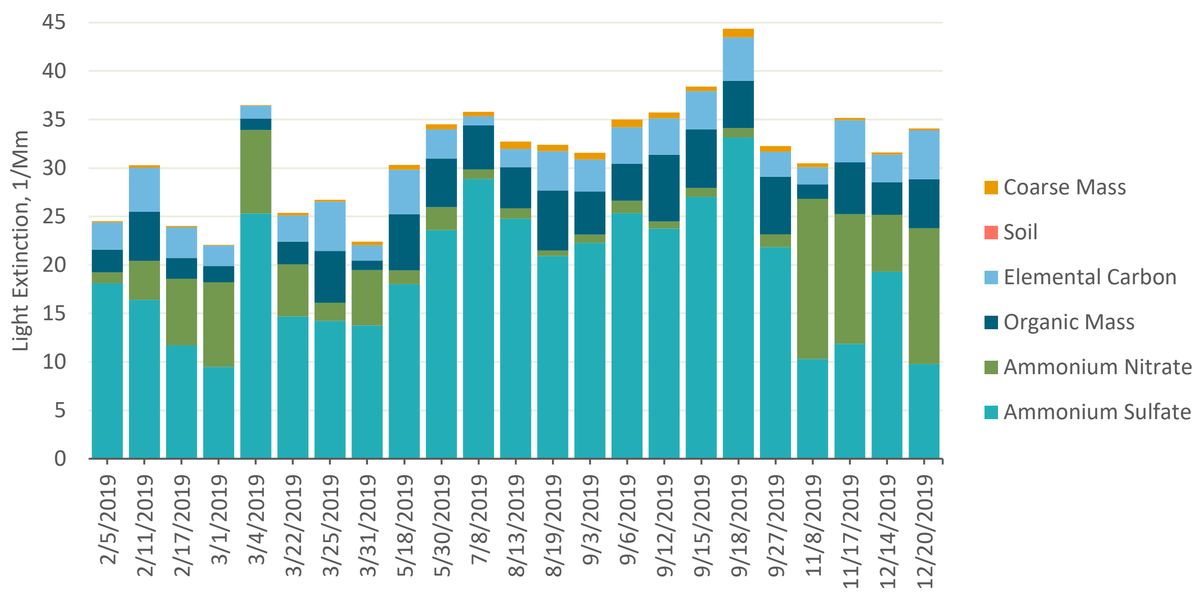
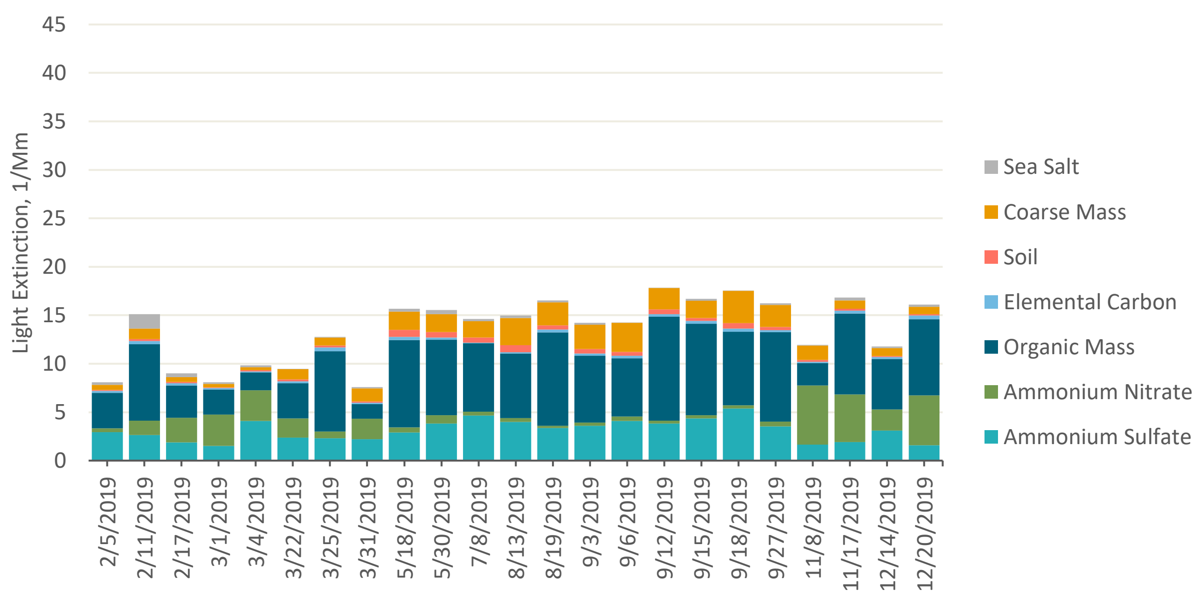


Figure III-43: Daily Haze Composition Due to Natural Sources, Most Impaired Days at Sipsey, 2019[53]



[52] Data obtained from IMPROVE data file sia_impairment_daily_budgets_12_20.

[53] Data obtained from IMPROVE data file sia_impairment_daily_budgets_12_20.

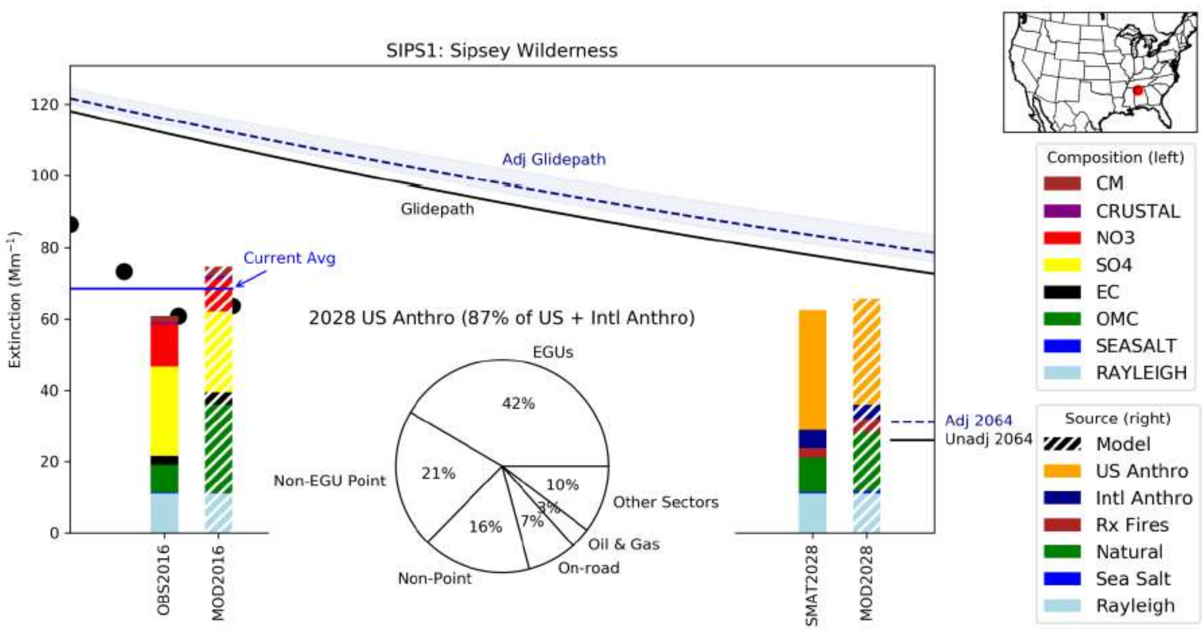
Figures III-43 and III-44 show that light extinction at Sipsey on the most impaired days from ammonium sulfate, ammonium nitrate, and elemental carbon are primarily anthropogenic in nature. Extinction due to natural and anthropogenic organic mass are similar with natural sources contributing more to light extinction than anthropogenic sources. Sea salt, soil, and coarse mass are primarily due to natural sources. On the most impaired days, ammonium sulfate is the predominant species in the summer.

Based on these monitoring data observations, strategies to reduce visibility impairment at Sipsey from manmade air pollution during Planning Period II should focus on the following key pollutant: ammonium sulfate.

2. Modeling Data Analysis

Figure III-44 illustrates for Sipsey the results of EPA's modeling effort. The figure presents observed data for 2014–2017, 2028 base case projections, and possible glidepaths under different assumptions. The dashed line represents EPA's default adjusted glidepath, which was adjusted based on relative international anthropogenic model contributions and ambient natural conditions.[54] The figure also includes a pie chart representing the specific anthropogenic emissions sector contributions identified as contributing to visibility impairment at Sipsey in 2028.

Figure III-44: IMPROVE Site Summary Plot for Sipsey



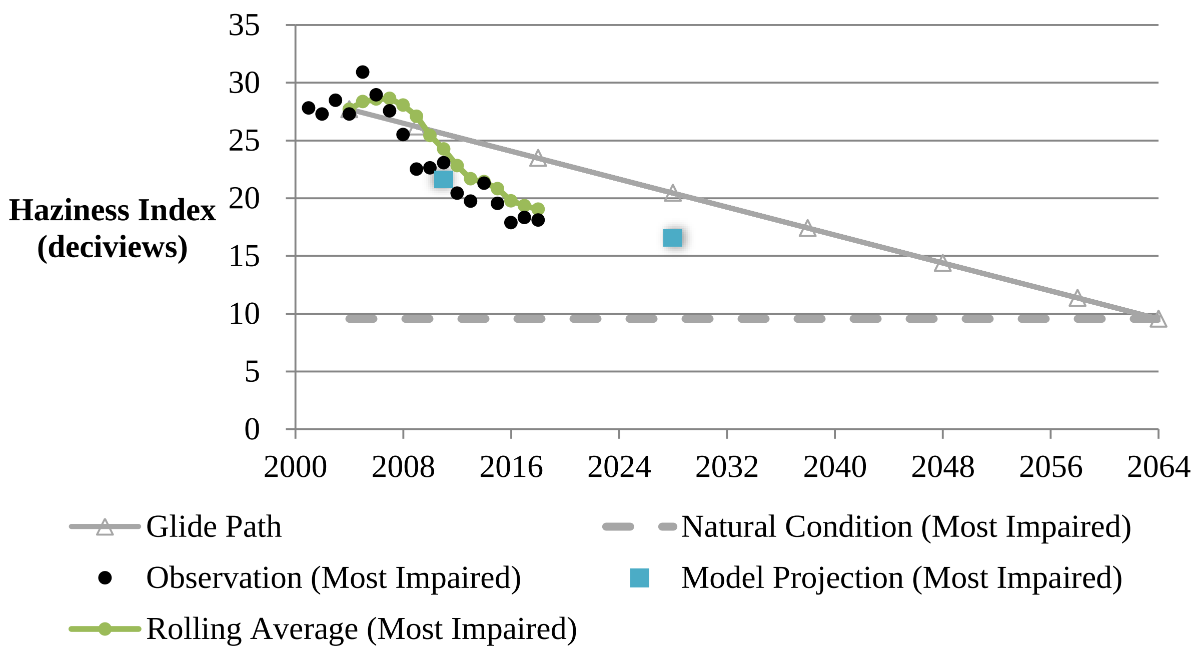
[54] The different glidepaths EPA included in their summary plots are based on different 2064 endpoint adjustment assumptions.

Figure III-44 shows that visibility impairment on the most impaired days in 2028 is projected to remain below any glidepath that the State Alabama may establish in their Planning Period II SIP even before consideration of additional control measures to ensure reasonable progress.

The pie chart represents specific source categories projected to contribute to visibility impairment at Sipsey on the most impaired days in 2028 and indicates that the most prominent source categories are EGUs and non-EGU point sources, with smaller contributions from non-point sources, on-road sources, other sectors, and oil and gas. The source apportionment presented in the pie chart suggests that strategies to reduce visibility impairment in 2028 should focus on reducing emissions from the following source categories: EGU and non-EGU point.

Figures III-45 and III-46 illustrate the 2028 base case results for Sipsey of the VISTAS modeling effort. The VISTAS modeling base case results project visibility impairment in 2028 at Sipsey on the most impaired days (16.62 deciviews) to be below the unadjusted glidepath (20.44 deciviews).[55] The projected base case results for the clearest days (11.11 deciviews) show no degradation from the 2000–2004 baseline (15.57 deciviews).

Figure III-45: VISTAS Base Case Results for Sipsey Wilderness (Most Impaired Days)[56]



[55] Alabama Department of Environmental Management confirmed plans to use the unadjusted URP for this planning period.

[56] Model results obtained from Metro 4/SESARM: Copy of V5_GlidePath_MI20_unitDeciview_07-17-2020_jb

Figure III-46: VISTAS Base Case Results for Sipsey Wilderness (20% Clearest Days)[57]

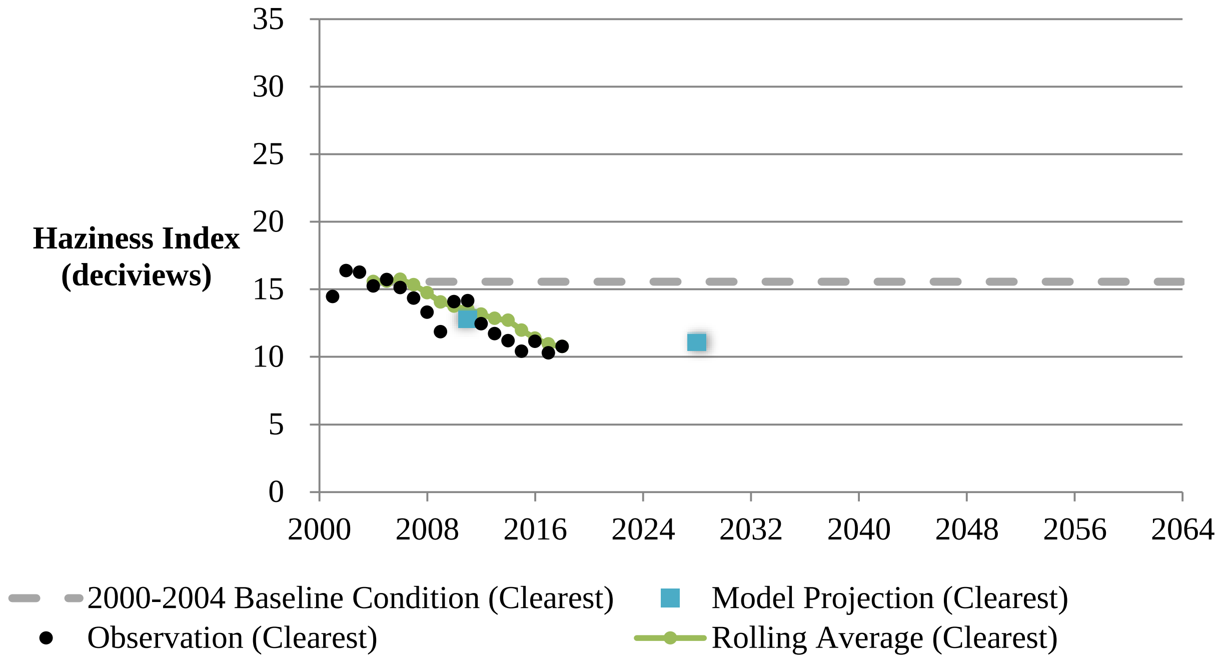


Figure III-47 shows how a vista at Sipsey would look during the most impaired days in 2001 (left), 2019 (center), and under natural conditions (right). The improvement between the center image and the left image shows how the visibility has improved over time on the most impaired days. The image on the right visualizes natural conditions for the area.

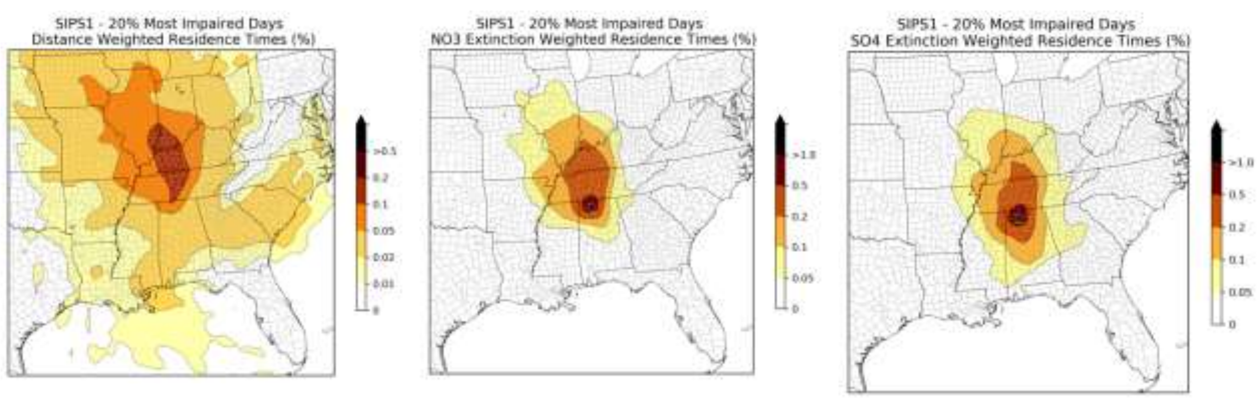
Figure III-47: Sipsey WinHAZE Visualization Twenty Percent Most Impaired: 2001, 2019, and Natural Conditions[58]

[57] Model results obtained from Metro 4/SESARM: Copy of V5_GlidePath_20C_unitDeciview_07-17-2020
[58] Interagency Monitoring of Protected Visual Environments. http://vista.cira.colostate.edu/Improve/winhaze/

3. AOI Analysis

As described in Chapter II, DEQ used the AOI analysis results produced by Ramboll for the CenSARA states to evaluate which geographic regions and sources have a high probability of contributing to anthropogenic visibility impairment at federal Class I areas within the CenSARA region and in neighboring states. Figure III-48 shows the distance-weighted residence time and pollutant-specific extinction-weighted residence times (EWRT NO_3 and EWRT SO_4) for Sipsey for the most impaired days. Based on the distance-weighted residence time plot, air masses from the following states are within the 0.05% distance-weighted residence time contour for Sipsey on the most impaired days: Alabama, Arkansas, Illinois, Indiana, Iowa, Kentucky, Mississippi, Missouri, Ohio, Tennessee, and Wisconsin. The EWRT NO_3 plot indicates that air masses coming from the following states may be impacting ammonium nitrate concentrations at Sipsey on the most impaired days: Alabama, Arkansas, Georgia, Indiana, Illinois, Iowa, Kentucky, Mississippi, Missouri, and Tennessee. The EWRT SO_4 plot indicates that air masses coming from the following states may be impacting ammonium sulfate concentrations at Sipsey on the most impaired days: Alabama, Arkansas, Georgia, Illinois, Indiana, Kentucky, Mississippi, Missouri, North Carolina, Ohio, and Tennessee. Darker areas on these plots indicate a larger influence on Sipsey on the most impaired days for the examined metric.

Figure III-48: All Trajectories Distance-Weighted Residence Times, EWRT NO_3, and EWRT SO_4 for the Twenty-Percent Most Impaired Days—Sipsey (Normalized Percentages)



Based on the EWRT NO_3 and EWRT SO_4 plots, air masses from northern Alabama and southern Tennessee have the greatest influence on ammonium nitrate and ammonium sulfate at Sipsey on the most impaired days. The individual sources with the highest visibility impact surrogate values for Sipsey in 2016 were sources in Alabama, Illinois, Indiana, Kentucky, Missouri, and Tennessee. Two percent of the inventory's visibility surrogate total for Sipsey in 2016 is attributable to Arkansas sources.

Although only a small percentage of the AOI inventory's visibility surrogate table attributable to Arkansas sources, the pollutant-specific EWRT plots do extend into Arkansas. Therefore, DEQ concludes that emissions from Arkansas sources are reasonably anticipated to contribute to visibility impairment at Sipsey.

F. Wichita Mountains

The Wichita Mountains federal Class I area consists of 8,900 acres of canyons and grasslands. Wichita Mountains serves as a wildlife refuge to preserve bison. The southern portion of the wilderness is open to the public and provides recreational opportunities including hiking, rock climbing, hunting, and camping.[59] Figure III-49 illustrates the scenic nature of the Wichita Mountains.

Figure III-49: Wichita Mountains[60]

1. Ambient Data Analysis

The Wichita Mountains monitor is located at latitude 34.7323, longitude -98.713, at an elevation of 509 meters above MSL.

Figure III-50 shows that visibility impairment decreased between 2002 and 2019 at Wichita Mountains on the twenty percent most impaired days. Light extinction due to ammonium sulfate decreased over this period. In 2019, the relative impact on light extinction on the most impaired days was thirty-seven percent for ammonium sulfate and thirty-six percent for ammonium nitrate. Coarse mass, elemental carbon, organic mass, sea salt, and soil make up smaller fractions of the overall particulate species impairing visibility on the most impaired days.

[59] https://wilderness.net/visit-wilderness/?ID=650#trip-planning

[60] https://wilderness.net/visit-wilderness/image-search-results.php?w:650#4206-Modal (left)
http://www.wilderness.net/images/NWPS/lib/small/03RobWood041315.jpg (right)

Figure III-50: Annual Extinction Composition, Most Impaired Days at Wichita Mountains, 2002–2019[61]

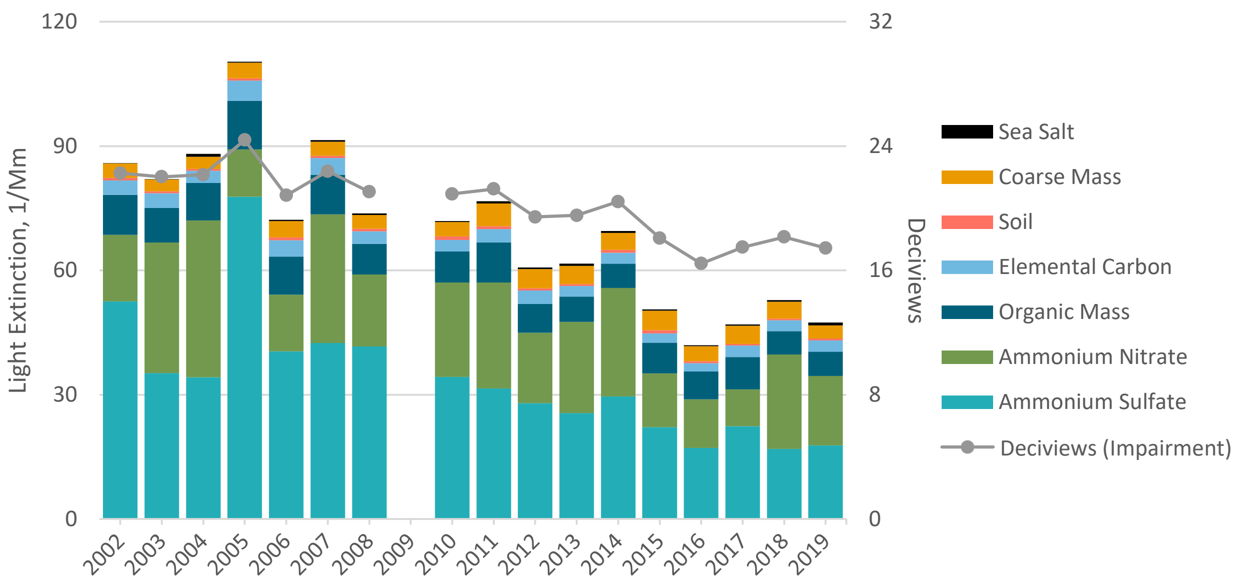
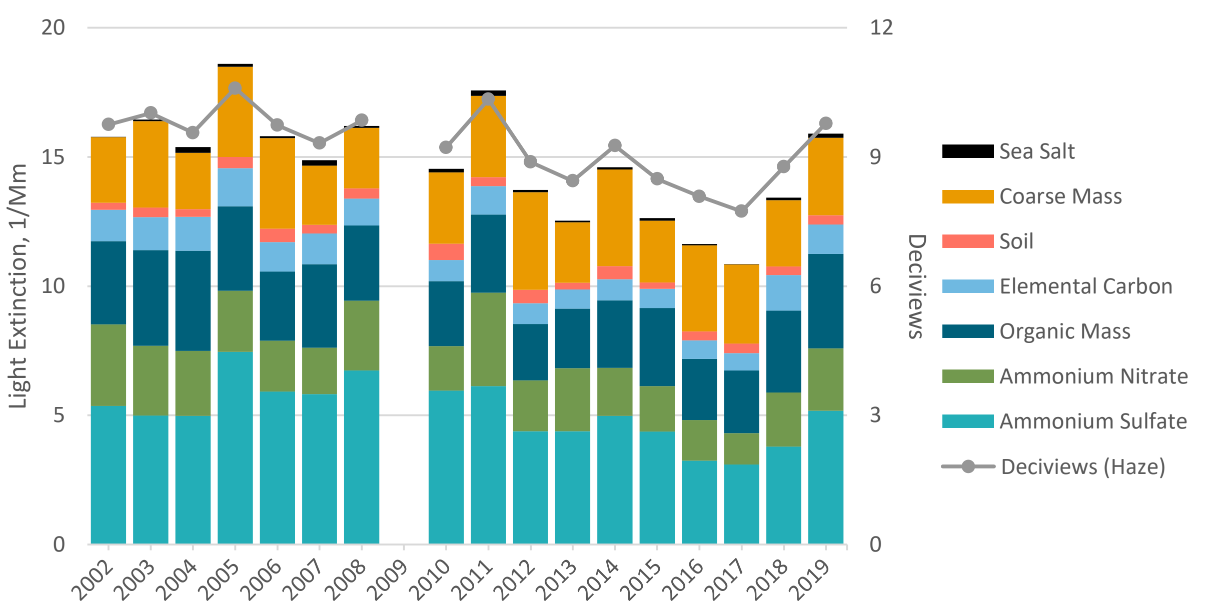


Figure III-51 shows no degradation on the clearest days at Wichita Mountains during the 2002 to 2019 period.

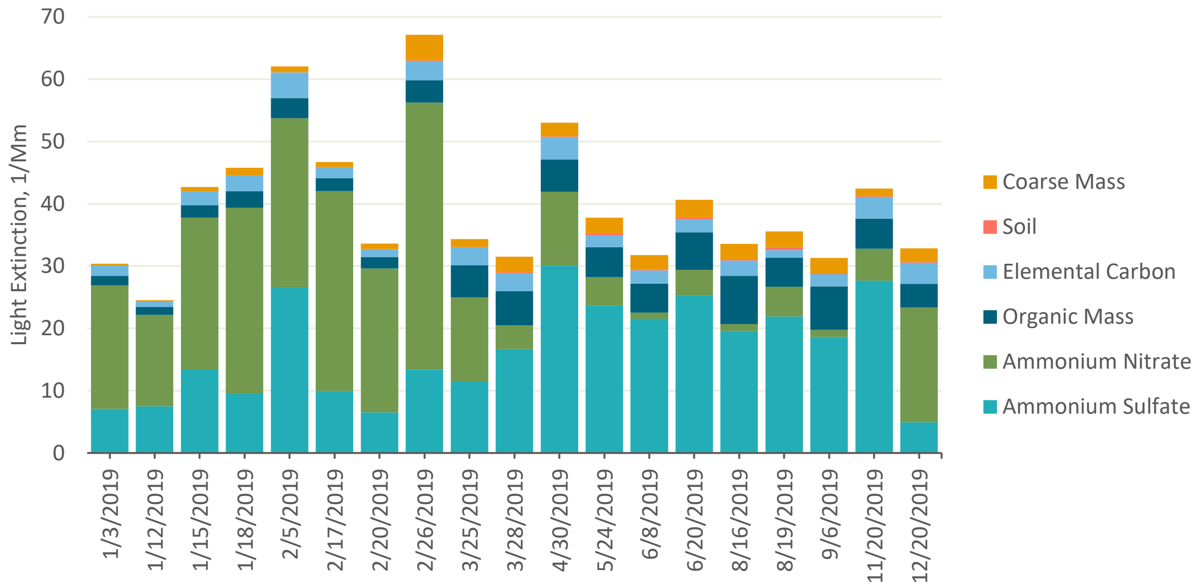
Figure III-51: Annual Extinction Composition, Clearest Days at Wichita Mountains, 2002–2019[62]



[61] Data obtained from IMPROVE data file sia_impairment_group_means_12_20.
[62] Data obtained from IMPROVE data file SIA_group_means_12_20.

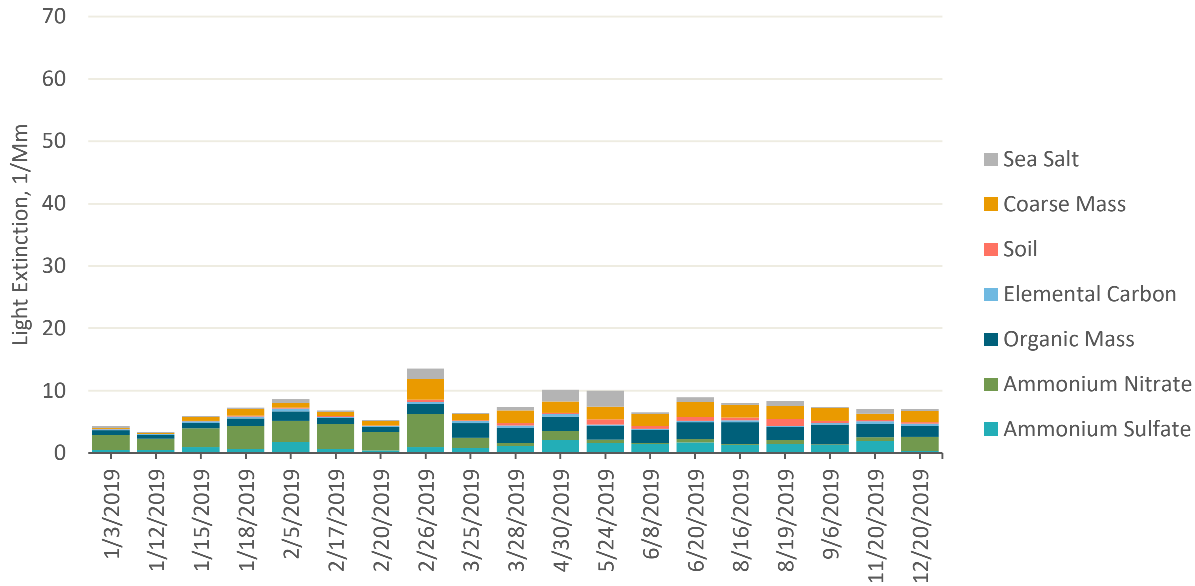
Figure III-52 shows daily haze composition due to anthropogenic sources and Figure III-53 shows daily haze composition due to natural sources on the most impaired days at Wichita Mountains in 2018.

Figure III-52: Daily Haze Composition Due to Anthropogenic Sources, Most Impaired Days at Wichita Mountains, 2019[63]



[63] Data obtained from IMPROVE data file sia_impairment_daily_budgets_12_20.

Figure III-53: Daily Haze Composition Due to Natural Sources, Most Impaired Days at Wichita Mountains, 2019[64]



Figures III-52 and III-53 show that light extinction on the most impaired days at Wichita Mountains from ammonium sulfate, ammonium nitrate, elemental carbon, and organic mass are primarily anthropogenic in nature. Light extinction due anthropogenic sources and natural sources of coarse mass is similar. Light extinction due to ammonium nitrates is more pronounced in the cooler months.

Based on these monitor data observations, strategies to reduce visibility impairment at Wichita Mountains from manmade air pollution during Planning Period II should focus on the following key pollutants: ammonium nitrate and ammonium sulfate.

2. Modeling Data Analysis

Figure III-54 illustrates for Wichita Mountains the results of EPA's modeling effort. The figure presents observed data for 2014–2017, 2028 base case projections, and possible glidepaths under different assumptions. The dashed line represents EPA's default adjusted glidepath, which was adjusted based on relative international anthropogenic model contributions and ambient natural conditions.[65] The figure also includes a pie chart representing the specific anthropogenic emissions sector contributions identified as contributing to visibility impairment at Wichita Mountains in 2028.

[64] Data obtained from IMPROVE data file sia_impairment_daily_budgets_12_20.

[65] The different glidepaths EPA included in their summary plots are based on different 2064 endpoint adjustment assumptions.

Figure III-54: IMPROVE Site Summary Plot for Wichita Mountains

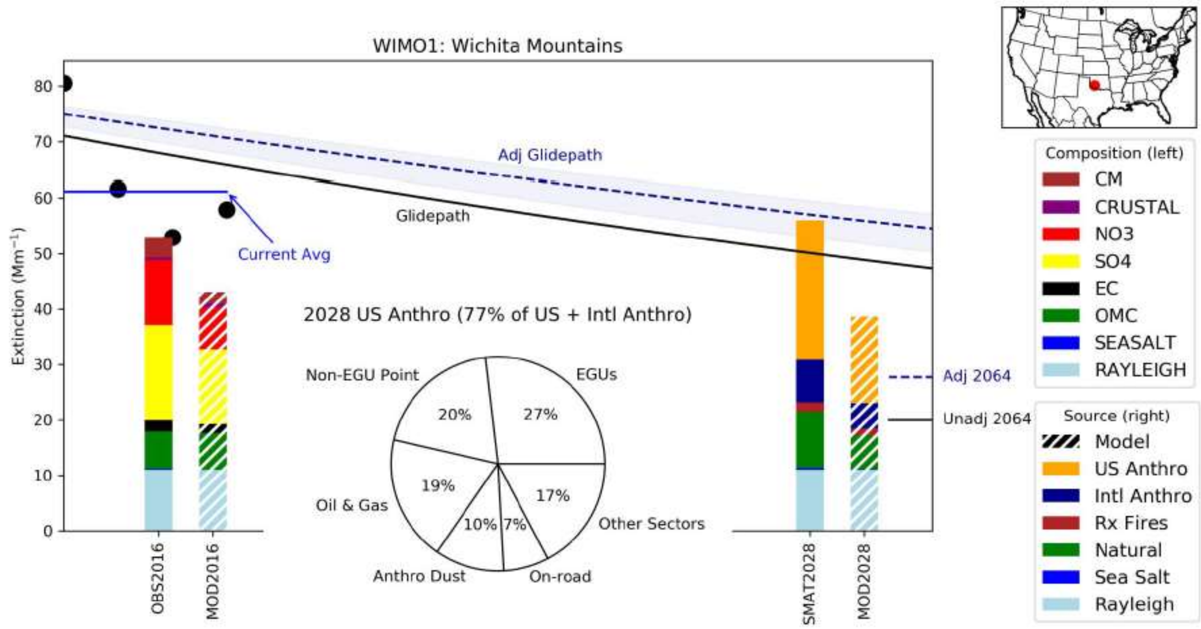


Figure III-54 shows that visibility impairment on the most impaired days in 2028 is projected to remain below some glidepaths that the State of Oklahoma may establish in their Planning Period II SIP even before consideration of additional control measures to ensure reasonable progress. The projected 2028 visibility impairment calculated using the SMAT software is above the unadjusted glidepath and some of the adjusted glidepath options. The absolute 2028 modeled impairment (MOD2028) is below all of glidepaths.

The pie chart shows that the largest contributors to visibility impairment in 2028 are projected to be EGUs, non-EGU point sources, oil and gas, and other sectors. Anthropogenic dust and on-road sources make up smaller fractions of the projected contribution to light extinction in 2028 at Wichita Mountains. The source apportionment presented in the pie chart suggests that strategies to reduce visibility impairment in 2028 should focus on reducing emissions from the following source categories: EGU, non-EGU point, and oil and gas.

Figures III-55 and III-56 illustrate the 2028 base case results for Wichita Mountains of the VISTAS modeling effort. The VISTAS modeling base case results project visibility impairment in 2028 at Wichita Mountains on the most impaired days (18.10 deciviews) to be above the unadjusted glidepath (16.06 deciviews). Based on consultation between DEQ and Oklahoma DEQ, DEQ understands that Oklahoma DEQ intends to adjust the URP glidepath consistent with EPA guidance. In 2028, the adjusted URP value for Wichita Mountains is 17.36 deciviews. The projected base case 2028 results for the clearest days (8.56 deciviews) show no degradation from the 2000–2004 baseline (9.78 deciviews).

Figure III-55: VISTAS Base Case Results for Wichita Mountains (Most Impaired Days)[66]

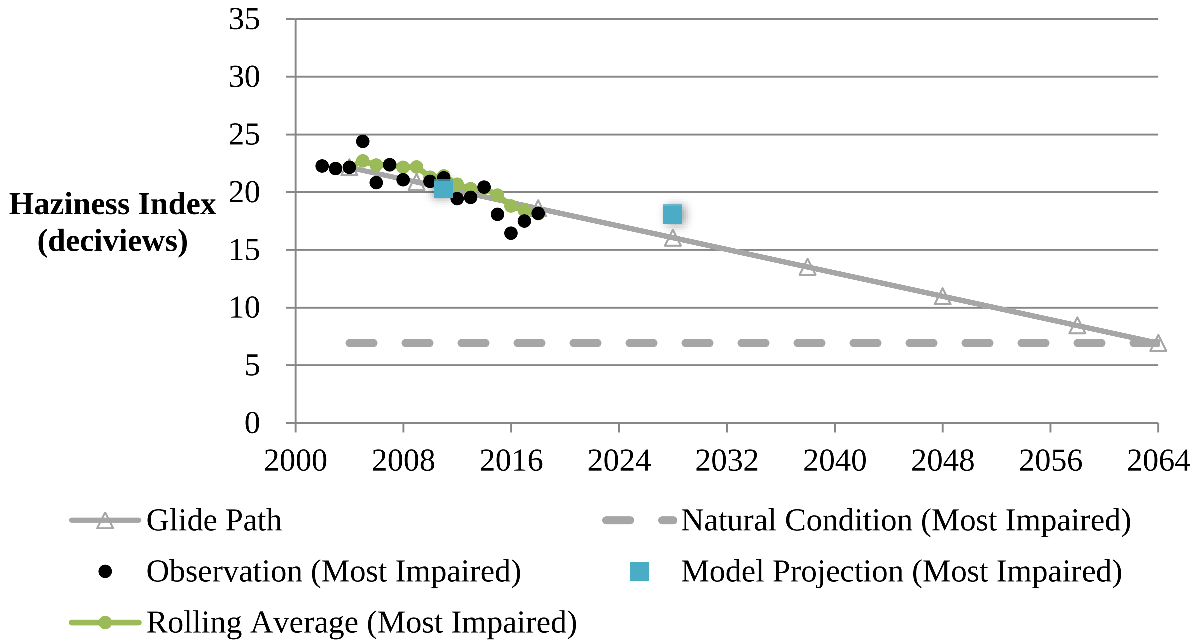


Figure III-56: VISTAS Base Case Results for Wichita Mountains (Clearest Days)[67]

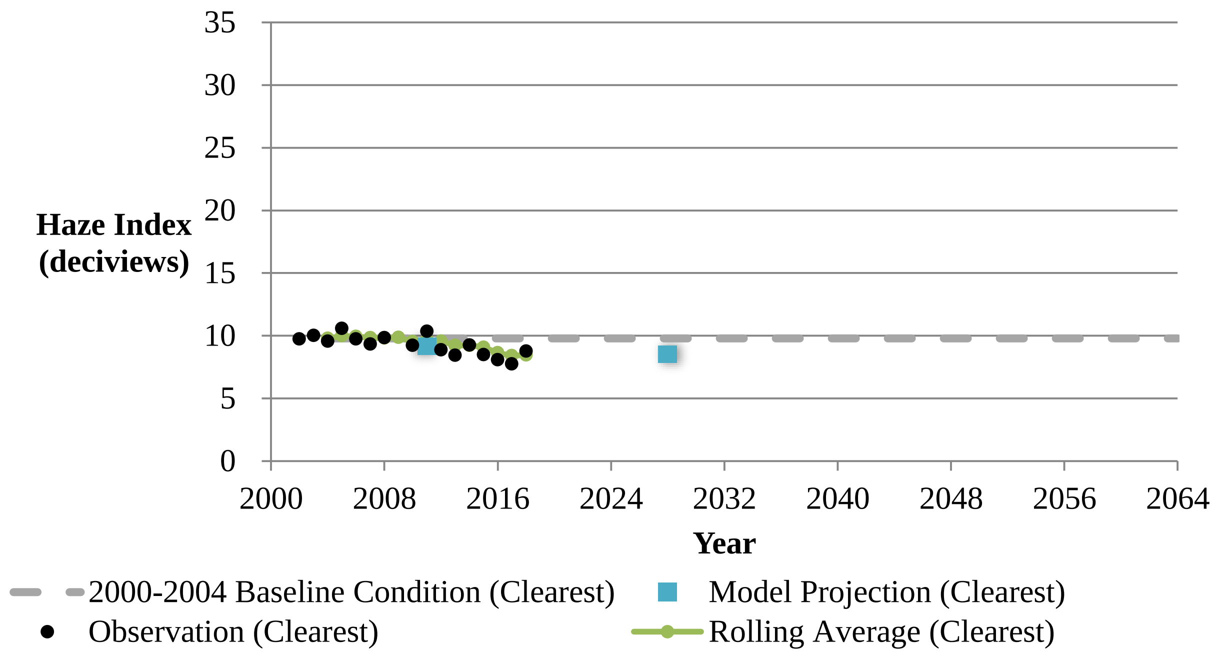


Figure III-57 shows how a vista at Wichita Mountains would look during the most impaired days in 2002 (left), 2019 (center), and under natural conditions (right). The improvement between the

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[66] Model results obtained from Metro 4/SESARM: Copy of V5_GlidePath_MI20_unitDeciview_07-17-2020_jb
[67] Model results obtained from Metro 4/SESARM: Copy of V5_GlidePath_20C_unitDeciview_07-17-2020

center image and the left image shows how the visibility has improved over time on the most impaired days. The image on the right visualizes natural conditions for the area.

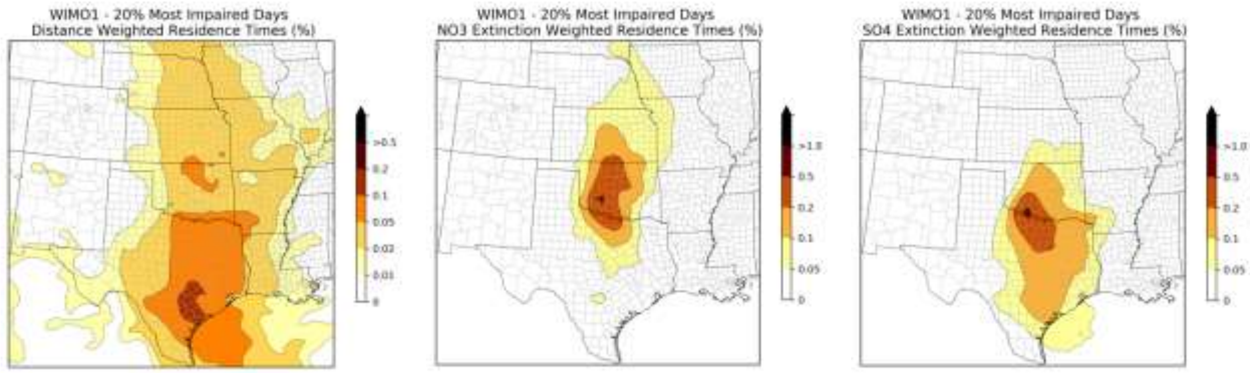
Figure III-57: Wichita Mountains WinHAZE Visualization Twenty Percent Most Impaired: 2002, 2019, and Natural Conditions[68]

3. AOI Analysis

As described in Chapter II, DEQ used the AOI analysis results produced by Ramboll for the CenSARA states to evaluate which geographic regions and sources have a high probability of contributing to anthropogenic visibility impairment at federal Class I areas within the CenSARA region and in neighboring states. Figure III-58 shows the distance-weighted residence time and pollutant-specific extinction-weighted residence times (EWRT NO_3 and EWRT SO_4) for Wichita Mountains for the most impaired days. Based on the distance-weighted residence time plot, air masses from the following states are within the 0.05% distance-weighted residence time contour for Wichita Mountains on the most impaired days: Arkansas, Kansas, Louisiana, Oklahoma, and Texas. The EWRT NO_3 plot indicates that air masses coming from the following states may be impacting ammonium nitrate concentrations at Wichita Mountains on the most impaired days: Iowa, Kansas, Missouri, Nebraska, Oklahoma, South Dakota, and Texas. The EWRT SO_4 plot indicates that air masses coming from the following states may be impacting ammonium sulfate concentrations at Wichita Mountains on the most impaired days: Arkansas, Kansas, Louisiana, Missouri, Oklahoma, and Texas. Darker areas on these plots indicate a larger influence on Wichita Mountains on the most impaired days for the examined metric.

[68] Interagency Monitoring of Protected Visual Environments. http://vista.cira.colostate.edu/Improve/winhaze/

Figure III-58: All Trajectories Distance-Weighted Residence Times, EWRT NO_3, and EWRT SO_4 for the Twenty-Percent Most Impaired Days—Wichita Mountains (Normalized Percentages)



Based on the EWRT NO_3 and EWRT SO_4 plots, air masses from Oklahoma have the greatest influence on ammonium nitrate and air masses from Oklahoma and Texas have the greatest influence on ammonium sulfate at Wichita Mountains on the most impaired days. The individual sources with the highest visibility impact surrogate values for Wichita Mountains in 2016 were sources in Arkansas, Iowa, Kansas, Missouri, Nebraska, Oklahoma, and Texas. Less than one percent of the inventory's visibility surrogate total for Wichita Mountains in 2016 is attributable to Arkansas sources.

Based on the pollutant-specific EWRT plots for the dominant pollutants and the small percentage of the AOI inventory's visibility surrogate table attributable to Arkansas sources, DEQ concludes that emissions from Arkansas sources are reasonably anticipated to contribute to visibility impairment at Wichita Mountains.